

At Bangalore objections had been raised by the Commissioner of Mysore, and correspondence and much delay had occurred in the introduction of these rules into other military cantonments. No new Lock Hospital had been established during the year under review, but property had been purchased for one at Madras, and works were in progress for adapting the building to its new purposes. MADRAS

A committee was convened (G.O. 20 August 1867) to collect information on the extent to which venereal disease prevails among the crews of vessels frequenting the seaports of the Madras Presidency, and to report how far the machinery of the Contagious Diseases Act 27 & 28 Vict. c. 85., or any similar machinery, could be made applicable to the seaports of the Madras Presidency. The Committee submitted their Report on the 10th December, and in consequence a Draft Act was laid before the Legislative Council of the Government of India, extending Act 29 Vict. cap. 35. to seaports in India.

Additional cholera encamping grounds for British and Native troops were selected, half a mile being laid down as the minimum distance from any station; and the following instructions were issued by the Commander-in-Chief, with the sanction of Government (G.O.C.C. No. 150, 29 Nov. 1867). Cholera encamping grounds.

- “ 1. All encamping grounds used as cholera camps are to be ploughed immediately after the troops have quitted them.
- “ 2. Cholera encampments, after having been ploughed, up are not, except when unavoidable, to be reoccupied within 12 months.
- “ 3. The ground, especially latrine trenches and such like, within the limits of an encampment, is not to be disturbed during occupation, but all refuse, &c. is to be buried at a distance of at least 500 yards.
- “ 4. In all encamping grounds, whether ‘cholera’ or otherwise, a portion of the ground in the right rear angle, 30 by 30 yards (or in very small encamping grounds 30 by 20 yards) will be at once *clearly marked off and kept so*, to be used if necessary as a burial ground.
- “ 5. Whenever it is necessary to inter a corpse in any encamping ground, *immediate notice* should be given by the commanding officer to the chief civil authority of the district, and to those on the spot; and Government will be requested to provide for such grounds being *at once* neatly enclosed by a good hedge, or other fence, as may be most convenient with reference to the locality, with a wicket for entrance, and also for the ground and its enclosure being thenceforward properly cared for.
- “ 6. Instructions relative to the above have been issued by Government to local civil authorities.”

The General Hospital at Madras had undergone many material improvements, especially with reference to water supply, and progress had been made in provision of new, and re-allotment of existing buildings, for the accommodation of the troops. Public buildings.

Further action had been taken towards the provision of a new military hospital for H.M. British troops garrisoning Fort St. George. At St. Thomas Mount steady progress was made in the improvements suggested by the late Sanitary Commission.

At Bangalore the new barracks were approaching completion, and the hospitals nearly finished; plans and estimates ordered for drainage of the site, a scheme for which was specially reported upon by the Sanitary Commissioner, who in his Report strongly urged the collection and storage of all rain water falling on the roofs of barracks and subsidiary buildings, as proposed by the late Governor Sir W. Denison in 1865; urging also the consideration of subsoil drainage, and pointing out the danger of leakage from the joints of tubular drains. Drainage of stations.

Efficient drainage, both surface and subsoil, was still considered the crying want of our Indian cantonments. Notwithstanding the strong comments made by the Royal Commission, no progress had been made on this great sanitary question. Subsoil drainage had not been applied to any station in the Presidency, nor to any new site selected for barracks, hospitals, or jails.

The Commissioner, in his Report on Bangalore, contends for all the measures recommended by the Royal Commission in relation to drainage, both surface and subsoil, being carried out at this site, in addition to the proposed system of tubular drains for removal of liquid refuse from kitchens, lavatories, and stables, and further raised the whole question of subsoil drainage by suggesting a Committee to determine whether it shall be acknowledged as a necessary and authorized part

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of every scheme for drainage of all new sites selected for barracks, hospitals, jails, and other similar institutions.

Water supply to garrison at Fort St. George.

The scheme referred to by Mr. Ellis in the last Report was brought into operation during the year, and a filtering cistern, as proposed by the Sanitary Commissioner, was completed and used, but the principle of upward filtration was not found suited to the requirements of this case, and the surface of the water was found to become rapidly foul when exposed to the action of the sun. The water is now admitted at the top, instead of the bottom, and is distributed by gravitation to the Fort and General Hospital. For the Fort it is stored in covered reservoirs, and thence distributed by pipes to the lavatories, cook rooms, and swimming baths.

Dry earth conservancy.

Dry earth conservancy had been carried out more or less efficiently in every barrack and hospital in the Presidency, and introduced into gaols, dispensaries, and public institutions, but was still supposed to be under experiment.

A Report was submitted on experiments in Fort St. George, which was not generally favourable to the system, which Colonel Worster, the barrack master, held does not present any advantages superior to Dr. Hathaway's dry system. The Sanitary Commissioner submitted a report on the applicability of this system to the army, recommending its authoritative introduction under the provisions of a General Order.

The Sanitary Commissioner states that :—

"The inquiries instituted referred not only to the properties of earth as an efficient deodorizer of night soil, but necessarily extended to the financial aspect of the question. Doubtless its general introduction will entail additional expenditure, and at the Presidency this may be something considerable in the cost of provision of earth, owing to the distance from which it has to be brought being great, while the expenses connected with the removal of the mixed earth and ordure will be still greater. On these grounds I suggested that McDougall's disinfecting powder or carbolic acid might be used in the urinaries at a smaller cost, as the bulk added to the excreta would be but trifling in comparison with the large quantity of earth required."

"At up-country stations I apprehend, however, that no difficulty will be experienced in the provision of earth and in the disposal of the 'poudrette'; not that the commodity has at present any marketable value, but because it is not necessary to convey it to such distances as at the Presidency town."

"Could the ryots and cultivators be made to understand the value of the product as a manure, all difficulty on the score of expense would vanish; but at present they will not generally touch it, though prejudice is in some stations beginning to give way before conviction of its value as a manure. But before it can be expected that native farmers generally will use the product of our latrines and urinals as a manure, its value must be demonstrated to them, and to this end it has been proposed to utilize it upon farms to be established by Government in the neighbourhood of every large station. There can be no question that such farms will prove remunerative, besides forming schools of instruction for native ryots in the utilization of manure of this description."

"Since the introduction of the dry earth system, the condition of our barrack and hospital latrines has marvellously changed for the better, and the joint use of earth and coal tar, which is also generally employed, leaves nothing to be desired in the conservancy of places of this description."

"Formerly, and that but a very few years since, they were most intolerable nuisances, their locality being made known a hundred yards away. No one could enter them without a feeling of overpowering nausea, and they were doubtless actively instrumental in the propagation of disease. Now in well kept latrines no odour is perceptible, but that of the coal tar with which the vessels are painted, and even the walls to the height of two or three feet from the floor."

"Having been one of, if not the first, to introduce the use of coal tar into this Presidency, when serving with Her Majesty's 105th regiment of foot (late Madras 2nd European Light Infantry), I can testify to the comfort and advantage it has been to the soldier, and have consequently recommended that in any General Order introducing authoritatively the dry earth system, the use of coal tar be enjoined as a part of that system."

"I also took occasion in my Report to bring prominently to notice the opinions of the experts (Messrs. Smith and Crookes) engaged upon the investigation of disinfectants, in connexion with the Cattle Plague Commission, in regard to the properties of carbolic acid, the introduction of which, or of McDougall's dis-

infecting powder, I have urged at all times in hospitals, and in barracks on all occasions of the prevalence of cholera, typhoid fever, or epidemic dysentery." MADRAS.

Attention had been drawn to the ruinous and disreputable state of the Vepery lines, and the abandonment of the old lines and erection of new ones in a better locality was determined on. A committee was appointed to decide on the most eligible site, and their recommendations were concurred in by the then Commander-in-Chief, Sir Gaspard Le Marchant. The site was, however, subsequently altered by Government, as the area of that first selected was insufficient for the requirements of the Native regiment. New lines at Vepery.

As noticed in the last Report, the removal of the 21st Regiment N. I. to the French Rocks, from the insalubrious cantonment near Mysore was followed by a marked improvement in the health of the men. Mysore, cantonment of.

In a detailed Report on the causes of the fever experienced at Mysore the medical officer in charge of the corps remarked that he attributed the large preponderance of miasmatic diseases in the Mysore cantonment to,—

1stly. An endemic exciting cause in the sub-soil emanations of slow decomposition of beds of magnetic oxide of iron.

2ndly. An epidemic exciting cause in the surface evaporation prevailing in the cantonment in the month of November.

The health of the men gradually improved, and the reduction of sick, as shown by the weekly Reports, was so satisfactory, that the submission of these Reports was ordered to be discontinued by Government on the 25th of January 1867.

On the 27th February the Madras Government communicated to the Commander-in-Chief and the head of the Indian Medical Department a resolution of the Governor-General in Council, in which his Excellency inquired whether the Madras Government were of opinion that a further trial should be made of the Mysore cantonment, or whether they concurred in the opinion expressed by the officiating Commissioner of Mysore, that "the fate of the new cantonment must be considered as already sealed." His Excellency further desired to be informed whether the cantonment of the French Rocks was, as a rule, appreciably healthier than that of Mysore; and he further directed that the Madras Government and the officiating Commissioner of Mysore should discuss whether a really healthy site could be discovered on the right bank of the Cauvery preferable in a strategical and political point of view to the French Rocks situated on the left bank of the river.

Subsequently the Madras Government, in reply to a communication from the Commissioner of Mysore, recommended that officer to consult the principal military and medical officers in the Mysore division in considering the question of another site.

On 26th April Government concurred in the opinion of the Commander-in-Chief that no further steps need then be taken towards the selection of another site for a cantonment in the neighbourhood of Mysore, and the propriety of this decision was endorsed by the Government of India.

Great improvements in the conservancy of these lines had been carried out, and the dry-earth system of conservancy had been generally introduced. In some instances the Native commissioned and non-commissioned grades seemed fully to appreciate the benefits arising from the strict observance of sanitary measures, and had shown a very proper zeal in supervising the conservancy establishments. Native regimental lines.

Considerable advancement had been made. Plunge baths were recognized necessities in every station occupied by British troops, existed in many, and were in course of provision in all. The standard plan rooms were found well suited, and each soldier is now supplied with a separate basin, and half a cask allowed to every family quarter. Ablution accommodation.

Considerable improvements had been made in the cell accommodation for confinement of military prisoners, and in prison room; and the subject of military prisons for soldiers of British regiments sentenced to terms of imprisonment exceeding three months was engaging the attention of the Government of India. The sanitary Commissioner with the Government of India, who was consulted on the subject, strongly advocated the location of such prisons at hill stations. The separate cell system is also advocated, and a larger superficial and cubic space than that hitherto allowed. Punishment.

MADRAS. Improvements had been gradually introduced into this department, with a liberal scale of diet. Experiments were made in the Commissariat Department upon feeding cattle and sheep before being slaughtered for troop rations. These experiments were considered satisfactory, both in a sanitary and economical point of view, and the meat gave much satisfaction, and was considered greatly superior to the meat usually issued.

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Cooking, &c.

Station butchers were selected from the non-commissioned officers, rank and file, to inspect all cattle prior to being slaughtered.

The bread issued to the troops was wholesome and good. It is mostly supplied by contract, but at some stations by Government bakeries, as at Madras itself.

Vegetable
ration.

Although so much encouragement has been given to the institution of soldiers' gardens, the supply of green food to the troops is at many stations insufficient or precarious, and dependent entirely upon that procurable in the bazaars, and which often consists of brinjall, bandikai, and pumpkins; the potato forms a part of the vegetable issue in the proportion of one-half all the year round in stations in India, but in Burmah it is not always procurable. There the yam becomes its substitute, unless it is issued in the "desiccated" form of the vegetable.

Beer and
spirits.

Some complaints have been made of the beer, and a sample of porter examined by the Sanitary Commissioner at Trichinopoly was very acid, and contained more sulphates than could be accounted for by any "hardness" of the water with which the beer was made. He pronounced that sulphuric acid had been added for the purpose of giving to the beer the character of age. The question of the supply of beer to our troops in India has engaged the attention of the Houses of Parliament.

The rules in force to ensure that the beer and spirits issued to canteens are wholesome ought fully to protect the soldier against any bad liquor being introduced.

Recreation
and amuse-
ment.

The institution of libraries, recreation rooms, gardens, workshops, and gymnasias, leaves little to be desired in this important department of preservation of the soldier's health. The Sanitary Commissioner is not however prepared to say that every advantage is taken of the means of recreation and instruction placed at the soldier's disposal.

"Libraries and reading rooms are fully appreciated; gardening, gymnastics, and such like recreations, are taken up at first with eagerness, but as the novelty wears off they become more or less deserted."

The great amusements of the soldier are theatricals and skittles. In almost every station fives and racket courts exist, but they are often unused for weeks together. The cost of provision of balls is alleged to be the reason why they are not more frequented. Certainly the Government have neglected no measures calculated to remove the curse of the soldier's life in India, "*ennui*."

Bedding.

The Commissioner records what he considers a retrograde movement in the matter of bedding issued to our troops. It has been decided that the old straw-stuffed paillasse shall be reverted to, instead of the coir mattress which has been so strongly advocated, and which is in use in hospitals. The decision of his Excellency the Commander-in-Chief upon the question was conveyed in a letter to the Commissary-General under date the 14th January of the present year.

Accommoda-
tion for war-
rant officers
at the Pre-
sidency.

The majority of the new quarters are now in occupation, and it is impossible to over-estimate the advantage to the health of this most deserving class of officers by their location in properly ventilated buildings in an open airy site.

Rules and Regulations for Military Cantonments.

The Rules and Regulations for Military Cantonments under clauses 4 to 11 of Section xix., Art. 1, 1866, confirmed by the Governor-General in Council, were promulgated, and are given "in extenso" in the Report as having an important bearing upon the health of troops and sanitation of stations.

These, unless otherwise ordered, are to be held applicable to all cantonments in the Madras Presidency, representation being made to the Commander-in-Chief if any portion of these Rules and Regulations was found inapplicable to a particular cantonment.

In every cantonment a Cantonment Committee was to be appointed, consisting ordinarily of— MADRAS.

The Officer commanding the Cantonment, President.

The Sanitary Officer of the Cantonment,	} Members.
The Executive Engineer,	
The Magistrate of the District,	
The Cantonment Magistrate, Member, and Secretary.	

This Committee to be mainly a consultative body, with executive duties distributed amongst its members with individual responsibility. The Deputy Inspector-General of Hospitals, the Sanitary Commissioner, and other officers being "ex officio" members of all such Committees.

In each cantonment a fund was to be formed called the "Cantonment Fund" from certain defined sources, such as the proceeds of fines and penalties and sale of produce within the limits of the cantonment, this fund being applied to police and conservancy expenses.

Weekly reports on all matters affecting public health were to be submitted to the Cantonment Committee, who on their part were to forward a monthly Report on the sanitary state of the cantonment generally for the information of the officer commanding the division or district.

Chapter III. defines the offences affecting the public health, safety, convenience, and decency, punishable under the rules and regulations of the cantonment, imposing a liability of a fine not exceeding 50 rupees, or imprisonment not exceeding eight days, with or without labour.

Chapter IV.—Provisions for the enforcement of the rules and regulations of the cantonment. The cantonment magistrate, except when otherwise provided, being answerable for the actual execution, and making a personal inspection of all parts of the cantonment at least once a month.

Chapter V. contains provisions for the inspection and controlling of houses of ill fame, and for preventing the spread of venereal disease, providing for the registration of prostitutes, &c.

Little progress was made during the year under review, but a scheme proposed by the Sanitary Commissioner has since been approved by Government, and the necessary apparatus and materials were to be forwarded from England. Analysis of water.

Civil.

No further steps had been taken in this Presidency to give effect to the scheme proposed by Mr. Ellis of a "Public Health Service" entrusted with the sanitary administration of the country. Additional Sanitary Commissioners had been appointed for provinces subject to the Government of India, but these appointments had not been extended to Madras.

The several municipal Commissions that have been established in many of the largest towns (a list of which is marginally shown) have given an undoubted impulse to works of sanitation, and will react to some extent upon the rural districts as the civil functionaries exercising authority in such municipalities become more and more interested in an extension of knowledge of the laws that govern and regulate the public health.

But as Municipalities are only established in first-class towns, the smaller towns and villages are left without any systematic sanitary supervision, and it is in this direction that the health officers proposed by Mr. Ellis will find such a wide field for exercise of their important functions.

The Sanitary Commission considers that as a State measure of large importance Mr. Ellis's scheme commends itself; while, financially considered, the annual cost (estimated at rupees 108,000) may be accepted as very moderate, both absolutely and relatively; absolutely as to amount, and relatively as to the incalculable benefit the institution of such a health service will undoubtedly have upon the public health.

The Commissioner doubts whether these public health officers, or, as he would prefer calling them, the "Sanitary Inspectors General" and "Sanitary Inspectors" would be able to maintain the minute sanitary supervision of the extensive

MADRAS. — provinces committed to their charge, without the aid of a subordinate staff, which is indicated in Mr. Ellis's scheme, but he joins issue with Mr. Ellis as to the necessity of appointing Local Health Officers to military stations, and would attach officers of this class to the civil department, leaving military cantonments to be administered entirely by military authorities, public health inspectors however having the privilege, in communication with the military authorities, of inspecting military buildings.

Cholera Committee. The first meeting of this Committee "to report on the arrangements which should be made before practical effect in the Madras Presidency to the recommendations and suggestions of the International Cholera Conference"* was on 20th March 1867.

Fairs and festivals. The Sanitary Commissioner prepared a list of all fairs and festivals throughout the Presidency and rules for their management and conservancy.†

The Cholera Committee, above alluded to, were further directed to report to Government the measures which appeared to them best calculated to prevent agglomerations at fairs and festivals, pilgrims and other travellers proceeding along public thoroughfares being attacked with contagious epidemic disease, and to check the spreading of the same to the general population.

The Committee while fully admitting the very serious obstacles in the way of enforcing a strict system of quarantine for bands of pilgrims leaving shrines and for large concourses of people dispersed from fairs and festivals, recorded their opinion "that the time had now arrived when a law should be passed placing these collections of people under strict supervision, and further, that local taxation should be had recourse to in order to defray the cost of such supervision and such measures of conservancy and police as may seem best calculated to prevent the appearance or check the diffusion of epidemic disease," also "that a power to control the route to be travelled by the masses should be one of the most imperative and rigidly enforced conditions upon which fairs and festivals should be permitted to be held."

The measures necessary to be adopted to carry out these recommendations were carefully discussed, and the following suggestions adopted: "That a strict *cordon* should be maintained round places of encampment, and intercommunication between them and neighbouring towns and villages should be prevented, should epidemic disease break out either amongst the temporary or permanent residents."

This Committee also discussed the several theories that had been advanced in explanation of the outbreak of cholera at the great fair of Hurdwar in Bengal; and without committing themselves to any particular theory, agreed that, whatever explanation be accepted, they must all be taken as pointing clearly to the necessity of examination of all persons arriving at or leaving places of congress, and the careful medical supervision of all assemblages of people.

In regard to the cause of the origin of the outbreak assigned by Dr. Murray, viz., that the heavy falls of rain had brought into activity the germs of the disease sown in the soil on some previous occasion, the Committee advised "that at all encampments occurring annually, the use of fresh ground not previously occupied should be as far as possible enforced;" further, that ground once used as an encampment should be ploughed up and put under cultivation after the dispersion of the temporary occupants.

Special measures of conservancy were also broadly indicated.

Upon the very important question of enforced control of the frequenters of the different fairs and festivals, and the levy of a tax, the Committee placed themselves in communication with a number of native gentlemen, Hindoos and Mahomedans, and, after careful conference, the following questions were put and answers recorded."

"*Question.*—How far would Government interference increase or decrease the number of pilgrims or travellers resorting to shrines, or fairs, or other places of large concourse.

"*Answer.*—It is considered that if the measures to be adopted are confined simply to those of sanitation and police, there would be no objection on the part of the people to resort to the places where these were in force.

* The Report of the Cholera Committee has since been forwarded to England in Despatch No. 28, dated 30th November 1868, Public Department.

† This was submitted to Government in July 1868.

" *Question 2.*—Is the preliminary issuing (on payment of a small fee) pass tickets to permit pilgrims and travellers to proceed from distant stations to the place of congress approved? MADRAS. —

" *Answer.*—No, it is preferred that those alone who reach the place of congress should contribute payments for the purposes of conservancy and police.

" *Question 3.*—Is the issue of tickets (upon payment of a small fee) to all persons actually resorting to the place of congress approved, on the understanding that without such tickets admission will not be granted?

" *Answer 3.*—It is unanimously approved."

The amount of tax suggested to be levied upon all pilgrims actually resorting to shrines was fixed, as a tentative measure, at 6 pie (three farthings), and it was further suggested that the "Sundey" or "Sundhee" tax (or tax upon sale of provisions, &c. in temporary stalls or booths) should be used as a further source of income. A Legislative Act would be required to give force to these recommendations.

In the Madras Presidency the sanitary precautions taken at fairs and festivals had been attended by uniformly beneficial results. The evidence of these good results were collected by the Cholera Committee into a report, and it was anticipated that the organized supervision of these gatherings would be enforced under special legal enactment.

The protector of emigrants, in answer to an inquiry from the Sanitary Commissioner, stated that in consequence of the heavy expenditure attending the Madras agency for emigration to the Mauritius, Government had suspended for a time drawing emigrant labour from that Presidency, so that the erection of isolated buildings for the treatment of infectious and contagious cases among intending emigrants was deferred. On the question of the extent of accommodation for each emigrant in depôt the Governor of Fort St. George was informed by the Secretary of State, in a Despatch dated the 9th of January 1867, that 24 superficial feet and 12 feet in height would be sufficient.

Emigration
depôts in
Madras.

The intercourse between Madras and the Mauritius led to some apprehension in relation to the possible importation of the fever that recently decimated that island, and precautionary measures were taken, and all ships from the Mauritius were subjected to quarantine at Ennore (a port about 10 miles to the north of Madras). Subsequently the Mauritius fever of 1866-67 was pronounced to be "a malarious fever of intermittent and remittent form, to have no affinity to yellow fever, and not to be of a contagious nature."

Captain Tulloch, whose project for the drainage of the Presidency town was noticed in the Report of 1866, returned to India in June 1868, after visiting England and perfecting his acquaintance with recent improvements in main and house sewage, and in the utilization of sewage for the fertilization of land. The question of the disposal of the refuse of the town of Madras had occupied the anxious consideration of Government and the Municipal Commissioners. "The expense attending anything like a system of conservancy upon the dry method is enormous, and even in carrying it out to the extent that is now done the greatest difficulty is experienced in disposing of the refuse. It was formerly deposited upon waste land in several localities, but these became intolerable nuisances, and were abandoned. Burial in pits was then adopted, covering the refuse immediately with earth; but this could not be continued,—land was no longer procurable,—and it was considered that surrounding the place with a chain of these ordure pits must, sooner or later, cause dangerous contamination of the already contaminated water supply: cinerators were proposed to burn organic refuse, and one was to be built as an experiment. The question of utilizing the sewage by irrigation of grass lands in the centre of the town at the people's park was referred to the Sanitary Commissioner by the President of the Municipal Commission, but the former did not feel justified in giving the proposal his official sanction. The President, however, brought to his notice that irrigation of this nature had actually been practised upon fields not 100 yards from the peoples' park, and without any ill effect upon the health of the neighbourhood."

Drainage of
Madras and
disposal of
sewage.

The Sanitary Commissioner personally inspected the locality and found the sewage ponded up in a wide masonry drain, from which it was raised by "pecottahs" and distributed over the fields. The drain itself stank most abominably, but the fields were not offensive, and the earth taken from them was free from smell.

MADRAS. "If sewage can be thus utilized without detriment to the public health it will solve a question now perplexing the Government, viz., the disposal of sewage from the lines of the regiment located at Perambore, regarding which a long correspondence has taken place.

"The Municipal Commissioners refuse to allow the sewage to find its way to the nearest drains, and insist upon the regimental authorities disposing of it themselves, which they cannot do, except at a very large outlay."

The Government had quite recently referred the question for the consideration of their Law adviser, and there the matter at present rested.

Drainage of
Ootacamund. A Report on a project for the main drainage of the station of Ootacamund was submitted to Government by Captain H. Tulloch, R.E.

The only outfall for the drainage of this sanitarium was said to be the extreme end of the valley, the difficulty to be overcome being to convey away the sewage without allowing it to enter the lake which is interposed between the town and the natural outfall. The two propositions which had previously been made to meet this difficulty were, 1st, to lay the main sewer along the bottom of the lake after draining it dry; and, 2nd, to buy up the lower portion of the town, and to run the main sewer at a considerable elevation above the lake, and with such slope that it should issue at the lower end of the lake on a level with the water.

Captain Tulloch disapproved of both these proposals, the former chiefly on account of the insurmountable difficulty of, and the expensive arrangements necessary for, keeping the main sewer in order after it had been once built and the lake filled again. The latter plan was objected to by Captain Tulloch not only on account of the enormous expenditure it would involve, but also because if a sewer is built at a high level no houses situated below that level could be drained; and, further, that as such a sewer could run along one side only of the valley no drainage from the other side could be received into it.

Captain Tulloch advocated, moreover, the separation of sewage from rain water, and in the case of Ootacamund would leave the latter to escape by the natural outfalls in each district. He proposed to lay an egg-shaped sewer $2\frac{1}{4}$ feet high by $1\frac{1}{2}$ feet wide (for the main drainage) along the margin of the lake, and to start it from a point close to the junction of the Ootacamund lake with the main stream which feeds it. The main drain was to be laid at a slope of 3 feet per mile, and Captain Tulloch proposed arrangements for flushing the sewer at every 100 yards of its length, as well as providing man-holes, lamp-holes, and ventilators. He considered that the street drainage of the different districts would be a very simple matter, so far as engineering is concerned, when once the main sewers had been laid correctly, and he recommended the use of 6-inch earthenware pipes (similar to those proposed for the drainage of Madras) running generally parallel with the surface of the roads, and placed about three feet below them.

Captain Tulloch further advocated the reclamation of a swamp at the head of the lake to be utilized as a public garden or park.

His Report was referred to the Acting Sanitary Commissioner, Dr. Montgomery, on the 1st August 1867, who considered the scheme in every way suitable to the station, but recommended deferring definite sanction of the expenditure contemplated by Captain Tulloch, until an estimate was made of the cost of constructing the house and street drains, and until it was decided how this expenditure was to be defrayed; if these matters were not settled beforehand the construction of a system of main drainage might eventually prove a useless expenditure of money.

Water
supply of
Madras.

This important question was still under consideration. In the last year's Report, Mr. Ellis writes that by the end of 1868 the Spur Tank "would receive an almost abundant supply of good water." No final decision regarding the distribution of the water had been arrived at; the Spur Tank scheme was out of favour, and it was considered probable that the water would be brought by pipes to a series of reservoirs in convenient localities. There was considered little hope, even if the Spur Tank was made the reservoir, of bringing the water in during 1868. The Municipal Act for Madras contemplated a supply of water under pressure, but the arrangements and necessary machinery for this system it was feared would prove too expensive for the Municipality to carry out; and an entirely new system of gravitation was to be proposed which would require to be legalized by a Local Act modifying that of 1867. As this could not be done till

the scheme was approved, and the scheme could not be carried out till its adoption was legalized, it was feared there might still be considerable delay before a good water supply was made available for the inhabitants of Madras. MADRAS

Progress had been made, and a number of cottages erected, but it was not expected that the institution could be completed within the current year. Three other lunatic asylums are sanctioned, at Trichinopoly, Vizagapatam, and Calicut. Lunatic asylum at Madras.

The asylum now in course of construction at Madras is situated in an extensive premises on the confines of the town, and will comprise compartments for European, East Indian, and Native lunatics, male and female, with accommodation for "superior patients," (whose friends may be disposed to pay for their maintenance, and provision), and for so-called criminal lunatics.

All will be accommodated in detached cottages in suitable divisions, and the criminals within a high walled enclosure.

The accommodation for criminal lunatics will comprise two cottages for males and one for females, duly separated from each other. Each enclosure will contain the following subsidiary buildings:—A cook room, padded room, sick ward or hospital, and privy.

The division assigned to male patients will comprise two cottages for Europeans, two for East Indians, nine (including accommodation for filthy patients) for Natives, with two work sheds, two padded rooms, a cook room, and two privies.

The females will be accommodated in six cottages, two of which are intended for East Indians and four for Natives, with a complement of subsidiary buildings, viz., apartments for filthy patients, a cook room, work shed, padded rooms, and two privies.

The cottages for superior patients are four in number.

The total accommodation of the asylum is fixed at 238 souls, with residence for the superintendent, two apothecaries, four male and one female keepers.

As little semblance of restraint will be given to the buildings and enclosure as possible; the separating wall will be kept low and hidden from view as far as practicable by thick-set hedges.

Provincial asylums will be constructed upon the same general plan, being modifications of the standard plan sanctioned by the Government of India.

In this very important department progress had been made. A department Meteorology.

Secunderabad.	Negapatam or	had been organized under the Government
Vizagapatam.	Tranquebar.	Astronomer, who had recently distributed instru-
Bellary.	Madura.	ments to the different stations, noted in the
Bangalore.	Salem.	margin, selected as centres of meteorological
Cannanore.	Coimbatore.	record.
Trichinopoly.	Kurnool.	
Wellington.	Masulipatam.	
Tinnevely.	Cochin.	

No observations were available for the year under review, except those recorded for the Presidency town.

Neither was it certain that returns would be available for the whole of the year 1868 from all stations, as delay has been experienced in fitting up the observatories and in commencing the observations.

So soon, however, as returns are regularly available from the principal stations of the army, means will be taken to tabulate in a diagramatic form the "wave lines" of disease in association with the leading meteorological features of each station.

SKETCH OF SANITARY PROGRESS IN THE PRESIDENCY OF BOMBAY FROM 1830 TO 1860, BY DR. C. MOREHEAD.

BOMBAY. — SANITARY progress depends on three conditions :—1. A knowledge of the causes of disease. 2. The use of means of prevention or removal of the causes. 3. A good system of treatment of disease.

The first and third, derived from the observations and investigations of practical physicians, commence with the origin and advance with the cultivation of medical science. The second, based on the first and contingent on the enlightenment and co-operation of governments and communities, is of modern date.

In this sketch of sanitary progress in the Bombay Presidency from 1830 to 1860 frequent reference will be made to the Transactions¹ of the Medical and Physical Society of Bombay. This society² originated in 1835 in the suggestion of the Governor, Sir Robert Grant, and has experienced the unvarying support of the Government and of the medical authorities.

The present inquiry will be arranged under the following heads :—

- I. MEDICAL TOPOGRAPHY OF PROVINCES AND STATIONS.
- II. REGIMENTAL MEDICAL HISTORIES.
- III. GENERAL HOSPITALS, GAOLS, MILITARY ASYLUM, LUNATIC ASYLUM.
- IV. STATISTICS OF SICKNESS, MORTALITY, AND CAUSES OF DEATH.
- V. CLIMATES OF THE BOMBAY PRESIDENCY.
- VI. CAUSES AND PREVENTION OF :—

1.—Fevers.	8.—Delirium Tremens.
2.—Small Pox—Vaccination.	9.—Diseases of the Heart and Aorta.
3.—Measles, Scarlet Fever.	10.—Guinea Worm.
4.—Cholera.	11.—Scurvy.
5.—Dysentery.	12.—Leprosy.
6.—Hepatitis.	13.—Snake Bites.
7.—Sunstroke.	14.—Urinary Calculus.
- VII. INDIGENOUS MATERIA MEDICA.
- VIII. MEDICAL EDUCATION.
- IX. SANITARY WORKS, &c.
- X. CONCLUSION.

¹ These Transactions are in two series, the first consisting of ten numbers and the second of eight. As the references will be numerous, the following abbreviated form will be used. *For*, Transactions of the Medical and Physical Society of Bombay, 1st series, No. vii., for the year 1844, page 104, *substitute*, B. M. P. S., 1st, vii., 1844, p. 104.

² Report of Grant Medical College, No. i., for the year 1845–46, p. 1.

1 MEDICAL TOPOGRAPHY OF PROVINCES AND STATIONS.

The reports on medical topography may be classed under two heads:—1. Those which relate to localities within the limits of the Bombay Presidency. 2. Those which are descriptive of countries beyond these limits, but which have come within the sphere of the duties of the Bombay Medical Department.

In the year 1836 the medical topography of the province of Guzerat¹ was described by Mr. A. Gibson. The physical features of the province, the vegetable, animal, and mineral products, the classes of inhabitants, the climate, the diseases, and other details important to health, were considered. The localities which had chiefly proved unhealthy were pointed out; and the relation of malaria to season, to jungly tracts, to the amount of rainfall, to a surface broken into ravines and to ruined cities was explained. The causes which led to the unhealthiness of the military stations of Kaira and Hursole were stated, and the principles which ought to be observed in selecting positions in that province were inculcated. Province of Guzerat.

Mr. Gibson treats in another report² that portion of the Deccan table land which ranges north of Sholapore and west of Aurungabad, much in the same order as that observed in his account of Guzerat, but in less detail. The characteristics of the climate from elevation about 2,000 feet above the sea are stated. Though malaria³ exists in much less degree than in other districts of the Presidency, Mr. Gibson does not fail to specify and to describe the physical features of the tracts and localities in which the occurrence of intermittent fever gives evidence of its presence. Facts observed during the prevalence of cholera in the Deccan are brought forward which strengthen Mr. Gibson's belief in the communicability of the disease. Deccan.

Mr. Barra, in his description⁴ of Ahmudnuggur, till lately the head quarter station of the Bombay artillery, adverts to the unhealthiness of the fort and its cause. The construction of the wells, the occasional brackish quality of the water, and the injurious effects resulting from it are noticed. The report concludes with a careful account of the geology and of the varieties of soil of that part of the Deccan in which Ahmudnuggur is situated, by Lieutenant Ash of the artillery. Ahmudnug-gur.

The advance of a large division of the Bombay army into Affghanistan in 1839, and the occupation of various stations in Lower and Upper Scinde and beyond the Bolan Pass during the two succeeding years, afforded the medical officers of the force the opportunity of contributing much useful information respecting these countries, to be found partly in the medico-topographical reports referred to below,⁵ and partly in the regimental histories which will come under notice in an after part of this sketch. Dr. Don and Mr. Inglis in their descriptions of Sukkur and of Tatta pointed out with great care and accuracy, at an early period of our connection with the province of Scinde, the leading facts of physical and geological feature, of climate, season, method of irrigation, and periods of rise and fall of the river Indus in their relation to the health of troops, European and native, more especially in their bearing on the causation of malarious fevers and of sunstroke. Dr. Leith, in his report on Quetta in the valley of Shâl, at an elevation of about Scinde.

¹ The subject of medical topography has been much advanced by the writings of Dr. John Hennen. In 1821 he published in the Edinburgh Medical Journal a sketch of a plan for memoirs on Medical Topography; and in 1830, after Dr. Hennen's death, his valuable work, titled Sketches of the Medical Topography of the Mediterranean, was published.

² B. M. P. S., 1st i., 1838, p. 1.

³ *Ib.*, ii., 1839, p. 200.

⁴ Whenever in this sketch the term *Malaria* is used, it is in the exclusive and restricted sense of the specific agency which causes intermittent and remittent fever, or allied affections, and not in the more general sense of *Miasm*. This restriction, whether etymologically correct or not, is necessary to prevent confusion.

⁵ B. M. P. S. 1st ii., 1839, p. 160.

⁶ J. Don. B. M. P. S., 1st iii., 1840, p. 1.

J. Inglis	"	"	p. 29.
A. H. Leith	"	"	iv., v., 1841-42, pp. 46 and 56.
R. B. Owen	-		
J. Patch	-		
A. Wright	-		
W. S. Babington	-		
Capt. Boyd	-		
G. F. Forbes	-		
J. Jephson	-		
E. W. Edwards	-		

} B. M. P. S. 1st v., 1842, p. 66.

Heffernan, B. M. P. S., 1st, x., 1849-50, p. 216.

BOMBAY. 6,000 feet, treats of the climate and endemic causes of the diseases which affected the troops while stationed there.

Deccan. From 1856 to 1861 further additions have been made to our knowledge of the
Concan. medical topography of the Bombay Presidency.
Khandeish.

Cutch. The chief characteristics of the table land of the Deccan were shown in the reports¹
Scinde. on Belgaum, Sholapore, Kolapore, and Sattara by Mr. G. Waller, Mr. J. C. Sylvester, Mr. F. Broughton, Mr. C. J. Wiehe, and Mr. E. Batho; those of the Concan in the reports² on Sawnut Warree, Rutnagherry, and Tannah, by Mr. J. Kearney, Mr. E. De Crespigny, and Mr. O. V. Ward; and those of Khandeish in the report³ on the civil station of Dhoolia by Mr. M. Mackenzie.

The peculiar physical features of the province of Cutch are described by Mr. W. J. Moore in his account of Bhooj;⁴ and the climate of Scinde is again made the subject of ample details in the report⁵ on Jacobabad by Mr. Bond, and in that on⁶ Jacobabad and the hill districts S.W. of Mehur by Mr. J. Lalor, as well as in the annual medical report⁷ of the Scinde division by Mr. C. F. Collier.

These contributions to science are very carefully prepared. They describe, of the countries of which they severally treat, the physical features, the geology, the climate, the products, the people, the diseases; in a word, all those influences, physical or moral, in their varied details, which affect the health and prosperity of man, favourably and unfavourably. Moreover, they relate to countries which differ much in latitude, altitude, proximity to the sea, &c., and they express the opinions of many independent observers; so that a careful study and comparison of them cannot fail to be of value in all questions bearing on the public health, civil and military, in India and other countries of similar character.

Mesopotamia. Between the years 1835 and 1842 a survey of the river Euphrates was more or
Bagdad. less actively carried on with reference to the question of the overland route from
Mohamreh. India to Europe. This duty was performed by a steam flotilla of the Indian
Bussorah. naval department, and Mr. J. C. Floyd, the surgeon in medical charge, contributed two reports⁸ to the Medical and Physical Society; one for the year 1839 described that part of Mesopotamia which includes the malarious delta of the Tigris and Euphrates, ranging from Bagdad to the Persian gulf; the other for the year 1840 extended to the districts of the upper Euphrates, which are for the most part free from malaria, evidenced by the physical character of the country and the altered nature of the diseases which affected the crews.

Dr. Hyslop, residency surgeon at Bagdad, in his account of the medical topography of Bagdad⁹ in 1850, and of Mohamreh¹⁰ and Bussorah in 1853, supplies important additions to our knowledge of the climate and diseases of Mesopotamia. The reports are prepared with great care and under the impression at the time entertained, afterwards realized in 1857, that the countries of which they treated might in all probability before long become the scene of active military operations, in which an Anglo-Indian army might be engaged. But, apart from this special value, the writings of Dr. Hyslop and Mr. Floyd are important contributions, of wide application to sanitary science. The contrast between the swamps about Mohamreh and Bussorah, and the dry and elevated localities higher up the rivers, between years of great and small inundation around Bagdad, between former periods in history when cultivation was carefully attended to and embankments and canals kept in perfect repair, and the present time, when general inundations are frequent and the country desert and neglected, affords a practical lesson which the sanitary inquirer of all countries may consider with advantage.

Beloochistan. In 1859 Dr. H. Cook in medical charge of the Khelat agency submitted a
tan. report¹¹ of great interest on the geology and meteorology of part of Beloochistan in which he exhibits the contrast in climate of the hot months, May, June, July, August at Dadur and Bhag, in the plains about 700 feet above the sea, and at Khelat, Quetta, and Moorstung on the table land at an altitude of 5,700 to 7,000 feet. In the winter in the valley of Khelat, at an elevation of 7,000 feet, the frosts are severe and continued, and bitterly cold winds, with heavy falls of snow, prevail. But the inhabitants for the most part rarely await these inclemencies of season, but descend into the milder climate of the plains. "The¹² wandering tribes," Dr. Cook writes in his second report, "first move off, and these are speedily followed

¹ B. M. P. S., 2nd, iv., 1857-58, pp. 53, 174, 121, 100.

³ *Ib.*, p. 137.

⁴ *Ib.*, 2nd, vi., 1860, p. 284.

⁶ *Ib.*, 2nd, vi., 1860, p. 271.

⁸ *Ib.*, 1st, iv., v., 1841-42, pp. 27, 1.

¹⁰ *Ib.*, 2nd, ii., 1853-54, p. 212.

² *Ib.*, 2nd, iv., 1857-58, pp. 142, 72, 186.

⁵ *Ib.*, 2nd, iv., 1857-58, p. 114.

⁷ *Ib.*, 2nd, vii., 1861, p. xxxiii.

⁹ *Ib.*, 1st, x., 1849-50, p. 40.

¹¹ *Ib.*, 2nd, v., 1859, p. 105. ¹² *Ib.*, 2nd, vi., 1860, p. 17.

“ by all who have no urgent obstacles to their emigration. The Khan and his court adjourn to Gundava and await the return of the summer.” This movement from the cold hills to the plains in winter and return to them at the commencement of summer, is of interest in reference to the utilization of hill climates in India; it embodies the principle which should guide the Government of India. BOMBAY.

The dust storms and the simoom of the plains are described in detail and with much ingenious speculation regarding the causes of these peculiar atmospheric phenomena.

In 1860, Dr. Cook continued his valuable investigations, and contributed two detailed reports, one¹ on the topography and geology of Sarawun, the northern portion of Beloochistan and the other² on the topography and geology of the province of Jhalawan and the eastern division of Mekran.

The lengthened residence in 1841 and 1842 of the British Embassy to the court of Shoa at Ankober in southern Abyssinia enabled Dr. Kirk, the surgeon attached, to make many useful observations³ on the climate, and to institute a comparison between the chief meteorological features of the highlands of Shoa and those of the Neilgherries and Mahabuleshwur. The characteristics and habits of the various tribes and inhabitants are noted, and a concise account is given of the classes of disease which came under Dr. Kirk's observation. There is also a brief notice of the *materia medica* of the country and of the system of medical and surgical practice. Shoa-Abyssinia.

II.

REGIMENTAL MEDICAL HISTORIES.

The faithful observation of all the facts bearing on the health of a large number of individuals of the same sex, of a limited range of age, exposed to the same influences, subject to control and under the constant supervision of able medical officers is of value, increasing with the time over which the observation has extended. It constitutes a method in the study of etiology only second in accuracy to clinical investigation.⁴

Regimental medical histories are the record of this system of inquiry, and the sanitary lessons which they teach are of much importance. It will not be possible within the limits of this sketch to give even a brief summary of those which relate to the Presidency of Bombay. A reference to the documents themselves and an indication of the leading facts is all that can be attempted.

⁵The medical history of the 2nd or Queen's Royal regiment from the 1st April 1836 to 31st March 1842, with exception of the year 1840—41, is fully narrated by Mr. R. H. Hunter. During the six years included in this history the Queen's was exposed to much variety of climate and engaged in arduous active service. At the end of May 1836 it was moved unseasonably from Poona, on the Deccan table land, an altitude of 1,800 feet, where it had been stationed for two years, to Bombay. The health of the men suffered, and the regiment was again unseasonably transferred in December to Belgaum, an altitude of 2,000 feet. After a residence of nearly two years at Belgaum the Queen's was ordered in October 1838 to form part of the Bombay division of the army of the Indus. It moved by Bombay to the mouth of the Indus, then marched through Scinde by the Bolan pass to Candahar, Ghiznee, and Cabul; thence returned by Ghiznee, Khelat, and the Indus, and reached its destination, Deesa, on the 4th April 1840. The regiment during these 18 months passed from 15° 50' to 34° 30' N. latitude, marched Her Majesty's 2nd or Queen's Royal regiment.

¹ B. M. P. S., 2nd, vi., 1860, p. 1.

² *Ib.*, p. 45.

³ *Ib.*, 1st, vi., 1843, p. 3.

⁴ As frequent allusion will be made to the importance of clinical investigation in etiological inquiry, it may be well to explain what is meant by this assertion. The clinical investigation of disease includes an inquiry into its causes or its previous history, as it is usually termed. All our certain knowledge of the causes of diseases has been originally derived from the faithful study of numerous individual instances and generalizations from these. If this be true of the past, it must also be so of the future in respect to diseases, the causes of which are complex, uncertain, or unknown. The hypotheses originating in other methods of investigation are often suggestive and useful, but, when misrepresented and regarded as established truths, they are apt to mislead and to impede the progress of true science.

⁵ B. M. P. S., 1st, i., 1838, p. 226. *Ib.*, 1st, ii., 1839, p. 22. *Ib.*, 1st, iii., 1840, pp. 131 and 146. *Ib.*, 1st, v., 1842, p. 34.

BOMBAY. exclusive of river and sea voyages 2,039 miles, and played an active part in the military operations against Ghiznee and Khelat. It descended after two years' residence from an altitude of 2,000 feet (Belgaum) to the coast, was five months and a half at the sea level in the arid plains of Scinde and Cutch Gundava. It then ascended to an elevation of 6,000 feet, the valley of Shal. After a service of seven months on the table land of Affghanistan, at altitudes varying from 4,000 to 8,000 feet, the Queen's descended again to the plain of the Indus and became stationed at Deesa, 200 feet above the sea.

Mr. Hunter describes with distinctness the physical aspect of the countries in which the regiment served, and notes from month to month the atmospheric changes and their relation to the prevailing diseases. The interesting incidents of the march and of the active operations in the field are detailed with much spirit and ability.

There is one fact, above others, relating to health in India which is well illustrated in the history of this regiment, and which Mr. Hunter does not fail fully to appreciate, viz., the necessity of great care in respect to season and other conditions in transferring men whose constitutions have been impaired by long continued tropical influences, from the highlands to the coast, and again from the coast to the highlands.¹ It is a change which relates to temperature, humidity, density, and possibly other atmospheric conditions also; and to states of the human system, in the direction of debility and deterioration, by which it has become predisposed to disease. It refers to a law in etiology which has been well understood, but which seems to be in some danger of being pushed aside by the too exclusive miasmatic doctrines of the day.

1st Bombay
European
regiment
(Fusiliers).

The medical history of the 1st Bombay European Infantry is very full and interesting. The first part is written by² Dr. F. S. Arnott and embraces the eight years during which he was surgeon of the regiment, from 1st April 1846 to 31st March 1854. At the close of 1845 the Fusiliers then stationed at Deesa received orders to proceed *via* Bombay to Scinde for service on the Indus consequent on the Seikh invasion of our provinces on the Sutledge. The regiment reached Sukkur about the end of February 1846, but the war having been brought to a close by the battle of Sobraon, it returned by steamers on the Indus as far as Tatta, thence marched to Kurrachee and remained there till towards the end of 1848. It was in June 1846 that one of the most calamitous outbreaks of cholera recorded in Indian military history took place at Kurrachee. From 5th June to 31st July, out of a strength of 6,626, European and native, there were 1,348 attacks and 679 deaths. The Fusiliers suffered, though in less degree than other regiments, yet the attacks were 31 per cent. of the strength and the deaths 38 per cent. of the attacks. In October 1848 this regiment left Kurrachee to join the army engaged in the siege of Mooltan, and after acting a prominent part in that operation it proceeded to the Punjab and reached the army of the Commander-in-Chief in time to assist in the battle of Goojerat on the 21st February 1849, and in the subsequent pursuit of the Seikh and Affghan armies. On the termination of this service the Fusiliers moved to Peshawur at the end of March and remained at that frontier station till the end of December, when it commenced its return to the Bombay Presidency and arrived at Poona in April 1850, having travelled 1,800 miles in three months and five days, and passed from 34° to 18° N. latitude. During these four years and a half the regiment had been two years and a half in tents. The Fusiliers remained at Poona for two years, and in 1852 were transferred to Bombay and Aden, the head quarters being at the latter station. This was not the first visit of the regiment to Aden, for it had been stationed there³ in 1839 shortly after the transfer of the Peninsula to the Government of India.

Every subject of importance to the health of the soldier in India comes under Dr. Arnott's consideration in the course of this lengthened history. Many defects in sanitary arrangements and the methods of correcting or removing them are pointed out; to some of these, allusion will be more particularly made in an after part of this sketch.

The year 1857 found the Fusiliers again stationed at Kurrachee. Dr. Costello, the surgeon in charge, writes⁴ that on the 21st May intelligence of the mutiny at

¹ Useful practical observations on this subject will also be found in Dr. Leith's report on Quetta, B. M. P. S., 1st, v., 1842, p. 56.

² B. M. P. S., 1st, x., 1849-50, p. 1. *Ib.*, 2nd, ii., 1853-54, p. 102.

³ Howison, *Ib.*, 1st, iii., 1840, p. 79.

⁴ *Ib.*, 2nd, iv., 1857-58, p. 288.

Meerut and the capture of Delhi was received, and the regiment was warned for service. The circumstances were most unfavourable; the great heat at that season forbade marching; the Indus was at flood and the best steamers were absent in Persia. The movement commenced on the 28th May in the only available steamer, by detachments of 200 at a time, and in this manner 800 Europeans were conveyed 800 miles from Kurrachee to Mooltan under much exposure and fatigue in assisting to warp the vessel against the stream, in good health in the hottest month of the year in Lower Scinde, with the thermometer at 110° under the ship's double awning. The second dram of spirits was discontinued; cold bathing was encouraged. The full flood of the river lessened the risks from malaria, so that the men slept on the river bank every night, allowing the decks of the steamers to be well cleansed and ventilated. The head quarters, 465 strong, remained at Mooltan exposed to the sanitary disadvantages inseparable from the circumstances of the service in which they had become unexpectedly engaged. The ratio per cent. of treated to strength was 409, of deaths to strength 2·7 and of deaths to treated 0·6; the average daily number of sick being 48. The left wing 355 strong, under medical charge of Mr. Straker,¹ was detached to Lahore and Ferozepore, marching in June and July. Several deaths occurred from sunstroke, but these Mr. Straker believed might have been lessened had turbans for protecting the head been provided sufficiently early and prompt affusion of cold water been more exclusively depended on in the treatment. The ratio per cent. of treated to strength was 128; of deaths to strength 3·9; and of deaths to treated 3·0.

The medical history² of the 14th Light Dragoons for 1841-42 is drawn up by Mr. J. W. Moffat, the surgeon in charge. The regiment arrived in Bombay in September and October 1841, was landed at Panwell, and immediately marched to Kirkee, the European Cavalry Station of the Presidency. Mr. Moffat remarks:—"The regiment, 500 strong, arrived in Bombay in a healthy state. From the excellent regulations and arrangements now enforced by the Company for the transport of their troops the men maintained their health and spirits throughout the voyage of four months, and disembarked in good condition." The immediate transfer from the ships to the march to the Deccan was in accordance with the practice which had for some time been observed of giving European troops on their arrival in the Presidency the advantage of the cooler climate of the Deccan, and of avoiding the more enervating conditions of the coast. The disadvantages of the old system, the transfer in country boats to Panwell, and the march of six days thence to Kirkee, shown in this report, contrast strikingly with the advantages of the few hours' journey by the present railway system. The physical features of Kirkee and the surrounding country are well described. The barracks built in 1826-27³ allowed 1,400 cubic feet of space. Mr. Moffat points out the error that had been committed in timing the arrival of the regiment at the latter part of the monsoon instead of towards the end of November, by which the men were exposed to the influence of the malarious months, September and October, and 197 were received into hospital ill with fever between the end of October and middle of November.

Her Majesty's
14th Light
Dragoons.

The subsequent history of this regiment, its residence for many years at Kirkee, its admirable services in Persia and Central India, are not recorded in the Transactions of the Bombay Medical and Physical Society.

The medical history of the 3rd Troop Horse Artillery for the last four months of 1834, when stationed at Deesa, has been written by Dr. Brown,⁴ and for the year 1843, when at Mhow, by Mr. E. Impey.⁵

Bombay
Artillery.

The prevalent diseases of the 1st Troop Horse Brigade for the years 1838 to 1841 inclusive, when stationed at Sholapore, Poona, and on field service in Scinde, are described⁶ by Dr. A. H. Leith; and those of the 2nd Battalion, when in Fort George, Bombay, in 1841, by Mr. T. Robson.⁷

The medical history of the 1st Battalion 4th King's Own Regiment, when stationed at Ahmedabad in Guzerat in the year 1860, is written by Dr. J. Goringe,⁸ and embraces detailed accounts of some of the chief diseases. For the short notice of the medical topography of the province and the description of the city of Ahme-

1st Battalion
4th King's
Own Regi-
ment.

¹ B. M. P. S., 2nd, iv., 1857-58, p. 299.

⁴ *Ib.*, 1st, vii., 1844, p. 166.

⁶ *Ib.*, 1st, v., 1842, p. 94.

² *Ib.*, 1st, v., 1842, p. 122.

⁵ *Ib.*, 1st, iv., 1841, p. 46.

⁷ *Ib.*, 2nd, vii., 1861, p. 105.

³ *Ib.*, 1st, i., 1838, p. 200.

Ib., 1st, v., 1842, p. 56.

BOMBAY. — dabad the author is mainly indebted to Mr. Gibson's report, which has been noticed in an early part of this sketch.

10th Regiment Native Infantry. The 10th Regiment was stationed at Aden for three years, 1840 to 1842, and forms the subject of an interesting report¹ by Mr. Scott. During the first two years the sickness and mortality were great, in consequence of fatiguing duties, scurvy, and defects in the sanitary condition of the part of the station allotted to the regiment; but there was a great improvement in 1842 from the judicious removal of the causes which had acted injuriously. The report is of pathological as well as of sanitary interest, for it describes a peculiar form of chronic peritonitis, not much noticed either before or since.

The 10th Regiment, during the two years from 1st April 1857 to 31st March 1859, was in Rajpootana and Central India, and for 14 months of that period was engaged in active service in the field, the incidents of which are detailed by Mr. T. Murray.²

17th Regiment Native Infantry. After the 17th Regiment had been four years stationed at Baroda, the diseases for the eight months, April to November 1854, are described in detail by Mr. Stratton.³

18th Regiment Native Infantry. The medical history⁴ of the 18th Regiment for five years from 1838 to 1842, during which it was stationed at Baroda in Guzerat, narrated by Dr. F. S. Arnott, contains much that is interesting relative to the causes, symptoms, and treatment of the diseases of that station, which at one time had the character of being very unhealthy. But it was not so during the period included in this history—a circumstance which Dr. Arnott thus explains, "Some years ago, however, the whole camp was thoroughly and scientifically drained, and as the soil is loose and sandy not a drop of surface water can now be seen an hour after the heaviest rain," and by the further statement that the greatest attention was paid to the cleanliness of the lines and compounds, and to the removal of superabundant vegetation.

Intermittent fever was the principal disease. The relation of its greatest prevalence to the malarious months, July, August, September, October, and of its greatest mortality to December and January, is dwelt upon by Dr. Arnott in illustration of a well known law in the etiology of disease in India already adverted to (p. 120), and again to be more fully noticed in this sketch (p. 141).

19th Regiment Native Infantry. The 19th Regiment, after three years' service in the Punjab and Scinde, became stationed at Kolapore in the Deccan, in the year from the 1st April 1851 to the 31st March 1852, the period embraced in Dr. Willie's report,⁵ which contains an interesting notice of the physical and climatic conditions of the station in relation to the causation of disease, as well as an account of the prevailing diseases.

22nd Regiment Native Infantry. The 22nd Regiment, after service in Scinde, arrived in the month of May 1840 as Malligaum in Khandeish, and remained there for four years. Dr. A. Arnott's report⁶ refers chiefly to the year 1843, but it also gives a comparison of the sickness and mortality in the different years. In 1840 the deaths were 41; in 1841, 10; in 1842, 6; and in 1843, 5. The strength in 1840 was 869, and in the three subsequent years it averaged 1,100. The effect of the deteriorating influence of the climate of Scinde, and of the favourable influences of that of Malligaum is thus well shown. Dr. Arnott makes also useful observations relative to the unhealthy jungles which intervene between Khandeish and Malwa—a subject more fully noticed by Mr. A. Graham in his report⁷ of the 15th Regiment Native Infantry in the year 1840.

23rd Regiment Native Infantry. Dr. J. R. Miller, in his medical history⁸ of the 23rd Regiment for the year ending 31st March 1858, states that the regiment forming part of the force on service in Persia, under Major-General Outram, was at the close of the report of the previous year, March 1857, encamped on the alluvial plain at Mohamreh at the mouth of the Euphrates and the Tigris. It thence proceeded to Bushire in May and to Karrak in August. The left wing moved to Rajcote in December and the head-quarter wing to Bombay in the following February. This service, under varied influences of climate and country, necessarily suggested useful remarks on the causes, the prevention, and treatment of such diseases as malarious fevers and affections of the bowels.

¹ B. M. P. S, 1st, vi., 1843, p. 153.

⁴ *Id.*, 1st, vi., 1843, p. 102.

⁷ *Id.*, 1st, iv., 1841, p. 86.

² *Id.*, 2nd, v., 1859, p. 76.

⁵ *Id.* 2nd, i., 1851–52, p. 329.

⁸ *Id.*, 2nd, iv., 1857–58, p. 268.

³ *Id.*, 2nd, iii., 1855–56, p. 233.

⁶ *Id.*, 1st, vii., 1844 p. 119.

The 25th Regiment formed part of the Scinde force in the year 1841, and, after being stationed on the plain of the Indus, it was moved to the elevated localities of Quetta and Khelat. The influence of this change on the health of the Sepoys and other circumstances of interest are detailed by Mr. A. Wright.¹

BOMBAY.
25th Regiment Native Infantry.

The medical history of the 25th Regiment for the two years from the 1st April 1857 to 31st March 1859 is narrated by Mr. W. J. Stuart.² During one year and ten months of this period the regiment was marching or engaged in active operations in the field, in the campaign in Malwa in 1857, and as part of the field force of Central India, under command of Sir Hugh Rose, in 1858. Many important questions regarding the health of the soldier under the vicissitudes of climate and the incidents of marching, exposure, and warfare, are discussed by Mr. Stuart. For example, when treating of the subject of protection from the sun, Mr. Stuart remarks that, while attention is paid to the head-dress, "more attention should be paid to protecting the spinal column and the great centres of the organic system of nerves, by using a light loose coat, well wadded, or made of a light woollen material."

The published extract³ of Mr. J. F. Steinhæuser's report of the 26th Regiment for the year ending April 1851 is chiefly occupied with a detailed account of the Scinde boil, an affection also common in the upper provinces of India, Guzerat, and Mesopotamia.

26th Regiment Native Infantry.

The 26th Regiment formed part of the same division of the Persian force as the 23rd Regiment in the year 1857, but suffered less from sickness. Mr. J. Batho⁴ traces in his report the characteristic features of the climate from month to month and their relation to the prevailing diseases. The 26th Regiment moved to Bushire from Mohamreh in May, then to Karrak and Bombay in September, and in October was engaged in field service against the Bheels in Khandeish.

Mr. G. Nuttall⁵ communicates a short notice of the diseases which prevailed in the 29th Regiment when stationed at Surat in the year ending 31st March 1852.

29th Regiment Native Infantry.

III.

GENERAL HOSPITALS, GAOLS, MILITARY ASYLUM, LUNATIC ASYLUM.

The published reports of the European General Hospital extend over a period of 22 years from 1838 to 1860. The first report⁶ for 1838 is by Dr. Bird; the reports⁷ from 1846 to 1856 are by Dr. Stovell, and those⁸ from 1857 to 1860 by Dr. Leith. The interval between 1838 and 1846 supplies the data for several contributions,⁹ not drawn up in the form of official reports, on various classes of disease, as delirium tremens, intermittent and remittent fever, dysentery, apoplexy, cholera, smallpox, and several others. As the inmates of this hospital are derived from various classes of the European community—soldiers, seamen, artificers, unemployed, females, children, resident in Bombay, and strangers from other stations—the full and continuous records of an institution of this kind must necessarily contain much valuable information on disease, not only as it may be traceable to causes existing in Bombay, but also as depending on influences to which the sick may have been exposed elsewhere. Intermittent and remittent fever in seamen are in many instances clearly attributable to malaria generated in the Bombay dockyard, but in others—chiefly admissions in January and February—the disease has been caused by the autumnal malaria of the Persian Gulf, the Red Sea, the coasts of China, and the banks of the Indus, and in such the type is generally tertian.¹⁰ It is of importance to note facts of this kind, because they go to prove, what indeed is indisputable, that mere statistics of disease if applied uncorrected by clinical observation to the elucidation of etiology are as likely to lead to error as to truth.

European General Hospital, Bombay.

¹ B. M. P. S., 1st, v., 1842, p. 153.

² *Ib.*, 2nd, v., 1859, p. 1.

³ *Ib.*, 2nd, i., 1851–52, p. 323.

⁴ *Ib.*, 2nd, iv., 1857–58, p. 281.

⁵ *Ib.*, 2nd, i., 1851–52, p. 310.

⁶ *Ib.*, 1st, ii., 1839, p. 55.

⁷ *Ib.*, 1st, ix., 1847–48, p. 45.

Ib., 2nd, i., 1851–52, p. 294.

Ib., 2nd, ii., 1853–54, p. 57.

Ib., 2nd, iii., 1855–56, p. 1.

⁸ *Ib.*, 2nd, iv., 1857–58, p. 221. *Ib.*, 2nd, v., 1859, p. 89. *Ib.*, 2nd, vi., 1860, p. 217.

⁹ Morehead, B. M. P. S., 1st, ii., 1839, p. 100. *Ib.*, 1st, vi., 1843, pp. 32, 139, 170. *Ib.*, 1st, vii., 1844, pp. 31, 131, 183. *Ib.*, 1st, viii., 1845–46, p. 25. *Ib.*, 1st, ix., 1847–48, p. 112.

¹⁰ Morehead, Clinical Researches, 2nd edition, p. 19.

BOMBAY.

Native
General
Hospital and
Jamsetjee
Jejeebhoy
Hospital,
Bombay.

The insufficiency of the sanitary condition of the building of the European General Hospital has, throughout the long period embraced in these reports been, and it is feared still continues to be, the subject of frequent representation and complaint.

The Native General Hospital¹ and Jamsetjee Jejeebhoy Hospital² are classed together, because they are one institution, the hospital for the native civil population of Bombay. The designation was changed in 1845, when the small unsuitable Native General Hospital was closed and replaced by the Jamsetjee Jejeebhoy Hospital. This institution³ originated in the liberality of Sir Jamsetjee Jejeebhoy amply supplemented by the Government. It was adapted for 300 patients, and in construction and organization was much in advance of any previously existing hospital in the Presidency. It constitutes the practical school of Grant Medical College, and this association has necessarily led to the diseases of the inmates having been observed and studied in all their relations with great care and by scientific methods. A reference to the contributions⁴ made to medical science by the officers of the hospital will show with what success these investigations have been conducted. It will be sufficient to allude here to one or two practical facts of interest. In a native population so varied and fluctuating as that of Bombay there must be many seeking admission into a general hospital affected with diseases which owe their origin to the morbid influences of other localities. For example, of the cases of intermittent and remittent fever many are not due to the malaria of Bombay because they occur in travellers just arrived from other countries, as Mahomedans on pilgrimage to Mecca from inland districts and sepoy guards of opium from Malwa, who have recently passed through the malarious tracts which intervene between that province and Bombay. It has also been proved that, in addition to such diseases as intermittent and remittent fever, affections of the bowels, and cholera, which affect both Europeans and natives, diseases of the liver, including abscess, generally considered of unusual occurrence in natives, are in reality not so. It has further been shown that diseases common in European countries, but supposed to be rare in India, are frequently present in the hospital, frequenting classes of the native population of Bombay, as pneumonia, phthisis pulmonalis, pericarditis, and diseases of the heart, and Bright's disease of the kidney.⁵ The very numerous admissions of tetanus, 554⁶ in 15 years, have afforded the opportunity of studying this grave affection on a scale of unusual extent, and the results have been carefully recorded.⁷ The statistics of the Registrar-General show that tetanus is a rare disease in the United Kingdom, and almost always presents itself in the traumatic form; but in the native population of Bombay a large proportion is idiopathic, and in many instances registered as traumatic the injury is so slight as to raise the question whether these might not be more correctly regarded as idiopathic. The causes of idiopathic tetanus are obscure and call for further investigation. The frequent instances of poisoning by *Datura*, generally for the purpose of facilitating the commission of petty thefts, has at times been made evident by the admissions of individuals found by the police in the street and brought to the hospital labouring under the peculiar effects of that poison. The circumstance is adverted to in some of the early reports⁸ of the Native General Hospital. From 1837 to 1848, from 6 to 10 cases were admitted annually, but during the year 1848⁹ 51 cases came under treatment.

In the writings relating to the important diseases studied in this hospital the subject of etiology has always been carefully attended to, in the belief that faithful clinical investigation of which etiology is a part constitutes the only sure basis of a sanitary system.

The gaols of
the Presi-
dency.

The sanitary condition of the gaols of the Bombay Presidency forms an important consideration in the annual reports of the several civil stations, as Rutnagherry,¹⁰ Ahmedabad,¹¹ Tannah,¹² Dharwar,¹³ Ahmudnuggur,¹⁴ Dhoolia.¹⁵

¹ B. M. P. S., 1st, iii., 1840, p. 106.

² A. Graham, B. M. P. S., 1st, v., 1842, p. 19.

³ Report of Grant Medical College, No. i., p. 5.

⁴ J. Peet, B. M. P. S., 1st, x., 1849-50, p. 147.

⁵ *Ib.*, 2nd, i., 1851-52, p. 1. *Ib.*, 2nd, v., 1859, p. 189. C. Morehead, B. M. P. S., 1st, x., 1849-50, p. 228. *Ib.*, 2nd, i., 1851-52, p. 189. *Ib.*, 2nd, ii., 1853-54, pp. 1 and 87. G. R. Ballingall, 2nd, iii., 1855-56, p. 229. *Ib.*, 2nd, iv., 1857-58, p. 1.

⁶ Clinical Researches, 2nd edition, pp. 465, 508, 554, 581. Peet, B. M. P. S., 2nd, v., 1859, p. 189.

⁷ Peet's Principles and Practice of Medicine, p. 447.

⁸ Peet, B. M. P. S., 2nd, i., 1851-52, p. 1. Clinical Researches, 2nd edition, p. 672.

⁹ D. C. Bell, B. M. P. S., 1st, ii., 1839, p. 169. *Ib.*, 1st, iii., 1840, p. 49.

¹⁰ H. Giraud, B. M. P. S., 1st, ix., 1847-48, p. 209. ¹¹ J. Bourchier, B. M. P. S., 1st, iii., 1840, p. 117.

¹² S. Sproule, B. M. P. S., 1st, v., 1842, p. 159.

¹³ J. W. Winchester, B. M. P. S., 2nd, viii, and ix.,

1845, 1847, pp. 64, 237.

¹⁴ G. F. Forbes, B. M. P. S., 2nd, i., 1851-62, p. 337.

¹⁵ D. Wyllie, B. M. P. S., 2nd, ii., 1853-54, p. 73.

¹⁶ J. J. Faithfull, B. M. P. S., 2nd, iii., 1855-56, p. 281.

Defects are pointed out without reserve, and methods of improvement suggested. **BOMBAY.**
Though good had been effected in many respects, as in the dietaries, space, clothing, labour, conservancy, &c., still in 1860 much remained for a sanitary department to accomplish.

The schools of the Bombay Education Society established at Byculla in the island of Bombay about the year 1820 by the advocacy of Archdeacon Barnes, are chiefly for the maintenance and education of the children of the European soldiers of the Presidency. The children are partly of unmixed European extraction and partly Indo-Britons, and from 1830 to 1860 the annual numbers, both sexes included, have ranged from 235 to 355, and their ages from 3 to 16. **The Military Asylum.**

In this institution there has been the opportunity of observing the influence of the climate of Bombay in the causation of disease in the children of Europeans, a subject of much importance and interest. Fever, intermittent and remittent, bowel complaints and cholera, have received attention.¹ An epidemic² of cynanche parotidea and of chicken pox is noticed. In the course of 22 years there were four epidemics³ of measles with intervals of from five to seven years. While measles was present in these schools in 1857 it prevailed also in the native population of Bombay⁴ and affected severely the children of the first battalion of artillery at Ahmudnuggur.⁵

The question of transferring the military asylum from the coast climate of Bombay to the table land of the Deccan was at different times brought under discussion, but financial reasons interposed in preventing a measure of the expediency of which there could be no doubt. The climate of the Deccan table land from the middle of June to the end of February, and of an accessible hill station, of which there are several, from March to the middle of June, is what ought to be aimed at.

Considering the short time of the British possession of the greater part of the western Presidency and the extent of the population, the arrangements for the care and treatment of the insane have necessarily been imperfect and insufficient. There has been one asylum at Colaba, in Bombay, and indifferent accommodation of a limited nature in connexion with the civil hospitals at Poona and Ahmedabad. This state of matters has not existed from ignorance of what was required, but from the difficulties inseparable from organizing and giving effect to a system at all commensurate to the largeness of the object. That the means at disposal have been judiciously used, and the wants wisely apprehended, is evident from the following extracts taken from Dr. Arbuckle's report⁶ of the Colaba Asylum for the year 1848-49:—"In the treatment pursued kindness and consideration to every patient in the asylum has been the invariable rule, whilst much attention has been given to the advantages arising from the daily salt water bath outside the asylum, perfect cleanliness and ventilation, regular hours, and carefully regulated food; as well as separating the noisy and refractory from the tranquil, and occupying the minds of the patients as much as possible with healthy amusements, such as for the natives garden employment, making mats, &c., whilst the Europeans had their bagatelle table, backgammon board, card table, and reading room, to amuse and attract their attention. Restraint has never once been had recourse to, tranquillity being always produced in acute cases of mania by separation and isolation with mild aperients, cold effusion, and the occasional use of the acetate or muriate of morphia, as recommended by Dr. Seymour."

"With an asylum objectionable as to construction and situation it is difficult to suggest what is best to be done in the way of improvement, and I therefore hesitate to encourage a much greater outlay of money in trying to make the present building at Colaba meet the desired end, as I am of opinion that the real interests of Government and those of the community will be best consulted by adopting the wiser plan of building a new asylum on some dry, large, open, and elevated site in the vicinity of Bombay, possessing an abundant supply of water suitable for garden purposes, and all the other essentials necessary for the improved moral treatment of insanity, such as the separation of castes, various workshops, &c."

"Cases of insanity occurring in the Southern Mahratta country, where the

¹ Clinical Researches, 2nd edition, pp. 181, 233, 318.

² B. M. P. S., 1st, ii., 1839, p. 197.

³ *Ib.*, p. 181. W. C. Coles, B. M. P. S., 1st, ix., 1847-48, p. 225. H. J. Carter, B. M. P. S., 2nd, i. and iv., 1851-57, pp. 128, 253.

⁴ Moreswur Lunardhun. Grant Medical College Society's Proceedings.

⁵ Clinical Researches, 2nd edition, p. 196.

⁶ B. M. P. S., 1st, ix., 1847-48, p. 222.

BOMBAY. Canarese language is spoken, should also, in my opinion, not be sent to Bombay for treatment, as their removal to a distant country, where their language is neither spoken nor understood, only tends to aggravate their maladies; and to make provision for such cases a district asylum should be built at Dharwar (or Belgaum) similar to what I recommended when stationed there as civil surgeon. Encouragement would then be given to the friends of insane patients to bring them to an asylum within their reach at the first onset of the disease, when treatment is so efficacious, and the villages would then be relieved from the many victims to chronic insanity who go about disseminating all the evils of such an hereditary disease, and who are never once brought under the influence of medical treatment until they have committed some criminal offence and are brought before the civil authorities to be consigned to an asylum for the rest of their lives. The same remarks may be applied to cases of insanity in Scinde, and a district lunatic asylum should not, in my opinion, be lost sight of amongst the improvements introduced into that part of the Presidency."

IV.

STATISTICS OF SICKNESS, MORTALITY, AND OF THE CAUSES OF DEATH.

Statistics are more or less included in the regimental medical histories, chiefly in that of the Fusiliers, and in the reports of general hospitals. The Transactions¹ of the Medical and Physical Society, however, contain several contributions, more specially on the statistics of disease.

Mr. Hunter (2), in his statistical review of the principal stations for European troops, viz., Bombay, Poona, Belgaum, Deesa, in 1841, shows the comparative rates of mortality per 1,000 deduced from the limited data of the 2nd Queen's Royal Regiment and of the 6th Regiment, supplemented by his own observation, viz., Bombay, 27·1; Poona, 21·8; Belgaum, 23·5; Deesa, 55·4. The rate at Deesa Mr. Hunter considered to be exceptionally high, consequent on the great prevalence of fever, and doubtless also on the condition of the men who had just returned from the service in Affghanistan already detailed; and in this view he was correct; for, if this rate be compared with that given in the Report² of the Royal Sanitary Commission the latter will be found to be 26·41.

Mr. Hunter, after a succinct notice of the climate and prevailing diseases of the different seasons, remarks "that the stations of Poona and Belgaum in the Bombay Presidency are in point of locality everything that can be desired, and therefore that all European troops not elsewhere required should be cantoned at one or other of these, or some similar intermediate point, where with due care in making the reliefs from the low country the mortality would little exceed that in England."

¹ 1. General Abstracts of the Returns of the Sick of the European and Native Troops of the Presidency of Fort George, from 1827 to 1835, presented by the Medical Board, 1st, i., 1838, p. 339.

2. Statistical Review of the Climates of the Principal Stations for European Troops in the Bombay Presidency, by R. H. Hunter, 1st, iv., 1841, p. 75.

3. Contributions to the Military Medical Statistics of China, by John Kinnis, M.D., 1st, ix., 1849, pp. 3 and 73.

4. Tables and Remarks on the Medical Statistics of European Troops stationed at Bombay and the Deccan between the years 1830 and 1846, by Mr. H. Webb, 2nd, i., 1851-52, p. 63.

5. Decennial Return of the Age, Caste, Country, and Casualties of the Bombay Army, by Lieut.-Col. G. J. Jameson, 2nd, ii., 1853-54, p. 253.

6. Abstract of Strength, Admissions into Hospital, and Deaths of European Troops in the Bombay Presidency from 1830 to 1849, and of Native Troops from 1840 to 1851, presented by the Medical Board, 2nd, ii., p. 259.

7. Tables of Mortality in Bombay from 1848 to 1853 inclusive, prepared from Dr. Leith's Mortuary returns, by W. C. Coles, M.D., 2nd, ii., 1853-54, p. 269.

8. Hospital Statistics of the Bombay Presidency, from 1st April 1855 to 31st March 1856, by W. C. Coles, M.D., 2nd, iii., 1855-56, p. 190.

9. Observations on and Tables of Sickness and Mortality amongst Native Troops in the Northern Division from 1841 to 1852, and in the Southern Division from 1840 to 1854, by J. Scott, 2nd, iii., 1855-56, p. 261.

10. Replies to certain Inquiries from the Royal Commission on the Sanitary State of the Indian Army, by the Principal Inspector General, Medical Department of Bombay, 2nd, vii., 1861, p. 235.

11. Report on the Health of European and Native Troops in the Bombay Presidency for 1860, presented by the Inspector General, 2nd, vii., 1861, p. 278.

² Vol. 1st, p. 698.

Mr. Webb's (4) communication on the medical statistics of European troops, BOMBAY. drawn up with great care from the records of the Medical Board, includes the 17 years from 1830 to 1846. It treats of the ratio of admissions and deaths to strength, from fevers, dysentery, cholera, hepatic affections, pulmonic affections, diarrhoea, and "other diseases" in relation to station, to half years from April to September and October to March, and to months.

The hospital statistics for the year from 1st April 1855 to 31st March 1856, prepared by Dr. Coles (8) from the records of the Medical Board, include European and Native troops, prisoners in gaols, the police force, civil hospitals, sanatoria, the Indus flotilla, and the public dispensaries. Dr. Coles commences his report with judicious observations on the defects in the existing methods of registering the statistics of sickness and mortality, and on the importance of an improved nomenclature of disease. In respect to the troops, European and Native, the gaols and police force—the strength, the treated, the deaths and the causes of death, with their ratios, are recorded in relation to the divisions of the Presidency. The paper concludes with a careful analysis of the tables, and with an additional table showing the aggregate monthly admissions and deaths of the several classes, arranged also according to the divisions of the Presidency. In the year 1855-56 cholera prevailed to a very limited extent on the troops of the Bombay Presidency. The deaths in Europeans were five, in Natives, 14; an aggregate of 19, of which 14 occurred in the island of Bombay. The ratios of deaths to strength and to treated for this year per thousand in the several classes were as follows:—

	To Strength.	To treated.
European troops	18·	9·
Native	9·	7·
Prisoners	36·	22·
Police	6·	13·

It will be useful to view the above ratio (18·) of deaths to strength in European troops in connexion with that for the 10 years from 1850 to 1860 as shown in the replies (10) of the Principal Inspector-General of the Medical Department to the inquiries of the Royal Sanitary Commission, viz.:—

¹ Kirkee	-	13·7	Sholapore	-	20·9
Aden	-	16·7	Ahmudnuggur	-	27·2
Poona	-	17·3	Kurrachee	-	27·4
Belgaum	-	17·8	Hyderabad	-	28·7
Deesa	-	19·5	Colaba (Bombay)	-	32·0

being 22·7 per 1,000 strength as the average of the Presidency for 10 years from all causes, the mutiny included.

To this may be added the ratio for three years, from 1857 to 1860, of seven stations occupied after and in consequence of the mutiny under the disadvantages of temporary barracks, &c.

Asseerghur	-	13·5	Nusserabad	-	37·8
Ahmedabad	-	20·8	Baroda	-	42·3
Mhow	-	28·4	Surat	-	51·7
Neemuch	-	30·3			

An average of 32·1. Half the mortality at Baroda was from sunstroke. The strength at Surat was only 58, and the quarters in the fort were unsuitable; two-thirds of the deaths were from diarrhoea and dysentery. Adverting to the mortality at Colaba (Bombay), 32· per 1,000, the Inspector-General remarks, "This state of things will not probably again happen, as the establishment of the Khandalla dépôt relieves Bombay of invalids; whilst the railroad to Poona permits invalids from that large station being kept in their own hospitals until the eve of embarkation; still there is no doubt but that Bombay is a very unhealthy station both for European and Native troops. Very severe epidemics of fever prevailed in 1858, and in the present year, owing to the bad structure of barracks and hospitals, insufficient drainage, and unwholesome effluvia from the neighbouring beach."

Mr. Scott's tables (9) of sickness and mortality in Native troops in the northern division of the army from 1841 to 1852, and of the southern division from 1840 to 1854, show in respect to the first the monthly ratio of admissions and deaths

BOMBAY. from fevers, dysentery, diarrhoea, cholera, hepatitis, and all diseases with the average daily number of sick per 1,000 strength at the following stations:—Ahmedabad, Rajcote, Deesa, Baroda, Broach, Surat. The same facts are given of the stations of Belgaum, Sholapore, Kolapore, and Dharwar in the southern division. Mr. Scott points out that a comparison of the tables of the two divisions seems to show that though in the northern division the ratio of attacks and deaths to strength from fevers, dysentery, and diarrhoea is greater than in the southern, yet the ratio of deaths to admissions from these diseases is greater in the latter than the former division.

The registration¹ of deaths in the island of Bombay, commenced in 1848 and continued onward by Dr. Leith, relates the deaths and their causes to different castes, ages, sexes, divisions of the island, months, and quarters.

The value of these registrations has been impaired by the want, during the period within the limits of this sketch, of a trustworthy census of the population, and of accuracy in the returns of the causes of death. Each annual series of tables is accompanied with an abstract of the meteorological observations made at the Magnetic Observatory at Colaba; and the prefatory reports on the state of the health of the island call the attention of the authorities with much wisdom and force to the agencies which were affecting injuriously the public health, as foul drains, cesspools, undrained flats, burying grounds, &c.

A knowledge of the causes of disease is the foundation of a sanitary system, that is, of the prevention of disease. It is therefore useful to inquire in what manner and to what extent the statistics of mortality and its causes, that is, the statistics of deaths and of diseases, may conduce to a knowledge of the causes of disease, and consequently to a right sanitary system.

As sickness and mortality are very materially influenced by the state of predisposition, well termed bad general health, induced by impure air, insufficient food, water, covering, depressing passions, intemperance, &c. a high rate of mortality at once suggests more or less of these conditions, calls for investigation, and in a general way indicates the nature of the preventive means.

If the cause of a disease be certain, simple, and unvarying, then to register the existence of the disease is equivalent to registering the existence of its known cause; but information of this kind can hardly be predicated of any disease, therefore statistics from this point of view are of little use in prevention.

If, as is not unusual, the causes of a disease are variable and complex, the statistics of such a disease, though they do not teach the precise cause, guide and assist the clinical investigation by which alone it can be accurately ascertained.

If the causes of a disease are uncertain the uncertainty can only be removed by further clinical observation. Statistics by proving the existence of such diseases suggest the necessity and importance of further inquiry, but teach nothing further as respects the cause.

In order that the statistics of deaths and their causes may become the true measure of the healthiness of a locality the community must be fixed; hence it often happens that the army statistics of India are not a true measure of the healthiness of stations, because the system of regimental reliefs impresses on the communities a condition of fluctuation; and it therefore follows that army statistics of mortality and disease alone teach even less of the causes of disease than the same statistics of civil fixed communities.

In order that the statistics of deaths and of diseases should afford the assistance now indicated in determining the causes of disease it is necessary not only that the disease should be accurately diagnosed but that the nomenclature and classification in the instance of diseases whose causes are uncertain, should not express or imply a theory of causation, for it is very evident that the tendency of a theory habitually expressed or implied on the general public, who are ignorant of etiology, and on those of the medical profession who do not reflect, must be to assume the false form of a fact. There is reason for apprehending that the nomenclature and classification of disease which has for many years been in use by the Registrar-General of the United Kingdom, and more recently adopted by the army and Indian medical departments, has had this unfortunate influence, for it is otherwise difficult to understand how within the last 10 years a change

¹ Deaths in Bombay, 1848 to 1857.

of opinion as to the causes of disease in India, of the nature implied in this nomenclature and classification, is gradually taking place, because a change of this kind in order to be justifiable or intelligible should rest on new and more extensive clinical data, and of such there is no published record within the period referred to. BOMBAY.

V.

CLIMATES OF THE BOMBAY PRESIDENCY.

Climate and meteorology are considered, in more or less detail, in the reports on medical topography and the medical histories of regiments already referred to.

The observations made in the observatory at Colaba are the full record of the meteorology of the island of Bombay. Abstracts, in part, have been prepared by Dr. Leith¹ and Dr. Lownds² in forms more accessible than the original observations. Climate of the island of Bombay.

During the period between 1830 and 1860 much useful information has been collected³ on the meteorology and climate of the Deccan. Climate of the Deccan table land and of the Deccan hill stations.

The difference of climate between the coast level, the Deccan table land (1,800 feet); and hill stations (4,000 to 4,500 feet), caused by altitude and proximity to or distance from the sea, is a leading characteristic of the Presidency of Bombay, and is a sanitary fact of great importance, for good or evil, according as it is applied wisely or unwisely with reference to season and conditions of health.

Mr. Murray is the great authority on these climates. He resided on the Mahabuleshwur hills as Superintendent of the Sanitarium from 1831 to 1844, with the exception of the years 1834 and 1835, when he was absent at the Cape of Good Hope. From 1844 to 1847, and during the five additional previous monsoons, Mr. Murray was stationed at Sattara. An experience of 12 years at Mahabuleshwur, during which time upwards of 3,000 visitors must have passed under his observation, and during which he was earnestly engaged in registering meteorological observations and in collecting and collating the numerous facts which came before him, illustrative of the physical, physiological, therapeutic, and prophylactic characters of hill climates, not only of the Deccan but of India generally, followed by a residence of four years at Sattara on the Deccan table-land, gives an *a priori* value to Mr. Murray's writings, which a careful perusal of them fully sustains. The temperature and humidity of the different seasons of these climates in relation to health and disease are considered with care, but there are two other conditions of hill climates to which Mr. Murray attaches, justly it is to be believed, considerable importance, and which in their influence on the animal system have of late years been too much overlooked, viz., rarefaction of the air from diminished atmospheric pressure, and the contrast between the high degree of solar radiation and the reduced temperature of the shade.

The full consideration which has thus been given to the qualities of the climates of the Deccan table land and hill stations in comparison with those of the climate of the coast and of the low-lying provinces of Guzerat and Scinde, left no doubt in regard to the sanitary use of the Deccan climates for European troops. It was no question of theory, but the result of experience and observation, duly recorded, for 30 years at Mahabuleshwur, relative to about 9,000 civilians and military officers, including their wives and children, and to 650 sick soldiers at Poorundhur, and to the condition of health generally of Europeans in the different seasons at the various stations throughout the Presidency. The conclusions applicable to Europeans in the Bombay Presidency may be thus briefly summarized.

¹ "Deaths in Bombay." ² Clinical Researches, 2nd edition, p. 741. B. M. P. S., 2nd, vi., 1860, p. lxix.

³ A. Young, B. M. P. S., 1st, ii., 1839, p. 211. J. Murray, B. M. P. S., 1st, i., 1838, pp. 79, 344. *Ib.*, 1st, ii., 1839, pp. 35, 244. *Ib.*, 1st, iii., 1840, p. 195. *Ib.*, 1st, v., 1842, p. 176. *Ib.*, 1st, vii., 1844, p. 1, 199. *Ib.*, 1st, ix., 1847-48, p. 155. C. Morehead, B. M. P. S., 1st, iii., 1840, p. 212. *Ib.*, 2nd, iv., 1857-58, pp. 193, 208. *Ib.*, 2nd, vii., 1861, p. vii. Clinical Researches, 2nd edition, pp. 728, 747. Chesson, B. M. P. S., 2nd, v., 1859, p. xxv. F. H. Plumptre, B. M. P. S., 2nd, vi., 1860, p. xl. W. A. Shephard, B. M. P. S., 2nd, vii., 1861, p. 45.

BOMBAY. 1. The cold season from the middle of November to the end of February is suitable throughout the Presidency; it is the season for marching and drilling.

2. The hot season from the beginning of March to the middle of June and the month of October are more or less injurious to the European constitution, with exception of at elevations of from 4,000 to 5,000 feet, with, if possible, such proximity to the sea as shall bring them within the influence of the sea breeze.

3. The rainy season of the south-west monsoon, from the middle of June to the end of September, is, from humidity, heat, malaria, or cold more or less injurious at all elevations, with however some remarkable exceptions, the chief being that part of the Deccan table land, between 20° and 15° north latitude within 60 miles of the eastern side of the Western Ghats with an elevation of from 1,700 to 2,300 feet.

4. The system which for 30 years had been found by civilians, military officers, and their families, to include all the benefits which the Deccan table land and hill stations were capable of conferring, and which had been confirmed by medical experience was to pass the cold season at their official stations, and as often as practicable to resort to Mahabuleshwur in the hot season and to Poona in the rainy season.

5. The logical inference from these facts, as respects European troops, is not to station them for a succession of seasons and of years in hill climates, but to transfer them in such proportions as the contingencies of service will allow to a hill station—Malcolm Pait on the Mahudbuleshwur hills being the best—in the hot season, to move them down to the table land within the salubrious limits for the rainy season, and to return them to their respective stations in the succeeding cold season. Thus giving to every soldier and every family in rotation, and the more frequently the better, the advantage of protection from the injurious influences of the hot and rainy seasons of the lower levels and of the rainy season of the hills. The movements involved in a system of this kind might have been a difficulty in former times, but with the extension and adjustment of a railway system they may be effected with great facility, and in themselves possess a sanitary value.

6. The expediency of not including the cold season in the period of residence at the hill stations has been questioned, but as a rule it will be found that the cold season at the lower elevations will prove more suitable to health, particularly for individuals who have been some years in India: and the change will prevent the tedium which invariably attends a continuous lengthened residence on the hills.

Climate of
Mount
Aboo.

The climate of Mount Aboo in Northern Guzerat, 4,000 feet above the sea and 45 miles north-east from Deesa, has in its relation to health been the subject of several reports.¹ The first experiment with invalids was made in 1840, and in 1847 barracks and a hospital were erected, but the situation was badly chosen, as was evident from the physical feature of the locality and the state of health of the men. This was the more to be regretted because Mr. Gibson, in alluding to Mount Aboo as a probable sanitarium in 1836, remarked "it seems very doubtful whether the top of the hill does not abound in malaria for half the year."² A consideration of all the facts connected with this hill station seemed to point to the following conclusions:—

1. That like the hill climates of the Deccan its chief use should be as a preventive of disease by maintaining a high standard of general health and not as a means in the treatment of actual disease. If invalids are transferred to the station great caution should be exercised in the selections both as respects season and kind of disease.

2. The position of the barracks should be changed to an unobjectionable locality and should be of suitable construction.

3. That a large proportion, if not the whole of the Deesa regiment, should be stationed at Aboo in the hot season.

4. The monsoon climate of both Deesa and Aboo is insalubrious, but in a question between them the preference may be given to Aboo, particularly in the months of August and September.

¹ T. M. Lowndes, B. M. P. S., 2nd, iii., 1855–56, p. 163. W. C. Roe, B. M. P. S., 2nd, v., 1859, p. 222. J. Ogilvy, B. M. P. S., 2nd, vi., 1860, p. 192.

² B. M. P. S., 1st, i., 1838, p. 71.

5. In the cold season, as respects health, Deesa is preferable to Mount Aboo, and even if not, a break in the irksome monotony of a long-continued residence on the hills, for drilling, &c. would prove a sanitary advantage. BOMBAY.

The climate of the Cape of Good Hope was formerly a subject of much interest to the Indian invalid. Mr. Stovell, during a residence there of 18 months in 1848 and 1849, directed his attention to the subject and communicated the result of his observations and inquiries to the Medical and Physical Society. ¹ Climate of the Cape of Good Hope.

VI.

CAUSES AND PREVENTION OF—(1) FEVERS. (2) SMALL POX—VACCINATION. (3) MEASLES, SCARLET FEVER. (4) CHOLERA. (5) DYSENTERY. (6) HEPATITIS. (7) SUNSTROKE. (8) DELIRIUM TREMENS. (9) DISEASES OF THE HEART AND AORTA. (10) GUINEA WORM. (11) SCURVY. (12) LEPROSY. (13) SNAKE BITES. (14) URINARY CALCULUS.

In this section it is proposed to consider the causes of some of the principal diseases in their relation to prevention.

There is one fact, above others, that has been impressed on the observers of disease in the Bombay Presidency; it is the importance of marking the distinction between predisposing and exciting causes. The cachectic states which predispose to disease not only augment sickness and mortality, but necessitate a modification of treatment. These states, for the most part preventible or avoidable, are produced by such causes as impure air in all its varieties, insufficient food, insufficient supply of good water, climatic influences, unsuitable exercise and occupation of body and mind, intemperance, injudicious medical treatment, sequelæ of disease, &c. The removal of these predisposing causes is in an Indian military sanitary system, included in the selection of sites for cantonments, the position and construction of barracks and other buildings, conservancy, drainage, dietaries, water supply, use of hill climates, system of regimental reliefs, the dress, duties, occupations, and amusements of the soldier, the canteen system, the clinical study of disease, &c. By these means efficiently conducted, not only will these cachectic states be prevented, but the force of the exciting causes of disease will become materially lessened in two ways:—1st, by reducing the susceptibility of the community. 2nd, by obstructing the development, spread, and intensity of the exciting causes. The exciting causes of disease are specific, as epidemic, endemic, infections; and ordinary, as atmospheric vicissitudes, &c. Knowledge, in part at least, of the exciting causes of disease is still incomplete and uncertain and requires to be further investigated; it suggests that part of a sanitary system which deals with disinfection, segregation of the sick, vaccination, and contagious disease Acts, &c.

It must be manifest that a right sanitary system is one which regards all these details in their proper place, order, and proportion; and that a system which tends to give too great prominence to one set of morbid influences and to neglect another is sure in the long run to lead to confusion and errors of omission or commission, and consequently to discredit a most important department of social policy.

1. FEVERS.

Intermittent and remittent fever are different degrees of one type caused by marsh malaria, and hence termed malarious fevers. These have been more or less noticed in the various writings already referred to and elsewhere ² in the Transactions of the Bombay Medical and Physical Society. It will be sufficient to state here some of the leading facts of the etiology of this form of fever. It would seem that a certain degree of heat acting on the earth's surface previously soaked with water is essential to the production of malaria, and that it is most certainly generated when the process of drying is going on, and when it may be assumed that aeriform emanations exist in proportion to the rapidity of the drying process. Intermittent and remittent fever.

¹ B. M. P. S., 1st, x., 1849–50, p. 195.
B. M. P. S., 1st, viii., 1847, p. 32.

² Thomson, B. M. P. S., 1st, v., 1842, p. 84. Carter,

BOMBAY. From this fact it follows that, whether we have to deal with tracts habitually swampy, as at the mouths of large rivers, or with districts within the influence of the south-west monsoon, as the western coast of India and provinces adjacent, or with countries subject to the annual inundation of rivers, as Scinde, the autumnal season is that in which malarious fevers are most prevalent. In the instance of ground habitually marshy, or where the rainfall is great and the surface level, as in Bombay, these fevers will prevail most and be of greatest severity in September and October. But where the rainfall is less, as in the Deccan and at Deesa, July and August are the months of greatest frequency, varying according to the period and amount of rain in the year of observation. In jungly tracts, where the shade of the underwood postpones the process of drying, and where diffusion of the malaria is interfered with by the foliage, as in the jungles which intervene between Khandeish and Malwa, November and December may become the months of greatest danger. At Mount Aboo also, for similar reasons, the fever season would seem to be delayed till November.

Intermittent fever may also occur in the cold months, December, January, and February, the more likely when the reduction of temperature is considerable; but in this the causation is different and consists in cold acting as a determining cause on individuals previously tainted with malaria, and may operate in localities not malarious. Intermittent fever thus caused is usually of the tertian form.

The production of malarious fever in jungly districts by drinking impure water, presumably water tainted with malaria, is alluded to by Mr. A. Graham, who states that the deputy post-master of Hoosingabad in 1837 wrote to this effect relative to the Khandeish jungles:—

“¹ For the benefit of the police chokees and travellers I had wells made at all the stages to Baitool, which precaution has quite put a stop to jungle fever, which used to be contracted by the Najeems, dawkmen, travellers, and people who resided there.”

Mr. Bettington, of the Bombay Civil Service, afterwards called the attention of the Government² to the opinion entertained generally by the natives of jungly tracts as Wynaad, Guzerat, and Khandeish, and shared by himself, that fever was caused more by drinking impure water than by malaria in the atmosphere, and he recommended that wells of good water should be provided for all the villages thus situated, and be kept clear of organic contamination. The wisdom of the advice was indisputable, and reduction of fever is believed to have resulted. In these circumstances there is ground for scientific investigation, but not for the establishment of an etiological fact, for it must be noted that the opinion rests on native popular impression, and that the natives of India attribute disease generally to impure water.

That sol-lunar agency is instrumental in inducing malarious fevers was a favourite idea of Dr. Francis Balfour in the latter part of the last century, and has from time to time received attention since.

Mr. Murray³ and Dr. Peet⁴ have considered the subject in detail, but without arriving at a satisfactory conclusion. The truth probably is that when recurrences of fever are noted at the periods of full and new moon there will generally be found to be present an appreciable atmospheric change of temperature, moisture, direction of the wind, &c. to which the febrile disturbance may reasonably be attributed.

The relation of cachectic states⁵ to mortality, form, and methods of treatment of malarious fevers is very important, because it serves to explain the great discrepancy of opinion which existed on those points among medical observers of the latter part of the past century and the first quarter of the present one, and also to inculcate the right principles of prevention. The influence of malarious fevers on health in India is not restricted to the immediate attack, because there is no cachectic state in India

¹ B. M. P. S., 1st, iv., 1841, p. 89.

² Indian Annals of Medicine, vol. iii., 1856, p. 526.

³ B. M. P. S., 1st, ii., 1839, p. 171.

⁴ *Ib.*, 1st, vi., 1843, p. 210.

⁵ Fever with an unusual proportion of adynamic cases and consequent mortality prevailed in the gaol at Sattara from October 1858 to May 1859, and illustrated, 1. The influence of temporary errors in dieting and clothing, of fatigue, and of vitiated atmosphere, in creating a predisposition to be acted on by the malaria of the locality, and the reduced temperature of season and of elevation, thus increasing the quantity of fever. 2. The effect of the predisposition thus engendered and of ill directed medical treatment and management in aggravating the type and augmenting the mortality.—Clinical Researches, 2nd edition, p. 63.

more predisponent to attacks of other severe forms of disease, as will subsequently appear, as that induced by the prolonged duration of intermittent and remittent fever. The course of this disease is very much influenced by proper medical treatment. The mercurial treatment in the first quarter of this century was not only wanting in power to shorten the duration of the fever, but was further injurious by adding a mercurial to a malarious cachexia. Clinical observation in the Bombay Presidency was instrumental in no small degree in correcting this grave error and in bringing back medical opinion and practice to the principles of the best observers of the latter part of the 18th century, chiefly the two Linds, Cleghorn, Balfour, and Cullen, but with the great advantage resulting from the discovery of quinine. The principle is easily understood; it consists in watching for the periods of intermission or remission and of exacerbation, and of using the different remedies appropriate to these different stages of the disease. So important is it to mark the remissions that, as pointed out by Dr. John Hunter in 1788 in his work on the diseases of the army in Jamaica, the early hour of visiting hospitals in tropical countries originated in the circumstance of the morning being a usual period of remission which it was of consequence not to miss. The right medical treatment of malarious fever is in truth a preventive or sanitary measure of no small moment in its bearing on sickness and mortality in India. It is the more important that this should not be lost sight of, because the principle in question has little application to the diseases of temperate climates, and, under the present system of more frequent regimental reliefs, medical officers not previously familiar with tropical disease are apt not fully to realize it. It may be urged with some show of reason that under an improved sanitary system malarious fever will become less frequent and this experience less necessary, but the contingencies of service may at any time reproduce the disease, and there never can be any excuse for ignorance and neglect of a great doctrine in therapeutics. So convinced is the writer from personal observation of the necessity of these remarks that he has no hesitation in transcribing the following valuable extract from Dr. Hunter's "Observations on the Diseases of the Army in Jamaica" already referred to:—

"A surgeon that would do justice to the men under his care must be very frequent in his visits to the hospital; for unless he watch assiduously the remissions of the fever, and be ready to take immediate advantage of them, he will not be able to check the disease speedily, without which both the constitution and life of the patient will be in imminent danger. A man that has three or four fits of the fever is in greater danger of dying than one that has only one or two; but, taking the risk of death out of the question, a man that has his fever stopped after the first or second fit will generally be restored to health in a few days, whereas if he have four or five fits it will often require as many weeks to recover the same degree of strength in the latter case as days in the former. It must, therefore, be obvious how much the diligence and attention of the surgeon importeth, of which a very striking proof occurred in a regiment which was strong and consisted of 12 companies. The regiment was provided with two hospitals and two surgeons, each of whom took charge of the sick of six companies. It was presently found that one hospital was much fuller than the other, which did not appear to proceed from a greater sickness among one division of the companies than the other, for there was no material difference in the number of sick sent from the several companies. In order to bring the sick in the two hospitals to an equality a company was taken from one division and annexed to the other. The sick of the five companies were, however, still more numerous than that of the seven; and after a short trial they were divided into four and eight companies, and then the sick of the two hospitals were nearly equal, and varied from 40 to 60 each. It may be supposed that so great a difference depended upon the method of treatment being entirely different in the two hospitals. That, however, was not the case; the general plan of treatment was nearly the same in both, and not materially different from what has been mentioned in speaking of the cure of the remittent fever. It was owing to the following circumstances: one surgeon visited his hospital four or five times a day, the other only twice a day; the first seldom allowed any remission to pass without taking advantage of it, the latter often; one was always at hand to palliate the untoward symptoms, as vomitings or purgings, proceeding either from the medicines or the disease; the other not. Add to these that vigilance in the surgeon at the head of an hospital extends itself to the servants and nurses under him, and thence a greater degree of attention both in administering nourishment and medicines. The effect of all these causes was that the men

BOMBAY. recovered in half the time in one hospital than they did in the other, and therefore the hospital for eight companies had no greater number of sick than that for four."

The use of quinine as a prophylactic in malarious districts is distinct from its use in the treatment of intermittent and remittent fever. It would seem that up to 1860 there was no evidence of the prophylactic power of quinine from experience in the Bombay Presidency.¹ It is a question not easy to determine, and its decision ought not to be hastily assumed, because undue confidence may lead to unfortunate consequences. Dr. Livingstone² has some interesting remarks on this subject, he says, "It was at first believed that a daily dose of quinine would prevent the attack. For a number of months all our men except two took quinine regularly every morning. The fever sometimes attacked the believers in quinine, while the unbelievers in prophylactic powers escaped. Whether we took it daily or omitted it altogether for months made no difference; the fever was impartial and seized us on the days of quinine as regularly and as severely as when it remained undisturbed in the medicine chest, and we finally abandoned the use of it as a prophylactic altogether. The best preventive against fever is plenty of interesting work to do and abundance of wholesome food to eat." Though the confidence of this party in the prophylactic power of quinine was gone, it remained unshaken as to its value in the treatment of the fever.

Adynamic
remittent
fever.

The term adynamic, which implies great prostration of the vital powers indicated by certain well known symptoms, may be applied to any type of fever in which these symptoms appear. Adynamic cases of remittent fever are not uncommon, and depend, it may be, on a pre-existing cachectic state, on the intensity of the malaria, or on injudicious management during the attack. It is not these occasional instances which are to be considered here, but the occurrence of adynamic remittent fever epidemically, attended by great mortality and of which there have been several accounts recorded within the 30 years of this sketch. Fever of this kind prevailed in Kattywar, Cutch, and part of Guzerat from 1815 to 1820, and was described³ by Messrs. McAdam, White, and Gilder. It appeared at Pali⁴ in Marwar and in the adjoining districts in 1836 and 1838, and was reported on by Messrs. McLean, Irvine, Keir, and Russel, and the results embodied in a memoir by Dr. James Ranken, at the time Secretary to the Medical Board of Bengal. It has also been described by Mr. Crammond and Dr. Forbes.⁵ Fever of similar character again occurred in Gurhwal and Kumaon in 1849, and in Rohilehund in 1853, and was noticed⁶ by Drs. Pearson, Francis Renny, Stiven, and more fully described by Dr. Mackinnon in his treatise⁷ on the prevailing diseases of Bengal and the North-western Provinces. In 1856, the disease was observed at Joosode on the confines of Guzerat, and described by Mr. Bow.⁸ It is of interest to note that the districts which have now been mentioned are either extra-tropical or on the confines of the tropic. The character of the fever and the circumstances of its origin have been similar in all these instances. It would seem to have been malarious remittent, very adynamic in consequence of the cachectic condition of the attacked, caused by previous famine, crowding, and filth. The question of infection was always an important one to consider and determine. That there is no infectious property in malarious remittent fever as usually seen and treated in India is undoubted, but Fordyce, Clark, Lind, and others believed that malarious fevers were liable to become infectious under the favouring circumstances of crowding and filth, and probably this was true of the adynamic remittent fever which has now been considered.

In a report on the medical topography and diseases of Aden, by Mr. Ruttonjee Hormuzjee,⁹ an outbreak of adynamic remittent fever is described as occurring in 1855 and 1856 amongst the native labourers engaged on the public works. It prevailed with greatest severity from February to April 1856, during which time there were 188 admissions and 60 deaths. The disease was attributed to undue crowding in a hot and badly ventilated valley, in close ill constructed huts in the proximity of sources of foul effluvia from decomposing animal excreta and other

¹ Clinical Researches, 2nd edition, p. 149.

² Narrative of an expedition to the Zambesi, and its tributaries, by David and Charles Livingstone, 1865, p. 72.

³ B. M. P. S., 1st, i., 1838, pp. 155, 183, 190.

⁴ According to the too common practice of giving local or native names to disease indulged in by Indian medical writers, this form of fever has been designated the Pali disease and Mahamurree.

⁵ B. M. P. S., 1st, ii., 1839, p. i.

⁶ Indian Annals of Medicine, Nos. 2 and 3.

⁷ Indian Annals of Medicine.

⁸ B. M. P. S., 2nd, iii., 1855-56, p. xxvii.

⁹ Clinical Researches, 2nd edition, p. 158.

matters, coupled with poor living and especially an inadequate supply of fresh water. The question of infection is not noticed in the report, but the causes of the disease and their preventible character are sufficiently apparent. BOMBAY.

It would seem that epidemic visitations of adynamic forms of fever have been of late years more frequent than ever in some parts of India. These when occurring should be clinically investigated with great care and the record should be published. But in the meantime the important questions of diagnosis and etiology involved should not be prejudged by the use of such terms as "Typhus," and the dogmatic assertion of individual opinion.

These are names used to designate forms of idiopathic fever distinct from malarious fever, and produced by ordinary exciting causes, as vicissitudes of temperature, great heat, fatigue, excitement of mind, excesses in eating, intemperate habits, and neglected excretion. The fevers of three or four days' duration thus excited differ in degree rather than character. To the milder form the terms common continued, ephemeral, febricula, have been indiscriminately applied. To the severer forms the designation ardent has been given. They are common in those parts of India which are beyond the influence of the monsoon rains, and the heat of which is not tempered by regular breezes from the sea, as the central parts of the Deccan, Mysore, the Ceded districts, the coast of Coromandel, Scinde, and the Punjab, rather than Bengal, Bombay, and the western coast south of Surat. They occur chiefly in March, April, and May, but also in June and July where the temperature is high and the conditions of malaria are absent. The milder form, though most common in Europeans recently arrived in India, also occurs in natives and in Europeans some time resident; but the severer form is almost confined to the hot and dry months in arid localities and to regiments or recruits fresh from Europe or other cold climates. An important sanitary question¹ is related to this type of fever, viz., that of acclimation. The longer and more continuous the exposure of the European to the adverse influences of high temperature, excessive humidity, and malaria, the greater will be the deterioration of his constitution; but, on the other hand, there are few facts in physiology more satisfactorily proved than that in change from Europe to India the constitution of the European undergoes a modification by which the various functions are brought into harmony with a climate of higher temperature. This may be truly called acclimation perfected in one cycle of the seasons. If the arrival in India has taken place in the cold season, then, with ordinary care as regards diet, dress, exposure, exercise, &c., the change will be insensibly effected, and the European at the commencement of the second cold season will have become acclimatized in the only sense in which the term can be rightly used. But if arrival should take place in the hot season, or if there should be excesses in food, intemperance, undue exposure or fatigue, then one or other of the forms of fever under consideration will be excited, and these in common language are correctly enough termed seasoning fevers. But this rude process of seasoning Europeans to an Indian climate not only for the time fills the hospitals with sick, but leaves the soldier shattered in constitution and predisposed to the serious forms of tropical disease. With a good sanitary system it ought to be a very rare occurrence, and what that system ought to be is clear enough. It includes in addition to ordinary sanitary details attention to the season of arrival and a free resort to hill stations during the hot months.

The statistical system which has classed these fevers depending on ordinary causes with those proceeding from specific causes, under a designation miasmatic, which implies a miasm or poison to be the exciting cause, must tend to suggest an erroneous etiology and imperfect methods of preventing a preventible disease.²

Typhoid or enteric fever, established as a distinct species by Sir W. Jenner in 1849, has been recognized in India only within the last 13 years, chiefly on the authority of Dr. Ewart,³ Mr. Scriven,³ and Dr. Edward Goodeve,⁴ in the Bengal Presidency, of Mr. Cornish⁵ and Mr. Rankin in the Madras Presidency, of Mr. Hanbury⁶ in H.M.'s 33rd regiment at Deesa in 1859, and of Dr. Peet⁷ more recently in Bombay.

Common continued fever, ephemeral fever, febricula, ardent continued fever.

Typhoid or enteric fever.

¹ B. M. P. S., 2nd, vii., p. x.

² To consider the occasional varieties of fever in which, from season, physical character of locality and predisposition, there may be a combination of malarious and continued fever, would be to transgress the limits of this sketch. The principle is intelligible to the practical physician, and should be recognized in a sanitary system.

³ Indian Annals of Medical Science, vol. iv., pp. 65, 511.

⁵ Madras Quarterly Journal of Medical Science.

⁷ *Ib.*, 2nd, viii.

⁴ *Ib.*, No. xi., p. 141.

⁶ B. M. P. S., 2nd, vii., 1861, p. 144.

BOMBAY. This form of fever has hitherto been of rare occurrence in India. The opinion has however been entertained that it existed also in former times, but was not distinguished from other species. ¹ This belief is probably correct, but not to the extent supposed; for it is certain that some of the cases referred to in support of it have not been rightly apprehended. On the other hand, in reports hitherto published there is a tendency to be satisfied with data hardly sufficient in extent and precision. The inquiry is one of great interest and importance, requiring to be prosecuted with much method and care.

The rarity of enteric fever in India compared with European countries has a bearing on the etiology of the disease which it may be well to notice. If enteric fever be caused by decomposing exposed excreta or other animal matter it ought to be a common disease in India; but if, as supposed by Dr. Murchison and others, "it is necessary that the matter undergoing fermentation be either in a confined space, as in a drain or sewer, or that it be in a state of stagnation," states implying a previous admixture of the excreta with water,² then it ought to be rare in India, and the fact of its being so is an argument in favour of Dr. Murchison's opinion, and a reason for not heedlessly introducing on a large scale into India the water sewerage and river pollution system of England, the evils of which have not yet become fully developed.

(2.) SMALL-POX.—VACCINATION.

Small-pox. From the Bombay records³ on small-pox this interesting law appears, that the greatest amount of the disease is in the quarter which includes the vernal equinox, and the least in that which includes the autumnal equinox; also that the difficulty in propagating the vaccine disease is coincident with the period of minimum prevalence of small pox. On these and other points of interest the records may be consulted.

Vaccination. The discovery of vaccination was published by Jenner in 1798. The practice was followed by Chevalier Jean de Carro, a physician in Vienna in 1799, and by him brought to the notice of Lord Elgin, at the time ambassador at Constantinople, by whose exertions its efficacy became known in Turkey and Greece. Mr. Duncan, Governor of Bombay, the Medical Board, and the Political Residents at Bagdad and Bussorah, used every endeavour to secure the transmission of vaccine to Bombay. Jenner had failed in his efforts by the sea route by the Cape of Good Hope. Mr. Duncan early in 1801 addressed himself to Lord Elgin, and Dr. De Carro was applied to. He at the time was making experiments with vaccine lymph, not obtained from Jenner or the English stock, but from cows of Lombardy. In 1802 some of this lymph, preserved and transmitted with great care, was received at Bagdad at the end of March, and was successfully used by Dr. Short, the Residency surgeon. Thus vaccination was established at Bagdad from the Lombardy lymph through the efforts of Dr. De Carro. Thence it passed to Bussorah, and by the 17th of May Mr. Milne had vaccinated there 40 persons, among whom were the crews of ships bound for Bombay. The vaccine reached Bombay early in June and succeeded in the hands of Dr. Helenus Scott, the second member of the Medical Board. From Bombay it was disseminated to Calcutta, Madras, Ceylon, and the Malabar coast. Before the end of 1802 vaccination was established in Poona, Tannah, Surat, and Baroda. Dr. Keir was appointed superintendent of vaccination, and his first report, dated 15th September 1803, laid the foundation of the system which has since obtained. Till the year 1820 vaccination was conducted by superintendents at the principal stations. In 1821, during the Government of the Honourable Mount Stuart Elphinstone, the

¹ The writer of this sketch in the 1st edition of his *Clinical Researches* published in 1856, stated that typhoid (enteric) fever was unknown in India. In the 2nd edition in 1860 this opinion was modified. Since then it has been suggested in various quarters that the disease, though occurring, had been overlooked. This may have been the case in one or two instances, but hardly in several, because in 1843 (*B. M. P. S.*, 1st, vi., p. 193), six years before Sir W. Jenner had established the distinction between enteric and typhus fevers, the writer, in his notes on the malarious fevers of the European General Hospital, had mentioned an occasional anatomical relation between some cases of remittent fever and some forms of European continued fever. His words are, "A state of ulceration of the glands of Peyer at the end of the ileum also occurs in cases of typhoid remittent fever with gastro-enteric symptoms, just as it occurs in European continued fever, with typhoid symptoms and similar local complication. But it is not, I think, very frequently observed, partly perhaps from the disease not running so long a course as in European typhus, but terminating fatally before these morbid lesions have had time to evolve themselves."

² Murchison on Continued Fevers, p. 452.

³ Morehead, *B. M. P. S.*, 1st, viii., 1847, p. 25. *Id.* *Clinical Researches*, 2nd edition, p. 182. Leith, "Deaths in Bombay," 1857, p. xi.

Bombay territories were portioned into four divisions, which from time to time have been increased with the extension of the Presidency, and a travelling vaccinator was appointed to each; great importance was attached to these offices, and great care exercised in the selection of qualified officers. In 1855 the staff of subordinate vaccinators was increased from 55 to 139, and another division was added. BOMBAY.

¹ If periods of five years from the introduction of vaccination to the year 1855 be taken, the following are the numbers vaccinated :—

Before the year 1806	-	-	25,000
From 1806 to 1810	-	-	123,000
„ 1811 „ 1815			No data.
„ 1816 „ 1820	-	-	106,000
Upon the introduction of the new system :			
From 1821 to 1825	-	-	261,000
„ 1826 „ 1830	-	-	374,000
„ 1831 „ 1835	-	-	403,000
„ 1836 „ 1840	-	-	324,000
„ 1841 „ 1845	-	-	330,000
„ 1846 „ 1850	-	-	446,000
„ 1851 „ 1855	-	-	849,000

The annual reports of vaccination in the Bombay Presidency from 1854 to 1859, prepared by Dr. Coles, the secretary of the medical department, contain much useful information. The report for 1856-57 briefly states the means employed to be as follows :—

1st. By Government vaccinators (itinerant) under divisional superintendence of vaccination, of whom there were eight.

2nd. By Government vaccinators (stationary) under civil surgeons, of whom there were 20.

3. By the itinerant and stationary vaccinators of six native chiefs under divisional superintendents of vaccination.

Vaccination is compulsory on the unprotected recruits of the native regular troops of the Bombay army; it is also largely practised on the families of sepoys, and on camp followers and their families throughout the army generally. In 1859 there were, independent of the army, 252,760 vaccinations throughout the Presidency; of these, 91·2 per cent. were successful. The largest number vaccinated was by the district superintendents, and amounted to 70·3 per cent. of the whole. “The next largest sphere,” to quote from the report, “of conducting vaccinating operations, is through the agency of the native chiefs, and about 28,000 individuals annually receive the benefit of vaccination through the liberality of the chieftains, jageerdhars, &c. of Western India, and that in the remotest and wildest parts of the country. The smallest number vaccinated is under civil surgeons in the chief Sudder stations. Civil surgeons, however, have only a very limited establishment, viz., one vaccinator allowed to each, or a total of 20.”

The data for estimating the ratio of vaccinations to native population throughout the Presidency do not exist, but probably, notwithstanding the efforts of the previous 60 years, it did not in 1859 reach 1·5 per cent.

The vaccination report for 1858-59 gives a table of the admissions and deaths from small-pox in European and native troops, prisoners in gaols, civil hospitals, and dispensaries in each division of the Presidency, with per-centage of deaths to strength and to treated, for the years 1858 and 1859. From this table it is learnt that in 1858 in Europeans the per-centage of deaths from small-pox to strength and treated was 0·2 and 13·3; in 1859, 0·02 and 7·2; nearly two-thirds of the excess of 1858 occurred in the Rajpootana and Gwalior field forces. The per-centage in native troops was in 1858, to strength 0·02, and to treated 4·3; and in 1859 0·004 and 2·0; showing in the natives a greater degree of protection than in Europeans, not by vaccination however, for about 60 per cent. of the protection in native regiments is by previous small-pox natural or inoculated. But there is still further evidence of the protected state of the native army. In the five years from 1851-52 to 1855-56 there were 310 admissions of small-pox and 21 deaths, a

¹ The facts of this narrative and the statistical facts are taken from an interesting paper on the rise and progress of vaccination in Western India, by Dr. W. C. Coles, recorded in the proceedings of the Medical and Physical Society of Bombay, 2nd ser., iii. p. xiv., for the year 1855-56.

BOMBAY. mortality of 7 per cent. to the treated; but the fact of interest is that during the same period there were returned 612 admissions of varicella (chicken pox), no deaths, and there is no doubt that of these a considerable proportion¹ were small-pox, very modified, from previous small-pox, natural or inoculated, or from vaccination. These remarks apply to an adult male population with compulsory vaccination, where not previously protected; but a very different state of matters appears when attention is turned to the families of sepoys and to regimental camp followers.

The prevalence of small-pox at several of the military stations of the Poona division in the early part of 1858 led to the system of military vaccination, in the division being closely scrutinized, and the results were published² in the General Orders of the army.

The following was the state of protection per cent. in adults :—

	By Small-pox.	By Vaccination.	Unprotected.
Sepoys -	61·8	34·5	3·5
Followers -	68·8	27·1	3·4
Sepoys' wives -	69·7	29·3	0·9
Followers' wives -	73·7	21·3	5·7

The difficulty in determining the number of adults affected with small-pox before coming under regimental observation rendered the returns of this class an imperfect test of the degree of observance or neglect of vaccination. But in respect to children this uncertainty did not exist, for it might be fairly assumed that a large proportion of those under 10 years of age had been born and reared in the regimental lines; and it was the prevalence of small-pox amongst them that gave rise to the investigation. The following are the results :—

	By Small-pox.	By Vaccination.	Unprotected.
Children of sepoys -	27·0	57·3	15·5
Followers -	40·6	34·3	25·1

Showing a defective state of vaccination in a community favourably circumstanced for its systematic observance.

A comparison in these particulars with the European troops and their families serving at the same time in the Poona division gives these results :—

	By Small-pox.	By Vaccination.	Unprotected.
Soldiers -	13·5	83·5	3·4
„ Wives -	11·6	86·2	0·5
„ Children -	2·8	93·0	4·1

The mortality from small-pox in the island of Bombay represents that of a very imperfectly protected community as respects the native population, and the contrast on this point with European residents may be stated. Taking a period of five years, from 1848 to 1852, the deaths from small-pox in Europeans are about 10 per 1,000 deaths, which is about double the average of European countries in which vaccination is compulsory, but not half that of England and Wales, and only one-sixth that of the native classes in Bombay; in these the rate is 60 per 1,000 deaths, and of these deaths from small-pox 80 per cent. is in children under seven years of age.

3. MEASLES AND SCARLET FEVER.

Measles.

This disease has already been noticed in connexion with the military asylum at Bombay, but it is again alluded to in this place with the view of noting that the same law obtains in regard to it as to small pox, viz., that the period of maximum is about the vernal and of minimum the autumnal equinox. It is of interest also to observe the difference of prevalence in different years. The deaths registered from measles in the island of Bombay for the ten years from 1848 to 1857 amounted to 2,362; of these there was no death in 1855, but in 1857 there were 1,734, viz.—

³ 1856, January -	123	1857, July -	21
1857, February -	327	„ August -	11
„ March -	498	„ September -	1
„ April -	441	„ October -	1
„ May -	228	„ November -	2
„ June -	82	„ December -	1

¹ Clinical Researches, 2nd edition, p. 186.

² Clinical Researches, 2nd edition, p. 191.

³ Leith, "Deaths in Bombay."

The same law of maximum and minimum prevalence obtains in respect to BOMBAY. *chicken pox*.

From 1830 to 1860 no case of scarlet fever was observed in the Bombay Presidency, and probably the remark may be extended to India generally. Scarlet fever.

4. CHOLERA.

It is unnecessary, in the present stage of inquiry respecting cholera, to say much. The writings referred to in the foot note¹ do not throw any light on the specific cause of the disease, but they confirm the undoubted conviction that, whatever that cause may be, it is much increased in power, and perhaps at times really developed, by general unsanitary conditions of localities, and favoured by predisposing bodily and mental states of communities and by such determining causes as impure water, bad food, and inclemencies of weather. These auxiliary causes are preventible, and attention should be fixed on them with the assurance that, whatever the specific cause or poison may be, cholera will by their removal be materially abated, possibly in time altogether prevented.

It would be out of place here to enter on a consideration of the various current opinions relative to the virus and nature of the specific cause. It is sufficient to remember that they are merely hypotheses, more or less probable, which serve to suggest the direction of further inquiry and to inculcate certain useful sanitary measures, as scrupulous care in the disposal of excreta and the use of disinfectants; care being at the same time taken to guard against the neglect which special views tend to encourage, of those general sanitary measures of whose preventive powers there can be no question. Above all, future investigations relative to these hypotheses and others which have probably yet to appear, should be conducted by minds without bias capable of grasping the entire subject and not satisfied with moving within the limited circles of certain sets of opinions. It is very right to endeavour, by studying the conditions of localities, seasons, and peoples visited by cholera, to enlarge our knowledge of the causes, but it should be in connexion with that surest but too neglected etiological method, the generalization from a large number of carefully observed instances of the disease. For example, in the plausible doctrine that the cholera poison has its nidus in the discharges and often infects through the medium of drinking water, two links in the chain of causation are generally, if not always, wanting, viz., proof that the discharges had really mixed with the suspected water and proof that the units of mortality had really drunk of the suspected water and were free from other influences of admitted power to the same extent as those who escaped. It is a good practical doctrine, but to regard it as an established truth is to warp the entire field of etiological inquiry and sanitary practice in this disease.

The experience, however, of these years in Bombay has suggested useful and definite conclusions on the treatment of cholera which may be stated as follows:—

There are degrees and stages of cholera as of other zymotic diseases beyond the direct resources of medical art, that is beyond the power of medicines, but in which the mortality may be materially reduced by abstinence from rash and restless empiricism and by placing the patient in circumstances most favourable for the revival of vital actions under the influence of their ordinary stimuli. Whilst on the other hand there are degrees and stages of cholera which are frequently readily controlled by medicines and the right treatment of which also materially reduces the mortality. These are the conclusions of no limited clinical observation, and as the question is one of medical practice exclusively, they of course can only be controverted by observation of the same kind more extensive or better considered.

As respects measures for the prevention or curtailment of epidemics of cholera, in addition to those grounded on general sanitary principles and on reasonable hypotheses of the causation, there is one on which a few words may be hazarded, viz., the movement of communities from the locality of attack; this is chiefly practicable in the instance of troops and the prisoners in jails, but it is in regard

¹ Gibson, B. M. P. S., 1st, ii., 1839, p. 209. Leith, *Ib.*, 1st, iv., 1841, p. 48. Arnott, *Ib.*, 1st, vi., 1843, p. 108. *Ib.*, 2nd, ii., 1853–54, p. 144. Hyslop, *Ib.*, 1st, x., 1849–50, p. 51. Moffat, *Ib.*, 1st, v., 1842, p. 137. Murray, *Ib.*, 1st, ix., 1847–48, p. 195. Stovell, *Ib.*, 2nd, iii., 1855–56, p. 47. Lownds, *Ib.*, 2nd, vi., 1860, p. 247. Morehead, *Clinical Researches*, 2nd edition, p. 202. Ruttonjee Hormuzjee, B. M. P. S., 2nd, v. 1859, p. xxxii.

BOMBAY. to the former that orders of great stringency have been issued in India. In the Bombay Presidency throughout the 30 years included in this sketch the occurrence of cholera in a regiment usually suggested to the minds of military and medical officers the question of movement into camp. There are no published records bearing on the frequency of the practice, but it is not likely, more especially during the last 15 or 20 years of the period, that it was much observed. In many instances the want of sufficient marching and other equipment to meet the hurried requirement, and in others considerations of season, condition of the troops, and health of the locality and surrounding districts may have influenced the decision.

Movement is now made imperative in the Indian army on the occurrence of two or three cases of cholera irrespective of every other consideration; this system is now on trial and a few years will determine its wisdom. It may by chance meet the requirements of the yet unknown specific cause, but it assuredly has not the merit of being based on a scientific method. This is not the place or the time to discuss the subject in detail, but what is already known of the causes, origin, and course of cholera in numerous epidemic visitations seem to justify certain conclusions, viz.—

1st. The extent, severity, and duration of epidemics are related to extreme unsanitary conditions of locality.

2nd. The movement of troops from such localities into camp is an absolute necessity at all seasons, but there may be evils attendant on movement, as increase of attacks and of mortality from fatigue, inclemency of season, possibly change to a bad site, which should not be overlooked in directing and conducting the measure.

3. Where the cases increase slowly, where there is no distinct unsanitary condition of the locality, where there is good barrack space and means of separating ordinary from cholera sick, where there is regular inspection of the men, with cheerfulness and tact, and careful treatment of the preliminary diarrhoea, the disease may be speedily checked without movement, and under such circumstances in adverse seasons the question requires grave consideration.

These seem to be the conclusions of unbiassed judgment, and they are those which are logically drawn from the able report of the Bengal Commission on cholera in 1861. The first and second rest on facts relative to the 96th and 51st Regiments at Meer¹ and to the 27th Regiment at Morar.² The third rests on facts relative to the Artillery at Morar³ under the judicious care of Dr. Mountjoy. The lesson which these facts teach, is without delay to bring every station in India into a good sanitary condition as respects site, barracks, and hospital space, water supply, conservancy, occupation and amusement of the men, &c., and to encourage the exercise of judgment, tact and confidence on the part of officers, medical and military. It is by these means that cholera in India will be reduced to its minimum, and not by a method based on one idea and made absolute.

Another reflection is suggested by Indian legislation on cholera. Enactments which obstruct the landing of tainted or suspected pilgrims arriving by sea and enforce a system of quarantine, which recognize, and no doubt justly, the infection of villages by tainted pilgrims from inland shrines passing through them, and which at the same time enjoin the movement of troops from infected localities and while suffering from the disease cause them to move to and fro in the surrounding districts, may fairly be regarded as chargeable with some degree of inconsistency. It may be that advancing knowledge will prove the wisdom and necessity of a quarantine system; but past and existing knowledge already prove that it ought to be, in extent, organization, and humanity, a system very different from anything that has hitherto existed in European or other countries.

5. DYSENTERY.

On Dr. Ewart's⁴ authority it appears that the statistics of the Bombay army from 1803–4 to 1853–54 give the following ratios in dysentery:—

		Europeans.	Natives.
Per-centage of admissions to strength	-	16·61	4·12
„ deaths to strength	-	1·53	·135
„ death to admissions	-	9·22	3·29

¹ Report, p. 31.

² p. 127.

³ p. 133.

⁴ Vital Statistics of the Armies in India, pp. 86, 119.

The etiology of a disease which produces a sickness of 166 and a mortality of 15 per thousand in Europeans (and other more partial statistics may place these ratios still higher) is very important, because it is the basis of the right means of prevention. BOMBAY.

The causes of dysentery as observed in the Bombay Presidency are well understood.¹ In no disease is predisposition from cachetic states more operative, a fact which has been well illustrated in the occurrence of dysentery consecutive on malarious fevers, in crowded barracks, transport ships, gaols, standing camps, besieged garrisons, beaten and retreating armies, &c.

The most common cause which, favoured by these states of predisposition, excites the disease, is those atmospheric conditions which unduly or suddenly depress the temperature of the surface of the body, as absolute lowness of temperature, considerable diurnal ranges, that is, cold nights, much moisture, and currents of dry or humid air. The action of these conditions is often favoured by imprudent exposure of the body deficient in resisting power, in consequence of that lowered capacity of generating animal heat which is physiological in tropical climates, and which is still further increased by enfeebled states of the constitution. Hence it is found that in the Bombay Presidency generally the admissions and mortality from dysentery are greatest in the cold months—November, December, January,—and in the wet months of the S.W. monsoon, chiefly in July. Mr. Hunter, writing on this subject in 1841, remarks,² “We think after all more may be gained by observation; and, as the result of ours, we would say a high temperature is essential to give the predisposition to dysentery; but that pure uncomplicated colitis, the dysentery which prevails in June and July in the Bombay Presidency, is more or less prevalent according to the degree of moisture, exposure to bleak winds, and crowded state of barracks, the latter rendering the body more susceptible. It is perhaps a curious fact that I have only met with one unequivocal case of this dysentery in an officer in 10 years, out of an average strength of 30 or upwards, and that was mild and yielded readily to treatment.”

Illustrations of this law of predisposition, and cold and wet as an exciting cause, have been numerous in the Bombay Presidency; of these the following may be cited:—

During the unhealthy monsoon of 1841 Her Majesty's 17th Regiment stationed at Colaba, in Bombay, suffered much from malarious fever. ³“In October a few cases of dysentery occurred, but when the cold nights of November and December came, dysentery became more prevalent and 130 cases were admitted during these months, and 23 died.”

The same relation of malarious fever and dysentery has also been observed in Her Majesty's 78th Regiment in Scinde and in the 28th Regiment at Colaba. “The ‘mortality has in truth followed upon those terrible visitations of fever with which the troops at Colaba have been occasionally afflicted. As happened during the fearful havoc among the 78th Highlanders in Scinde, so also in Bombay, it has invariably occurred that three, or four, or five weeks from the outburst of fever dysentery appears, also aiding in the work of destruction, and increasing in intensity until it speedily becomes the more prevalent disease of the two. One of the most remarkable instances of this occurred in Her Majesty's 28th Regiment, stationed at Colaba in the end of 1843. The regiment had upwards of 200 admissions from fever in November, but only 28 or 30 from dysentery. During December the admissions from fever had doubled, but the number suffering from dysentery had increased six or sevenfold. By the succeeding month, January, fever had abated, and dysentery was the principal disease.”

“As a general rule, there always is a rise in the number of admissions and deaths from dysentery about November, December, and January; but this can hardly be attributed to the meteorological conditions of these months. A far more probable supposition is that it follows and is dependent upon the congestive fevers which mark the close of the monsoon. The more numerous the admissions from fever in October the more prevalent is dysentery in December.”

During part of the year 1843 the Bombay 2nd European Regiment was divided; one wing was moved to Kurrachee, in Scinde, in the month of May,

¹ Morehead, B. M. P. S., 1st, vii., 1844, p. 133.

³ Thomson, B. M. P. S., 1st, v., 1842, p. 92.

² B. M. P. S., 1st, iv., 1841, p. 78.

⁴ Webb, B. M. P. S., 2nd, i., 1851–52, p. 94.

BOMBAY. was healthy, and lost few men; the other wing was stationed at Bhooj, in the province of Cutch, during the monsoon, and suffered much, chiefly in September, from intermittent and remittent fever. The sick of this wing were sent to Mandavie on the coast of the province with a view to their transport to Bombay, but they were delayed there about a month badly supplied with quinine and other necessaries, and then, instead of being sent to Bombay, were shipped to Kurrachee, and arrived there in November, and between their arrival and the middle of December they lost 40 men, chiefly from dysentery.¹

After the conquest of Scinde in the spring of the year 1843 troops were stationed in the fort and town of Hyderabad, and in many of the adjacent villages. In July the canals were sensibly filling with the water of the Indus; and during the latter part of that month, as well as in August, the inundation was at its height. The subsidence commenced in September and continued in October. During these two months 1,553 Sepoys of the 15th Regiment were admitted with fever; and in November and December 57 deaths occurred chiefly from dysentery.¹

These facts are sufficient to show the influence of predisposition from malaria and excitement by cold, or, in other words, the relation of succeeding seasons in the causation of dysentery. This law has also been well illustrated in the history of the campaigns in Scinde and Affghanistan alluded to in former parts of this sketch, and has possibly been more impressed on observers in the Bombay Presidency in consequence of alternations of climate from latitude and altitude being more marked, and occasionally overlooked in the relief of troops.

Whether it be applicable to India generally or not it is very necessary that it should constitute the basis of a sanitary system in respect to dysentery in the Bombay Presidency, which would thus simply be resolved into the prevention of the causes of bad general health, and the protection from cold and wet of predisposed troops, by caution in moving them in the cold season to localities still colder from latitude, elevation, or other physical characters, and by the provision of suitable barracks and clothing. There is good reason for suspecting that in climates, as those of the Deccan and Scinde, in which the nights of the cold season are chilly, that sufficient attention has not at all times been given to the bed coverings of the soldier. It is a common and a just complaint that when the method of barrack ventilation is open to the interference of the inmates it is apt to be obstructed; but is it reasonable to infer from this that the soldier has a dislike for pure air? If the atmospheric impurity of Indian barracks be closely inquired into it is believed that it will be found to exist in greatest degree in the cold season in cold localities, and that the air has been excluded, not from a distaste of its purity, but because it is cold and the soldiers inadequately protected by bed coverings.

Though great care is necessary in the protection and caution in the movement of predisposed troops in the cold season, more especially to colder localities, it must not be understood that the same risks attend the movement of troops whose general health is good.

The opinion may be safely hazarded that when, by a sanitary system which deals in a large sense with the principle of predisposition, the general standard of health in European troops in India has been raised and maintained, and when the English mind has fully realized that there are differences of season in India, which require to be considered in houses and dress, then cold as an exciting cause of dysentery and other diseases in India will cease to occupy that position in etiology which past experience has truly assigned to it. When this condition of European troops has been brought about, and with energy and clearness of purpose it ought not to be remote, and when in consequence dysentery has become comparatively rare and mild in character, it will be illogical to attribute the lessened ratio of mortality to treated to the method of treatment which at the time may chance to be most in favour.

Impure water has not been found to be a common exciting cause of dysentery in the Bombay Presidency, not from its having been overlooked as an occasional one, for it is frequently adverted to with reference to this question in the reports on medical topography and the medical histories of regiments. This conclusion is further confirmed by the statistics of the disease for the 50 years from 1803 to 1853, because if impure water were a general exciting cause dysentery would

¹ Clinical Researches, 2nd edition, pp. 27, 25.

be more common in Native troops, who drink more unmixed water than Europeans, and who have no monopoly of the best supply; and yet it appears that the admissions to strength are in the former 41 and in the latter 166 per 1,000. If the further test of classifying dysentery and diarrhoea together be applied the difference will be found to be still greater, viz., 65·7 in Natives¹ and 271·3 in Europeans.

The Royal Sanitary Commission for India remarks:—²“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 tanks at Secunderabad, however, gives results of an extraordinary character. The 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 2½ grains to 8, 11, and apparently in one instance up to 30 grains per gallon.”

On referring to the station³ report from which this statement is taken it appears that the waters which contained 8, 11, and apparently 30 grains of organic matter were obtained from the Hoossain Sagur tank, and three wells in the Native infantry lines, that is, from sources of supply distant from and never used by the European troops. Therefore, if this impure water was a potential exciting cause, dysentery at Secunderabad ought to have been more common in Native than European troops; but, on referring to the statistics⁴ of disease for the four years from 1855-56 to 1858-59, it is found that the ratio of dysentery in Natives was 14·3 admissions per 1,000 strength, and in Europeans 272·3.⁵

The Royal Commission further observes:—⁶“But it must 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.” The statement “that bowel diseases are generally most prevalent and fatal in the hot dry weather” does not accord with the experience of the Bombay Presidency, nor of Secunderabad.

It may be of interest to inquire what the causes of dysentery at Secunderabad have been. The description of the cantonment shows that many sources of malaria exist; the temperature in the hot season is high, and the statistics of disease from 1855-56 to 1858-59 show in Europeans 340 admissions of fever per 1,000 strength and in Natives 540. The station⁷ report says:—“The station 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, and producing internal congestions resulting in hepatic disease, dysentery, diarrhoea, and fevers often of a typhoid type. Hot land-winds prevail from March to June, which exhaust and enervate the system; but health is generally better among the troops, though cholera and small-pox then prevail sometimes, and no doubt the exhausting effects of a long-continued high temperature on the system, especially on the skin, leave a proneness to the diseases of the succeeding cold and wet season.”

Dysentery as occurring at Secunderabad affords another very apt illustration of the etiological law which has already been explained, and the means of prevention present no difficulty in principle whatever they may in execution.

Malaria has been considered an exciting cause of dysentery. Restricting the term to the specific cause of intermittent and remittent fever, its relation to

¹ Ewart's Vital Statistics of the Armies in India, pp. 87, 119.

² Report, vol. 1st, p. 44.

³ *Ib.*, li., p. 344.

⁴ Report of Royal Commission on the Sanitary State of the Army in India, vol. ii., p. 351.

⁵ Probably this analysis of the water made at the station and at a season of unusual drought should be regarded, if accurate, as very exceptional, the more so as the following note is appended in the analysis. “Samples from the site of the New Trimulgherry Barracks have been analysed by the Professor of Chemistry at Madras, also from the Hoossain Sagur tank, and from the wells in the Native lines in its vicinity, and both pronounced remarkably pure.”

⁶ Report, vol. i., p. 46.

⁷ Report of Royal Sanitary Commission, vol. ii., p. 343.

BOMBAY. dysentery, with or without the intervention of fever as a predisposing cause, has already been explained; but there is no reason for believing that it excites dysentery as it does ague; on the contrary, the fact that dysentery is generally consecutive on and not coincident with the season of the generation of malaria is evidence that the action of malaria is predisposing just as cachectic states induced, in the same relation to succeeding seasons of cold and wet, by continued heat, scurvy, crowded barracks, over fatigue, bad conservancy, injudicious medical treatment by mercury or other means, secondary syphilis, &c., might equally predispose to dysentery, the difference being that these have not been so operative in extent and degree as malaria, and hence, with the exception of scurvy, have not been so generally recognized in the causation of dysentery. But if the term malaria be used, as it sometimes is,¹ in the sense of a miasm from decomposing animal matter, as excreta, the product of injudiciously placed or ill kept latrines, or arising from the evacuations of the affected and bearing infectious properties; and if it be supposed that it excites inflammation of the intestinal lining, just as the specific causes of small-pox, scarlet fever, and measles excite inflammation of the skin and the pharyngeal and bronchial linings, an argument from analogy may be admitted;² but the results of clinical observation in the Bombay Presidency give no support to the theory.

6. HEPATITIS.

The etiology of hepatitis is very similar to that of dysentery. It is not, improbable, however, that elevated temperature may be more influential in the instance of hepatitis, and that further inquiry may indicate more precisely than has yet been done, the particular forms of bad general health which give the predisposition. There is no good reason for believing that intemperance in drinking has a peculiar influence in causing hepatitis. That a considerable proportion of hospital admissions from hepatitis is of intemperate individuals is undoubted; but this is equally true of other forms of disease. The cachexy from spirit drinking, with exposure to cold and wet in states of intoxication, are very operative in inducing disease in India, but not hepatitis more frequently than dysentery. That spirit drinking is the special cause of some affections of the liver, as cirrhosis, is true of India and all countries, but to conclude that hepatitis, inflammation of the liver in its severest form, is a proof of intemperate habits in those in whom it occurs, would be a great error, for it is not an unusual event in persons of temperate habits, as experience in India has amply testified.

• 7. SUNSTROKE.

The active services in which the Bombay army has been engaged, more especially in the years 1857-58, have afforded the opportunity of studying the etiology, symptoms, treatment, and methods of prevention of sunstroke.

As on these subjects, there is great unanimity of opinion, it is sufficient to refer to the accessible³ sources of information.

8. DELIRIUM TREMENS.

The cause of delirium tremens is so well known that it is unnecessary to enlarge upon it. The lamentable frequency of the disease in the European General Hospital at Bombay has supplied the means⁴ of carefully studying the symptoms and of inculcating with the authority of large experience, the best methods of management.

Dr. Stovell, in his statistical report of this hospital for the 10 years from 1846 to 1856,⁴ gives the per-centage of admissions with delirium tremens and ebrietas

¹ Maclean, Reynold's System of Medicine, vol. i., pp. 109, 111.

² Clinical Researches, 2nd edition, pp. 237, 273.

³ Don, B. M. P. S., 1st, iii., 1840, p. 12. Hefferman, *Ib.*, 1st, x., 1849-50, p. 219. W. Simpson, *Ib.*, 2nd, iv., 1857-58, p. 246. Board of Medical Officers, *Ib.*, p. 237. T. W. Ward, *Ib.*, p. xxx. Costello, *Ib.*, p. 298. Straker, *Ib.*, p. 299. A. K. Simpson, *Ib.*, p. xxxiv. Wilmot, *Ib.*, p. xxxvi. Peet, *Ib.*, p. xxix. Stuart, *Ib.*, 2nd, v., 1859, p. 24. Morehead, Clinical Researches, 2nd edition, p. 603.

⁴ Stovell, B. M. P. S., 2nd, iii., 1855-56, p. 54. Leith, *Ib.*, 2nd, viii., 1862, p. 54. Morehead, *Ib.*, 1st, vi., 1843, p. 32. *Ib.*, Clinical Researches, 2nd edition, p. 624.

on the total admissions from fever, dysentery, diarrhoea, hepatitis, cholera, delirium tremens, and ebrietas, in the following classes :—

Soldiers	-	-	27·076
Paupers	-	-	37·355
Warrant officers	-	-	30·000
Sailors	-	-	13·676
Women	-	-	24·430

And then remarks, "This is a most painful statement, and especially so from the fact it brings to light that the per-centage of admissions with women is enormously great, and is almost equal to that with soldiers. The great majority of these women had led a barrack life. The statement also shows that while the per-centage with paupers is deplorably high, the rate with sailors is only one half of what it is with soldiers. It further shows that the per-centage of admissions with warrant officers, the class of men whose position ought to make them an example of good conduct, is higher than the rate with soldiers."

It is well that these facts should be made known ; but it need hardly be observed that they are contingent on the classes and circumstances of the inmates of a general hospital at an Indian Presidency town, and are not to be applied to the European army generally : in it the per-centage of admissions with delirium tremens and ebrietas on the total admissions of the diseases included in Dr. Stovell's calculations, may be stated at 3·02 ;¹ on the admissions from all causes at 1·4 ; and on the strength at 1·8.

9. DISEASES OF THE HEART AND AORTA.

It is many years since the frequency of diseases of the heart in European soldiers and its probable dependence on unsuitable dress attracted attention in the Bombay Presidency. In the year 1831, when the use of the stethoscope was slowly making way in the medical schools of Europe, and was almost confined to the immediate pupils of Lænnec, Mr. Hunter² was patiently working out for himself in the 2nd Queen's Hospital at Colaba the physical signs of cardiac and pulmonary disease, and his published cases may still be regarded as good illustrations of accurate observation and graphic description. In the course of this inquiry, he was struck with the frequency of cardiac and aortic disease in the regiment, and became satisfied that the active duties which the soldier undergoes whilst buttoned up in his accoutrements was a very efficient cause in producing it. On this subject Mr. Hunter remarks, in 1836, "Ever since I joined the 2nd or Queen's Royal Regiment in Colabah in 1831, I have been struck with the frequency of cardiac and aortic disease. At first I thought it might be connected with the same morbid state of the blood which gave rise to purpura, so frequent at that station ; but it afterwards prevailed to an equal extent at Poona, where no such cause could be assigned. Neither does it appear to be altogether connected with rheumatism, though certainly most frequently so. In some it has been directly traced from that cause, and in others a previous rheumatic attack has rendered it suspicious. Some, however, have denied such altogether ; but whether or not rheumatism be the first link in the morbid chain, a more efficient cause for hastening its progress, I am convinced, is the active duty a soldier undergoes whilst buttoned up in his accoutrements. These by compressing the neck and chest, obstruct the circulation to such a degree as to excite the heart to inordinate action, and consequent hypertrophy in the strong and muscular, or to dilatation in the weak and sickly ; and in either case, particularly if there is any original disproportion of the organ, according to Lænnec a very frequent occurrence. Again in the former, the natural resiliency of the aorta being overcome by the inordinate force of the circulation, that vessel yields, dilates, and finally gives way, giving rise to aneurism. It seems extraordinary that now the effects of tight lacing on females are so well known, a soldier intended for the most active and long continued exertion, should be placed in a similar predicament, when that very exertion is required. Is it possible he could be placed under more unfavourable circumstances ?"

From these observations it appears that Mr. Hunter anticipated by upwards of

¹ Calculated from the Tables, vi., p. 47, and vi., p. 38, of Reports of the Bombay Sanitary Commission for 1865-66. Similar data of earlier periods not being readily available.

² B. M. P. S., 1st, i., 1838, p. 239. *Ib.*, 1st, ii., 1839, p. 222.

BOMBAY. 30 years, much that has been lately said on the injurious influence of the dress and accoutrements of the soldier on the organs of circulation; and it is just that his labours should be known and acknowledged.

10. GUINEA WORM.

Guinea worm, in consequence of its great prevalence in many parts of the Bombay Presidency, has at different times engaged the attention of several medical officers.¹ The object of research has been to determine whether there exists any relation between this affection and season, soil and water; and to discover whether the soil or water of affected localities constitutes the habitat of any species of worm zoologically allied to guinea worm. Mr. Carter found in the confervæ of some tanks in Bombay minute worms having a great resemblance to the young guinea worm, and he believed in their identity, and that they worked their way into the human body by the tubules of the sudoriferous glands. Objections may be urged to these views, which need not be repeated here; and though it may be admitted that water is the source from which the worm proceeds, still the manner of propagation of the guinea worm, its mode of entrance into the human body, and its relation to an external species are subjects for further inquiry.

11. SCURVY.

The occurrence of scurvy in the European troops of the Presidency has, during these 30 years been exceptional; but admissions² into the European General Hospital at Bombay have not been infrequent, chiefly, however, of seamen belonging to small vessels from English and Scotch provincial ports, many of them engaged in the coal trade, badly provided for the long voyages to which they are often exposed and ill protected from inclemencies of weather. Of the admissions into the Jamsetjee Jejeebhoy Hospital at Bombay, a large proportion have been of Native labourers on the public works at Aden; but in 1853-54 many lascars in a very scorbutic state were received into hospital, from ships arrived from Melbourne. In consequence of the desertion of European crews from ships at Melbourne, for the gold diggings, lascars had been shipped in large numbers from Calcutta to supply the deficiency thus arising, and on arriving at Melbourne, after voyages of two or three months, they were transferred to the deserted ships and again soon sent to sea; hence the development of scurvy before reaching their ports of destination in India. The sanitary blunders in these instances were so glaring that it may be hoped they have not since been repeated.

Scurvy has frequently been a great evil in the gaols, chiefly those on the coast, as at Tannah³ and Rutnagherry;⁴ also in Native troops at Aden,⁵ in Guzerat⁶ and Scinde;⁷ and there has been no want of successful endeavour to remove and prevent it, of which the dietary and general management adopted by Dr. Leith⁸ in 1846 in the House of Correction at Bombay, may serve as a good illustration.

The conclusion to which this experience has led is, that though the essential cause of scurvy is a diet deficient in the just proportion of azotised nutritive principles, succulent vegetables, and supply of good water, there are very generally co-existing debilitating influences which materially favour, in the way of predisposition, the development of the disease, such as cold and wet, continued heat, malaria, vitiated atmosphere, inattention to cleanliness, over fatigue of body, anxiety and depression of mind, and these should receive a full measure of attention in prevention and treatment. This fact is simply an illustration of the importance of predisposing and exciting causes in the etiology of disease, and of the necessity of regarding both, in directing means of prevention and cure; it teaches in respect to scurvy that protection from cold, wet, heat, malaria, bad

¹ In the 1st, 6th, 7th, and 8th volumes of the Transactions of the Medical and Physical Society of Calcutta, there are papers by Smyttau, Bird, Kennedy, Morehead, and Duncan. Forbes, B. M. P. S., 1st, i., 1838, p. 215. Grierson, *Id.*, 1st, iv., 1841, p. 90. Peet, *Id.*, x., 1845-46, p. 166. H. J. Carter, *Id.*, 2nd, ii. and vii., pp. 45, 252, and iii. Moore, *Id.*, 2nd, vi., 1860, p. 313. Clinical Researches, 2nd edition, p. 720.

² Clinical Researches, 2nd edition, p. 701. Stovell, B. M. P. S., 1st, x., 1849-50, p. 82.

³ Winchester, B. M. P. S., 1st, viii., 1845-46, p. 70.

⁴ Bouchier, *Id.*, iii., 1840, pp. 119, 206.

⁵ Black, B. M. P. S., 1st, iv., 1841, p. 133.

⁶ Prichard, *Id.*, 1st, iii., 1840, p. 101.

⁷ Ritchie, *Id.*, 1st, ix., 1842-43, p. 230. Stuart, 2nd, v., 1859, pp. 3, 11.

⁸ *Id.*, 2nd, i., 1851-52, p. 114.

ventilation, with attention to cleanliness, cheerful occupation of mind and avoidance of bodily fatigue, must fortify the system against the influence of the exciting cause (a defective dietary) when operative, must tend to keep off the disease for a time, to lessen its severity, and hasten its cure. There was an instructive instance of this in the German Legion which arrived at Poona in November and December 1858 from the Cape of Good Hope, with many of the men tainted with scurvy. They all recovered rapidly under the ordinary Indian ration, combined with the other favouring influences just adverted to.

Though the phenomena of scurvy are well marked it is reasonable to infer that the changes in the blood which constitute the disease take place gradually, and that they are present in some degree before they attain to that which occasions the well-known symptoms of scurvy. This supposition is practically important, because it justifies the belief that these slighter and not very well marked degrees of the scorbutic taint are sufficient to give a predisposition to various forms of disease. It is the probable explanation of much of the dysentery and diarrhoea and of the adynamic character of fevers in gaols in India and in Native troops, and should always receive attention in devising sanitary measures for and conducting the treatment of these and indeed of all forms of disease in these communities.

The Aden¹ ulcer and la plaie de Yemen²; the date mark³ or Scind boil, and Beriberi⁴ are related to a scorbutic or allied diathesis; the two former certainly, the two latter probably.

12. LEPROSY.

The admissions of leprosy into the Jamsetjee Jejeebhoy Hospital in Bombay are not unfrequent. The disease has been investigated by Mr. Lesboa⁵ and Mr. V. Carter. The researches of the latter observer have been embodied in the report of the Royal College of Physicians on leprosy issued in 1867.

13. SNAKE BITES.

Snake bites have attracted considerable attention in the Bombay Presidency, and in the foot note⁶ there is a reference to the reports which have been published in the Transactions of the Medical and Physical Society. In the year 1854 the mortality from this cause was so great in the province of Scinde as to lead to much inquiry and to the suggestion of offering a reward for every poisonous snake that was killed.

The particulars of this investigation and a tabular statement of the leading facts relating to 306 cases of snake bite will be found in Mr. Imlach's report.

14. URINARY CALCULUS.

The opinion at one time entertained that urinary calculus was of rare occurrence in India has been long since disproved in Bengal by the experience of Burnard, Brett, Twining, Darby, Cole, Simpson, Ruddock, Narain Doss and other graduates of the Bengal Medical College. In the Bombay Presidency the experience of Peet, Ballingall, Ritchie, Bowie, Bhawoo-Dhajee, and Stedman has led to a similar conclusion.⁷ The success which has attended the operation of lithotomy in the hands of Indian surgeons has been considerable, both in Bengal and Bombay; but it is the latter only which is to be dealt with here. For details on this point reference may be made to an account of the calculi in Grant Medical College Museum by Mr. H. V. Carter,⁸ and to a tabular statement of the results of 45 operations performed by Mr. Stedman⁹ in the Civil Hospital at Hyderabad in Scinde between June 1858 and December 1859.

¹ Campbell, B. M. P. S., 1st, iii., 1840, p. 84. Pruner, *Ib.*, 1st, iv., 1841, p. 146. Peet, *Ib.*, 1st, x., 1849-50, p. 174. Steinhaeuser, *Ib.*, 2nd, ii., 1853-54, p. 234. Craig, *Ib.*, 2nd, iv., 1857-58, p. xxv.

² Dr. Chedufay, *Ib.*, 1st, iv., 1841, p. 94.

³ Floyd, *Ib.*, p. 42. Hyslop, *Ib.*, 1st, ix., 1847-48, p. 231. Steinhaeuser, *Ib.*, 2nd, i., 1851-52, p. 324.

⁴ Carter, *Ib.*, 1st, viii., 1845-46, p. 78. Morehead, *Clinical Researches*, 2nd edition, p. 704.

⁵ B. M. P. S., 2nd, ii., 1853-54, p. 290. *Ib.*, 2nd, viii., p. 290. *Clinical Researches*, 2nd edition, p. 695.

⁶ Forbes, B. M. P. S., 1st, ii., 1839, p. 16. Don, *Ib.*, 1st, iii., 1840, p. 11. Morehead, *Ib.*, 1st, x., 1849-50, p. 304. Medical Board, *Ib.*, 2nd, i., 1851-52, p. 314. Lownds, *Ib.*, 2nd, ii., 1853-54, p. 328. Imlach, *Ib.*, 2nd, iii., 1855-56, p. 80. Sylvester, *Ib.*, p. (xiv). Barnett, *Ib.*, 2nd, iv., 1857-58, p. xxxvii. De Crespigny, *Ib.*, p. xxxviii.

⁷ *Clinical Researches*, 2nd edition, p. 505.

⁸ B. M. P. S., 2nd, v., 1859, p. 140.

⁹ *Ib.*, p. 264.

BOMBAY. The etiology of urinary calculus is the subject which comes more properly within the object of this sketch.

It is very desirable that the place of birth and of residence, varieties in modes of life from habits, caste, difference of circumstance of the subjects of the affection, and the chemical composition of the calculi should be inquired into and recorded. Mr. Bransby Cooper¹ in 1851 suggested that probably a relation would be found to exist between the climate and peculiar systems of diet of the people of India and the composition of urinary calculi in that country; and that where a great number of the people subsisted in great part on vegetable food a large proportion of oxalate of lime calculi might be looked for.

These questions have been considered by Mr. H. V. Carter with great care, and so far as his inquiries had gone the Hindoo would seem to be less liable than other castes, and Scinde to be the province affected in greatest degree. The conclusions drawn by Mr. Carter on the chemical composition of the urinary calculi in Grant College Museum may be viewed in connection with Mr. Bransby Cooper's suggestion; they are thus summed up by Mr. Carter:—

"1. That in the Bombay Presidency the proportion of calculi having oxalate of lime for their nucleus, or wholly composed of it, is about twice as great as in England, taking for comparison certain standard collections there.

"2. That the proportion of calculi having uric acid or a urate for their nucleus or entire substance, is considerably less in India than in England; in the former urate of ammonia calculi are somewhat more frequent than uric acid calculi; the opposite is the case in England.

3. That the number of calculi wholly composed of earthy phosphates, or having them for a nucleus, is proportionately much fewer in India than in England, the difference being chiefly owing to the rarity of mixed phosphates in the former."

VII.

INDIGENOUS MATERIA MEDICA.

To find articles of the materia medica indigenous in India or sold in Indian bazaars as substitutes for those in use in European countries has been an inquiry to which the Indian Governments have at times directed attention. About the year 1838 Committees² were appointed with this view at each of the Presidencies. In the Transactions of the Bombay Medical and Physical Society there are contributions on the materia medica of Scinde by Mr. Lord³ and Mr. Stocks;⁴ of the Deccan by Dr. Walker;⁵ of the Concan by Mr. Kearney;⁶ of Bagdad by Mr. Hyslop;⁷ of Shoa by Dr. Kirk;⁸ and of Aden by Mr. Vaughan.⁹

VIII.

MEDICAL EDUCATION.

In 1835 Sir Robert Grant assumed the government of the Presidency impressed with the belief that there was much loss of life and great increase of suffering among the people of India proceeding from ignorance of the laws of health, and that to ameliorate this an educated native profession of medicine was a necessary condition. With the view of advancing this object, Sir R. Grant¹⁰ encouraged the formation of the Medical and Physical Society, and through its agency an investigation into the state of native medical practice throughout the Presidency was conducted and an inquiry instituted into the fitness of the educational institutions to supply students qualified to commence the study of medicine. The result was that an educated profession of medicine seemed to be urgently required, and that the establishment of a medical school was an opportune and practicable measure. Sir R. Grant then explained his plan in detail and submitted it to the Government

¹ Guy's Hospital Reports, 2nd ser., vol. vii.

² B. M. P. S., 1st, ii., 1840, p. 248.

³ *Ib.*, 1st, i., 1838, p. 276. *Ib.*, 1st, iv., 1841, p. 115.

⁴ *Ib.*, 2nd, iii., 1855-56, p. 141.

⁵ *Ib.*, 1840, p. 50.

⁶ *Ib.*, 2nd, iv., 1857-58, p. 152.

⁷ *Ib.*, 1st, x., 1849-50, p. 56.

⁸ *Ib.*, 2nd, ii., 1853-54, p. 225.

⁹ *Ib.*, 1st, vi., 1843, p. 28.

¹⁰ *Ib.*, 2nd, i., 1851-52, p. 147.

¹⁰ Grant Medical College Report, No. 1, p. 1.

of India, but his lamented death shortly followed, and the commemoration of his worth and the realization of his ideas were combined in the establishment of Grant Medical College, which was opened in 1845. BOMBAY.

In arranging the details of instruction two leading principles were kept in view ; (1.) That "medicine" includes both the prevention and treatment of disease ; (2.) That the test of success must be not the numbers borne on the rolls, but the practical fitness of the graduates. It was believed that in courses of medical study generally, the several subjects (consequent on the expansion of the sciences) were taught too much as distinct and independent branches of knowledge, that they were not sufficiently exhibited in their relations to each other and in their relation to the ultimate practical object of the study, the prevention and cure of disease. Influenced by these considerations and the attendant circumstances of this new institution, it was thought well to go back a little in the history of medical education, and in the first years of the college to revive a course which at the end of the last and early part of the present century occupied a prominent place in the European schools, viz., the Institutes of Medicine ; this course included physiology, the principles of pathology, etiology, hygienics, and therapeutics, and the relation in which they stood to each other. ¹As taught in Bombay, more than usual attention was given to the general doctrines of etiology and hygienics ; and it was explained that these doctrines applied to particular localities constituted a department of practice named medical police, which bore much the same relation to the general principles of hygienics that the practice of medicine did to the general principles of therapeutics, that medical police applied the general principles of prevention to particular communities, and the practice of medicine the general principles of cure to particular instances of disease. At a more advanced period of study medical police or State medicine, as it has been more recently termed, was taught in the course of medical jurisprudence.²

In order that the practical knowledge of the graduates in medicine and surgery might be sure, great care was taken in organizing and conducting the system of clinical instruction and clinical examination ;³ and the importance of this branch of medical education is frequently enforced in the Principal's reports. For example, in that for 1853-56, he says, "Success cannot be said to attend the efforts made " by the Indian Government to establish medical education unless the graduates " on leaving the schools are qualified for the safe and successful practice of " medicine and surgery. If they are so, they will in a reasonable time acquire " the confidence of the community, and be preferred to irregular and unqualified " practitioners ; this is the true test of the efficiency or not of the system of " instruction followed in our Indian medical schools. And again, "It cannot be " too frequently inculcated, more particularly on the non-professional public, that " the mind may be stored with facts of chemistry, anatomy, physiology, and " *materia medica*, and yet be a perfect blank as regards that kind of knowledge " which fits for the safe practice of the art of healing. This fitness can only be " acquired by actual, patient, continuous observation of disease and of the action " of remedies at the bedside of the sick, and by applying there, in their proper " place and order, the necessary facts previously acquired of the elementary " branches of medical science which have just been named. It is to this that the " term clinical instruction is applied ; upon the manner in which it is conducted " the usefulness and efficiency of a medical school mainly depend." Again, "Clinical instruction must be conducted in the wards of an hospital ; there must " be always, then, a relation between the size of an hospital and the number of " pupils which it is capable of adequately instructing. If this number be much " exceeded, then the efficiency of the clinical system and of necessity of the " medical school must begin to decline." Again, "The true test of the efficiency " of a medical school is the just relation being observed between the number of " the students and the clinical means, and the rightful use of these means ; so " soon as this relation is deranged on the side of excess of numbers the school " must necessarily begin to decline. The number of regular students has never " been equal to its clinical means, they have never exceeded 30 ; my belief is " that the clinical means of this school are sufficient for a roll of 50 students ; " this number would give ten admissions and ten graduates annually, and 30 " students in attendance in the clinical wards. If their numbers at any time

¹ Grant Medical College Report, No. ii., Appendix.

² Grant College Medical Report for 1851-52, Appendix.

³ *Ib.*, 1852-53, p. 88. *Ib.*, 1853-54, p. 10.

BOMBAY. " become much increased and the clinical means remain as at present, I venture
 — " with much confidence to express a very firm conviction that from that time
 " the efficiency and usefulness of the school will begin very sensibly to decline,
 " and that the object of its institution, viz., the giving to the people of this
 " Presidency a class of truly, not merely *nominally* qualified medical practitioners
 " will soon cease to be realized."

Another condition of success in medical education is noticed in the Report for 1856-57 in the following words :—" Defective preparatory education has been the
 " chief difficulty against which this institution has had to struggle. It has led to
 " the rejection of a large proportion of the candidates for admission, and has
 " consequently materially limited the numbers borne on the rolls. It has entailed
 " upon the Professors the task of supplying by their assiduity the deficiencies of
 " school training ; it has tended to invest the subjects of study with discouraging
 " difficulties unknown to minds previously adequately disciplined and cultivated.
 " It has kept the degree of general proficiency below that which, under the
 " system of instruction and the practical advantages of the college ought to have
 " been reached."

It does not come within the scope of this sketch to inquire what has been the success of medical education in the Bombay Presidency since 1860, or whether these original principles of its institution have been maintained or set aside ; but there is one subject which it would be unwise not to notice. It would seem that very recently it has been matter of discussion whether Grant Medical College was part of the system of national education or an adjunct of the medical department for the education of the subordinate medical service. The writer of this sketch, amazed that this question should have been raised in the year 1868, may be permitted to answer it in the words which he used in the year 1851, when, as Principal of the college, he addressed the meeting assembled to witness the presentation of diplomas to the first graduates :—" On occasions such as this, when
 " well considered principles have been amply confirmed, and great and important
 " ends have been fully achieved, it is useful and good for us to pause and reflect,
 " and to do honour and homage to the great minds from which they have sprung.
 " In acting thus we not only indulge in the exercise of a generous sympathy, but
 " we at the same time do that which best conduces to fixing the principles and
 " extending their influence. If sentiments such as these be true of human
 " actions generally, they are surely very true of all that we perform in this land
 " of our temporary sojourn. Who, I would ask, that has lived for any time in
 " this country, has not witnessed well digested plans of public good marred in
 " their execution, simply because in the changes of Government and the fluctua-
 " tions of society the grand principle upon which they were based has been
 " forgotten and overlooked, and its place usurped by secondary and subordinate
 " purposes ? I have ventured to suggest this train of reflection, for there is good
 " reason for apprehending that this medical school is beset with dangers of this
 " very kind, and of no ordinary degree ; and I feel that there is a propriety in
 " taking advantage of this hour of its acknowledged triumph, and using my feeble
 " efforts to protect it from the risk of future harm. Though barely 15 years have
 " elapsed since the conception which led to the establishment of this college first
 " took possession of the enlightened mind of its distinguished founder, and five
 " years only have passed since the courses of instruction were commenced in it, yet
 " so fluctuating has been the state of society in this place, that it may, I believe, be
 " safely affirmed, that of those whom I have now the honour to address, a very
 " small proportion entertain precise and definite ideas in regard to the purposes
 " which the establishment of this medical school was intended to accomplish."

" Familiar from his early years with India, its people, their customs, their wants, Sir Robert Grant was well aware that the medical art, as followed in this country, was most defective, and that in consequence the people were subjected to suffering, which a scientific art, practised by enlightened and conscientious men, would go far to ameliorate. Nor did he fail to anticipate that another important end would at the same time be gained. He justly reasoned that it was in accordance with the principles of human nature to conclude that it was not possible for educated and upright men to be the ministers of good to others amid the scenes of domestic life, in the hours of physical suffering and mental anguish, without shedding around them the influence of their enlightenment, and thus tending to

¹ Grant Medical College Report for 1850-51, p. 95.

elevate the intellectual and moral condition of their country. It was with the object of conferring advantages such as these upon the people of Western India that this college was endowed. The ends aimed at were truly important, and the principle of easy comprehension. Yet there were not wanting many who anticipated obstacles in the way of their fulfilment; who believed that there existed prejudices on the part of the people against an European system of medicine; and who questioned the aptitude of the youth of India to attain to the necessary acquirements. In regard to the first objection, it seems strange that it should ever have been gravely entertained, for surely it is not to be disputed that, as a general principle, man in a state of suffering will court relief and accept it readily from whatever hand it comes, and under whatever name it may be presented to him. In regard to the second objection, it is amply refuted by the proceedings of this day. To what extent and in what manner the acquirements of these young graduates have been tested it is not my province to explain, for it has been wisely ordered by the rules of the college that the final examination shall be conducted and reported upon by officers unconnected with it."

BOMBAY.

Since the year 1850¹ Grant Medical College has, as a secondary purpose, been instrumental in increasing the fitness of the army subordinate medical department for its responsible duties, and thus to confer upon it advantages which its highly useful members have never failed to feel, and which the Government has lately acknowledged by improvement in pay, pension, rank, and position.

IX.

SANITARY WORKS, &c.

It was during the last 20 years of the period to which this sketch is limited that State medicine in the United Kingdom may be said to have originated, commencing with the improved registration of the causes of deaths in 1838, and followed in the succeeding five years by the sanitary inquiries and reports of the Poor Law Commission.

From 1838 to 1860 was a time of action for the Bombay army and of considerable territorial addition to the Presidency. It includes the occupation of Aden in 1839, of the two expeditions to the Persian Gulf in 1838 and 1856, of the war in Affghanistan in 1839, of the conquest of Scinde in 1843, of the wars in the Punjab in 1846 and 1849, and of the mutiny of 1857 and 1858.

It was also a period of activity in the arts of peace, for it embraces the regular and frequent communication with Europe by the Red Sea, the origin and considerable progress of the railway and telegraph systems, which necessarily led to a community of knowledge and of principles of action between the cultivated minds of India and of European countries.

Dr. F. S. Arnott communicated in 1845 a paper² to the Medical and Physical Society on the enlistment of recruits and the system of invaliding pursued in the Native army of the Bombay Presidency.

The conclusions are drawn from the statistics of 11 years, from 1833 to 1843, and point to defects in the methods of enlistment and invaliding, affecting the efficiency of the Sepoy and the state of the Pension list.

In the medical history³ of the Bombay Fusiliers for the eight years from 1846 to 1854, already adverted to, Dr. Arnott makes many practical observations on the various subjects which affect the health and comfort of the European soldier, as barracks for the men and their families, hospitals, cook rooms, baths, tents, accoutrements, dress, rations, water supply, canteens, occupations and amusements, invaliding, furloughs, transfers, shipboard, &c.

In a separate communication⁴ he discusses the points of importance in moving troops, treating of the order and pace of marching, the dress, sick carriage, tents, hospital establishment, baggage, &c. The necessity of attention to the season is enforced, and the months of January and February, as most suitable in all the divisions of the Presidency, are preferred. Illustrations are given of the evils resulting from neglect of this principle; as in the 78th Highlanders moved from Lower to Upper Scinde in August 1844; in the 22nd Native Infantry,

Enlistment
of recruits.
Barracks.
Hospitals.
Dress.
Rations.
Canteens.
Recreations.
Invaliding.
Marching,
&c.

¹ Report for 1849-50, p. 14.

³ *Ib.*, 2nd, ii., 1853-54, p. 102.

² B. M. P. S., 1st, viii., 1845-46, p. 2.]

⁴ B. M. P. S., 1st, x., 1849-50, p. 128.

BOMBAY. marched from Mhow to Baroda at the end of April 1846, with a loss of 200 men from cholera; and in the 18th Regiment, N. I., which left Kalludghee on the 1st November 1837, when the weather was wet, and also sustained considerable loss from cholera.

During the latter half of the period now under review the tendency to improvement in sanitary works in the Bombay Presidency was well marked and kept fair pace, difference of circumstances considered, with the similar movement in the United Kingdom. The details, such as fixing in 1853 the standard cubic space for barracks and hospitals at 1,200 and 1,800 feet, will be found in the records of the medical department; but as these have not been published they cannot be more particularly referred to here. It is however well known to all who served in the Presidency that throughout a lengthened period of distinguished service, both in his private and official capacity, Dr. McLennan exercised a great and judicious influence on the proceedings of the Government in this department of public policy.

Con-
servancy.

The conservancy of the native town of Bombay was a constant difficulty increased by the dense and fluctuating population of various races, and the low level interfering with efficient drainage, and baffling the skill of the engineering department.

The last act within this period was the construction of a large reservoir at Vihar in Salsette for the ample supply of Bombay with good water, but this, without sufficient outfall for drainage, left the scheme incomplete.

The conservancy of military stations, hospitals, and gaols was also perplexing. The cesspool system in connexion with latrines had not existed to any great extent in cantonments, and long before 1860 had been condemned, and it is believed almost entirely abolished.

The system of frequent daily removal of excreta was in general use, but it was difficult to work, required great and constant supervision, and the ultimate innocuous disposal was often imperfectly effected.

Fortunately, however, the Government has since been relieved from these serious difficulties by the dry-earth system, due to the ingenuity and perseverance of Mr. Moule. It is admirably suited for the wants of India and of many other countries also.

The evils of a water-sewerage system for inland military stations in the Bombay Presidency have been well pointed out by Dr. Leith in a report on the general sanitary condition of the Bombay army. Dr. Edward Goodeve, after much thought and inquiry, has arrived at a similar conclusion in respect to Bengal. He remarks, "The dry-earth system permits complete removal and decomposition of the excreta in the least possible offensive way. It is to be hoped that Indian cantonments will long be free of sewers." In these views sanitarians in India will generally concur.

Water
supply.

As a rule the natives of India attach great importance to the quality of their drinking water. The supply of the city of Sattara by aqueduct from a source on an adjoining hill, Euteshwur, the storage of rain water in underground tanks of masonry in Bombay, and the system of draw wells and tanks with sides of stonework to the rock, parapet walls, sloping pavement with surrounding gutter, are indications of this care.

The opinion universally entertained by the people of India that bad water is the common cause of disease has necessarily called the attention of medical officers in India to this question in a greater degree than has been usual in other countries; but bad water has not been observed to be a common cause of disease in the Bombay Presidency during these 30 years. The water at military stations in the Presidency, though often insufficient in quantity and admitting of much improvement in methods of storage and distribution, has not in general been of bad quality and injurious to health. There are stations, as Aden and Kurrachee, in which there is much bad water to be avoided, as shown by the results of chemical analysis¹ and the effect on the troops. The test by chemical analysis has been too much restricted to suspected waters and not sufficiently extended, as of course it ought to be, to all water used for domestic purposes. The absolute necessity of this test must vary however according to the circumstances connected with the source of supply, storage, and distribution. It must be frequently had recourse to when the water for domestic purposes is in various

¹ Haines, B. M. P. S., 2nd, iv., 1857-58, p. 19. Giraud, *ib.*, 2nd, v., 1859, p. 242.

ways in close association with an imperfect water sewerage system, as obtains in all the large cities of Great Britain, and in towns and villages in the proximity of rivers used as the outfalls of sewage. BOMBAY.

In the only instance of water supply under these conditions in the Bombay Presidency, that of the cantonment bazaar at Poona, from the Moota Moola, the test of chemical analysis in different seasons and states of the river was found to be a very necessary precaution.

The water supply up to the close of the period (1860) was inadequate throughout the Presidency, and much consideration was necessary in devising the best methods of remedying this deficiency.

Whether by an extension of the system of tanks and wells in masonry, free from the conditions which generate malaria, with improvements in distribution and protection from impurities by direct conveyance or surface soakage; or whether by the formation of large reservoirs by embankment, were questions that would necessarily come under discussion. Doubtless in respect to the latter the peculiarities relating to India would not be overlooked, particularly (1) that in most of the localities the supply would not be required to include provision for a system of water sewerage; (2) that in a tropical climate of periodical rains and a long dry season the margins of reservoir-lakes, open water-courses, and wastage outfalls would become sources of marsh malaria, and therefore their position, relative to habitations, their construction and conservancy would necessitate a consideration and a forethought greater than might suffice in temperate climates. The known conditions of malaria leave no doubt on this head, and illustrations are ready at hand, as sickness among the labourers at the Vehar lake, among the troops in the barracks on the margin of the lake at Mount Aboo, and more recently among the prisoners working in the vicinity of the dammed-up reservoir near the Central Deccan Gaol at Yerrrowda.¹

X.

CONCLUSION.

The Review which has been taken of Sanitary progress in the Bombay Presidency from 1830 to 1860 leads to two conclusions:—

1. That the encouragement of medical investigation and the publication of the results in the Transactions of a Scientific Society have been a great and permanent assistance in Sanitary progress, which a wise Government and a loyal medical service will do well to maintain.

2. That in 1860 the time had fully come for the formation of a department of direction of sanitary works on well-considered standard principles, and of general sanitary inspection and administration, military and civil.

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Deputy Inspector-General of Hospitals,
Bombay Establishment (retired).

May 5, 1869.

¹ Bombay Sanitary Report for 1867. Inspection Reports, p. 32.

BOMBAY. ABSTRACT OF REPORT OF THE SANITARY COMMISSIONER FOR BOMBAY, 1867.

INTRODUCTORY.

Change of President.	In the beginning of February 1867, Dr. Leith, President of the Commission, left for England on sick certificate; and Colonel Bell, R.E., a Member, was nominated, in the same month, to act in that office.
Change in constitution.	In June, under orders from the Government of India, the Commission was abolished; and a Sanitary Commissioner, with a Secretary, for the Presidency of Bombay, was appointed.
Appointments.	Dr. Leith was elected Commissioner, Colonel Bell continuing to act for him, and Dr. Gordon Asher remaining Secretary.
General work.	Numerous plans for public buildings, military and civil, were examined and duly reported upon; various questions, relative to sites for cantonments, individual buildings, market places, &c. (involving, in several instances, inspection of the ground) came under consideration; and subjects, pertaining to the transport of troops and of emigrants, to clothing, water supply, pilgrimage, epidemic disease, health of prisoners, and general conservancy, engaged attention.
Printed proceedings.	The proceedings of the Sanitary Commission and of the Commissioner were printed regularly throughout the year, in monthly parts, and distributed as formerly.

SECTION I.—EUROPEAN TROOPS.

Barracks.	The plan modified from the Bengal standard plan of barrack, was objected to by the Government of India on the score of expense. The plan was therefore again modified, alterations being made in the serjeants' quarters. The staircase was to be retained in the centre of the building, suggestions being adopted for further ventilation; and it was also decided that the lower barrack rooms, not used as dormitories, should be 16 feet only in height. It was considered that floors being made of planking would not be impervious to sound, and it was suggested that they should be made of stone slabs, or in damp climates of some bituminous compost.
Doors and windows.	The Government of India, after consideration of numerous opinions, arrived at the conclusion that the simple kind of doors then in use, partly panelled, partly glazed, with moveable glazed frames over them, and with the lower panels pierced with holes, or made of perforated metal plates, should be generally adopted, with certain modifications and improvements, in all barrack buildings. The provision of fire-places was extended, and plans of details, as also of corrugated iron and other roofing, showing arrangements for ventilation, were circulated for general guidance.
Ground floor of barracks.	Plans were received from the Government of India regarding the appropriation of the lower floors of barracks, with arrangements for auxiliary and day accommodation. Several alterations were suggested, and the objection was pointed out to arrangements being made for the distribution of liquor within a barrack; and the Government of India, with reference thereto, remarked that the canteen should be a separate building. It was also noted that the necessity for using tan, or sawdust (possibly damp) on the floor of a gymnasium, rendered it objectionable to appropriate any part of the basement floor of a barrack as such; but the opinion that the gymnasium should be a detached building was not concurred in by the Government of India.
Rest houses.	Government having issued orders, with reference to the Deolalee Dépôt, that accommodation was to be provided in the barracks at the rate of 65 square feet and 1,040 cubic feet per man; that the serjeants were to be lodged in the enclosed end verandahs; and that in the family quarters, each room for a family was to be

12 feet square; it was again pointed out that a traveller should have as much consideration as a prisoner, for whom, in a lock-up, 80 superficial feet and 1,680 cubic feet were the regulated spaces; and that a single room 16 feet square was more suited to the requirements of a family, taken at two adults and one child. Strong objection was also taken to providing only verandah rooms for the serjeants, an arrangement which the use of corrugated iron for roofing was likely to render peculiarly dangerous. Government considered the point of space as settled, but conceded that regarding accommodation for serjeants.

At the suggestion of his Excellency Sir R. Napier modifications were made in the standard plan for cook-houses, including alterations in the chimney arrangements. BOMBAY.
—
Cook-houses.

On the recommendation of the Government of India, a separate moveable basin was provided for each soldier. A plunge bath was also suggested for the use of women and children, but this project was deferred. Lavatories.

The decision of the Government of India regarding hospital accommodation for women and children of British soldiers in India was published. Hospital accommodation for 10 per cent. of the full complement of wives allowed by Regulations to reside in barracks was to be provided at all stations for the artillery, and at unhealthy stations for British cavalry and infantry; and accommodation for 8 per cent. of the full complement at all other stations for cavalry and infantry; one and a half as much in addition being provided for the accommodation of children. A standard plan for hospitals for the Bombay Presidency was approved by the Government of India. Hospitals.

Block plans with reference to various barrack buildings were circulated, and also designs for—1. Quarters for warrant and non-commissioned officers. 2. Staff serjeants' quarters. 3. Canteens. 4. Plunge bath. 5. Covered Fives court. Block plans.

It was decided that the barrack cots were to consist of iron trestles with planks, in accordance with a recommendation made by the Commander-in-Chief in India. Cots.

No report had been received regarding the sanctioned experiment of lighting hospitals with Kerosine oil. Lighting.

In answer to a question as to the quantity of water essentially necessary for the daily use of European troops in India, an estimate was given (as per margin) of a <i>minimum</i> necessary supply; but it was at the same time pointed out how undesirable it was that the amount of water supplied should be restricted to the quantity specified.	Water supply. Quantity.
Drinking - - $\frac{1}{2}$ gallon.	
Cooking - - $\frac{1}{4}$ "	
Washing - - 1 "	
Bathing - - 4 "	
General purposes 1 "	
Total - <u>7</u> gallons.	

The inefficiency of the present system of filtering water in barracks having been represented, the Government of India called for suggestions as to the most simple and practical method of purifying, for the use of the troops, the water that is generally available in military cantonments. In reply, two designs for filters, with some general remarks, were furnished. Filters.

It was communicated that indents for filters, which had been forwarded to England, were held in abeyance, pending the result of experiments which were being carried on with a view of testing the relative value of different kinds of filters.

The transport of troops between England and India and vice versa, commenced in September, and was regularly (fortnightly) carried on during the remainder of the year. The comfort and convenience of the troops were considered to have been well met in the initiation of the "Overland Transport service." Exception was taken on some points to the transport "Malabar," especially as regards the accommodation for officers, which is described as "frightful," the scuttles never open except in the calmest sea, and light so deficient that a couple of lamps were burning all day. The want of an officers' hospital had been greatly felt. The accommodation for soldiers and their families was excellent, and the provisioning unexceptionable. After the close of the year, it was learnt that in consequence of the failure of some of the transports to keep to their programme, risk had been incurred that some of the troops arriving by the latest trips might have to move after the close of the regulation season for marching in India. Home reliefs.

An opinion of his Excellency Sir Robert Napier, that rules for the ventilation of troop-ships should be reduced to a system, bearing a fixed proportion to the superficial space allowed, by regulation, to invalids, men in health, women and children, and hospitals, led to its being represented that the disturbing effects of the varying force and of the relative direction of the wind, as well as of the

BOMBAY. differences of temperature, rendered it impossible to prescribe one rule suited to all circumstances; but it appeared desirable that there should be plenty of ventilating tubes, with the means of closing, wholly or partially, some of them. It was stated to be considered necessary that there should be throughout five superficial inches of ventilating opening to every ten and a half feet of occupied deck surface, or, to facilitate calculation, that there should be a minimum of half a square inch to one square foot of net deck surface, after deducting for hatchways, masts, lockers, &c.

STATISTICAL.

Increase and decrease. The strength of the European army serving in the Bombay Presidency on the 1st of January 1868 was 13,725, showing a decrease of 679 men on the number borne on the returns on the corresponding date of 1867.

The loss within the year amounted—

By invaliding to 60·6 per mille, and
By death to 15·6.

This information was derived from a return furnished by the Adjutant-General of the Army, and the calculations made on a gross total of 18,881, after deduction of 4,397 men removed from among the “Effectives” by other causes than those pertaining to health.

The invaliding and the mortality, as compared with the rates of the preceding year, show an increase of 24·9, and of 5·1 per mille, respectively.

Marriage. The return exhibiting the number of married and unmarried men in the Bombay Army, bears date 1st May 1867.

The 11th Hussars, newly arrived from England, and the 3rd Dragoon Guards, many years in India, had among the rank and file—

Of the Hussars 9·8 per cent. married;
Of the Dragoons 7·3 ditto ditto.

Among the rank and file of the other two branches of the service the rate was—

In Artillery 10 per cent. married;
In Infantry 7·7 ditto ditto.

The medical returns range from the 29th December 1866 to the 27th December 1867, and show a mean strength of effectives, non-commissioned, rank and file, of 11,411. 670 men were constantly sick, or nearly six per cent., a trifle less than in 1866. 221 men died, or very nearly two out of every 100, approximating to double the death rate of 1866.

Cholera. Nusseerabad was the only station at which cholera prevailed in an epidemic form. Sporadic cases occurred at Indore, Ajmere, and Asseerghur. Cholera contributed five per cent. to the rate of mortality.

Fever. Malarious fever was the cause of much sickness in Ajmere, Neemuch, Indore, Mhow, Ahmedabad, Mount Aboo, and Sholapoor; the rates per mille of strength being in a descending scale according to the order in which the stations are named. It was the cause of 27 per cent. of the total sickness.

Bowel disease. Hyderabad, Nusseerabad, Neemuch, and Ahmedabad were the stations at which bowel complaints were most frequent; and, in respect of liver disease, Neemuch, Kurrachee, Ahmedabad, and Belgaum yielded the highest proportions. Liver and bowel diseases contributed 11 per cent. to, and with fever were the cause of more than one-third of, the total sickness.

Liver disease. There were very few admissions under the head of scurvy. An error in computation led to a mistake in treating of this affection in the report for 1866.

Scurvy. There was a great increase of admissions to hospital owing to the effects of drunkenness. A large amount of bounty money was distributed towards the end of the year, and it is notable that, against 158 admissions to hospital owing to intemperance during the three earlier quarters of the year taken together, there were 128 admissions from the same cause in the last quarter alone.

Intemperance. At Belgaum there were 680 admissions to hospital for venereal disease; a number which actually and relatively far exceeds that of any other station in the Bombay command. The cases were proportionately numerous at Sattara, Nusseerabad, Poona, and Kirkee; few at Aden and Bombay. Venereal disease caused upwards of 15 per cent. of the total sickness.

Venereal disease.

SICKNESS and MORTALITY among EUROPEAN TROOPS.

BOMBAY.

YEARS.	Mean Strength from Weekly Returns.	Admissions into Hos- pital.	Daily Sick from Hospital Diets.	DEATHS IN INDIA.			Invalids to be discharged.	RATIO TO STRENGTH PER MILLE.				
				In Hospital.	Out of Hospital.	Total.		Admissions.	Daily Sick.	Deaths.		Invalids.
										In Hos- pital.	All Deaths.	
1865	11,898	18,089	671	402	16	418	176	1,520	56.4	33.8	35.1	14.8
1866	12,051	16,998	717	136	17	153	556	1,410	59.5	11.3	12.7	46.1
1867	11,411	16,186	670	199	22	221	—	1,418.5	58.7	17.4	19.3	60.6

SICKNESS and MORTALITY from CLASSES of DISEASE.

				Zymotic.	Cachectic.	Local.	Developmental.	Violence.
Admissions	-	-	-	10,265	342	4,203	125	1,251
Deaths	-	-	-	128	7	58	2	26
<i>Per mille of strength.</i>								
1867 { Admissions	-	-	-	899.6	30.0	368.3	11.0	190.3
Deaths	-	-	-	11.2	0.6	5.1	0.2	2.2
1866 { Admissions	-	-	-	946.9	26.1	322.7	11.4	103.4
Deaths	-	-	-	4.8	1.9	3.7	—	2.2

Stational.

Simultaneously with the separation between the administrative medical departments of the British and Native forces in India a change took place in the circles of superintendence, and consequently in the grouping of stations. Copies of hospital weekly Returns and of monthly sanitary Reports are now prepared specially for the office of the Sanitary Commissioner.

In the Appendix to the present Report a detailed statement is given of works in connection with military buildings completed, or in progress, for the year under review.

PRESIDENCY DIVISION.

Average strength, 2,337. Daily sick, 90.

				All Causes.	Cholera.	Fever.	Dysentery.	Diarrhoea.	Scurvy.	Phthisis.	Hepatitis and Icterus.	Spleen Disease.	Eanthetic Disease.
Admissions	-	-	-	2,607	3	765	43	132	3	28	104	3	314
Deaths	-	-	-	35	2	5	2	—	—	1	4	—	1
<i>Ratio per mille.</i>													
Admissions	-	-	-	1,115.6	1.3	327.3	18.4	56.5	1.3	12.0	44.5	1.3	134.4
Deaths	-	-	-	15.0	0.9	2.1	0.9	—	—	0.4	1.7	—	0.4

At Bombay itself the sickness and mortality were both under the average. The average strength was 458; daily sick, 20; admissions, 565; and deaths, 6, two of which were from accident. There was comparative immunity from fever (251.1 per mille), but liver disease was on the increase (83.0). Venereal disease was little prevalent. The supply of water failed at times in consequence of derangement of the conduit. Complaint was frequently made of the quality or dirtiness of the rations, meat, salt, tea, and potatoes.

BOMBAY.

An Inspection Report was submitted by Colonel Bell, Acting Sanitary Commissioner, on Colaba with a view to its appropriation as a military cantonment, in consequence of a proposal by Sir Robert Napier to establish the whole of the troops composing the Bombay garrison at Colaba. The Sanitary Commissioner concurred generally in the proposed arrangements, but made recommendations for further improvements to the Peninsula, and considered that extensive reclamation of the foreshore would be necessary before a proper site could be obtained. The Bombay Government considered the latter objection might be met by the construction of barracks of two or more stories.

Ahmedabad.

Average strength, 256; daily sick, 18; admissions, 531 or 2074·2 per mille; deaths, 7 or 27·4. There was great and increased prevalence of fever, 609·4 per mille; and also of venereal diseases, 226·6 per mille.

The hospital was reported as overcrowded and objectionable in situation. Here, and also at Deesa, the meat ration was found fault with, and the quality of water was bad in February.

The drainage of the barracks was imperfect, and the state of the camp followers, 300 in number, with their families, is described as "deplorable; no regular lines, "a few only having broken down filthy huts."

Aden.

The ratio of sickness among the troops at Aden amounted to not much more than half of that of the average of the Bombay command.

Average strength, 662; daily sick, 19.

Admissions, 515; deaths, 8.

Three new upper storied barracks had been completed, and additional family quarters provided.

POONA DIVISION.

Average strength, 4,506. Daily sick, 281.

	All Causes.	Cholera.	Fever.	Dysentery.	Diarrhoea.	Scurvy.	Phthisis.	Hepatitis and Icterus.	Spleen Disease.	Enthetic Disease.
Admissions - - -	5,746	—	1,177	69	223	9	27	196	8	1,452
Deaths - - -	38	—	7	4	2	—	1	4	—	—
<i>Ratio per mille.</i>										
Admissions - - -	1,275·2	—	261·2	15·3	49·5	2·0	6·0	43·5	1·8	322·2
Deaths - - -	8·4	—	1·6	0·9	0·4	—	0·2	0·9	—	—

Average strength, 2,117; daily sick, 125; admissions, 2,801; deaths, 23.

Kirkee.

Average strength, 508; daily sick, 26; Admissions, 573; deaths, 3.

At Poona itself, fever, 266·4 per mille, dysentery, 15·6, and diarrhoea, 47·2, prevailed beyond the average in 1867. Part of the sickness and seven deaths occurred in the 108th regiment, which arrived in bad health from Madras. There was a general deficiency of hospital accommodation.

The general health at this station was excellent, but there was a large number of admissions, 111, or 218·5 per mille from venereal disease.

Various works for the improvement of the barracks and hospitals and their out-buildings had been executed, and were in progress. Seven new upper storied barracks were in course of erection.

Dry earth conservancy had been efficiently carried out in the barracks and hospital; in the latter a little carbolic acid was used as well and with much good effect. Works for increased supply of water were reported as well advanced.

At Ahmednuggur (average strength 495) the large number of cases of venereal disease was again noticed, 202·0 per mille.

At Sholapoor there was much sickness from fever; it was intended to withdraw European troops from the station.

At Sattara, average strength 190; daily sick, 9; fever 331·6 per mille, and venereal disease, 273·7; prevailed in high ratios.

Belgaum.

There was more than eight per cent. of strength (1,019) constantly sick at this station; the rate of mortality, 7·9 per 1,000, however was small. Liver and bowel complaints were common.

A difficulty in procuring European vegetables was reported. This has frequently attracted attention; it was the subject of special consideration in 1866, with the

result of an Order by Government that the troops at Belgaum should have a specified vegetable ration without reference to cost. Belgaum, too, is a station where there is great facility for the cultivation of vegetables. BOMBAY.

The prevalence of venereal disease (667·3 per mille), as usual among the soldiery at Belgaum, was most remarkable.

It is understood that a building has been purchased and adapted for use as a Lock hospital.

A special report was submitted on this new location for troops, and it was contemplated providing much extended accommodation and a hospital. Deolalee.

MHOW DIVISION.

Average strength, 2,594. Daily sick, 155.

		All Causes.	Cholera.	Fever.	Dysentery.	Diarrhoea.	Scurvy.	Phthisis.	Hepatitis and Icterus.	Spleen Disease.	Enthetic Disease.
Admissions	-	4,276	73	1,624	104	289	10	29	127	15	422
Deaths	-	116	55	21	4	8	—	—	11	—	—
<i>Ratio per mille.</i>											
Admissions	-	1,648·4	28·1	626·1	40·1	111·6	3·9	11·2	49·0	5·8	162·6
Deaths	-	44·7	21·2	8·1	1·5	3·1	—	—	4·2	—	—

The health of the troops at Mhow was much as the preceding years. Fever being again prevalent (660·7 per mille) but less than in 1865, since which time considerable drainage works had been carried out. Mhow.

The hospital building was so unhealthy that it had to be abandoned. Two new barracks and a hospital for the cavalry were in course of construction. The ventilation is noticed as defective in hospital and barrack buildings generally; and the great prevalence of fever was attributed in a measure to defects pertaining to sanitation in the matters of accommodation and conservancy. Average strength, 1,341; daily sick, 79; admissions, 2,067; deaths, 23.

At Neemuch there was, "as usual, much sickness among the troops, more than 8 per cent. constantly sick." Fever, bowel affections, and liver disease very prevalent, but a decrease in venereal cases. The supply of vegetables failed on several occasions, and it was considered that "many of the causes of bowel affections may have been dependent on a scorbutic taint."

There was cholera in the city of Ajmere in August,* and the disease, in a severe epidemic form, broke out among the troops at Nusseerabad in September. Within the month there were six cases in the artillery and 65 in the infantry, causing 2 and 51 deaths respectively.

At Asseerghur the health of the troops was highly satisfactory.

SIND DIVISION.

Average strength 1,377. Daily sick 72.

		All Causes.	Cholera.	Fever.	Dysentery.	Diarrhoea.	Scurvy.	Phthisis.	Hepatitis and Icterus.	Spleen Disease.	Enthetic Disease.
Admissions	-	2,335	—	604	32	171	1	10	100	5	235
Deaths	-	11	—	2	1	—	—	—	1	—	—
<i>Ratio per mille.</i>											
Admissions	-	1,695·7	—	438·6	23·2	124·2	0·7	7·3	72·6	3·6	170·7
Deaths	-	8·0	—	1·5	0·7	—	—	—	0·7	—	—

At Kurrachee there was increased sickness, fever being more prevalent (437·7 per 1,000) than in the two preceding years; the mortality was small, four deaths.

* Four cases, two deaths.

BOMBAY. The sanitary condition of the station generally was unsatisfactory, and the conservancy in enclosures of officers' houses as defective as formerly; "the foul state of the servants' privies in almost every enclosure was the source of a dangerous nuisance."

The water is described as tolerably good, but a little brackish. The want of a Lock Hospital was felt.

At Hyderabad the sickness for 1867 was more than double either of the preceding years.*

HYDRABAD.

Average strength 342. Daily sick 19.

	All Causes.	Cholera.	Fever.	Dysentery.	Diarrhea.	Scurvy.	Phthisis.	Hepatitis and Icterus.	Spleen Disease.	Enthetic Disease.
Admissions - -	699	—	151	17	87	—	9	16	—	36
Deaths - - -	7	—	1	—	—	—	—	1	—	—
<i>Ratio per mille.</i>										
Admissions - -	2,043·9	—	441·4	49·7	254·4	—	26·3	46·7	—	105·3
Deaths - - -	20·5	—	2·9	—	—	—	—	2·9	—	—

"It was perceptible that the general health of the men of the Artillery had deteriorated." "Small parties of the men (2nd Regiment) were sent down (to Ghizree) constantly by rail, as they were seen to be losing stamina, and others were sent back to the Regiment." Several cases of sunstroke occurred in May among the men of the infantry.

The duties of both artillery and infantry allowed of only three and four "nights in bed."

Diarrhoea in the artillery in January was attributed to insufficient clothing at night. "The hard bedstead and scanty bedding" was "complained of by the men." "Extra bedding was allowed during the cold season," to the infantry.

The well from which the plunge bath was filled smelt of "Sulphuretted hydrogen" in August, and the bath water is reported to have been offensive in September. The surface drainage about the well was defective.

The conservancy establishment was diminished, and the cleanliness of the barrack premises was thereafter not satisfactory.

The ground in rear of the hospital was very dirty; it seems to have been a dépôt for filth; and "natives construct latrines here."

It is now reported (compare Report of last year) that "hardly any smell is perceptible in close proximity to it" (the manure yard).

INVALIDS and CONVALESCENTS at SANITARIA and DEPÔTS.

Total Invalids and Convalescents.

Average strength 299. Daily sick 61.

	All Causes.	Cholera.	Fever.	Dysentery.	Diarrhea.	Scurvy.	Phthisis.	Hepatitis and Icterus.	Spleen Disease.	Enthetic Disease.
Admissions - -	957	—	134	34	33	2	63	69	2	152
Deaths - - -	19	—	2	4	2	—	2	2	—	—
<i>Ratio per mille.</i>										
Admissions - -	3,200·7	—	448·2	113·7	110·3	6·7	210·7	230·8	6·7	508·4
Deaths - - -	63·5	—	6·7	13·4	6·7	—	6·7	6·7	—	—

* 1865. Admissions per mille - - 914·9
Deaths " - - 8·0
1866. Admissions " - - 861·1
Deaths " - - 0·3

SECTION II.—NATIVE TROOPS.

BOMBAY.

Lines.

Standard block plans of lines for native cavalry and native infantry were issued by the Government of India, and forwarded by the Bombay Government for report. Several objections to the proposed arrangements were raised, and the Government of India subsequently called for a block plan embracing generally the recommendations made. The plans were duly furnished in January of the current year. Block plans.

In accordance with the recommendation noted in last year's Report (page 54), plans and estimates for a system of drainage of the lines of native troops were prepared; but it was found that the cost would be so excessive that the projects must lie over indefinitely. Drainage.

Latrines.

Macfarlane's latrines, modified to suit native habits, were erected and brought into use, in the lines of the Marine Battalion, Bombay. Difficulties in working details were met with, and it was found that a monthly expense of 1,088 rupees would attend the use of these latrines. Government therefore ordered that the regiment should revert to the use of the Sonapore public latrines. Macfarlane's.

Hospitals.

In supplement of the "principles to be adopted in the construction of hospitals," laid down by the Government of India and printed in Appendix to last year's report, further matters pertaining to certain points of detail were settled and published. Construction.

Statistical.

25,298 men were borne on the returns of strength of the native army serving in the Bombay Presidency on the 1st of January 1868, being 238 fewer than on the corresponding date of the preceding year. Strength.

Out of a gross total of 27,754 men in the native army during the year 1867, 1302 were removed by dismissal, desertion, and other like causes. Decrease.

Basing calculations on a net total of 26,452 men, there were lost during the year,—

By invaliding 33·8 per mille.

Invaliding.

And by death 9·7 per mille.

Mortality.

These figures approximate closely to those derived from the returns of the preceding year. Comparison.

The general health of the native army, during the year 1867, is shown to have been very satisfactory; 35 per mille indicates the number constantly sick. Sickness.

Fevers and bowel affections were the only diseases that to any great degree caused sickness, the former appearing to have been very prevalent at Mehidpore, Surat, Jacobabad, and Nusseerabad, and the latter at Perim, Bombay, Surat, and Ahmedabad.

There were four cases of cholera, of which only one proved fatal.

Cholera.

There were 49 cases of smallpox, as compared with 5 and 21 in the years 1865 and 1866 respectively. Small pox.

There was no death from the disease.

49 cases of scurvy occurred amongst the native soldiers at Aden; 37 at Bombay; 23 at Bhooj; also at Poona, Surat, and Jacobabad there were more than the average number of cases. Scurvy.

At Poona fever prevailed in a high rate and caused seven deaths.

At Kirkee fever and venereal disease were more prevalent than usual.

At Sholapoor, Dharwar, Kulludge, Ahmedabad, Rajkote, Mehidpore, Nusseerabad and Surat fever appears to have been very prevalent. At the other stations the health of the native troops appears to have been generally satisfactory.

BOMBAY.

SICKNESS and MORTALITY among NATIVE TROOPS.

Year.	Mean Strength from Monthly Returns.	Admissions into Hospital.	Daily Sick.	Deaths in Hospital.	Invalided to be Discharged.	Ratio to Strength per Mille.			
						Admissions.	Daily Sick.	Deaths in Hospital.	Invalided.
1865	24,737	26,443	1,001	365	1,015	1,068·7	40·5	14·8	41·0
1866	24,451	28,769	902·6	162	920	1,176·6	36·9	6·6	34·4
1867	24,835	27,417	873	194	896	1,104·0	35·1	7·8	33·8

SICKNESS and MORTALITY from various DISEASES.

	Admissions.	Deaths.	Ratio per Mille of Strength.		Ratio of each to all, per cent.	
			Admissions.	Deaths.	Admissions.	Deaths.
Cholera - - - -	4	1	0·2	0·0	0·0	0·0
Smallpox - - - -	49	—	2·0	—	0·2	0·0
Measles - - - -	—	—	—	—	—	—
Dysentery - - - -	545	13	21·9	0·5	2·2	0·1
Diarrhoea - - - -	893	8	35·9	0·3	3·6	0·0
Fever, remittent and intermittent	12,101	42	487·3	1·7	48·7	0·2
„ of other type - -	614	1	24·7	0·0	2·5	0·0
Scorbutus and purpura - -	215	4	8·7	0·2	0·8	0·0
Delirium tremens - - -	2	—	0·1	—	0·0	—
Ebriositas - - - -	5	—	0·2	—	0·0	—
Hydatid - - - -	—	—	—	—	—	—
Vermos - - - -	—	—	—	—	—	—
Phthisis pulmonalis - -	31	12	1·2	0·5	0·1	0·
Hepatitis - - - -	57	5	2·3	0·2	0·2	0·
Icterus - - - -	31	4	1·2	0·2	0·1	0·
Spleen - - - -	97	2	3·9	0·1	0·4	0·
All other causes - - -	12,773	102	514·8	4·1	51·4	0·4

SECTION III.—CANTONMENTS.

Surveys.

It was not known that any steps had been taken towards effecting, in compliance with the requisition of the Secretary of State, a contoured survey of all military stations, wherever British troops are stationed in the Bombay Presidency; though it appeared some progress had been made in the surveys of several stations in the Bengal Presidency.

Legislation.

An Act for regulating the administration of military cantonments was passed into law. Bombay Cantonments Act No. III. of 1867.

Cantonment rules.

At the instance of the Commander-in-Chief, Government desired that the measures for the prevention of the spread of infectious disease, referred to in the Report on the proposed cantonment rules, by the Sanitary Commission, in the previous year, should be specified in detail.

Earth closets.

Several designs for self-acting earth closets have been considered and remarked upon.

Cholera camps.

The Government of India issued orders that all encamping grounds used as cholera camps be ploughed immediately after the troops have quitted them.

Farms.

A proposal, emanating from the Sanitary Commissioner for Bengal, for the establishment of Government model farms in the vicinity of all military cantonments, as affording a ready and very desirable means for the disposal of sewage matters and refuse in the way of manure; as likely also to prove a source of profit; to serve as centres of instruction, and to result in various other benefits was circulated, with the remark that the subject seemed deserving of attention.

Death rate.

The general population of cantonments is not accurately known, and is

fluctuating. The highest rate of mortality (41·4 per mille) is shown in the BOMBAY. returns from Bombay; the lowest (7·3 per mille) in those from Poona.

Eighteen deaths were caused by cholera at Nusseerabad; and at Mhow, Surat, Cholera. Ahmednuggur, and the Sind stations, a few fatal cases occurred.

Smallpox was considerably more prevalent than in the preceding year; at Smallpox. Nusseerabad there were 41 fatal cases, at Bombay 22, at Asseerghur 9, at Ahmednuggur 7, at Aden 6, and at Malligaum 3.

SECTION IV.—GENERAL POPULATION.

In May 1867 Government directed that a statement, bearing upon population, Statistics. number of births and deaths, vaccination, and other points of kindred interest, should be annually prepared on the 1st January. An agency for the purpose had not yet been organized; and the matter was in abeyance.

Thur and Parkur is the only district which seems to have had complete Cholera. immunity from cholera during the year. A very severe outbreak of the disease in an epidemic form occurred in Sind in the months of August and September. In the collectorates of Rutnagherry, Ahmednuggur, and Canara, deaths are reported to have occurred from cholera in every month of the year; and in Kaira, Kulludghee, and Sholapoor districts, in eleven out of the twelve months.

The great and general increase of mortality from small pox calls for special Smallpox. remark. When it is considered that smallpox is a disease death from which can be, almost with certainty, averted by a harmless prophylactic measure, the large mortality from this cause among the general population, as exhibited in the statistical returns for last year, (the figures in which may be certainly accepted as not being below the actual numbers,) seems to urge on the notice of Government the question of a further consideration of the various propositions that have, from time to time, been made with a view to the adoption of more stringent measures than the merely moral pressure on the people of simple dissuasion from inoculation, and simply offering for their acceptance the boon of vaccination.

In connection with the quarantine established by the Egyptian Government Quarantine. on account of epidemic disease at Aden, notice was drawn to the fact of ships from Indian ports for ports in the Red Sea being unprovided with bills of health; this subject remained under consideration.

A health officer was appointed for the port of Bombay, but his powers had not yet been defined.

Police and conservancy arrangements had been rigorously carried out and with Pilgrimages. apparent success, as there had been no instance of unusual mortality or prevalent epidemics at places of pilgrimage. A proposition for inspecting at fixed points the pilgrims returning from these gatherings was approved by Government, but it was found that the law did not provide for the detention of a traveller on the score of sickness. At the temple of Pundhurpoor improved ventilation and greater facilities of ingress and egress were carried out.

It was ruled by the Secretary of State, that the accommodation in the depôt Emigration. for the Mauritius emigrants at Bombay should be calculated on an allowance of 24 superficial feet, with a minimum in height of 12 feet to each emigrant; the exportation of coolies to the Mauritius was however still prohibited under the Government order of 1865.

A proposal for the establishment of a leper hospital, with special reference to Lepers. the Rutnagherry district, had been mooted, and information as to the number of lepers in the various districts called for.

The death rate as gathered from returns, ranges from 2·7 per mille in Thur Mortality. and Parkur district to 22·6 in North Canara collectorate, but these returns were held to be "grossly inaccurate." The number of deaths from accidental drowning in wells seems to indicate a frequent want of desirable precautions, such as fencing.

Accidental deaths.

		In wells.			In tanks.
Men	-	195	-	-	129
Women	-	359	-	-	74
Children	-	251	-	-	221
		X 2			

BOMBAY.City of
Bombay.

The statistics for the city of Bombay are taken from the Government Gazette. The general health of the inhabitants was considered, as compared with previous years, to have been highly satisfactory. The complete immunity from cholera in the month of December is noteworthy.

BIRTHS and DEATHS reported in the Civil Population in the Island of Bombay during the Year 1867.

Population by census of 1864.									
Males	530,450								
Females	286,112								
816,562									
		Still-born.	Cholera.	Small-pox.	Fever.	Accident or Violence.	Other Causes.	All Causes, exclusive of Still-born.	Births.
January	-	69	20	16	643	42	964	1,685	866
February	-	42	21	62	535	21	700	1,339	487
March	-	34	10	194	448	19	641	1,312	428
April	-	61	29	270	624	26	788	1,737	555
May	-	35	6	176	562	15	580	1,339	354
June	-	48	12	145	450	23	571	1,201	364
July	-	53	6	98	454	20	735	1,313	443
August	-	47	6	40	276	13	715	1,050	354
September	-	49	6	16	357	20	665	1,064	329
October	-	59	8	13	478	20	748	1,267	310
November	-	48	4	9	410	14	636	1,073	331
December	-	57	—	19	639	26	726	1,410	385
Total	-	602	128	1,058	5,876	259	8,469	15,790	5,206

Death ratio 19·3 per mille.
Birth ratio 6·3 „

Smallpox.

In the Tanna District the increased prevalence of smallpox calls for remark. Reported population, 900,000; deaths by smallpox, 248.

In Surat also (reported population 792,638) smallpox prevailed in greatly increased numbers. Deaths: males, 201; females, 159. The city itself, where vaccination is carefully practised, comparatively escaped.

Smallpox was much more prevalent than in the previous year: at Khandeish, 514 deaths; Ahmednuggur, 886; Poona, 1,000; Sholapore, 448; Sattara, 379; Belgaum, 887; Dharwar, 816 (more than double 1866); and Hyderabad, 419 deaths.

Cholera.

The returns of three years indicate that the germs of cholera were never absent in Kaira, Ahmednuggur, Sholapoor, Kulludhee, Canara, Rutnagherry.

In Kurrachee there was no cholera till August, when it prevailed in epidemic form till the end of the year, causing 557 deaths.

Hydrabad had comparatively few, 135 deaths, principally in August and September.

Shikarpoor.

The district of Shikarpoor was visited with cholera, in a very severe epidemic form in July, August, September, and October, 3,467 deaths being attributed to that cause. With the exception of one case which occurred in Shikarpoor talooka in May, the scourge seems to have been limited to the four months named, but to have prevailed in all parts of the collectorate. In Meerpoor talooka there were but two cases. Rutta-Dera, Shikarpoor, Larkhana, Nowshera, Roree, and Sub-Durya talookas, in a descending scale, according to the order of their names, each afforded a large number of cases.

Upper Sind.

The frontier district of Sind escaped with 194 deaths from cholera, during the prevalence of the epidemic in the province.

Poona.

It has been reported that “the native town of *Seroor* adjoins the cantonment. “Ruins of old houses are everywhere to be seen. * * * It has no latrines, “and the poorer inhabitants use the *nullahs* for purposes of nature. The result “is that to the south and east of the village, and in courtyards and *nullahs* in “the neighbourhood, the ground is littered with human ordure, and in the “morning * * the smell is most offensive. In the rains, too, these *excreta* are “washed into the river. * * Water for drinking and cooking purposes is “chiefly obtained from the river. * * * Dead bodies burned on the banks “of the river are afterwards thrown into it at the place from which water is “drawn for domestic use.”

SECTION V.—GAOLS.

BOMBAY.

The general health of prisoners, whether confined in old established gaols or in subsidiary or temporary structures, was greatly better in the year 1867 than in 1866; the mortality too in 1867, among all classes of prisoners, had been 37·3 or less than a half of what it was in the previous year.

One death from cholera occurred among the prisoners at Carwar, and another fatal case at Sukkur. There were two fatal cases of small-pox; of which one occurred in the Bombay gaol and the other in the gaol at Ahmedabad. With these exceptions there seems to have been complete immunity from cholera and small-pox among the gaol population of the Bombay Presidency during the year 1867.

Only ten deaths are attributed to scurvy or atrophica during the past year, as compared with 29 and 42 in the years 1865 and 1866 respectively.

In the gaols marginally noted, the decrease in mortality, as exhibited in the Statistical returns of the three years 1865, '66, and '67, seems to bear a close relation to a diminution in the number of prisoners confined in each of them.

The gaols noted in the margin have been more unhealthy during the year, in a descending scale according to the order in which they are named, the ratio of mortality in them ranging from 78·1 per mille as a maximum to a minimum of 33·6 per mille.

The mortality in the gaol at Yerrowda in 1867 amounted to more than decimation, though it has been little more than half of the preceding year

			Admissions.		Deaths.
1866	-	-	1,926	-	177
1867	-	-	1,223	-	84

A special report was called for and submitted to Government by the acting Sanitary Commissioner Colonel Harry W. B. Bell, R.E., on the 21st December 1867. The mortality was caused by the re-appearance of a typhoid fatal type of fever nearly allied to that of the previous year.

The site of this central Deccan gaol had been determined on after much consideration of the subject, and fixed in the neighbourhood of Poona, ground to the extent of 500 acres being taken up around the gaol's premises for cultivation by convict labour. The supply of water was found abundant, and a body of prisoners were assembled at Yerrowda for the construction of the gaol in April 1865, with the usual gaol dietary and fixed working hours. They were at first accommodated in tents during the erection of temporary barracks, which were inhabited as they were finished. There were 18 of these barracks all on the same place. An improved dietary and other sanitary improvements were introduced, but sickness manifested itself soon after the first assembling of the prisoners, due apparently to malarious fever and bowel affections; and in May 1865 the sickness attained the annual rate of per centage of 335; there was gradual improvement till towards the end of the year, when 80 prisoners were transferred from the Ahmedabad gaol where there had been much epidemic sickness. The returns for January 1866 show increased sickness, and the mortality for the year was 177, 26 deaths occurring in July. Four-fifths of the total sickness (1,926 cases out of 1,223) being due to malarious fever and bowel complaints. In 1867, sickness reached its maximum in August, 258 per cent. per annum, since which time improvement took place.

Persons connected with the gaol are stated to have left from illness; but the residents of the village of Yerrowda enjoyed ordinary health.

Among suggested causes men of weak health and unfitted for labour are said to have been sent to work at the new gaol, a work that involved harder labour than usual, with greater exposure, defective shelter, and changed circumstances of life.

It was also alleged that in 1865-66 the arrangements for medical care of the prisoners was defective.

The prisoners from Goojerat, who had suffered more than the rest, were removed, the hours of labour diminished, the clothing and dietary improved; but these measures had not yet established a healthy standard among the prisoners.

It was recommended by Colonel Bell that the decision of Government to build a large gaol for upwards of 1,200 prisoners should be reviewed and the proposed number reduced; that a careful selection should be made of prisoners sent to

General health.

Epidemic disease.

Scurvy and atrophica.

Surat, Kaira, Ahmedabad, Dholia, Ahmednuggur, and Hyderabad.

Shikarpoor, Sawuntwarree, Kulludghee, and Dohud. Yerrowda.

BOMBAY. Yerrowda for labour, and a weekly inspection be made of them. Other sanitary and conservancy measures were recommended, and that, in the event of the sickness reappearing, all prisoners who could not be accommodated in permanent buildings should be transferred to other gaols.

SICKNESS and DEATHS in GAOLS in 1867.

JAILS.	Average Number of Prisoners.	Daily Number of Sick.	Admissions into Hospital during the Year.	Deaths from all Causes.	Deaths from										1867. Deaths from all Causes per Mille.
					Cholera.	Small-pox.	Fever.	Dysentery.	Diarrhoea.	Hepatitis.	Icterus.	Scorbutus.	Phthisis.	Atrophia.	
Bombay	425	10.2	246	5	—	1	3	—	—	—	—	—	—	—	11.8
Surat	156	6.4	173	3	—	—	—	—	2	—	—	—	—	—	19.2
Kaira	102	4.1	236	2	—	—	2	—	—	—	—	—	—	—	19.6
Ahmedabad	298	10.1	285	6	—	1	1	—	—	—	—	—	1	1	20.1
Rajkote	95	2.2	100	1	—	—	—	—	—	—	—	—	—	—	10.5
Dohud	149	3.4	123	5	—	—	1	—	—	—	—	—	—	—	33.6
Dhoolia	242	13.2	281	1	—	—	1	—	—	—	—	—	—	—	4.1
Admednuggur	163	9.1	299	1	—	—	—	—	1	—	—	—	—	—	6.1
Poona	343	7.6	228	9	—	—	4	1	3	—	—	—	—	—	26.2
Sattara	132	2.7	94	2	—	—	1	—	—	—	—	—	—	—	15.2
Kolhapoor	121	6.8	360	2	—	—	—	—	—	—	—	—	—	1	16.5
Sholapoor	127	6.6	189	—	—	—	—	—	—	—	—	—	—	—	—
Kulludghee	133	9.1	231	5	—	—	—	—	—	—	—	—	1	1	37.6
Dharwar	301	5.1	124	2	—	—	—	—	2	—	—	—	—	—	6.6
Sawuntwaree	34	1.7	43	2	—	—	2	—	—	—	—	—	—	—	58.8
Rutnagherry	158	11.4	333	4	—	—	1	—	—	—	—	1	—	—	25.3
Tanna	346	10.2	350	5	—	—	1	1	1	—	—	1	—	—	14.5
Kurrachee	452	10.4	224	4	—	—	2	—	—	—	—	—	—	—	8.8
Hydrabad	337	6.5	157	10	—	—	4	1	1	—	—	—	—	2	29.7
Shikarpore	538	18.0	594	42	—	—	20	1	2	—	—	—	1	—	78.1
Aden	169	5.8	282	2	—	—	—	—	—	—	—	—	—	2	11.8
Total	4,821	160.6	4,952	113	—	2	43	4	12	—	—	2	3	7	23.4
SUBSIDIARY GAOLS, GANGS, AND LOCK-UPS.															
Yerrowda	797	33.9	1,223	84	—	—	58	5	5	—	1	—	1	1	105.4
Belgaum	78	1.7	86	—	—	—	—	—	—	—	—	—	—	—	—
Carwar	170	9.2	293	5	1	—	—	2	1	—	—	—	—	—	29.4
Sukkur	258	12.6	593	18	1	—	10	1	—	—	—	—	—	—	69.8
Dhooliakote	327	10.2	462	—	—	—	—	—	—	—	—	—	—	—	—
Thur and Parkur	389	10.3	769	23	—	—	18	—	—	—	—	—	—	—	59.1
Mitrow Canal	95	3.0	115	16	—	—	13	—	—	—	—	—	—	—	168.4
Sadra	9	0.4	19	—	—	—	—	—	—	—	—	—	—	—	—
Total	2,123	81.3	3,560	146	2	—	99	8	6	—	1	—	1	1	68.8

ABSTRACT OF THE ANNUAL REPORT OF THE MUNICIPAL COMMISSIONER OF BOMBAY FOR 1866.

THIS Report is submitted by Mr. Arthur Crawford, Municipal Commissioner for the city of Bombay.

Several measures of a municipal character were before the Legislative Council during the year.

A Quarantine Bill.

A Bill regulating the sale of spirituous liquors.

A Town Duties Bill.

A Draft Bill for improving and laying out the Flats, which was forwarded to the Government of India.

A Draft Building Act was also in hand.

Reference is made to Dr. Hewlett's (the health officer's) report, of which a short abstract is given at page , and testimony is given to his zeal and efficiency, and the excellent organization of every department under him. Sanitary progress.

Many of Dr. Hewlett's suggestions had been adopted, and it was stated that a report from a committee on a Small Pox Hospital would be shortly submitted to Government; also a census was to be taken in 1868.

From the end of the year 1866 the registration of births and deaths was placed under the health officer.

At the close of 1865, Government presented the Municipality with a valuable site on the Esplanade (in the immediate neighbourhood of certain old markets), and measures were at once taken for building new general markets. Markets.

It was decided by the Bench that the right of occupancy of stalls in the market for the year should be sold by auction, but this led to some difficulties, and it was determined for the future to have a fixed rent payable for each stall.

The fruit trade of Bombay is very considerable, fruit and vegetables being brought from some distance. A large increase was expected in the consumption of English vegetables. Not many years ago natives would not eat potatoes, from some prejudice as to the mode of cultivation. Now potatoes are consumed by all classes, and grown all over the country, but the Hindoos as yet did not touch beetroot or pink varieties of turnips.

Early in the year sanction was obtained for the removal of the Slaughter Houses to Bandora, and for running a daily meat train thence. Slaughter-houses.

ENGINEERING DEPARTMENT.

The unusually heavy monsoon of 1866 did great damage to the roads. The cost of metalling, &c. for the year was Rs. 3,93,261 11a. 11p., at 20 Rs. per 100 cubic feet. Roads.

The cost of watering and rolling was Rs. 147,541 11a. 1p. 100 water carts were in daily use.

A careful survey was made of the harbour, and a series of tidal experiments made, with a view to the selection of an outfall for the sewage. Drainage.

A Commission appointed by Government reported in favour of the Light-house site, and the executive engineer prepared a general design for the drainage of the city, which was forwarded to Government at the close of the year.

The Fort drainage works were proceeding under Mr. Thwaites, the resident engineer.

Drainage works were also being carried on in Back Bay, at an estimated cost of Rs. 160,300, the whole being paid by Government.

All the dipping wells in the island were, in the year under review, thoroughly cleaned out and repaired with cement. Waterworks.

The water works at Vohar were reported to be in good order, and strenuous efforts were made to economize the supply by compelling the use of meters. A survey for the extension of the water supply was in progress during the season.

Great progress was made during the year, at the close of which there were 1,888 gas lights burning, exclusive of ornamental lights. There were only 220 streets. Lighting the streets.

BOMBAY. lights at the close of 1865. There were lamps in every street in which the gas company had mains; the people appreciated very keenly the comfort of gas, and made constant applications for its extension.

Miscellaneous. 560 applications to build were disposed of during the year. 318 ruinous houses were dealt with, &c. The Municipal Commissioner records his especial thanks to the following members of the Engineers' Department:—Mr. Rupel Aitken, Mr. Thwaites, and Mr. Zuggmath Suddasew.

Police and fire brigade. The extension of gas throughout the city would, it was anticipated, allow of reduction in the number of night guards.

The Commissioner of Police was, under the New Prisons Act, vested with authority to grant licences for sale of poison. The number of licences granted was 21, and the fees amounted to Rs. 52 8a.

Mr. Edginton was sent to England to qualify as captain of the new Steam Fire Brigade under Captain Shaw, and on his return proved himself thoroughly acquainted with all requisite details of management. The brigade itself was carefully organized by Major Henderson, late Commissioner of Police.

PROGRESS OF LAND SURVEY.

Major Laughton reported that the total area surveyed amounted to 2,870 acres, of which 2,416 were measured with the cross staff and chain, and are under cultivation. During the monsoon the whole of the Office work, with the exception of the field registers, and the fair maps or sheets of 23 out of 57 traverses was completed.

SURVEY FOR ASSESSMENT PURPOSES.

This survey was commenced at the close of 1865, and completed early in the year under report. During the year 21,100 properties were assessed, and their gross annual value was Rs. 1,48,94,893. To these were to be added 466 buildings unfinished or decayed, 332 plots of ground unused and unlet, and 301 charitable and religious edifices.

The Government properties give a gross annual value of Rs. 10,92,814, which would yield if assessed—

House rate 6 per cent.	-	-	Rs. 59,012
Lighting rate 2 per cent	-	-	19,671
			Rs. 78,683

The last previous general survey for assessment purposes was in 1864.

Rates and taxes. The licences issued under the Bombay Municipal Act during 1866 were in number 8,926, yielding a grand total of Rs. 266,114.

The total yield of water rate was Rs. 418,817 5a. 1p.

The liquor licences amounted to Rs. 108,476 7a. 5p.

The fines to Rs. 37,288 9a. 4p.

Fees to Rs. 44,496 11a. 4p.

The cost of assessment and collection of rates and taxes during the year was $3\frac{3}{4}$ per cent.

BOMBAY.—ABSTRACT OF HEALTH OFFICER'S REPORT, 1866.

The report of the Health Officer, Assistant Surgeon, T. Gillham Hewlett, to the Municipal Commissioner for the city of Bombay for the year 1866, shows the results of the first organized attempt in the cleansing of that vast city.

Census report. According to the census of the island of Bombay, taken on the 2nd February 1864, the total population amounted to 816,562 persons, of whom 783,980 resided on the island, the remainder forming the harbour population. The surface of the island is about 18.62 square miles, its extreme length being 11, its average breadth about two miles; only parts are densely populated. The native town covers a surface of 60,660 acres, with an average of only $6\frac{1}{2}$ square yards to each of its 449,891 inhabitants; its streets narrow and irregular, with houses ranging from one to five stories, no open spaces for ventilation, and no provision made for effective drainage.

Until May 1864, in spite of repeated warnings from the most eminent men in the Medical Profession, such of the daily garbage as was collected was deposited in the low-lying parts of the island, in the immediate vicinity of some of the most crowded parts of the native city; but the publication in February 1864 of Dr. Leith's admirable and startling report on the sanitary state of the island of Bombay, caused Government to recognize the necessity of taking immediate steps for the conservancy and improvement of the city. The Bombay Municipal Act (II. of 1865) was passed, and came into operation 1st July 1865, and the Public Health Department came into existence in November of the same year. This department consisted of—

1. The scavenging establishment.
2. The drain cleaning.
3. The road scraping establishment.
4. The town sweeping bunder establishment.
5. The foreman carpenter and storekeeper's establishment.
6. The market and slaughter-house establishment.
7. The night soil and halalcores establishments.

For the year under report a grant of Rs. 6,26,646. 12a. was made by the Bench of Justices.

The island was divided into 11 wards with distinct establishments, each ward being placed under a European inspector, whose duty was to attend to the executive cleansing of his ward, and to report offenders against the provisions of the Act to the Health Officer. The garbage was carried by cart and railway waggon to Coorla Swamp, $9\frac{3}{4}$ miles from Bombay.*

There was reported to be hardly a scientifically constructed drain in Bombay, certainly not in the native town, and in most of the open drains the sides only were made; the bottom, being left unpaved, was soaked with decomposing organic matter. Their construction rendered it impossible to cleanse them, but during the year under report covered drains equal to 54.96 miles in length were opened and cleaned.

The convictions and fines during the year amounted to Rs. 6,126.13, which was small compared with the previous year. Attention was directed to the disgraceful state of the various cow and milch buffalo sheds throughout the island, and congregated near all the large centres of the population. It was recommended that byelaws regarding space for each animal should be made, and the owners brought under the provisions of section CCI. which provides for dangerous and offensive trades; also that the Municipality should erect proper stables in each quarter of the town. 8,552 tenant houses were inspected during the year, much useful information thereby collected, and in several instances defective drains were altered.

Eighteen patent road scrapers were received from England and were considered to answer admirably.

Road scraping.

All the tanners were removed from the precincts of the town early in 1866, also catgut makers, fat boilers and dyers on a large scale; those on a smaller scale were allowed to remain under strict supervision. The dead cattle in the city are disposed of by being taken to the flats between the Bellasis Road and Mahuluxmee, where they are skinned and the carcase exposed to the vultures, who in an incredibly short time divest the bones of every particle of flesh. The hides are sold to tanners and the bones and hoofs shipped for England and America. About 100 animals are thus disposed of every month; the place was frequently inspected and kept clean.

Dangerous and offensive trades.

The state of some of the burial grounds was the subject of complaint during the year. It was hoped that the new cemeteries for the Christian dead would have been ready before the close of it, but various delays had prevented this from being carried out, though the want was seriously felt. It was considered that the question must soon arise whether a similar plan could not be adopted for the removal of the Hindoo and Mussulman dead beyond the precincts of the town. Dr. Hewlett recommended the erection of a cinerator at the Hindoo burning Ghat, to be at the disposal of the poor on payment of a small fee, and that the Parsee towers of silence should be closed and removed to the flats.

Burial grounds.

In January the public markets were closed by order of the municipal commissioner as the stall holders refused to pay the amount at which they had purchased

Markets and slaughter-houses.

* 45,288 tons of garbage were sent out of the city in 1865; 103,098 tons in 1866.

BOMBAY. the stalls at auction. After three days they paid the money and a sum of Rs. 56,916 was collected.

The slaughter fees were Rs. 7,581, the total being 19,497 in excess of what was estimated. Improvements were commenced at the Null market. Seven persons were imprisoned for sale of meat unfit for human food. The quality of animals brought for slaughter was generally inferior, and the accommodation for them on arrival at Bombay confined and crowded. The following table shows the large increase of price of provisions during the last 11 years, a matter having a serious bearing on the health of the population :—

	Increase per cent. in the 5 Years 1861 to 1865, as compared with the average Prices in the 5 Years 1856 to 1860.	Increase per cent. of Price in 1866 over average Price of 10 Years ending 31st December 1865.
Cereals - - - -	52½	37½
Legumes or pulses - - -	82	21
Vegetables - - - -	35	108
Meat - - - -	27½	53
Poultry - - - -	45½	63
Dairy Produce - - -	65½	39
Groceries - - - -	16½	6
Condiments - - - -	17½	61½
Fuel - - - -	64½	50

It was thought that Government might afford aid by importing sheep from England and Australia, and that only sheep and oxen of a certain weight should be allowed to be slaughtered. Attention is drawn to the improvement of pasture by the utilization of night soil, especially in raising forage for horses and cattle. Old slaughter-houses were condemned and new ones in course of erection; there was a daily average of 1,015 sheep and goats, 76 cattle, and five pigs slaughtered.

Night soil
and halalcore
establish-
ment.

Night soil throughout India was removed by a particular caste degraded to this service. During three months, from August to October 1865, 1,824 persons were convicted for having their receptacles for night soil in a filthy state, the invariable defence being the impossibility of procuring sweepers to cleanse the privies. Drafts of fresh sweepers from up country were introduced to meet this evil; new public latrines were built, the night soil carted off into tanks, and the contents allowed to flow into the sea. Testimony is borne to the general good-conduct of the European Inspectors employed in their arduous duties.

Rate of mor-
tality.

There were 5,904 births registered during 1866. Calculating from the birth rate in England, which is 33·1 per 1,000 of population, there should have been 27,028 births registered during the year.

Deaths from all causes in the city were 16,750 during 1866, being 11,881 less than the cases recorded in 1865, and 8,265 less than 1864.

Deaths from Cholera - - - -	·40 per 1,000
Small-pox - - - -	1·32 "
Measles - - - -	0·59 "
Fever - - - -	12·04 "
Other causes - - - -	6·15 "
	20·50

The year was considered unusually healthy. Taking the different districts of the town separately, in some of these a high death rate occurred, the highest being at Chaopatee, 37·3 per 1,000. The high rate of the Esplanade (25·7) is attributed to the emanations from the foul foreshore in Moody Bay.

The mean temperature was 78·3; the rain-fall, 79·34 inches on 98 days, being very near the average.

The Northern end of Bombay, the South and South-eastern shores of Salsette and Trombay, are formed by salt marshes, the existence of which has been frequently shown by Dr. Leith, (late Sanitary Commissioner), as the cause of the large mortality from fever. The necessity of communication with the main land led to causeways being made in 1805 and 1845, and an embankment was thrown across at Coorla by the G. I. P. Railway in 1852. Dr. Hewlett points out the advisability of opening a passage for the sea through the above-named embankment,

and re-claiming the marshes for cultivation and building purposes, which would relieve Bombay from the other leading cause of fever, the overcrowded state of the inhabitants. Illustrations are given in the report of some of these fever nests. Overcrowding was, however, much more excessive in 1864-5, when the reclamation mania brought thousands of labourers from up country. The subject of improved dwellings for all classes demanded immediate attention. Europeans drawing salaries of Rs. 300, 400, or 500 a month, have great difficulty in finding house accommodation, and it is almost impossible for mechanics and artizans drawing Rs. 80 to 150 a month, to find respectable lodgings.

The masses of the native labouring class pay Rs. 1. 4a. to 2. 4a. a month for the wretched accommodation afforded them, but such huts could not at once be removed, from the impossibility of finding other quarters for the inmates.

In Bombay, with a population of 816,562 persons, there were two Hospitals, the European General Hospital, and the Jamsetjee Jejeebhoy Hospital, making together a total of 370 beds, or 1 to each 2,206 of population: the total annual number of patients 6,051.

The European General Hospital was unsuitable in arrangement, in construction, and position, and had frequently been condemned. The Jamsetjee Jejeebhoy Hospital was overcrowded, and 15 to 20 patients daily refused admission. The imperative necessity of forthwith providing additional hospital accommodation for both European and native poor was urged by Dr. Hewlett; two additional hospitals for natives, one for Fever the other for Small-pox patients were urgently required. Plans for a new European General Hospital were before Government.

The amount of venereal disease in Bombay was "something appalling," 2,000 cases treated at the Jamsetjee Jejeebhoy Hospital, and 295 Europeans at the other Hospital, 88 out of 1,000 Halalcores, and between 200 and 300 cases among sailors in harbour. The necessity of legislative action to bring the prostitutes under Medical and Police supervision was insisted on, and the erection of a Lock Hospital recommended.

Great progress was made in the main drainage of the Fort; new markets were erected, presenting a very favourable appearance with the old ones; new slaughter-houses at Bandora were commenced, gas was introduced into Bombay during the year under record. Attention was also directed to the necessity of proper ventilation in connexion with gas, and to ventilation generally, and to the removal of the dense plantation of cocoa-nut palms at Gorgaon. For the future the Sanitary improvements considered most urgent were:—

The immediate improvement of the surface drainage in the native town;—attention to water supply, and the substitution of fountains for dipping wells;—the filling in tracts of low and malarious land;—the immediate sanction of a building Act;—a new street from Back Bay to Musjid Bunder.

An interesting account is given in the Appendix of the trades in Bombay, especially those affecting public health, with illustrations by Mr. F Knight.

ABSTRACT OF ANNUAL REPORT OF THE MUNICIPAL COMMISSIONER OF BOMBAY FOR 1867.

Dated 11th April 1868.

THE Quarantine Bill passed through its various stages and developed as the Act for the better sanitary regulation of the City of Bombay (Act VI. 1867), the scope of the Act being much more extensive than the original Bill. Sanitaria for infected persons can be established either on shore or in harbour, and Government is empowered to make rules and orders in special cases to prevent the spread of epidemics. Shipping on arrival or leaving the port is to be inspected by a duly qualified health officer, holding the position of assistant to the Health Office for the city.

Act IX. of 1867, for regulation of the sale of spirituous liquors, also became law.

The Act to amend the Municipal Act (Act IV., 1867,) had to be revised in conjunction with the Municipal Act itself.

The "Town Duties Bill" was abandoned, apparently as a hopeless case.

Mr. Crawford (the Municipal Commissioner) submitted a Draft Building Act to the Bench, and a Committee was appointed to report on and revise it.

The organization of Municipal establishments progressed steadily during the year; their working had been scrutinized by the Finance Committee, and several suggestions made by them had been carried out.

BOMBAY. The organization of the Health Department was considered as perfect as it could be, while the labourers were allowed to house themselves where they pleased in different parts of the town, at distances from centres of work. Great improvement was noticed in the engineer's department, and favourable mention is made of the establishment for the maintenance of the roads.

The placing the registration of births and deaths under the Health Officer was considered successful, though little improvement had been possible as regards registration of births. Favourable mention is made of the Commissioners' assistant, Mr. Hormusjic, Bappojee, Viccajic, for his untiring industry; his outward register of letters numbered 8,785, his inward register 7,686.

The public health.

Bombay was to be congratulated on remarkable improvement in the public health.

In 1864, 25,015 died, or 1 in every 32 of population.

1865, 28,631	„	1	„	28	„
1866, 16,865	„	1	„	48	„
1867, 15,500	„	1	„	52	„

The year was marked by almost total absence of cholera and epidemic. Small-pox caused one-fifteenth of total of deaths. Fever, one-third of the death roll, or 5,674 victims against 9,877 in 1866; the Parell district, including a great portion of the Flats, having the highest death rate. The Esplanade district, with the Native Infantry lines, comes next in order; out of 227 deaths, 163 occurred in the regimental lines, of which 75 were from fever. The Boreebunder lines are within a few hundred feet of the foulest piece of foreshore in the island. Dr. Hewlett's report shows that the principal causes of fever in Bombay are:—

1st. The flats, especially the so-called Government Estate.

A scheme had been submitted to Government and approved in principle, and sanction was given to the completion of some of the main roads across the Flats.

2nd. The Government property is Moody Bay, opposite the Boreebunder lines.

Government was constructing a portion of the Malet Basin in Moody Bay, which it was hoped would involve some reclamation, and thus the fearful nuisance at this spot might be abolished without delay.

3rd. The unmade or illmade side drains throughout the town, especially in Coombarwada and Cammatteepoora.

The Bench had sanctioned the construction of various drains and sewers; plans and estimates for side drains in Coombarwada were to be brought forward for sanction, and a complete sewer system for Cammatteepoora was in progress.

It was hoped that the new Sanitary Act (VI. 1867) would lead to diminution of small-pox.

The whole system of registration it was considered wanted improvement, especially as regards births.

The improvement in the public health was attributed to—

1. The more general use of pure Vehar water.
2. The regulation of foreshores by reclamation, converting the foulest swamps into dry land.
3. The filling-in innumerable small low unhealthy swamps and hollows, all over the island.
4. The daily removal from the precincts of habitations of about 105 tons of night soil, formerly either emptied into drains, allowed to putrefy in the sun, or filtrate into the wells.
5. The systematic opening and cleansing of miles of covered drains, and improved general conservancy.
6. The new sewer across the flats, by which a great portion of the town's sewage is discharged without intermission into the sea, instead of being forced back into the drains for 12 hours of every day.

SANITARY PROGRESS.

Public Health Department.

The organization was considered excellent, and every possible care was taken to economize. (A report by the Health Officer, Dr. Hewlett, is given at page 175).

The Municipal Commissioner considered the reform of markets and slaughter-houses the most pressing duty to be undertaken. The former public markets of Bombay are described as loathsome and disgusting. The Commissioners' scheme had been sanctioned piecemeal, and was to be completed in 1868. A photograph is given of the new general market, a handsome and airy building, arranged with due regard to the prejudices of castes, and part of which was opened for use at the close of 1867. It was calculated that this building would cost Rs. 400,000, would contain 688 stalls, and yield an income of at least Rs. 42,000.

Second class markets were erected at the Null Bazars, two eligible sites being covered with iron buildings at a cost of Rs. 136,000, which would yield an annual income of Rs. 34,000. BOMBAY.

The Fort Market was removed, and a new building was to be erected close to the old site at a cost of Rs. 15,214; it was to contain 100 stalls, and was to yield at least Rs. 4,000 per annum.

The opening of part of the New General Market on the Esplanade was inaugurated by a fruit, flower, and vegetable show, visited by upwards of 4,500 persons, of whom 900 were native ladies. In point of cleanliness the markets would now bear favourable comparison with most of the markets in Europe.

The new Bandora slaughter-houses were completed and opened in February 1867. There were many difficulties in effecting so radical a reform as the abolition of existing slaughter-houses within the town, and the removal of the entire butcher trade to Bandora, eight miles from the city, and many prejudices to be considered in the erection of the new buildings; but these difficulties were overcome, Vehar water laid on into the slaughter-houses and standing sheds, and it was doubted whether many towns in Europe possess better abattoirs than these. A code of byelaws was passed for the management of the new slaughter-houses, which were brought within the jurisdiction of the Bombay magistrates.

The report of a committee on the new cemetery was submitted in March 1867, and part of the ground allotted to the Protestant community was consecrated; but this could not be used until it was protected by a wall, and delay occurred in settling how this was to be done. A site was selected for the native Christian and Portuguese communities, and it was expected that the cemetery would shortly be opened. Burial grounds.

The cost for the year 1867 was :—

	R.	A.	P.
Metalling, scraping, and improving -	305,827	14	8
Watering and rolling -	125,000	0	0
Number of water carts used -	100		

The roads.

The expenditure on each road is reported daily, and monthly returns furnished to the Municipal Commissioner, who protests against the real want of economy in stinting the funds for repairing roads, the neglect of which had led to the necessity of unusual heavy outlay (13 lakhs of rupees) in 1865.

Mr. Crawford does not consider this all important subject as rapidly approaching satisfactory solution. Mr. Aitken, the engineer selected by Government in England, after having given about two years' study to the question in all its bearings, proposed a scheme based on an outfall at Colaba, as approved by Government and the Bench of Justices. This scheme was violently opposed in certain important details by a local committee of engineers at Bombay,—objected to as expensive by the Local and Supreme Governments, and finally by Her Majesty's Secretary of State, who referred all the papers to Mr. Rawlinson, C.E., and commissioned him to report on the drainage of Bombay, while the engineer's scheme was under consideration.* Mr. Crawford endeavoured, but failed, to obtain Drainage.

* The discussions respecting Drainage plans for Bombay are hence not as yet satisfactorily concluded.

Two methods of dealing with the question have been advocated; one, mentioned above, for providing sewers of large dimensions for carrying off the tropical rain-fall of Bombay, together with the sewage of the city, the whole to be discharged into the sea, leaving the sewers nearly empty during the dry season;—the other, proposed by Mr. Rawlinson, and adopted by Captain Tulloch, R.E., who was specially sent to England by the Madras Government to study the various questions regarding town drainage and the utilization of sewage. This latter project provides for draining and sewerage the city by sewers and drains large enough only to carry away the sewage, and for applying the sewage to agriculture at a distance from the city.

It has been objected to the first proposal that the large sewers being left almost empty during the dry season, will become generators of foul air, and tend to deteriorate the health of the city, while it is objected to the second plan, that there must of necessity be partial flooding of the surface during heavy rains, when the tide is unusually high.

It appears to be an important element in the discussion, to bear in mind that town sewers and drains are primarily intended for removing the foul water of the population, and not for removing rain-fall, while any attempt in such a climate as that of India to provide for rain-fall (sometimes 14 inches in 24 hours) by sewers, *even if practicable*, must entail an enormous outlay for an occasional and temporary purpose.

It might be well in any further discussions which take place on this subject, to consider the two as separate problems, so that while foul water only is removed in underground sewers the question of surface drainage may be settled, and the proper outfalls for this water into the sea provided for.

BOMBAY. any admission that the State should contribute to the cost of draining the second largest city in Her Majesty's dominions, the principal seaport of Hindustan, recently condemned by a congress of European nations as the hotbed from which cholera is carried into Europe. He considers that no doubt a mass of useful information has been accumulated during the inquiry, but it is to be dealt with by an absolute stranger to the town, and that it would still be economy to commission one of the leading engineers in England to reside in Bombay for three years and prepare a scheme. All that was to be done now, besides aiding Mr. Rawlinson in every way, was to improve surface drainage in particular districts, and to compel the owners of low-lying lands to raise them.

The main sewer and outfall at Sonapore had been completed within the estimate of Rs. 160,000; this was to be paid by Government, but, where estimates for further necessary works connected with this were submitted, Government repudiated any liability in the matter. Mr. Crawford, however, was sanguine that this decision would be reconsidered.

The low level drain from Bellasis road to Love grove sluices had been completed by the contractors in a satisfactory manner, and after careful consideration a system of pumping was introduced, by which the main drain of the town was kept constantly flowing. The open channel of the main drain was being cleansed from deposit, and plans and estimates were sanctioned for execution for the complete drainage of Cammatteepoora and the fort.

Waterworks. No new extensions were made during the year, though much needed in some outlying districts; there was a lack of funds and of necessary piping. The Dipping wells in the island were regularly cleansed throughout the year. The precautions against epidemic among the labourers employed had been successful, only one death occurring among upwards of 2,000 men encamped in an unhealthy locality in the Concau.

The use of meters had been enforced wherever a waste of water was observed. The question of supply of water to the shipping was settled satisfactorily. The old contract was stated to be highly prejudicial to the interests of the town, and, moreover, the price charged under the terms of this contract for Vchar water was so high (Rs. 8 per 1,000 gallons) that many captains preferred giving their crews tank water instead, which resulted in increased sickness. After lengthened negotiation Government took out a fresh contract; the Harbour Board undertook to supply water to the shipping at Rs. 1 the ton, the municipality being bound to deliver it at the bunder head at 4 annas a ton, or 1 rupee for 1,000 gallons, the existing town rate.

A survey for the extension of the water supply was completed, and the result was shortly to be published.

Lighting the streets. Want of funds prevented the extension of lighting in the town, which was however loudly and generally demanded, but was considered impracticable until either the lighting rate is raised or the price of gas reduced. Legal advice was being taken by the Municipal Commissioner on the claim of the Bombay Gas Company to enhance their rates for the supply of gas.

Experiments had been tried on a small scale by Mr. Crawford in lighting parts of the town with kerosine oil, and with such success that he proposes, should the system prove economical on a large scale, of which he entertains no doubt, the gradual substitution of kerosine oil for gas.

Miscellaneous. 678 applications to build were disposed of during the year, and 2,535 square yards taken from the applicants for improvements of streets. No less than 1,539 notices were issued to owners of buildings in dangerous state of repair, and in 156 cases it was necessary that the municipal officers should pull down the condemned buildings; 36 buildings actually fell before action could be taken, and 16 persons lost their lives in consequence.

Land survey. Extracts are given from Major Laughton's report, showing that the survey had made great progress during the year. The plans are stated to be excellent, and will be of the greatest value to the Municipality. There were some difficulties in carrying the work through parts of the town, but not one instance requiring judicial inquiry occurred in connexion with it.

At the conclusion of the chapter of the Report on Income and Expenditure, Mr. Crawford explains his having exceeded the Budget grants, and, the matter having been referred to the Finance Committee, they recorded that "the Commis-

“sioner was left to himself, and he acted boldly and to the best of his judgment,” and that, “although it is possible to take exception to an item of expenditure here and there, the money has, on the whole, been usefully and judiciously laid out, and that the past administration of the Commissioner has secured many and lasting benefits to the town.” BOMBAY.

Mr. Crawford also reviews shortly the difficulties that met him on entering the office of Municipal Commissioner. In Bombay's most prosperous times, at the end of 1864 and commencement of 1865, many were appalled at the fact that 35 people out of every 1,000 were dying each year in the town. An Act to deal with this evil was passed through Council. The existing Board of Commissioners showed a Budget deficit for the year of nearly 200,000*l.* or 50 per cent. more than their income. The Municipal Act became law on the 1st July 1865, and Mr. Crawford was selected to carry it out. Radical and expensive reforms were to be effected, and there were no funds. The cash in the Treasury had been borrowed from another fund; the rates and taxes in some cases for years had not been assessed, much less collected; there were contracts just commenced which absorbed three-fourths of the municipal revenue; an estimated deficit of nearly 20 lakhs for the year; the accounts for the previous year not made up; no statistics; and with the introduction of the Municipal Act, the Town Duties Act, the chief source of municipal revenue was rescinded, its substitute, the “Licence Act,” not becoming leviable till six months later. Mr. Crawford stated these matters to the Bench, and, feeling the necessity for immediate expenditure in certain directions, said plainly that the Budget could not be adhered to for the first few years, and felt that he must act boldly and alone, trusting to time to prove him right. Without at all defending the practice of exceeding the Budget grant, he contends that, under the circumstances, such excess was unavoidable, and even justifiable.

ABSTRACT OF SECOND ANNUAL REPORT OF THE HEALTH OFFICER OF BOMBAY (DR. T. G. HEWLETT) FOR THE YEAR 1867.

Dated 21st March 1868.

WITH a view to reducing the charges of the G. I. P. Railway, a larger sized railway wagon was introduced for carrying the garbage to Coorla, which effected a saving of Rs. 8,709. 6a.

The mounds of manure collected at Coorla bore testimony to the advantage that must have accrued from the removal of such matter from the midst of a crowded population, and it was considered that the time had arrived for utilizing this manure by erecting a wall to keep out the tidal waters, and spreading the manure over the unoccupied portions of the land so reclaimed, which would then become in a fit state to bear crops, and the expense incurred could shortly be recovered by letting the land out to market gardeners.

In the Native Town covered drains to the length of 102·86 miles were opened and cleansed during the year. The open drains, Dr. Hewlett again points out, are a disgrace to the city. Greater attention had been paid to them, but being unpaved at the bottom, the ground was so thoroughly saturated with sewage that the drains became the more offensive for scraping.

The Health Department issued 2,708 notices during the year, 1,269 of which were not complied with; of these 319 were subsequently disposed of by summonses, but in the remaining 950 the provisions of the Municipal Act could not be enforced. 1,455 persons were summoned by the magistrates for offences against the Act; as in the previous year, the largest number of offenders were the owners of milch cattle, and Dr. Hewlett again insists on the necessity of taking immediate action to improve the sanitary condition of milch cattle stables throughout the city, by making byelaws, and by the erection of proper stables by the Municipality. He points out that milk is the principal food for the young, and that milk from animals kept in impure atmosphere and insanitary conditions must be unwholesome.

All the tanneries were frequently inspected; complaints were received against certain indigo dyeing houses which led to their removal. Salt fish store-dealers and fat boilers were also removed. Offensive trades.

BOMBAY. In confirmation of his recommendation that the Parsee towers of silence should be closed, Dr. Hewlett mentions that many gentlemen of this community have during late years visited England, where several deaths have occurred, the bodies of the Parsees not of course having been exposed, but quietly buried in places where their friends in after years can go and visit the tombs erected over them.

Burial grounds.

Markets and slaughter-houses.

Night soil and halal-core establishment.

These are noticed in the report of the Municipal Commissioner.

The necessity for employing such a turbulent and debauched set of men as the halalcores is to be deplored, but is a matter of necessity. They require firm treatment and constant looking after. Many of these men seem to have absconded and to have left with the troops attached to the Abyssinian expedition; some of these were however detected on board the ships. The service was, however, much better done than formerly; the night soil is not allowed to accumulate round the dwellings of the poor, but is regularly carted off at the estimated daily quantity of 105 tons.

European Inspectors.

Dr. Hewlett bears testimony to the continued good conduct of the European Inspectors in his department. Their duties involve great tact and considerable risk of contracting disease, and are of an arduous and continuous kind. Dr. Hewlett suggested the foundation of a superannuation fund, entitling to some pension after certain length of service, a question which has since been brought before Her Majesty's Bench of justices.

Registration of births and deaths.

The duties connected with the registration of births and deaths were permanently attached to the Health Office 1st January 1867. The city was divided into 15 districts, a registrar appointed to each, and handbills circulated and warning given to the inhabitants that they were liable to penalties for failing to give the requisite information to the registrar of their district. Immediate good results attended. The number of births registered the following week went up from 145 to 267, and eight persons were summoned for neglect in giving information. In the meantime some of the justices pointed out that the Act hardly gave the Municipal Commissioners the powers stated in the notice that had been promulgated, and the Health Officer was ordered not to take action. The consequence has been that the number of births reported to have taken place during 1867 amounted only to 5,115, or 789 less than during 1866, both amounts being absurd as at all indicating what the birth rate has really been; and, as the matter stood, Dr. Hewlett considered the registration of births as the most unsatisfactory part of his work.

The deaths were generally reported with regularity, but the registrars did good service in reporting more correctly the causes of death.

During the year ending 31 December 1867, the total number of deaths recorded to have taken place from all causes was 16,088, or, exclusive of still-born, 15,500. 11,890 bodies were buried, 3,354 burnt, and 844 exposed to carrion birds. The proportion of sexes was 123 males to 100 females. Assuming the population to have been the same for four years, the rate of deaths per 1,000 from principal diseases would stand thus:—

	1864.	1865.	1866.	1867.
	Rate per 1,000.	Rate per 1,000.	Rate per 1,000.	Rate per 1,000.
Cholera - - - - -	5·93	3·53	·40	·13
Small-pox - - - - -	2·09	0·69	1·32	1·29
Measles - - - - -	0·16	0·45	·59	·02
Fever - - - - -	15·42	22·94	12·09	6·94
All other causes - - - - -	7·02	7·43	6·25	10·57
Total of all causes - - - - -	30·62	35·04	20·65	18·95
Population estimated at 816,562, one death to every - - - living person }	32	28	48	52

Only 111 persons died from cholera, 72 males and 39 females; the disease never assumed an epidemic type.

Small-pox carried off 1,055 persons, 836 of whom died before completing the ninth year of their lives. The average for the preceding 10 years was 880

Dr. Hewlett insisted on immediate steps being taken for rendering vaccination BOMBAY. compulsory.

Measles had been nearly extinct, only 24 cases in the year against a 10 years average of 419.

The total number of deaths from epidemic diseases were 1,190, the average of the previous ten years being 3,287.

5,674 deaths were recorded from fever during 1867, the decimal average being 9,309. The deaths from accident and violence amounted to 253, 13 of which were from injuries connected with railways, and 67 from drowning.

The low lying and swampy condition of the flats is again pointed out as a cause of the high death rate in the adjoining district Parell (4,013 persons), and Dr. Hewlett shows that any extension of the town must be in the direction of these flats. It is natural to suppose that when Bombay is connected with the most distant parts of India by three lines of railway, there would be a large influx of foreigners. Dr. Hewlett therefore urges that the filling up of these flats should be at once commenced, in order that the future native town, which must spring up here, may be properly laid out. He also attracts the attention of the military authorities to the high death rate (35·20) in the Esplanade, which is again attributed to the foul foreshore in Moody Bay; then, worse than ever, a native regiment is quartered within a few hundred yards of a deposit of mud, the stench from which at low water was so strong and foul as to reach the houses on Malabar Hill when the land breeze is blowing. The subsoil also at the Esplanade was wet, and its surface drainage very imperfect.

SANITARY RETROSPECT.

During 1867, a foul and offensive tank by the officers' quarters was filled in. The Elphinstone Land Company effected much good in covering the filthy foreshore with some feet of good earth and building a sea wall into deep water. A good deal of low lying swampy ground was filled by owners of various properties, and others have raised their land and metalled and constructed drains. A broad footpath had been made along the sea wall in Back Bay for nearly three-quarters of a mile. A dispensary had been established at Girgaum in connexion with the Edinburgh Missionary Society, and it was proposed to erect a hospital in connexion with it. An increasing interest in matters concerning public health was to be observed among all the educated classes of the community.

Sanitary Improvements.

The Sanitary improvements most urgently required appeared to Dr. Hewlett to be—

1. Measures to utilize the town sweepings.
2. Improvement of surface drainage.
3. Revision of Municipal Act.
4. Condition of milch cattle stables.
5. Removal of Hindoo cremation ghats.
6. House connexions with Fort drains when completed.
7. Superannuation fund for Sanitary Inspectors.
8. Measures for correct registrations of births and deaths.
9. Naming of streets and numbering houses.
10. Compulsory vaccination.
11. Completion of Moody Bay reclamation and dealing with the Flats.
12. Subsoil drainage at the Esplanade.
13. Drainage of Back Bay.
14. Reclamation of foreshore at Mazagon.
15. Action by Municipality regarding tanks, public latrines, &c.
16. Substitution of fountains for dipping wells.

India Office,
7th July 1869. }

CHARLES C. PLOWDEN,
Sanitary Department.

APPENDIX.

No. 1.

REMARKS by the ARMY SANITARY COMMISSION upon "Memorandum on Measures adopted for Sanitary Improvements in India up to the end of 1867," and Abstracts of Indian Sanitary Reports.

THE above-named paper contains an interesting account of past sanitary proceedings in India, together with abstracts of mortality among troops to the end of 1866.

There is also a most important paper of suggestions regarding the organization of a sanitary service for the civil population.

In this document it is shown how much may be done to improve native villages by very simple procedure; that in the majority of these villages no costly works would be required; that strict attention to cleansing of houses, courts, streets, cattle pens and the like, together with protection of existing water-sources from pollution, and opening new wells or deepening old ones for improving the water supply, would remove many existing sources of unhealthiness.

It is also shown that inspection, although a most necessary part of sanitary organization, is by no means an adequate provision to meet all the necessities of the case; that, besides this, means of execution are absolutely necessary; that not even advising commissions will be able to do all that might be expected of them, if means are not provided for giving effect to their recommendations; and that in certain cases the Imperial Government should step in to aid local effort, where the public health requires the execution of main arterial drainage works.

These great principles are in entire accordance with the requirements of the case, and the Commission cannot but hope that the time is not far distant when the same activity which this report shows to have been exercised in dealing with the sanitary deficiencies of stations, will be employed in improving towns and villages throughout India.

Groups of native population in their present state are the centres from which cholera originates, and not until the sources of this and other pestilences are cut off, can the health of troops be considered safe.

Another important subject dealt with in the Memorandum is the present gaol mortality. This is shown to be very great and excessive. It arises mainly from fevers of a fatal type, such as devastated English prisons before the days of Howard, or from cholera. No disease of this class can exist without a removable cause, and now that the facts regarding mortality are known, it is to be hoped the local causes of it will be ere long grappled with and removed.

There are certain suggestions for improving the abstracts of mortality made by Dr. Goodeve, of which the Commission have already approved on another paper. They would only further suggest the importance of publishing these abstracts annually for each station in each Government. This is already done in some cases, but might be advantageously extended to all the stations.

Similar abstracts of diseases and mortality for the civil population would be very important. At first it would be difficult to do this, but in time the facts would become more extensive and trustworthy.

If the Commission might suggest a further addition to this annual report, it would be to include in it a brief digest of the sanitary work done during the preceding year.

This would enable a sufficient knowledge to be obtained of the new works and measures carried out at stations, and also in cities, towns, and villages. And these proceedings, when compared with the disease and mortality abstracts, would afford to the India Office every information as to the results of sanitary works in India.

The Commission anticipate great benefit to the public service from the publication of annual progress reports, similar to this one which has been referred to them.

Before concluding, it is deemed advisable to make a passing allusion to one or two opinions expressed in paragraphs 43, 44, 45, and 71 of Dr. Goodeve's "Sketch," pages 25 and 29, lest in passing them over the Commission may appear to concur in them. It is sufficient to say that the difficulties and dangers anticipated by Dr. Goodeve, from the introduction of well-known improvements in drainage and water supply into India are not necessary consequences of these improvements, while the class of works which Dr. Goodeve deprecates are intended to answer other purposes of a very important kind as regards the public health, to which he makes no allusion.

It may be well also to correct a mistake made by Dr. Farquhar at page 64, regarding the comparative amount of rainfall in Algeria and India, an account of its bearing on the sanitary improvement of India generally. Among the difficulties in the way of improving public health in India, Dr. Farquhar states that the rainfall in Algeria, with which the French authorities have to some extent successfully coped, is only one half of what falls during three autumn months in one Bengal station. But a reference to Mr. Glaisher's account of Indian meteorology, in the report of the Royal Commission, shows that at some of the most unhealthy stations in India the rainfall

scarcely exceeds, and often falls below that of Algeria, while the wettest stations are not always the most unhealthy. Rainfall is one of the factors which must always be considered in sanitary improvements, and it is injurious or not just as it is dealt with by the engineer.

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

J. J. FREDERICK, Secretary,
War Office,
19th February 1869.

No. 2.

MEMORANDUM by the Army Sanitary Commission on Papers relating to Cholera in the North-West Provinces of India in 1867; and proposed Inquiry into the Causes of Cholera generally in that country.

12th April 1869.

AFTER a laborious analysis of the papers, and a careful consideration of the results, the Commission have arrived at the conclusion that the only lesson of practical importance conveyed by the papers is, that it is most desirable a special inquiry into the whole subject of epidemic cholera in the East should be undertaken.

Despatches Nos. 156, 178, 201, 214, 239, 257, 288, and 304 of 1867, forwarded with Letters from the India Office, dated 7th September 1867, and 7th January and 14th February 1868.

With this view we have, in communication with the Director-General of the Army Medical Department, prepared a code of instructions which includes the points necessary for ascertaining the laws of the disease, with the view of applying any knowledge so acquired to diminishing the fatality of cholera among the troops and civil population.

Some time since the Secretary of State gave authority for two young medical officers to proceed to Germany, with the view of making themselves acquainted with the latest inquiries in that country into the nature of cholera, and the microscopic character of organisms, to whose existence in the human body cholera had been attributed.

As this step would place two qualified observers at disposal for the more scientific portion of the work, it became necessary to lay down instructions not only regarding observation of the phenomena of the disease, but including all the scientific details calculated to throw light on the phenomena themselves.

The instructions which accompany this report contain the points on which information is necessary, and any further questions requiring answer will, in all probability, present themselves while the results of the proposed investigation are in course of being obtained.

It may be necessary to explain that we take for granted a subdivision of labour. It is not our intention that every officer engaging in the inquiry should devote his whole time to it, or that he should pursue it in all its branches. As a general rule, it will tend most to elucidation of the subject that each officer (except such as may be detached for special inquiries) should devote his attention to the careful acquisition of facts within the sphere of his ordinary duties.

The instructions embody a uniform statistical method; a uniform meteorological record; observations to be made on the movement of cholera over the epidemic region, with the view of ascertaining, by a reduction of the facts, what are and what are not the laws of the movement of the disease.

While this portion of the inquiry is being carried out, we have provided instructions for conducting special comparative and differential local investigations in a few selected localities where cholera is endemic, and in others where it never appears, with the view of ascertaining the conditions which are favourable and unfavourable to the development and progress of cholera.

We have likewise provided as complete a code as possible for the special scientific inquiry to be conducted by the two officers already mentioned, who are now in India.

These investigations, together with chemical analysis incidental to them, will, it is hoped, solve many of the disputed practical points in the epidemiology of cholera, and enable measures of prevention to be taken against the disease, with better hope of success than heretofore.

We beg to suggest that the instructions be laid before the Secretary of State for India, and, if his Grace should approve of the inquiry being carried out, that copies of the instructions be sent to the authorities in India, for distribution to Army Medical Officers through the principal medical officers) of British and Native Troops; to Sanitary Commissioners, Inspectors of Prisons, Civil Medical Officers, Officers of Health, and other persons who might aid in the inquiry.

We would further suggest that Army Medical Officers should report the results of each inquiry, through their respective chiefs, to the Government of India, who might be requested to send the reports home to the Secretary of State for India.

The Army Medical Officers of both services would keep the Statistical Register. They would make inquiries and record facts regarding the progress of epidemic cholera at stations occupied by troops.

They would make sanitary notes on local causes connected with stations, barracks, bazaars, and their vicinity.

No doubt, many of these officers would take a personal interest in other questions regarding cholera stated in the instructions.

They might also render valuable aid in the special inquiries; but bearing in mind the other duties these officers have to perform, we do not deem it to be advisable to require them to undertake any investigations which might interfere with their proper functions.

As regards the local inquiries among groups of native population living in endemic and exempted localities, these are so special, and require so much aptitude for sanitary work, as well as time to devote to it, that the best way, perhaps, would be to select men in India for this object. We understand that there are several Medical Officers serving with British and Native troops in India, who have shown more than ordinary ability for such investigations, and we would suggest that, on the recommendation of the Principal Medical Officers, such Officers should be temporarily detached for the duty. The reports of these Officers would be sent to their respective Principal Medical Officers, by whom they would be forwarded to the Government of India, for transmission to the India Office, in the manner proposed above.

As already stated, the special microscopic and scientific inquiries have been already entrusted to two trained Medical Officers. One of these, Dr. Lewis, is in Her Majesty's British Service; the other, Dr. Cunningham, is in Her Majesty's Indian Service. We would propose that both Officers should report to the Government of India, through their respective Medical Chiefs, for transmission to the India Office as already stated.

A most important part of the inquiry would have to be conducted by Medical and other Officers belonging to the Indian Civil Service.

This would include the statistics of cholera, and other inquiries among the Native population.

Cholera in prisons.

The question of pilgrimages, and the movement of cholera in relation to the movement of population.

Records of cholera among emigrants, &c.

All reports of this class would be forwarded, through the customary channels, to the Secretary of State for India.

It would be impossible for us to indicate the details of an organization for these objects. These must necessarily be left to the authorities in India.

J. HOPE GRANT, Quartermaster-General,
President.

DOUGLAS GALTON.

JOHN SUTHERLAND.

H. W. MASSY.

T. A. L. MURRAY.

W. E. BAKER.

J. R. MARTIN.

ROBERT RAWLINSON.

J. J. Frederick, Secretary,
Army Sanitary Commission,
War Office, 12th April 1869.

INSTRUCTIONS for conducting an INQUIRY into CHOLERA in INDIA (prepared by the Army Sanitary Commission).

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CHOLERA first appeared in an epidemic form in India, and it is to Medical Officers who had served there that we owe the earliest investigations into its nature and treatment. For many years nearly all that was known of the disease was contributed by these officers, and only at a comparatively recent date have investigations in Europe been more than extensions of inquiries previously begun in the East.

Lately, however, the whole subject of epidemic cholera has obtained a new development from scientific investigations carried out in Europe; while the great losses recently sustained by

troops serving in India have shown how little has been accomplished towards diminishing its fatality.

Under these circumstances it has been considered desirable that a special inquiry, in conformity with the following instructions, should be undertaken, with the view of ascertaining whether with improved methods of research any further information can be obtained regarding this disease.

An investigation, such as the one contemplated, is beset with difficulty, and trustworthy results can only be arrived at slowly; but the final object is so important to the public interests as to afford sufficient justification for undertaking the work.

§ I. OBJECT OF THE INQUIRY.

The object of this inquiry is to ascertain by an investigation, as complete as our present means may enable us to carry out, what cholera is? What are its laws of origin and extension? What is the real nature of the pathological changes which occur in persons suffering from it? What are the best methods of treating the disease, and by what proceedings the ravages of cholera may be mitigated, or its progress arrested?

The inquiry is a purely practical one, and as it may lead to legislative measures involving interference with freedom of intercourse, and to a large expenditure of public money, as well as to considerable private sacrifices, no results can be accepted for practical use unless these are fully sustained by obvious facts.

The inquiry is not to be undertaken with the view of establishing any particular doctrine or hypothesis in regard to cholera, neither is it to be carried out from any central doctrine or hypothesis, round which the facts are expected to range themselves.

If any beneficial result is to follow from it, the inquiry must be pursued without prepossession, and with the single object of ascertaining what is true.

It is necessary to give this caution, on account of a natural tendency which has shown itself in dealing with a subject of such difficulty, to trace the manifold phenomena of epidemic cholera to some single cause,—such as epidemic influence, water contagion, cholera excreta, unhealthy subsoil, cholera germs, and the like; and to build on single causes, or on hypothetical considerations, not only epidemic doctrines and pathological systems, but also methods of treatment and measures for arresting the ravages of the disease, at the risk of overlooking the real evils to be dealt with, and of inflicting suffering and loss by the execution of measures not adapted to the ends they are intended to serve.

No opinion or hypothesis, and no evidence, except such as is sufficient to prove the existence of uniformly operating causes of disease, can ever justify legislative action in public health questions, or the expenditure of public funds.

The inquiry will probably not be completed when the present instructions are exhausted. These instructions are directed solely to ascertain facts, which, when arrived at, may indicate other points requiring examination. It is hoped that by following rigidly and experimentally this course of proceeding, the time may arrive when all the phenomena of cholera may arrange themselves naturally under some general expression indicating the measures required for saving human life, and when the various and apparently contradictory phenomena of the disease may become self-interpreting.

It is not, of course, intended that all Medical or other Officers should undertake every detail in the following instructions. This course would be unadvisable, even if it were practicable. Medical Officers will, no doubt, at once perceive the points in which they can render efficient aid, and it is scarcely necessary to state that any officer who can communicate even a few carefully observed facts in his locality will do more to advance knowledge than if he were to transmit conclusions or opinions founded on imperfect observations made over a large area of country.

It is proposed to arrange the inquiry as follows:—

First. To obtain statistics of cholera as accurately as possible.

Those for the troops to be entered in detail by regimental surgeons at every station, whether for British or native troops.

Those for prisons and other public establishments by medical officers attached to them.

Those for the civil population by the most efficient statistical machinery available.

All Principal Medical Officers should be kept informed as to the statistics of cholera and other epidemic diseases among the civil population of towns, villages, bazaars, &c., in order that they may know the movement of epidemic diseases in their districts.

And all facts of this nature are to be carefully registered by the Principal Medical Officer for transmission with his reports.

Medical Officers of prisons and of other public establishments should be kept similarly informed.

Second. It is proposed that facts regarding the movement of cholera and the sanitary condition of troops and stations where there are British and native troops shall be given by the Principal Medical Officer of the station.

That similar facts regarding prisons and other public establishments shall be given by the Medical Officers attached to them.

That for cities, towns, and villages where inquiries of a special character are carried out, the sanitary reports should be drawn up by Officers of Health, or other Medical Officers selected for the duty, aided by Engineers or other persons having special knowledge, where necessary.

Meteorological observations should be supplied by existing observatories, and by the officers at stations in charge of meteorological instruments.

Third. Special microscopic physiological and chemical inquiries into the nature and cause of cholera to be conducted—

(a) In localities where cholera is endemic,

(b) In localities always exempt from cholera,

By officers specially set apart for these inquiries.

Two medical officers specially trained for such investigations have already been sent to India. Chemical analyses should be conducted by practised chemists.

Fourth. Although, for the sake of uniformity and comparison, it is deemed advisable that special local inquiries should be undertaken by qualified observers. Medical officers at stations, prisons, &c., are invited to undertake independent inquiries of this class to the extent of the means at their disposal. But it is not intended that they should feel themselves called on to do so if they have not the time or means.

Fifth. The special inquiries should be carried out in concert with existing sanitary authorities in India under arrangements made on the spot, and all reports shall be sent through the customary channels to the Government of India for transmission to the India Office.

§ II. STATISTICS OF CHOLERA AND DIARRHŒA.

Little that is reliable regarding epidemic diseases can be ascertained without accurate statistical information.

There is no difficulty in obtaining information on this subject among British troops serving in India; but British troops constitute only a small part of the population attacked by cholera. Epidemics seize on all classes of population, and no trustworthy information can be obtained regarding the movement of epidemic cholera, except by including all classes in the same general statistical inquiry.

Much valuable statistical information regarding cholera has been already collected by Medical and other Officers in India, which will be reduced and made use of in due time. But as the present inquiry has a definite object, it has been considered desirable that it should be undertaken as far as practicable on one uniform plan, as follows:

The accompanying statistical chart or register contains the data required for British troops.* A similar chart or register would answer for women and children.

Cholera chart for troops, &c.

We would strongly recommend that the same register, so far as it may be applicable, should be employed for native troops.

It would also be applicable, with a slight alteration, to the population of prisons and other establishments where numbers of people live together.

The data on this register, when reduced, will give most of the information required about the disease itself.

Any statistical inquiry among the civil population would have to be conducted on different principles, because it would be impossible to obtain all the points of comparison which might be attainable among distinct bodies of men under discipline. It would be necessary, therefore, to restrict the inquiry among the civil population to general facts showing the cause of epidemics. But this general procedure would not interfere with special local statistical inquiries into cholera among the civil population where it was found to be possible to carry out any such inquiries.

Civil statistics of cholera.

We would venture to propose the following statistical points for registration by the civil authorities in all parts of India affected by cholera, where it might be practicable to obtain the information.

In all statistical inquiries regarding cholera and other epidemic diseases, the dates and localities of events are of primary importance.

1. The date of any evident increase of any class of fevers, stating the nature of the diseases, and mortality generally.

2. The date of any evident increase of bowel diseases (diarrhœa and dysentery), stating the disease and mortality generally.

Should diarrhœa or dysentery break out suddenly, so as to present evidence of endemic attacks, the facts might be entered, wherever practicable, more in detail, as follows:—

(a.) Date of first endemic case.

(b.) Daily attacks and deaths. (This would include simply dates and numbers.)

4. A daily return of cholera attacks and deaths, wherever practicable.

A most important point in this record is the date of the first attack of cholera and of the first death. Both should be traced carefully.

A daily return should be prepared after the date of the first attack, unless it be impracticable to obtain the information.

If the disease has appeared among a group of population, an estimate of the population should be entered on the return.

Where a census has been taken, more numerous and accurate data would be available; such as—

The numbers and sexes alive at each age.

The daily number of attacks for each sex and each age.

The daily number of deaths for each sex and each age.

If it be impossible to obtain a daily record of cases and deaths, the return might be limited to the following points:—

a. Estimated population.

b. Date of first cholera case and of first death.

c. Date of last cholera case and of last death.

d. Total cholera cases and total deaths from cholera between these dates.

In bazars and native towns, near stations of British troops special arrangements might perhaps be practicable for obtaining daily statistical data regarding cholera and diarrhœa as accurately as

Statistics of station bazars.

* Registers of different sizes for different strengths of corps will be distributed together with these instructions.

possible, and also for recording all endemic outbreaks of fever, diarrhœa, or dysentery among their population.

In these circumscribed populations a special census might be made, and the data proposed above, as to daily attacks and deaths from cholera for each sex and age might be obtained.

The occurrence of cholera in the native population near British troops should be accurately registered, to admit of comparison with the course of the disease among the troops.

Cholera maps.

The dates of attack, and the localities, when transferred to station, town, or bazar plans, and to maps for the whole country, will afford information as to the laws of progress of cholera, such as can be obtained in no other way.

§ III. METEOROLOGY.

If meteorological observations are accurately kept, according to the instructions, at stations which have been provided with instruments, a comparison of the data over a series of years, including epidemic years, will afford all the required information in this department of the subject.

In comparing the meteorological elements of epidemic and non-epidemic years, for reports, the elements of most importance are—

Barometric pressure above the average.

Unusual droughts, leading to diminution and contamination of the water supply.

Unusual rainfalls leading to development of local malaria, or other local causes of disease; or unexpected rainfalls resulting in wearing of wet clothing.

Rapid changes of temperature, especially at unaccustomed times, leading to diminished or checked cutaneous action.

Unusually high temperatures combined with rainfalls.

Direction and strength of winds. It has been stated that winds coming from particular points have been accompanied by increase of cholera attacks, or that cholera has progressed in the direction, or against the direction of prevailing winds. All these points should be carefully noted.

Stillness of atmosphere, indicating stagnation in cities, villages, or dwelling-houses, as well as diminution of oxygenating power of the air.

Amount of ozone. Prevalence, or otherwise, of fogs. Excess or diminution of hygrometric state of the air. Peculiarities in electric condition of the air.

Unusual atmospheric phenomena preceding the appearance or disappearance of cholera should be noted.

§ IV. MOVEMENT OF CHOLERA.

Laws which determine the movement of cholera must be ascertained partly by careful observation of the phenomena of the disease itself, partly by scientific inquiry, the chief points of which are given in a subsequent section (§. VI).

Observations on the movement of cholera must necessarily be conducted by observers in numerous localities before the law of movement can be arrived at. But the scientific facts can be ascertained at a few selected stations.

It is proposed at present to enumerate the points in regard to which systematic observations on the movement of cholera are necessary among British and native troops, as well as among the population generally.

These are included in the following paragraphs:—

Premonitions of cholera.

1. When cholera is approaching a district, are there any indications of an altered state of health among the unaffected inhabitants, such as disturbance of the digestive organs, altered expression of countenance, or of colour of the conjunctivæ and other mucous membranes; or of the skin, in Europeans and light-skinned native races?

2. Are diarrhœal or dysenteric affections, or fevers, more than usually prevalent?

3. Are there any other premonitions of cholera observable?

Positive or negative replies on these points should be given.

Inquiry regarding the forms of cholera.

Cholera presents itself under three states or forms:—

1. The sporadic form.

2. The endemic form.

3. The epidemic form.

In regard to these three forms of the disease the following questions suggest themselves.

4. Are they precisely similar, or in what respects do they differ in their observed characters?

5. Do premonitory symptoms prevail among unaffected persons in localities where each of the three forms occur?

6. Are there any appreciable phenomena in the disease, in the locality, in the habits of the people, or in the nature of the seasons and atmospheric conditions, which would obviously account for the existence of one form rather than another, or for the passage of one form into another?

7. Are there any facts to show why a sporadic case of cholera is not followed by other cases? Or,

8. Why an endemic outbreak does not become epidemic?

Question of susceptibility.

During endemic outbreaks, as well as during epidemics of cholera, it is usually observed that of the population exposed apparently to precisely similar conditions, a portion only suffer from the developed form of the disease, while the majority usually escape, or suffer from comparatively trivial symptoms.

It has hence been the custom to divide a population exposed to the same causes of disease into two classes: "susceptible," those who have suffered; and "non-susceptible," those who have

escaped. But it is obvious that such a division affords no explanation of the occurrence. It merely repeats in other words the obvious fact that some have suffered while others have escaped.

It is proposed that an attempt should be made towards an explanation of differences in susceptibility by obtaining replies to the following questions. But any other points calculated to throw light on the question of susceptibility should be stated.

9. Of persons living in a circumscribed endemic locality, the numbers of whom at each age and of each sex have been ascertained by census, what per-centage of each sex and each age living is usually attacked by cholera? Influence of sex and age.

10. Does cholera take place equally in all temperaments, or do certain temperaments suffer more than others? Influence of temperament.

11. Is there any observed difference in the per-centages of attacks among persons who live altogether on vegetable diet, as compared with the per-centages among persons who live on mixed diet? Influence of diet.

12. Has the occurrence of cholera among a population any marked relation to a state of general health or habit of body among those who suffer which does not exist amongst those who escape? Influence of health and habit of body.

13. Is there any appreciable difference in the liability to attacks, or in the proportionate mortality from cholera among different races in India? Influence of race.

14. Are any trades or occupations observed to be more conducive to attacks of cholera than others? Influence of occupation.

15. Can it be shown by statistics whether mehters employed in collecting and removing excreta during times when cholera prevails suffer more from cholera, or only to the same extent as others living in similar localities?

16. Are occupations involving much fatigue, or, long marches and the like, more or less conducive to cholera?

17. Has the use of spirituous liquors any apparent influence on susceptibility to cholera? Influence of intemperance.

18. Have regular temperate habits of life any apparent influence on susceptibility to cholera?

19. Can the exact influence of aggregations of persons, both as regards—

(a.) Actual numbers,

(b.) Crowding on a given area,

Influence of the element of number.

on susceptibility to cholera be proved statistically.

20. The fact whether or not cholera is communicable directly or indirectly from person to person should be positively ascertained. Communicability of cholera.

21. Evidence, either positive or negative, on this most important subject, may be derived from two sources, experiment and observation. Sources of evidence.

22. The class of experiments most likely to prove or disprove communicability are stated under the special local inquiry (§ VI). It is proposed here simply to point out the kind of observations on the movement of cholera which would afford corresponding data. Experimental evidence.

23. If a solitary indigenous case of sporadic cholera presents itself, the following questions will arise:— Evidence from observations of sporadic cholera.

(a.) What was the origin of the case?

(b.) Is there or is there not evidence to show that infection was imported from some distant place where cholera prevailed?

(c.) If there is evidence of importation, every step in the proof should be very carefully investigated and given in detail.

(d.) If the case had no communication with any other case, this fact should be stated.

(e.) The results, whatever they may be, of every inquiry made into the foreign origin of sporadic cases should be recorded.

(f.) Were there any local, personal, or atmospheric conditions to which the occurrence of the sporadic case might be reasonably attributed?

(g.) Was the communication which existed between the sporadic case and other inmates of the house, or between these inmates and those in other houses, followed by any appreciable effect on health?

24. When an endemic outbreak of cholera takes place similar questions would arise, as follow:— Evidence from observations of endemic cholera.

(a.) Was there any communication between the seat of the outbreak and any other locality where cholera previously prevailed?

(b.) If so, the dates and other evidence should be carefully given, and the precise nature of the communication should be described.

(c.) Could the progress of the endemic attack be distinctly traced to communication between the first or earlier endemic cases in the same locality and persons subsequently attacked? If so, state in detail the nature of the communication with the dates.

25. To complete the evidence on the subject of communication it should be distinctly stated whether or not there was communication between affected and unaffected persons without extension of the disease.

26. Prisons afford excellent opportunities of investigating questions regarding cholera, including development of the disease, its relation to personal communication, or to purely local causes, its relation to endemic outbreaks in districts where prisons are situated, and to any general epidemic movement of the disease. Evidence from observation of cholera in prisons.

27. By observations made in prisons and prison infirmaries, we might ascertain whether cholera is preceded by appreciable changes in the health of prisoners; whether the disease breaks out without visible communication of any kind with affected districts; the laws of its development and extension among prison populations. Instances in which it appeared in different parts of the prison, without communication with affected prisoners, should be noted. As also the number of instances in which it did not appear after communication between affected and unaffected prisoners. Care might be taken to prevent all communication temporarily, between affected dis-

tricts or parts of the prison, and unaffected prisoners, with the view of ascertaining whether the disease could be kept out of the prison, or confined to that part of the prison first affected.

28. It may be necessary to state that, as in all similar inquiries, a large number of observations of this class are required before conclusions can be drawn from them.

Evidence from observations of epidemic cholera.

29. When cholera takes on the epidemic form it will become necessary to investigate very carefully the relation of movements of the population to movements of cholera. With this view the following steps should be taken:—

- (a.) A record of all groups of population, cities, villages, and the like, in the region of the epidemic, should be made.
- (b.) On this record the localities successively attacked from the first appearance of the epidemic onwards to its termination, with dates of attack and other particulars should be entered.
- (c.) The localities and dates of unusual outbreaks of other diseases of the epidemic class, fevers, diarrhœa, dysentery, if there have been any such, should be recorded.

30. These data are necessary in order to show the exact number of groups of population which suffered or escaped within the epidemic region, and also to show whether cholera was or was not present before the arrival of persons, pilgrims, and others from affected districts.

Means of communication to be described.

31. In describing the movements of population between affected and unaffected districts, the means of communication, whether by walking, carriage, steamers, boats, railways, together with the rate of travelling, should be stated.

Importance of observing the influence of railway communication during epidemics. Nature of data.

32. Where the exact places, dates, and times of arrival can be ascertained, as in the case of railways, very important facts can be obtained with little difficulty.

33. The following data for lines of railway would go far to show what is really the relation between movement of population and movement of cholera. Similar data might be obtained for main lines of highway and steamboats:—

- (a.) Names of stations and times of departure and arrival along the line of railway.
- (b.) If practicable, the names of stations and dates at which passengers booked at the first affected locality were put down. The facts might possibly be ascertained from the railway tickets.
- (c.) Names of stations and dates at which any passengers suffering from choleraic disease were left.
- (d.) Name of station first attacked with cholera, and date of appearance of cholera there.
- (e.) Dates of appearance of cholera in all attacked stations, and groups of population along the line.

Caution necessary in conducting these inquiries.

34. It is necessary, perhaps, to suggest a caution in carrying out inquiries into the relation between the movement of population and the movement of epidemic cholera, in order to avoid the disturbing influence of coincidences.

35. There are several known factors to be considered in all similar inquiries.

- (a.) There is the obvious movement of the disease.
- (b.) The obvious movement of the population.
- (c.) The fact that cholera appears without apparent or known movement of the population between affected and unaffected districts.
- (d.) The fact that cholera has appeared in unaffected districts after arrivals from affected localities; sometimes only in persons arriving; sometimes only in residents; sometimes among arrivals first, and residents afterwards; sometimes in residents first, and among arrivals afterwards.
- (e.) The fact that arrivals take place from affected localities in unaffected localities without any appearance of cholera following on arrival.

36. It would evidently be impossible to ascertain the truth by simply assuming that the arrival in unaffected districts of persons from affected districts was the cause of cholera appearing in these unaffected districts.

37. It would be equally impossible to arrive at truth by noting only those instances in which disease followed on the fact of intercourse without noting those instances in which intercourse was not followed by spread of disease.

38. In all statistical comparisons on this point two facts are indispensable—

- (a.) An estimate of the number of localities or groups of population which had communication with the affected centre, together with an estimate of their population.
- (b.) The number and population of localities in which cholera appeared after communication, together with the dates of both events.

39. But the fact to be reasonably shown by other evidence altogether is, that the movement of population was the cause of the movement of cholera in those cases in which dates and localities are well known, and where there can be no doubt that the date of the appearance of cholera was subsequent to the date of communication with affected districts.

40. It may be repeated that the arrival of persons from affected in unaffected districts, and the subsequent appearance of cholera there, or the accidental passage of pilgrims near places or persons subsequently attacked with cholera, are nothing more than facts, in regard to the relations of which with each other, rigid inquiry is to be made, and the evidence itself must not be an opinion simply; for, as already stated, no opinion would warrant the adoption of legislative measures and the expenditure of public money. The evidence must be sufficient to satisfy every reasonable demand.

There is no doubt that this part of the inquiry is beset with great difficulties, as well as by many sources of error. But at all events a minute detail of such evidence as it may be possible to obtain should be given, in the hope that eventually the truth may be arrived at by improved methods of inquiry.

Coincidences to be stated.

41. If there is no satisfactory evidence, except the coincidence; or if the alleged fact be exceptional, this should be distinctly stated.

Cholera appearing after intercourse. No proof possible of importation.

Negative facts as well as positive facts to be noted. Statistical data required.

But other evidence altogether required.

Recapitulation of nature of proof.

Much important information regarding the movement of cholera may be obtained by renewed observations on the appearance and course of the disease in troops on the march.

Observation of cholera among troops on march.

42. Besides the usual inquiries into the sanitary condition of camping grounds, water supplies, &c., it would be useful to record the following points:—

- (a.) The state of health of the place from which the troops started, and date of starting.
- (b.) The strength.
- (c.) The nature of the country, and length of marches, and dates.
- (d.) The number of marches.
- (e.) The state of health of towns or villages through which troops passed, and dates of passing, daily state of weather.
- (f.) Date of appearance of cholera (if any) in the corps.
- (g.) Names of places through which troops passed after cholera appeared, indicating those attacked, if any.
- (h.) Date of disappearance of cholera.
- (i.) Daily cases and deaths to be entered on the register.

Among no class of population in India more than among troops could accurate inquiries be made into questions regarding the communication of cholera from man to man, from passing columns affected with cholera to unaffected villages, and *vice versa*.

Epidemics of cholera have generally, but not always, travelled in a north-western direction in India; it has been assumed that the movement of population is in this direction, and that the two movements stand to each other in the relation of cause and effect. We have already suggested a caution on this subject. But there is another very important element requiring investigation, namely, whether movements of population towards the north-west are not accompanied by corresponding movements in other directions; and if so, whether cholera does or does not follow the course of movement in these other directions.

Movement of epidemics on lines of movement of population.

43. In other words, it should be determined by observation whether, if the movement of population has been oscillatory, the movement of cholera has been in one direction only; or whether it has oscillated with the population.

44. Again, as there can be no epidemic without population, it is important to determine whether lines usually taken by epidemics of cholera are or are not the lines of maximum fixed population.

45. Instances should be carefully examined where communication has existed between affected districts, and localities which have at other times been seats of cholera, without being followed by outbreaks of cholera in the unaffected districts.

46. In localities which have never suffered from cholera it should be ascertained whether this immunity has existed, notwithstanding communication with affected districts.

The next question of importance is to ascertain what is the relation of communicability, if it exists, to the phenomena of endemic and epidemic cholera? The following points require careful examination before an answer to this question can be given.

Relation of "communicability" to epidemics.

47. Can it be shown by the conclusive evidence of facts that endemics and epidemics are made up solely of cases arising from well-ascertained communication of the disease, either directly or indirectly, from sick to healthy persons?

48. Are there facts to show conclusively that endemics and epidemics are due solely to communication of the disease, and to nothing else? If so, the facts should be very carefully detailed.

49. Is communicability, if it exists, only one of the elements of the movement of cholera? If so, what is its importance in comparison with that of other elements?

50. Are there facts to show that the phenomena of epidemics are coincident with great general causes, such as the following:—

Relation of epidemics to great physical disturbances.

- (a.) General telluric disturbances affecting great areas of country, such as flooding of the country, dryness and cracking of the soil, excess of moisture in the subsoil, generally increased impurity of water sources, unusual disengagement of malaria, and the like. Great droughts and famines.
- (b.) A generally disturbed or contaminated state of the atmosphere, marked by unusual heats, colds, winds, calms, clouds, fogs, storms, rainfall.
- (c.) General vital disturbances affecting animals as well as men, and probably also affecting vegetable life, such as unusual prevalence of febrile diseases, diarrhoeas, dysenteries, influenzas, and the like. Epizootic diseases, blights in cereal crops, &c.
- (d.) These phenomena existing not only in the epidemic region, but in distant parts of the earth (for instance, the epidemic cholera of 1867 in India co-existed with the great Mauritius epidemic of intermittent and remittent fever, and with epidemics of cholera and yellow fever among the West India islands and round all the shores of the Gulf of Mexico).

Inquiry should be made to ascertain why endemic or epidemic attacks of cholera come to an end.

Inquiry into causes why epidemics cease.

51. If atmospheric conditions are causes of cholera, do the conditions undergo alteration when cholera declines and disappears?

52. If defective sanitary conditions are determining causes of outbreaks of cholera, why do they cease to act after a time?

53. If cholera is spread from person to person by contagion or cholera poison, how does it happen that the agent or poison communicated ceases to act after a time?

These questions require rigid scientific investigation; but light may be thrown on them by practical inquiries, such as the following:—

54. When cholera is in a district it might be observed to what extent the disease can be mitigated by better diet and regimen among troops and prisoners; and it might be further ascertained

whether improvements in these particulars have been extending themselves among these classes of population during outbreaks of cholera for the express purpose of precaution.

55. It might be further ascertained whether, when the arrival of cholera is anticipated, the past known susceptibility of a well-marked endemic district can be diminished by sanitary measures, cleansing, improved water supply, and the like, to such an extent that it may escape the disease more or less; and further, whether in other cases the progress of sanitary improvements has been coincident with decline of the disease.

56. Questions regarding locality might be further elucidated, as follows:—

- (a.) By observing and recording the effect produced on an epidemic or endemic attack among troops or prisoners by camping out on clean ground, as contrasted with the progress of cholera in barracks or prisons where this measure has not been adopted, or only partially adopted.
- (b.) By removing small groups of population out of bad sanitary conditions from houses where cholera prevails, into healthy localities under good sanitary conditions, and by noting carefully the results to health.

State of public health after cholera.

57. After an endemic or epidemic attack of cholera has ceased in a well-marked locality, it would be important to examine into the general health of the people, and to compare it with the state of health before cholera appeared.

Observations of cholera on board ship.

58. An important class of facts might be obtained regarding outbreaks of cholera on board troop and emigrant ships by the following form of record:—

- (a.) State of health of port and district from which troops or coolies have been embarked. Date of last cholera case. Date of departure of ship.
- (b.) Sanitary state of ship and passengers at the time of departure, including questions of ventilation, crowding, quality of water, food, &c.
- (c.) Whether cholera broke out on the passage, and if so, the dates, cases, deaths, state of weather, the then sanitary state of the ship, and other occurrences.

§ V. SANITARY INQUIRIES IN SPECIAL DISTRICTS AND LOCALITIES.

It is important that a special inquiry should be undertaken, not necessarily in all places affected with cholera, but in a few well-marked localities in different districts, including hill stations, with the view of determining what is the precise influence of bad local conditions on the origin and progress of cholera in India.

By whom to be undertaken.

This part of the inquiry should be carried out by Principal Medical Officers for stations of British and Native Troops, and by Sanitary Inspectors, Officers of Health, or other selected Medical Officers for cities, towns, villages, bazars, prisons, and pilgrimages.

Nature of localities.

With this view it would be advisable to select places--

- (a.) Where cholera never breaks out,
- (b.) Where cholera is endemic,
- (c.) Where cholera prevails epidemically,

And to obtain corresponding comparable data for each locality.

Comparative topographical details.

The topographical points specially calling for inquiry are:—

1. The approximate height of the station or locality above the sea level.
2. The approximate height or depression (if any) of the station or locality above or below the level of the surrounding country.
3. Whether the locality is near the sea, or near a river or any large collection of water, or near damp nullahs, marshes, or marshy wet ground; and if so, at what distance and in what direction the water or marshy ground lies, with reference to the locality and to the prevailing winds.
4. Also whether the level of the locality be above or below water level in the adjacent river or lake.
5. A general account should be given of the surface of the country around the station or locality, whether it is flat or undulating, or hilly or mountainous; and what effect (if any) the general configuration of the district is likely to have on the movement of air currents, and generally on the ventilation of the locality.
6. Whether the country around the station or locality is open or encumbered with vegetation, together with the nature of the vegetation, trees, jungle, and the like.
7. Whether there are damp or wooded ravines in the vicinity themselves productive of malaria, or leading directly from malarial districts of country.
8. The geological structure of the district should be described, including under this head:—
The general nature of underlying rocks.
But especially the nature of soils and subsoils, and the depth of these as far as it may be practicable to give them.

Prevailing malarial diseases.

9. Inquiry should be made as to whether marsh fevers are frequent among the population, and their sources.

State of agriculture.

10. Also whether cases of cholera or diarrhoea are influenced by malaria, and whether cases of marsh fever have passed into a choleraic state or into cholera.

River banks and water level.

11. An important element in this inquiry is the extent and condition of agriculture in the vicinity of towns and villages, nature of produce, condition of general drainage of the country, and whether irrigation is in use, and how it is carried out.

12. The state of river banks should also be examined, and it should be ascertained whether the subsoil of attacked as well as of exempted towns and villages situated on river banks is infiltrated by water from the river. The level of water surfaces of rivers, relatively to the level of surfaces of towns and villages, should be examined at periods when cholera prevails, and also at times when there is no cholera.

13. Intimately connected with this part of the subject is the position of inhabited buildings with reference to higher ground close to them, such, for instance, as buildings being erected close to slopes or sections of earth, or of rock rising more or less above the level of the inhabited floors. The distance at which buildings are placed from these sources of malaria, and also the height of the section above the floor should be stated. Position of inhabited buildings.

14. Instances in which foundations of infected buildings are below the general level of the country, or below the level of water services in rivers, should be carefully noted.

15. The next important point of the inquiry is into the subsoil drainage of stations, towns, and villages, subject to attacks of cholera, in comparison with the subsoil drainage of localities hitherto exempt from cholera. State of sub-soil drainage.

16. This inquiry involves the depth of the water-line below the surface in dry and wet weather, at times when cholera is present and at times when there is no cholera; the slope of the ground in reference to facilities of outfall for subsoil drainage, the nature of subsoil; whether the buildings rest directly on rock; if so, its nature, especially whether it is porous or impervious to moisture.

17. It should be stated whether water lies on the surface of station, town, or village after rains, and if flooding from rains or rivers takes place; together with the nature of surface drainage works (if any) provided for carrying away flood and surface water.

18. An inquiry should also be made as to the probable amount of water carried for consumption into the station, town, or village. Removal of foul water.

19. It should be stated distinctly whether foul water from barracks, hospitals, houses, baths, kitchens, lavatories, and the like, is drained away to a distance, or carried away by labour, or allowed to run away on the surface, until it sinks into the subsoil or evaporates. If there are surface-drains the fact should be stated; whether water thrown into them flows readily away to a distance, or sinks into the subsoil through the bottom of the drain; and whether foul water remains stagnant in the drains; and whether the drains give rise to nuisance.

The nature of the surface should also be examined, to ascertain:—

20. Whether the surface in and around inhabited buildings in stations, towns, and villages, is equal and smooth, so as to allow of a free flow of rainfall. State of surface drainage.

21. All collections of stagnant surface water in tanks, jheels, holes, ditches, and the like, should be noted, together with their extent, the condition of the water in them, the uses to which the water is put, and whether any nuisance arises from such collections of water.

22. The state of cleanliness of the surface of stations, towns, and villages selected for these inquiries, requires special attention. The vicinity of each should be examined, to see whether there are any heaps of foul matter, or whether the people resort to the outskirts for the purposes of nature; also the extent to which this source of nuisance exists; whether it is increased by rains or by close damp warm weather. If there be nuisance from the practice, the extent to which it was experienced before or during the outbreak of cholera should be stated. State of cleansing and nuisances.

23. An important part of the inquiry is into the condition of courtyards of dwelling-houses; whether there are accumulations of foul matter in them, or if the surface is kept clean.

24. The state of cleanliness of streets, lanes, roads, gutters, and the like, should be reported on.

25. It should be specially stated in what manner the excreta from barracks, hospitals, and native dwellings, are disposed of. How often the excreta are removed, the manner of removal, and whether there is much nuisance in the process; to what distance from inhabited buildings the excreta are removed; how they are disposed of; whether afterwards there is any nuisance from the accumulations, especially in wet or in damp warm weather.

26. In cases where outbreaks of cholera have been coincident with the existence of nuisance from any source enumerated above, the facts should be carefully examined and described.

27. A very careful inquiry should be made into the condition of water supply of these selected stations, towns, and villages, including the points regarding water supply stated in § VI. Inquiry into the water supply.

A copy of any chemical analysis made of water used for drinking and cooking by troops or civil population when cholera is present, should be appended to the Medical Officer's report.

28. In cases where violent outbreaks of cholera have accompanied an impure state of the water supply, the facts, both as regards the disease and the source and quality of the water should be carefully detailed.

Another important matter for observation is the general condition of barrack accommodation, and of houses of the native civil population liable to outbreaks of cholera. General condition of dwellings.

29. As regards barrack-rooms, the most important statistical elements on which information is required are included in the cholera register. Barrack-rooms.

It sometimes happens that at military stations troops living in barracks suffer much more from cholera than officers living in quarters. Also, that troops quartered in certain barrack blocks, or in certain rooms, or even in particular parts of the same room, suffer more than others. These differential facts are of great importance in this inquiry. They should be carefully examined into, and the cause of the difference in susceptibility stated as far as practicable.

30. As regards native dwellings, the following points are of importance:—

Native dwellings.

(a.) To ascertain whether cholera was spread more or less equally over the area of the town or village, or whether it was chiefly confined to certain localities only, and if so, to state any peculiarities in the sanitary condition of those affected districts or localities.

(b.) To give a very general account of affected native houses, including—

Construction and materials, usual dimensions, number of apartments, doors, windows, and the like.

Number of floors, and which floors are occupied for sleeping.

State of houses, courts, and compounds, as to cleanliness, keeping of animals, &c.

Nature, position, and state of privy accommodation, and arrangements for cleansing.

Position of private wells in relation to privies, and state of the water.

Number of inhabitants generally, and whether crowded or not. Condition of the air and ventilation of affected houses.

31. Any appearance of fungi or lichens on walls of affected houses should be examined under the microscope, drawn and described.

32. It would be important to ascertain whether newly-constructed native houses are less liable to attacks of cholera than old and long-inhabited houses among the same class of population.

Importance of differential inquiry.

33. Most important data might be obtained by selecting, say two stations, one notoriously subject to cholera, the other always exempt from cholera; by comparing all the elements presented by each, and by describing the differences.

Another important class of facts of the same kind might be obtained by selecting an endemic locality in which there are houses or portions always attached, and others always exempt, and comparing the differences in the two classes of dwellings.

Evidence from improvements.

34. A notoriously unhealthy locality might be thoroughly improved, and the results to health carefully given.

§ VI. SPECIAL LOCAL INQUIRY.

As already stated, this inquiry is intended to be conducted by specially appointed observers, now in India, but all Medical Officers are invited to contribute observations as far as it may be in their power to do so.

To be carried out in specially selected localities.

The inquiry should be carried out in specially selected localities where cholera is endemic, or where it breaks out occasionally.

It should also be carried out in localities always exempt from cholera.

And at different seasons.

The inquiry should be pursued at different seasons in both classes of localities, and the season and atmospheric conditions should be stated under which any observations of interest have been made.

Subjects of inquiry.

The inquiry will include a microscopic examination of air, water, soils, articles of food, organs and tissues, vital fluids, including secretions and especially diarrhoeal and cholera discharges.

Microscopic constants to be obtained.

The object which should be kept in view in the inquiry is to obtain what may be called microscopic constants for each selected locality when cholera is absent, in order that these observations may be compared with another set of microscopic constants obtained during the prevalence of cholera in the same localities.

The results of all observations, as well as all similarities and differences in observed results obtained in localities with and without the presence of cholera, should be carefully described and accurately measured and drawn by camera.

If the observer has arrived at what he considers to be a satisfactory opinion as to the nature of the objects figured and measured by him, he should state fully the reasons which have led him to his conclusions.

1. *Microscopic Examination of the External Atmosphere.*

Examination of air.

1. Samples of air should be taken at four or five feet from the ground (the height to be stated). This class of observations should be made under different atmospheric conditions, and besides the date or dates, and hours, between which observations have been made, the following meteorological elements, when obtainable, should be recorded.

Daily barometric height.

„ dry bulb temperature.

„ wet bulb „

„ maximum „

„ minimum „

„ winds, direction and force.

„ calms, &c., and whether wind blows over marshes, nuisances, and the like.

„ rain.

Methods employed.

2. For examining the air an aspirator of known cubic contents should be provided. An ordinary chemical gasometer, or an air-tight vessel, to be filled with water from a cistern, and emptied by a stop-cock from below should be used. Various methods have been adopted for straining the air in its passage from the atmosphere to the aspirator so as to retain foreign bodies contained in it. Cotton, or asbestos, placed in a glass tube through which the air is to pass, have been used. If this method of straining the air were employed great care would have to be taken to ensure that the material is perfectly clean, and it should be microscopically examined before being used.

For the purpose of immediate microscopic observations aspirated air is made to impinge on a glass plate moistened with glycerine, which retains any foreign bodies in the air.

Another method has been to draw the air through distilled water contained in Wolfe's bottles; care having been previously taken to cleanse the bottles and tubes perfectly, and to boil the distilled water immediately before use.

This method yields results more or less reliable, but it has been found that foreign bodies, both organic and inorganic, pass through the water, and that only a part are retained.

A third method consists in drawing the air through a horizontally-placed glass tube imbedded in a freezing mixture, so as to condense the moisture in the air; this condensed moisture being the vehicle for retaining any matters carried along by the air.

A modification of this plan is to expose a glass globe, containing a freezing mixture, to the atmosphere, and to collect and examine drops of moisture obtained in this way.

3. It is desirable that any method adopted should combine two objects: 1st, to obtain the contents of the atmosphere for examination; 2nd, to estimate the amount of foreign bodies in the air in proportion to the volume of the air. Objects to be attained.

4. A very important precaution to follow is to complete the experiments as quickly as possible, so that the results may not be vitiated by the rapid development of organic life in the climate of India. Precautions be observed.

5. A few trials will soon determine which process is the best, and when this is done the process should be adhered to.

6. It would be important to carry out similar inquiries at times when fogs are prevalent, especially during night, and also with air taken over or close to marshes.

7. As already stated, these observations on air should be made in localities where cholera never appears, and also in cholera districts at times when cholera is present, and at times when it is absent.

8. It would be advisable to make careful microscopic examinations of newly-fallen rain-water from time to time, but more especially in districts and at times when cholera prevails, and any foreign bodies found in the rain should be carefully described and figured. Examination of rain-water.

2. Examination of Soils.

The relation between the nature of soils and subsoils and cholera requires further elucidation.

For this purpose it would be desirable to select localities in which cholera is endemic, and localities in which it never appears, and to conduct comparative inquiries at each locality on the following points:— Relation of soils to cholera.

1. The general character and depth of the surface soil and subsoil occupied by the population.

2. If the surface consists of rock, its nature and general character should be stated.

3. Arrangements should be made for continuous observations on the water-level in the subsoil; its depth below the surface, and its temperature, should be registered at fixed periods when cholera is present as well as when there is no cholera. The fact of the presence or absence of cholera at the times of observation should be noted.

4. The upper layer of subsoil water should be examined chemically and microscopically at times when cholera is present or absent, and the results recorded.

5. The temperature of the soil at different depths, as well as at the surface, should be ascertained and registered at the time observations are being made on the water-level.

6. The night surface-soil temperature and its relation to fogs should be noted.

7. Average specimens of soil or of rock, as the case may be, at and near the surface should be taken from similar places among the houses in endemic and exempt localities, and submitted to the following examinations.

8. The proportionate amount of air in the interstices of a given weight of earth or rock should be determined.

9. The nature and constituents of this air should be carefully ascertained, especially with reference to the presence of microscopic organisms, and organic matter, animal or vegetable.

10. The proportion of water held in combination with the soil or rock should be determined. Also,

11. The amount of water which the soil or rock can absorb.

12. The chemical constituents of the soil should be examined, particularly as regards the amount of organic matter of animal origin in relation to the amount of ammonia, nitrites, nitrates, and chlorides.

3. Microscopic Examination of Water.

1. This, like other comparative branches of the inquiry, should include the microscopic condition of water used for drinking and cooking purposes, in localities subject to cholera, and also in localities which enjoy an exemption from cholera. Water to be examined at sources of supply.

2. In cholera localities the examination should be made at times when there is no cholera, and it should be carried on into times when cholera breaks out among the people. It should be continued during the whole period of the epidemic, and onwards until it has ceased. In this way a microscopic picture of the water supply of affected populations will be obtained.

3. In localities which have hitherto escaped cholera, a sufficient number of examinations should be made to enable the microscopic state of the water to be ascertained.

4. The points requiring notice and record are the following:—

(a.) The source of supply of drinking water, well, tank, river, &c.

(b.) The position and distance of the source, with reference to dwelling houses, or other causes of impurity.

(c.) The state of the surface and subsoil around the source, whether both are clean, or whether foul drainage or surface impurities are likely to find their way into the water.

(d.) Whether the people wash clothes, or wash or bathe themselves in the water, or near the mouth of the well.

(e.) The depth of the water level in the well, below the surface of the ground.

(f.) The sensible physical qualities of the water as to colour, taste, smell, and the like, and whether the water is alkaline or neutral.

5. Microscopic examinations should be made not only of specimens drawn from the sources of supply, but of samples of water taken from vessels in which it is kept for use by the people, or by troops. Water from water vessels to be examined.

Microscopic examinations of water should include the following elements:—

(a.) An account, illustrated with camera drawings and micrometric measurements, of all organic and inorganic bodies found in the water. Points for examination.

(b.) A comparative determination of the amount of microscopic organic and inorganic bodies in a given volume of water.

This determination should be made on some general principle, such as the following, which has been used in this country.

Half a gallon of water should be allowed to remain at rest in a scrupulously clean glass vessel, excluded from light and air, for a few hours, and the sediment examined under the microscope.

(c.) If the quantity of sediment be very small, the lower portion of the water should be transferred into a clean conical glass vessel, and excluded from light and air for such time as may allow of the subsidence of deposit into the narrow portion of the vessel. The deposit should then be examined.

(d.) Precaution should be taken that no development of organic bodies takes place in the water while being treated in this way.

(e.) After a few trials a rough estimate may be formed as to the number or proportion of microscopic bodies found in the quantity of water submitted to examination.

6. An account should be given of the larger non-microscopic forms of vegetable and animal life, if any, existing in the water source.

7. If the observer has arrived at an opinion as to the nature of the organic bodies discovered by the microscope, he should state it (and give his reasons for arriving at his opinion, unless the objects are already well known).

8. It would be important to make microscopic observations on water drawn from marshes near districts attacked by cholera.

4. *Microscopic Examination of Articles of Food.*

1. This examination should include articles consumed by troops, and also articles of ordinary consumption among the civil population.

2. Like other branches of the inquiry it should be carried out both in localities where cholera is of frequent occurrence, and in localities not subject to outbreaks of cholera.

3. In cholera localities it should be followed up when cholera is present, and when cholera is absent.

Points for inquiry.

4. The following would probably be a convenient mode of conducting the inquiry:—

(a.) To make a list of the alimentary substances made use of by troops and by civil population.

(b.) To examine these as to their apparent sensible qualities, goodness, inferiority, badness.

(c.) Then to examine them under the microscope, to become familiar with their normal characteristics when of good quality, with the view of ready detection of any departure from this condition.

(d.) To describe the microscopic changes observed, new bodies discovered, fungi and the like; noting any increase or decrease in amount when cholera is present or absent.

(e.) Any peculiarities observed, or any microscopic plants or animals in any articles of food should be measured, described, and drawn by the camera.

Diseases of plants.

5. The dates of all examinations of this kind should be carefully kept, to be collated, with the dates of appearance or disappearance of cholera, or other epidemic diseases.

6. Careful inquiry should be made as to diseases occurring among plants, especially among cereals and other plants used as food, during the presence of, or preceding, an outbreak of cholera. Samples should be microscopically examined, and the results stated.

5. *Microscopic Inquiry into the Pathology of Cholera.*

Tissues to be examined.

1. This branch of inquiry should include a careful examination of organs and tissues of persons who have died of cholera in comparison with the healthy condition of the same organs and tissues in persons who have died by accident or by diseases not of the epidemic class.

2. These examinations might be made in localities where cholera has not hitherto appeared, and also in localities where cholera breaks out, and in such localities examinations should be made both during the presence and absence of cholera; the dates being recorded.

Differences observed to be described.

3. The object is to ascertain whether the microscope can detect differences, and, if so, what differences in organs and tissues of persons who have died of cholera, or whether the presence of an epidemic in a given locality produces any change in organs and tissues appreciable to the microscope in persons who have not died of cholera, or who have died of non-epidemic diseases in districts where cholera was prevalent at the time.

4. All observed differences, and all bodies foreign to the natural state of organs and tissues, fungi, animalcules, and the like, should be carefully described, measured and drawn, by the camera.

Caution.

5. Care should be exercised in discriminating between organisms which were present during life, and those which were manifestly developed after death.

Examination of fluids and excretions.

6. Another very important branch of the pathological inquiry is the microscopic characters of fluids in persons living in cholera localities, and in persons suffering from cholera, as compared with the characters of the same fluids in persons living in localities where there is no cholera at the time, or where cholera never appears.

7. The most important points of comparison will be afforded by the blood, the urine, and intestinal secretions.

8. The general physical characters of all fluids submitted to examination should be carefully described, with the view of determining whether they have special physical characters, and of examining into the real cause of any peculiarities they may present.

9. The observer should make himself acquainted with the normal healthy microscopic appearances presented by these fluids in non-cholera districts, and in cholera districts when there is no cholera present, and he will then be in a position to detect with ease any departure from normal appearances when cholera prevails.

10. Special attention should be directed to the diarrhœal and choleraic discharges of cholera patients, and also to the diarrhœal discharges of patients not suffering from developed cholera. Characters of choleraic discharges. Objects of inquiry.
11. The object of this inquiry is to ascertain whether, when cholera is present in a district, any organisms, animal or vegetable, can be detected by the microscope in the discharges, other than these organisms (if any) which may have been found in the secretions of persons living in districts never attacked by cholera, or in districts liable to, but not at the time attacked.
12. It is most important, in the event of any such organisms being discovered, to examine the discharges in a sufficient number of cases, and frequently in the same case, to show whether their appearance is constant, or only exceptional and accidental. Constancy of results to be ascertained.
13. Care should be taken to examine the discharges microscopically at different periods of the disease, and immediately they are passed, and also the microscopic characters of articles of nutriment used by the patient, to guard against error from the foreign introduction of microscopic bodies, or their development in the secretion either before or after it has left the system. Caution.
14. Discharges should also be examined microscopically in various stages of putrefaction, and the results described and drawn. Effects of putrefaction.
15. For purposes of comparison similar microscopic examinations should be made of healthy excreta of native population in various stages of decomposition. Healthy excreta to be compared.
16. If any microscopic organisms are detected, of which it can be said that they are peculiar to, and constantly present, either in diarrhœa or cholera cases, they should be compared with any microscopic organisms discovered in the atmosphere, in water, or in articles of food and drink, and their similarities or differences described. Organisms to be described differentially.
17. Attempts might also be made at cultivating any fungoid bodies discovered, with the view of employing the product in experiments on animals.
18. Experiments of this class are necessary steps in solving a very important question—viz., whether these minute organisms are specific causes of disease, or whether their function is simply to convert noxious dead organic matter into innocuous living forms. Caution.
19. All microscopic organisms or other bodies discovered in discharges by the microscope should be described, measured, and drawn by camera.

6. *Microscopic and Physiological Inquiry as to the Cause of Cholera.*

1. The next step in the inquiry is to ascertain what is the precise nature of cholera poison, if such there be; and the agency through which it is conveyed from affected to unaffected persons and districts.
2. The nature of this poison can, perhaps, be best ascertained by inquiries conducted in hospitals set apart exclusively for the treatment of cholera cases, and the hospitals selected should be in open healthy situations, at some distance from affected localities.
3. This poison, if such there be, must exist in matters proceeding from the patient; in his expired air, cutaneous exhalation, matters ejected from the stomach, the urine, or intestinal flux; and it is in these that the cholera poison must be sought for if it exists. Seat of cholera poison.
4. The main dependence for discovering the poison must be placed on the microscope; but the result of microscopic observations would be inconclusive, unless there were some means of proving that microscopic objects discovered actually reproduced the phenomena of cholera. Physiological observation and experiment must, therefore, accompany microscopic inquiry. Physiological experiment necessary as well as microscopic observation.
5. Microscopic investigations should be comparative, i.e., they should show that objects discovered in the excretions of persons suffering from cholera do not exist in the excreta of healthy persons, or in those of persons suffering from other diseases. Again, the excretions of patients suffering from various classes of diarrhœa and from dysentery should be examined in order to ascertain whether any objects which may be discovered in them are similar to, or differ from, those discovered in the excretions of cholera patients. Investigations to be comparative.
6. The condensed moisture of the breath of cholera patients should be compared microscopically with the same object obtained from healthy persons, and with the same object obtained from persons suffering from diarrhœa.
7. The microscopic characters presented by condensed cutaneous transpiration in each class of persons should also be examined.
8. These examinations should be repeated a number of times in the same case, and also in a sufficient number of cases to ascertain whether the facts observed are constant; and if they are not, this should be distinctly stated. Examinations to be repeatedly made.
- It must be repeated that in this part of the inquiry two things are absolutely necessary for practical purposes.
- (a.) That the facts should be ascertained.
- (b.) That the constancy or otherwise of the facts should be determined.
9. A most important class of physiological data may be obtained from observing the movement of cholera in hospitals where the disease is under treatment, with reference to attacks among medical officers, attendants, and patients suffering from other diseases. Physiological inquiry on the poison of cholera.
10. To avoid sources of error, hospitals selected for this inquiry should not themselves be situated in endemic localities, otherwise pure endemic cases, due to locality (if there be such), might be confounded with cases arising from communication (if there be such). By observations in hospitals.
11. Suppose that the hospital is in a fairly healthy site, and that its sanitary condition is good, and the wards not crowded with sick; observations might be conducted as follows:— Statistical points for observation.
- (a.) The number of patients, with their diseases, should be recorded.
- (b.) A record should also be kept of the number and duties of attendants in the hospital, and of the medical staff; and at the conclusion of the outbreak the number of cases of cholera, and of diarrhœa which have taken place in medical officers, attendants, and patients, should be recorded.
- (c.) Differential observations might also be made on the proportion of attacks among attendants in good hospitals and in bad hospitals.

Nature of observations.	12. This part of the inquiry would include the amount and degree of communication existing between the attendant and the sick, his distance or proximity. The kind of communication, whether by inhaling the breath of the sick or exhalations from excreta, by accidental wetting of the skin or clothing by matters ejected from the stomach or bowels, the accidental wearing of articles of clothing fouled in this manner, using foul bedding, and the like, washing linen fouled by cholera excreta.
Both positive and negative results to be stated.	13. All instances should be carefully noted in which occurrences of this kind have taken place. The particulars should be recorded, and the instances in which disease has not subsequently appeared, as well as the cases in which it has, should be noted.
By experiments on animals.	14. Careful inquiry should be made as to whether any part of the excreta were likely to have entered the system by abraded surfaces, by the lungs, or by the mouth. 15. Another class of physiological experiments might be made with various species of animals in sufficient numbers to enable per-centages to be deduced. Possibly mice, pigs, and monkeys would be the most likely animals available in India. 16. These experiments might be conducted so as to test not only the physiological effects of cholera poison, if such there be, but also to determine the vehicle or medium through which the poison reaches the system. 17. Animals might be confined in cholera wards under such conditions as would expose them only to poisons carried in the air from cholera patients, <i>e.g.</i> , they might be kept day and night in an undoubted cholera atmosphere, and the results, if any, noted at brief intervals. 18. Another set of experiments might be instituted in which animals are made to inhale an atmosphere containing emanations from cholera excreta, fresh or in advancing stages of decomposition. 19. In another similar set of experiments, emanations proceeding from clothes or linen saturated with fresh cholera evacuations of two kinds (vomiting and purging) might be tried. 20. And a similar set with saturated clothes in a dry state. 21. The experiments with excreta and clothes could be best made in a room at a distance from the cholera hospital. The room should be light, and of fair dimensions, and without sanitary defects, which might vitiate the results. 22. In this class of experiments some simple method could easily be adopted to ensure that the animals made use of are exposed only to matters diffused in the air. Such, for example, as confining them in the upper part of a box communicating with the lower part, in which is placed the material to be experimented with. 23. Animals might be made to drink water or to use articles of ordinary food containing various amounts of cholera excreta. 24. Another distinct class of experiments should be performed by giving small quantities of fresh cholera dejections by the mouth or rectum. 25. Also by injecting larger quantities in the subcutaneous tissue. 26. In these trials fresh and decomposing excreta should both be used. 27. And for the sake of comparison, cholera excreta disinfected with carbolic acid should be employed in other instances. 28. Animals might be made to drink moisture condensed from the air in the vicinity of sick, or drawn over cholera excreta.
Objects to be attained.	29. But in conducting these experiments for practical ends, it should be kept in mind that there are two objects in view—first, to ascertain whether there is a specific cholera poison; second, to ascertain whether it is capable of producing choleraic symptoms in minute quantities, such as may be supposed to pass from person to person in ordinary human intercourse; and also to determine the probable channel of entrance of these minute quantities into the system.
Caution.	30. Care should be taken that the excreta used in these experiments are not those of patients who have taken active medicines.
Data to be recorded.	31. Should distinct specific effects be produced on animals, the following data should be recorded:— The dates. Temperature and moisture of air. The period after passing the excreta when the experiments were made, and condition of the excreta when used. The number and species of animals submitted to experiment. The number exhibiting specific symptoms. A detail of the symptoms in each case. The period after exposure when the symptoms showed themselves. The duration of the symptoms. The termination by death or recovery. Some account of post-mortem appearances. An account of any special microscopic objects discovered in the excreta or intestinal canal.
Animals not to be injured by processes.	32. Care must be taken that the animals are not exposed to injury or to production of disease simply by the methods or manipulations employed, which would vitiate the results.
Experiments with non-choleraic discharges.	33. Healthy animals might be confined in the same place with animals which have been subjected to these experiments, and the results noted.
Experiments with dysenteric excreta.	34. Any results from experiments on animals will be incomplete unless repeated with diarrhœal excreta not proceeding from cholera patients, and at times when cholera is absent.
Vehicle of the cholera poison.	35. For the sake of comparison similar experiments should be made with dysenteric excreta. 36. Experiments to determine the vehicle of cholera poison, if such there be, may be made by examining the air in the immediate vicinity of the sick, by condensing the moisture, and submitting the result to microscopic examination in the manner elsewhere stated. 37. This examination should be made, together with a corresponding examination of the outer air at a distance from the cholera hospital, and the results should be compared.

38. A similar set of experiments should be performed with moisture condensed from air taken from a vessel containing cholera excreta. The object of this is to ascertain whether any special organized bodies which may have been discovered in cholera excreta can be carried into the air, and afterwards deposited.

39. Similar experiments should be made by wetting articles of ordinary clothing in cholera excreta containing special microscopic objects, allowing them to dry, and then agitating them in an enclosed body of air, so that any dust from them may be condensed, and submitted to the microscope. The results should be carefully described and figured.

40. As already stated, condensed matters so obtained, found to contain appreciable organisms or not, might be used in experiments on animals.

41. Another class of facts, either positive or negative, might be obtained by examining objects found in the condensed breath, cutaneous exhalations, or excreta of persons who have been in close communication with cholera cases in hospitals, or who have lived in cholera localities. In this class of experiments the persons who have been so exposed should be removed from the hospital or locality before the microscopic examination is completed.

Examination of excreta of unaffected persons.

§ VII. CHEMICAL INQUIRIES.

1. These inquiries should be carried out at selected stations exempt from cholera, as well as at one or two stations where cholera is endemic. They should be undertaken during periods of health, and at epidemic seasons.

To be comparative.

2. They should include inquiries as to the constituents of the atmosphere, with special reference to estimating the amount of organic matter in air taken four or five feet from the surface of the ground.

Examination of air.

3. The same experiments to be made with air in localities specially the seats of cholera. The constituents of air in cholera wards to be likewise examined chemically.

Examination of water.

4. The rapid progress being made in water analyses throughout India will afford most of the information required about the water supply. But in order to have the requisite means of comparison, a chemical examination should be made of water in selected cholera localities at various periods, with the view of ascertaining whether any and what physical and chemical changes have taken place in the same waters during the prevalence of cholera.

5. Water used in selected localities exempt from cholera should also be examined.

6. The more important sanitary points of such an inquiry are:—

(a.) The amount of rapidly oxydizable organic matter in water.

(b.) The amount of ammonia, muriate of soda, nitrites, nitrates.

(c.) The amount and character of other salts.

7. A chemical re-examination should be made of the serum of the blood in healthy persons and in persons suffering from cholera, in comparison with rice water discharges in cholera. The comparative degree of opalescence of the two fluids, and the effect of dilution on this property in each, should be observed and described.

8. The influence of disinfectants on cholera excreta should be examined, and the results, microscopical and physical, stated. It is important to ascertain which disinfectants can best prevent decomposition of cholera excreta, and arrest the development in them of organic life.

No. 4.

REGISTER FOR RECORDING REGIMENTAL CHOLERA CASES.

During an epidemic visitation, when medical officers are suddenly subjected to a great increase of labour, and have their anxieties and responsibilities equally augmented, with possibly the inconvenience and discomfort of a movement of the troops, it is not of course to be expected that they can always make *post-mortem* examinations. Everything must be subordinated to the welfare of the sick. Where, however, medical officers can pursue and record these investigations, the accompanying Register will, it is hoped, economise their time and labour in doing so. The No. column on the left-hand side of each page is intended to furnish a reference by which to trace the medical history of the individual cases throughout.

In the absence of any well-marked character, the separation of ordinary from choleraic diarrhoea must be in great part an artificial one. By the former is to be understood the form of disease such as prevails at ordinary periods, marked by looseness of the bowels, the stools, though fluid, retaining a faecal character.

The relative amount of fluid excreted in a given time should be noted, as well as the absolute quantity, in consequence of the system sustaining a chronic drain with comparative impunity; while the effect of a sudden but smaller loss might induce shock or syncope.

In recording the character of the urine, its specific gravity, acidity, presence or not of albumen, &c., should be stated.

In the event of a patient dying collapsed, in whom there was little or no diarrhoea and vomiting, the amount and character of the fluids in the intestines should be carefully noted.

Note.—These Cholera Registers were made up in three sizes, to contain 21, 42, or 84 cases, to suit the strength of corps.

FOLIO 1.

Station _____.

No.	Name.	Age.	Date and Hour of Attack.	Patient attacked in Barrack, Hospital, Officer's or Married Quarters.	Floor of Room (ground, 1st. &c.), and No. of Room.	Number of Men in Room. Amount of Cubic and Superficial Space per head.	Ventilation (ample, good, insufficient).	If admitted into Hospital, Date and Hour.	Ordinary Diarrhoea.	Recovery.
1										
2										
3										
4										
5										
6										
7										

FOLIO 1—continued.

Station _____.

No.	Collapse, its Degree, Date, Hour, and Duration of Algide Stage.	Algide Stage.					Patient slept, or not.	Vomiting and Purging continued, and to what extent.
		Pulse.	Respiration.	Temperature.	Suppression of Urine, partial or complete, Hour and Duration of.			
1								
2								
3								
4								
5								
6								
7								

Corps or Detachment _____ . Strength _____ .

Date.	Treatment, and when commenced.	Transferred to— A. Choleraic Diarrhoea. B. Collapse.	Premonitory Diarrhoea.	Hour and Date of its Appearance.	Treatment.	Whether Symptoms became suddenly aggravated, and the Date and Hour.	Duration and Amount of Vomiting and Purging.

Corps or Detachment _____ . Strength _____ .

Secondary Fever.						
Treatment.	Date, Hour, Duration, and Character of.	Pulse.	Respiration.	Temperature.	Character and Amount of Stools.	Complications.
						Cerebral.

FOLIO 1—continued.

Station _____.

No.	Secondary Fever.			Event.			
	Complications.		Treatment.	Death.			
	Pulmonary.	Enteric.		Choleraic Diarrhoea.	Collapse.	Imperfect Reaction.	Secondary Fever.
1							
2							
3							
4							
5							
6							
7							

FOLIO 1—continued.

Station _____.

POST MORTEM APPEARANCES.

No.	Lungs, Size, Weight, and Condition; Pulmonary Arteries and Veins, relative Amount and Character of Blood.	Liver and Gall Bladder, and Contents, Size, Weight, Congestion, and Appearance of.	Spleen, Size, Weight, and Condition of.	Kidneys.	Bladder.
1					
2					
3					
4					
5					
6					
7					

Corps or Detachment _____ Strength _____

Recovery.			POST-MORTEM APPEARANCES.		
Choleraic Diarrhoea.	Collapse.	Secondary Fever.	Post-Mortem, Hour and Date of, and Time after Death.	External Appearances.	Heart, Size, Weight, and State of Blood, Pulmonary Artery, and Veins, State of.

Corps or Detachment _____ Strength _____

POST MORTEM APPEARANCES.		REMARKS.
Stomach and Intestines. Contents: Amount, Colour, Reaction, and Character of. State of Glands, Vessels, Mucous Membrane, and Villi.	Nervous System and other Organs.	

No. 5.

MEMORANDUM by the Army Sanitary Commission on Papers relating to the Duties of Inspecting Sanitary Commissioners in India.

Despatch from the Government of India, dated the 10th September, No. 7, 1868 (Sanitary), with enclosures.

sanitary condition of the Native population of India.

2. The Commission concur in the draft of duties for these Inspecting Officers at para. 15 (page 5) of the Resolution of the Government of India, Home Department (Sanitary), under date Simla, 10th September 1868.

3. But it appears that these duties are purely inspectional and advising, and not executive; and there is not sufficient evidence in the papers to show in what way the information collected by the inspecting Commissioners, and the advice tendered by them to local Governments and Administrations, are to result in practical action.

* *Vide* letter of Junior Secretary to the Chief Commissioner of Oudh (No. 2,060, 23d May 1868), paras. 9 and 10, in the papers; also,

Letters of Colonel Fytch, Chief Commissioner of Burmah (No. 550—478, 12th February 1868), para. 4, and reply thereon by the Government of India, No. 1,200, 7th March 1868.

1. The Commission consider the appointment of the new Civil Sanitary Commissioners as an important step towards improving the

4. This deficiency in the results is pointed out in several papers accompanying the resolution.* Dr. D. B. Smith, Sanitary Commissioner of Bengal, under date, Calcutta, 20th April 1868, states that the Sanitary Commissioners' proposition should be consultative, and that practical measures should be carried out by other officers.

5. The Commission agree with the opinion, that the functions of these medical sanitary Inspectors should be inspectional, advising, and reporting, but as it is obvious that provision for designing and execution of works is wanted besides, they think it very desirable that the nature of this provision should be carefully defined and well understood in each province.

6. As sanitary reports have already been made on several unhealthy localities, and the facts are already known; might not certain of these localities be at once placed under improvement, and the results used as encouragement for further efforts?

7. In anticipation of the advance of improvements among the Native population at no distant date, it is evident that, considering the vast area of country placed under each Medical inspecting Commissioner, he could do very little in dealing with local sanitary improvements among the people, even if he were competent to direct them.

England, with a population about two-thirds that of Bengal, has required twenty years of inspecting works to initiate measures for preserving the public health.

The execution of sanitary works and measures is an operation distinct from that of competent inspection, which has to deal only with the determination of disease causes, together with the most economical means of removing them, and these measures it is the special function of the executive authority to embody in plans of works, which plans it has been usual in this country to submit for approval to the inspecting authority, before they were carried out by the local executive.

Wherever there are municipal authorities in India, they would have their own engineering and sanitary officers. Such officers have been appointed already for Calcutta, Madras, and Bombay. But as a great part of the epidemic susceptibility of India comes from unfavourable conditions under which smaller groups of population live, it is worthy of consideration whether a class of officers might not be provided for doing both inspecting and executive work in districts, so as to save the cost of more than one set of officers.

The health problems in country districts are not so complicated as they are in cities and large towns, while the India Office Memorandum* has clearly shown how much may be done by inexpensive measures involving mainly a skilful direction of local labour in these districts, in the execution of works of cleansing, purifying water sources, prevention of nuisances, surface drainage, and the like.

If the health service were expanded in this direction, the officers, who would combine in their own persons the Inspectorial and Executive functions, might either be Engineers or Medical Officers, provided they had shown special aptitude for sanitary investigations and works, an acquirement quite apart from general, scientific, or medical attainments or studies.

If this view of the future Inspectorial Executive be adopted, the best way to give effect to it would be to select men for the work. Men with aptitude usually volunteer for such work, because they take interest in it. They would be easily discovered, and after having been in the service for a year or two in India, a selection might be made, with the view of sending the men home to England to receive instruction in hygiene, sanitary engineering, and sanitary practice, such as can readily be obtained in London and other towns. This would make them masters of detail, and on returning to India they would be ready to devote their whole time and attention to the charge of any district, town, or group of population, to act under the local authority, subject to inspection by the Inspecting Sanitary Commissioner. And there would be, at the same time, a staff of trained officers from which selections could be made for the more important appointments.

The Commission, on consideration of the circumstances stated in these papers, conclude,—

1. That the Government of India, in appointing Inspecting Sanitary Commissioners for Governments, have made an important advance towards the sanitary improvement of the country.

2. That the duties of inspecting, advising, and reporting are the chief duties which in the nature of things these officers can discharge.

3. That the time appears to have come when this important step may be followed up by giving

practical effect to reports on a few unhealthy localities already inspected, a proceeding which would afford valuable experience for future guidance in carrying out improvements elsewhere.

4. That the Commission have no information of the nature of the agencies that may be at present available for carrying out sanitary improvements in the Native towns and rural districts; but they beg to suggest for consideration by the authorities, whether, in the present state of the question, it would not be desirable to appoint officers, for districts and groups of population, especially qualified and trained, so that they may be competent both to ascertain and direct the removal of local causes of disease.

Army Sanitary Commission, War Office,
March 9th, 1869.

No. 6.

MEMORANDUM by the Army Sanitary Commission on Analyses of Indian Waters.

The Royal Commission on the Sanitary State of the Indian Army recommended that a careful

1. Reports on Water Analysis in Bengal, 1867.
2. Report on Analysis of Portable Waters of cantonments in Bengal Presidency, 1868, by F. N. Macnamara, M.D.
3. Third Report on Analysis of Portable Waters in Bengal Cantonments, by F. N. Macnamara, M.D.

analysis should be made of Indian waters, and these reports on Bengal waters are the first instalment of the results of this inquiry.

The examinations have been generally properly conducted, and have afforded for the first time a true insight into the condition of water supply in India, and into the relation of source and quality

of water to the health both of troops and of civil population.

It may give some idea of the magnitude and importance of the work to state that, within little more than a year the principal water sources of 38 cities, towns, and stations, extending from Calcutta north-westward as far as Peshawur, have been examined, some of them at different seasons, and that nearly 400 water sources have been analyzed, and the results tabulated for use.

Of the water samples analyzed,—

65	were taken from tanks.
4	„ „ canals.
26	„ „ rivers.
9	„ „ lakes.
2	„ „ springs.

The remainder were from wells, with few exceptions, of shallow depth, most of them dug in cities, or within the boundaries of cantonments.

The general plan of the analyses may be stated as follows:—

Physical properties of filtered water.

Reaction, alkaline or neutral.

Hardness, permanent or removeable.

Proportion of oxygen per 1,000 for destroying readily oxydizable organic matter (the most injurious to health).

Amount of ammonia, phosphoric, nitrous, and nitric acids.

Total solids, fixed and volatile, with their approximate nature.

Soluble salts, and their nature.

The results of each inquiry are given under these heads, and they possess a high scientific interest apart from their bearing on the public health. We shall, however, confine our remarks solely to questions of health, and these, as we shall presently see, are of great importance.

The plan of analysis is based on Dr. Angus Smith's "Estimation of Organic Matter in Water, with reference especially to sanitary purposes," which was printed and circulated extensively among Army Medical and other Officers in India, at the request of the Army Sanitary Commission. In this paper Dr. Smith gives simple and efficient rules whereby the nature and probable sources of noxious organic matter in water might be ascertained, and he lays down certain general principles, by which the effect of impurities on health may be approximately estimated.

This can now be done for nearly every one of the waters submitted to analysis in India. But, before proceeding to state what are the results arrived at, it will be necessary to enumerate briefly the general principles referred to.

Besides ascertaining the precise nature and amount of saline matters in water, and their probable effect on health, the plan of analysis enables us to ascertain the proportion in any given water of rapidly oxydizable organic matter, together with its origin, in some cases with certainty, in others with probability, whether it is of animal or vegetable origin, whether it is in a decomposing condition, and consequently more or less of a poisonous character at the time it is drawn for use; whether the organic matter enters into this dangerous state after the water is kept a short time; and lastly, whether the organic matter is of recent origin or of old date.

The class of organic matter most important in a sanitary aspect is that which proceeds from decomposing animal debris, and the test which enables the chemist to distinguish this with an almost certainty is the co-existence of organic matter in water with certain salts and saline bodies. These are ammonia, nitrates, nitrites, and common salt. The last of these is perhaps the most important, for if its presence cannot be traced to sea-water, spray, or salt deposits in the soil, it can have but one of two other origins,—it must proceed from certain processes of manufacture in which salt is employed, or it must have passed through the bodies of men and animals,—in other words, it must proceed from sewage. As Dr. Angus Smith gave every needful caution for avoid-

ing error in estimating the source of common salt, when analyses are given without assigning the salt to any natural source, we must conclude that the common salt in these waters, in all probability, proceeds from old or recent sewage impregnation, with which the soil yielding water to the well has become charged.

The ammonia has, for the most part, a similar origin.

Nitrites mark the existence of organic matter undergoing decomposing changes. Nitrates indicate the change completed.*

As an illustration of the test for organic matter, Dr. Smith gives the result from four natural waters examined by him.

First. The water supplied to Manchester contains, in every 1,000 grains, as much readily decomposable matter as requires 25-millionths of a grain of oxygen to decompose it.

His sample No. 2 required 500-millionth parts of a grain for the same purpose.

Sample No. 3 required 2,200-millionths of a grain, and No. 4 required 5,500-millionths of a grain to destroy, not all the organic matter it contained, but only the readily oxydizable matter which, as already stated, is the most dangerous to health.

He shows that, as regards organic matter readily decomposable, the waters contain the following relative proportions:—

Manchester water, No. 1	-	-	-	-	1
Sample No. 2	-	-	-	-	20
Sample No. 3	-	-	-	-	88
Sample No. 4	-	-	-	-	220

But without the other tests mentioned it would be impossible to arrive at the origin of these amounts of organic matter. Here the amount of chlorides becomes of importance. After stating that in England it is almost universally the case that the presence of much chlorine in water indicates drainage from animal matter, Dr. Angus Smith states, that one grain of common salt per gallon is too much, and is in many places to be suspected of being caused by impure drainage, and, further, that if chlorides and nitrates are found in water in which easily decomposable organic matter is also indicated by the usual tests, "the presence of animal matter, or injurious gases, or "nitrites may be assumed."

"Nitrites may be considered as hurtful as organic matter until their effect is better known
"Their presence is suspicious, and their company bad."

Dr. Smith states his opinion, that water which requires 50-millionth parts of a grain of oxygen to decompose the organic matter in 1,000 grains of water is sufficiently free from organic matter, but the quantity beyond this which can be borne without danger is not known. It is a question of degree, to be determined by experience.

If we assume the Manchester water as a practically attained standard, the quantity of oxygen will be 25-millionth parts of a grain.

Bearing these principles in mind, let us now see what is the condition of these Indian waters, as given in the reports before us.

As a general rule, water samples taken from Indian rivers, mountain streams, mountain lakes, and similar unpolluted natural waters, do not afford those indications of sewage impurities to which we have referred.

They all contain readily oxydizable organic matter in a greater proportion than Manchester water, but as this is accompanied neither by an excess of chloride of sodium (common salt), nor by ammonia, nitrites, or nitrates, the organic matter is most probably of vegetable origin and innocuous. But when waters of this class are taken near groups of population, or when they are conducted along open channels, exposed to the risk of impurities, they give sufficient evidence of deterioration to show the necessity of filtration and covered storage, and of improving the means of distribution.

The water supplied [by tanks, provided the tanks are carefully kept, stands next in order of purity. Tank waters generally contain a considerable amount of rapidly decomposable organic matter, from 50 fold to 100 fold or more, the amount of organic matter in Manchester water. The amount of chlorides is generally small, and there are only traces of nitrates. The organic matter may therefore be considered as mainly of vegetable origin. But when natives deal with tank waters as they choose, of course the entire character of the impurities undergoes a marked change. The presence of sewage matter is then obvious enough.

The worst of all the northern Indian waters are those on which both troops and native population depend mostly for their supply, namely, water from shallow wells.

With very few exceptions, these waters show a considerable degree of pollution by organic matter in all the stages of it recognized by chemical analysis, and of those impure well waters in which the organic matter has been so far oxydized as to form nitrates the physical qualities are good.

The proportion of readily oxydizable matter often exceeds that of the Manchester standard 40, 50, and 100 fold,† while the presence of common salt to the extent of several grains per

* In estimating the probable origin of saline matters of this class in India, it must, however, be borne in mind that over large parts of the North-West Provinces the natural soil is impregnated with salts, including an appreciable proportion of common salt, as, for instance, in districts where "Reh" exists, and that there are tracts where the nitre of commerce is found, and manufactured from the soil. A probable origin of part, at least, of these saline matters in certain districts of country is the former occupation, and sewage pollution of the ground, by populations which have long since removed from it.

† With reference to these quantities, Dr. Angus Smith, in his paper afterwards referred to, makes the following remarks:—

"The permanganate (the re-agent made use of for oxydizing putrescent organic matter) does not seem to have borne so much fruit in India as I expected. I should have expected more striking results. * * *

"If it does not show greater amounts of putrid matter in some of the waters it will, of course, surprise me." Dr. Smith points out that this result is probably due to the water having stood some time before being tested.

gallon,—sometimes to the extent of between 70 and 80 grains per gallon,—indicates that the organic matter is most probably of animal origin. A large proportion of these well waters contain ammonia due to fresh sewage, and also nitrous acid and its accompanying phosphates, indicating the presence of sewage matters undergoing oxydization in the soil. In many cases, the greater part of the readily oxydizable organic matter has been already oxydized in the soil, and appears in the well as nitric acid compounds, often to the extent of several grains per gallon.

Depth of well, as shown by the reports, is no safeguard against impurities, if foul matter is allowed to enter at the well's mouth, or if the immediate surface yields foul water to the well. There are instances given in these reports of wells 90 and 100 feet deep, yielding both ammonia, nitrous and nitric acids, in addition to organic matters.

In most cases there is no difficulty in tracing these impurities in well waters to their source in the foul neglected state of the ground round the well's mouth, to the method of drawing and of slopping the surface by which foul water is thrown directly back into the well, to the proximity of latrines, cookhouses, stables, and dwellings, to the long use and occupation of the surface in which the well is dug, and to similar causes.

It may be stated here that in a number of instances filtered waters, which had passed through the ordinary barrack and hospital filters, were found to have benefited very little by the process. In some instances, indeed, filtered water contained more organic matter derived from the filter than was contained in unfiltered water, a result which has been observed when filters, especially small filters, are used too long without cleansing or removal.

It may be remarked that water impurity may be increased by natural processes of vegetation in water impure enough for the purpose. Thus, when the organic matter is in solution it is not always perceptible, but when growth begins it is taken out of solution and seems to increase. Thames water at London, if allowed to stand in the sun, used to take an appearance of solidity, so abundant were the green weeds in it and within the whole vessel.

The reports being intended to give the chemical constitution of the waters, do not enter specially into their influence on health of troops and civil population. But, nevertheless, there are notices here and there which sufficiently indicate what the influence probably is. Take, for example, the case of Peshawur, a station which has been scourged by cholera and fever to so great an extent, and which suffered so severely from cholera in 1857.

This station is supplied partly by feeders from the River Barra, partly from wells. The artificial channels traverse every street; they are simply open ditches carried above the level of foundations of barracks and houses; there are miles of them in cantonments; they are filthy, and frequently choked up with mud; secondary streams supply the regimental tanks. It is notorious that these streams are polluted in consequence of the careless and disgusting habits of the natives.

Native houses are built close to the main stream, and cattle are kept close to it. Natives wash their bodies and utensils in it. A native was seen to be taken ill with vomiting within a few feet of the bank of the main stream in the 42nd lines.

The Artillery well is only 11½ feet deep. There are old graves all round the well, and the place is a favourite resort of washermen.

Dyeing processes are carried on round the mouth of the gaol well, and the dye water is allowed to stagnate on the surface and emits a most offensive odour.

The water is stated to be so bad that the prisoners should not be compelled to drink it. The fort water is so salt and bad that it is used only by native workmen.

These few facts, mentioned incidentally in the reports, show that, so far as concerns its water supply, Peshawur has been simply made a nest of epidemic diseases, resembling the south of London in the days of open ditches and bad water. And they indicate clearly what ought to be done. So long as these ditches are left in existence, and so long as the water supply is such as it is described to be, there is little hope for improved health among troops stationed at Peshawur. A competent sanitary engineer would very soon detect and remedy the evils.

Take another example, Delhi. Some time ago the Commission reported to the India Office that there was reason to believe that the sanitary state of Delhi, including the condition of its water supply, was a cause of the "Delhi sore."

Delhi is supplied with water from wells dug in the nitrous soil of the city. This nitric acid appears to be the result of a continuous impregnation of the soil, in houses and compounds, with urine and feculent matters. In proof of this, Dr. Sheppard shows that, while water taken from a well dug in the old cantonment, at a distance from houses, gave "not the minutest portion of nitric or nitrous acid or ammonia," a sample of earth taken within the city, from a locality formerly occupied by houses, yielded "an immense amount" of these sewage products.

Part of the water of Delhi is supplied from the river Jumna.

Dr. Sheppard gives the following facts in relation to the "Delhi sore," and the quality of water, but he also attributes part of the susceptibility to this disease to the impure air of the city.

Jumna water contains twice the amount of readily oxydizable matter existing in Manchester water. But it contains only $\frac{1}{10}$ ths of a grain of common salt per gallon, and affords no trace of ammonia, phosphoric, nitrous or nitric acids.

This water was used by the right wing of Her Majesty's 98th Regiment, among whom there were 15·6 per cent. attacked with "Delhi sore" during the first year's residence, and 10·7 per cent. during the second year. The decrease was 4·8 per cent.

There are two wells which supplied water to the 25th Native Infantry, namely, the Delhi Gate well and the Khyrattee Gate well. The former contains 137 grains of solid matter per gallon, of which apparently only a minute quantity consists of readily oxydizable matter; but instead of this there are no less than 15 grains of nitric acid, 41·3 grains of common salt, and 33·7 grains of sulphate of soda per gallon.

The Khyrattee Gate well contains more organic matter: 10 grains of nitric acid, 29 grains of common salt, and 19 grains of sulphate of soda per gallon. Its total solid constituents exceed 92 grains per gallon.

The regiments using these waters yielded 8·5 per cent. admissions from "Delhi sore" during the first year, and 23·9 per cent. during the second year of residence, showing an increase of 15·4 per cent.

The Putthur Ghatti well, used by the Royal Artillery, contains three times the amount of readily oxydizable organic matter that there is in the Manchester standard. It contains ammonia, $1\frac{1}{2}$ grains of nitric acid, and above $4\frac{1}{2}$ grains of common salt per gallon. It contains a considerable amount of inflammable nitrogenous organic matter.

The Royal Artillery, using this water, afforded 15·6 per cent. admissions from "Delhi sore" during the first year's residence, and 43 per cent. during the second year, showing an increase of nearly $27\frac{1}{2}$ per cent.

Dr. Sheppard further calls attention to the non-development of "Delhi sore" in former years among British Officers and Native troops who lived in the purer air and used purer water of the old Delhi cantonments, and to the absence of this sore in Meerut, where the water supply is purer.

The possible influence on the skin of these highly nitrogenized waters, when used for ablution, has likewise not escaped attention.

Dyspepsias and diarrhœas have also been traced to their use.

One illustration more will suffice. Many of the wells in Oude are so bad that Assistant Surgeon Orton, who visited the cholera districts of the province in 1867, reports that in every instance, without exception, the drinking water was filthy, or, as the Natives themselves expressed it, putrid. A glass of it would produce diarrhœa at once in a person unaccustomed to partake of it. It is loaded with sulphates, chlorides, nitrates, and organic matter. Mr. Orton further states that, where cholera prevailed among troops, the water supply was similarly objectionable.

On the other hand, he mentions that at the Havalet, where the water is bad, fever, diarrhœa, and dysentery were invariably the prevailing diseases, till the use of the water was prohibited by an order of the magistrate, and he says that since this was done scarcely a single case has come under his notice.

As a general rule, the well water supplied to sick in hospitals appears to be even more impure than the barrack supply.

It will be seen that this, as yet partial examination of Indian waters, has opened up an entirely new chapter of the disease causes in India.

Suspicion which formerly prevailed as to the efficient operation of this cause of ill-health among troops and civil population has become so strongly confirmed that the only question is what should be done.

First. In the first place, it is evident that these chemical examinations should be continued all over India, and that especial attention should be devoted to waters used in localities where cholera, dysentery, and fevers are endemic. And in estimating the source of the saline constituents in water, it might be well to analyze samples of soils and subsoils at different depths and in different localities, with a view of ascertaining whether these salts are due to the geological conditions, or to old or recent impregnation of the soil with sewage impurities.*

Secondly. There are the practical questions of water sources and means of distribution. In regard to these points, there is nothing indicated in these reports which has not occurred elsewhere. Like evils require like remedies. In former days London, as well as other cities and towns at home, suffered from precisely similar water impurities, arising from similar causes. London was formerly drained into cesspits, and derived its water supply partly from the impure river at London Bridge, and partly from wells among the cesspits. We have no chemical account of these waters, but we can form a very good idea of their nature by analyzing the existing wells even after the metropolis has been drained. This has been done, and not a single well is fit for drinking purposes. During epidemic seasons many are poisonous, like the well in Oude.

London was formerly scourged with fevers and dysenteries, just as India is, and yielded an enormous death rate.

The practical solution of the water question for India is the same as it was for London.

All old wells among groups of population in cities, villages, bazars, and the like, which afford such waters as the wells submitted to analysis have done, should be rendered impervious to any infiltration of surface water by careful puddling or other methods. It has been stated, for instance, that an impure well at Bangalore was purified from foul surface drainage water by so simple and inexpensive an expedient as digging and removing the soil round the well's mouth, to a distance of six feet from the tube, and about the same depth from the surface, and filling the space with clean sand.

After cutting off the surface drainage, the true deep subsoil water should be tested, and, if good, may be used, but if bad, then the well should be filled up and closed with as little delay as possible. Wherever these waters show readily oxydizable organic matter, requiring an amount of oxygen exceeding 0·000,050 of a grain per 1,000 grains of water, together with a grain or two of common salt per gallon, or wherever there is ammonia present, or nitrites in any quantity, or organic matter, nitrates, and common salt, it may be considered certain that the water is unsafe during epidemic periods, and that its constitution cannot be depended on.

* Dr. Angus Smith, with whom we have communicated regarding the results of his plan of analysis, already referred to, has placed at our disposal a paper of remarks, a copy of which we have appended, with the view of its being sent to the chemists engaged in this work

Thirdly. The best available sources of water in India, as shown by these examinations, are rivers, streams, and lakes, and in some places impounding reservoirs might be advantageously constructed. Properly constructed tanks, which are a species of impounding reservoir, would answer in localities where the requisite facilities existed for their construction, provided due care were exercised in protecting the water from pollution, and in sand filtering it before use.

The roof water of buildings, if filtered and stored under cover in places where it would not become impure by soakage of foul surface or subsoil drainage, would form, in many cases, an important source of supply for drinking and cooking purposes at military stations.

Wherever new wells must be depended on, they should be sunk in the cleanest ground available, and at a distance from dwellings, and from all sources of impurity. The top should be built up and covered, and care should be taken to cut or puddle off the immediate subsoil water from the well.

Fourth. It would be very desirable to improve the means of raising, conducting, and distributing water, so far as it might be practicable to do so, at stations where the present methods of distribution are found to add to the impurity of the water supply.

In conclusion, we would beg to suggest that the whole subject of these water sources may at once be taken up in India, with the view of devising some practical method for providing troops and civil population with pure water.

Army Sanitary Commission, War Office,
April 12th, 1869.

No. 7.

NOTES by DR. R. A. SMITH, with reference to the Analytic Examination of Waters in Northern India, described in Dr. Macnamara's Report.

16th February 1869.

I send a few notes after thinking over the analyses. They add a little to what was said, and may be of use if taken in good part by the analysts.

I am inclined to increase the number of questions relating to water. The value of many methods lies in the fact that there are many varieties of waters. I have put down, therefore, one or two more divisions of organic matter. Each may be useful in its way. Glad I am to see that the work is good, but naturally one feels inclined to wish always for more.

(Signed) R. ANGUS SMITH.

When we seek an analysis of water we merely desire such a full description as will enable us to see at once its character, and therefore we require something of its natural history. With this in our minds, we may consider if the late analyses of Indian waters satisfy every demand.

On looking over the work I consider that a good idea of the waters is obtained, and that the results will be of immense value. As it is difficult to be perfect I may be allowed to draw attention to some questions (rather, I ought to say, according to request I do so).

In all analyses of water I look on the organic matter as the most important point. I can imagine a very satisfactory investigation into the quality of the water where nothing but organic matter was spoken of. Instead of one or two columns I would give many to this point.

First, the description of the water.

It seems to me not to be very full, unless it be that there is uniformly little to observe. The same fault is found in analysis made here. Having a fellow-feeling with chemists I do not wish to see them burdened; it would, however, be well if they gave themselves a little experience in examining the organisms in the water as soon as collected, and later. A little of the deposit taken up and examined by a small microscope,* with a half-inch power, would give a valuable experience, even without the scientific names of the bodies seen.

After the water had stood, protected from air, for some days—in our climate (Great Britain) a week or so—it could be examined again. This will show if there is much vegetable or animalcular life.

So far as I know there is no such examination published as will distinguish (by the animal life) good and bad water. Forms of all kinds are generally shown together, the time of careful distinction has not come. It does, however, seem to me that fleshy or gelatinous forms are the most hurtful, as they also are the most disgusting. They seem to abound according as the water becomes worse, until a stage comes which destroys even them, bringing putrefactive gases and vapours.

It would be easy for the chemist to indicate these forms, and observe without much detail. I should not complain of waters at the bottom of which were deposited many of the forms of diatoms or desmidiacæ, or in which were swimming even the larger entomostraca, if carefully removed, unless they indicated something worse, although not readily seen, whilst I should fear water in which were floating the beautiful volvox or the englewa. If there did not exist material for the formation of these creatures they could not be found, and the material for the latter is hurtful.

This mode of developing them, at a proper temperature, and then observing them, is the simplest of all modes of examining water, and can be managed by any one. It is of value even without a microscope, but of more value with one. I wish simply to reduce into a scientific

* A Stanhope lens might be used for such purpose.

form the common and approved modes of observation, as our first step. One or two microscopes might be sent as a commencement, to see if they bear fruit.

There are cases in which gases are found as the results of decomposition, and in such cases by the usual modes of analysis they are entirely lost; the amount of organic matter, in weight, gives no idea whatever of the state of the water. Indeed, as a rule, the amount of organic matter in weight is of little value. Although I have often said this, and first said this, I see I am quoted with a very different meaning.

This putrid state is the only one which the permanganate was proposed for measuring. No other method does measure it, or even pretends to measure it. The permanganate does not seem to have borne so much fruit in India as I expected. I should have expected more striking results. There seem to be different modes of reading off. In one case there is sulphuretted hydrogen; even that has only slightly affected the permanganate.

Possibly greater quantities of water ought to be used. For example, it would be better, when possible, to use 100, or, still better, 1,000 centimeters, and reduce afterwards to any standard amount.

In order to diminish the fractions it would be better to change the decimal place, and to say "oxygen required for one million parts of water." This would do either for grains or cubic centimeters, and avoid the conflict of measures. It is merely a change of the decimal point three figures to the right. Still its results have been valuable, although no one has gone with interest into the details of the use of the permanganate. If it does not show greater amounts of putrid matter in some of the waters it will, of course, surprise me. It certainly may happen that the gases leave the water in warm countries sooner than with us, but then they are formed more rapidly. The test, however, is delicate, and it requires some time to know its peculiarities. It has been objected to it here that it is acted on by iron and nitrites. That is surely no real objection to a chemist, who will estimate these separately.

One reason why it has done less good is seen on a remark that the water was allowed to stand 24 hours before using permanganate, as it took up less then.

That fact shows that the test was right, but the gas having escaped during the 24 hours, it could not be measured. However, a valuable piece of information was gained by this, namely, that putrefaction was not forming new gases. If it is common to use the water only after standing that time, then also Dr. Macnamara had the most practical view of the case, but not its history.

Delicate as this is it tells us nothing of the solid matters undecomposed, and nothing of the growths that may take place when it is used cold, in the way which Forchhammer devised, and which I simply followed with details.

If we want to know the amount of matter containing nitrogen we must use it heated, and along with soda or potash, as Mr. Wanklyn has shown. His mode of first removing the ammonia by boiling with carbonate of soda, and keeping the distilled product, testing that then for ammonia, by Nessler's test, is very instructive. When this is done it is again boiled, after adding caustic soda and permanganate; the ammonia then collected and estimated as before. It seems to me well to use this test also as an indicator of the nature of the organic matter. Some chemists will probably take to one more than to the other; I do not well see that we can dispense with any of them when the work is to be done for a great rational purpose, and when we may expect the analyses to be models for the world, as they certainly may be expected to be when done by a great nation for another in many respects greater.

The advantage of Wanklyn's process being added to the others will be felt very strongly in cases where there are nitrates. Then the process by burning causes a loss both of organic matter and nitric acid. This loss is put down as organic matter frequently, and the true organic matter is never seen. Wanklyn's process will find it by showing the nitrogen. As it does not show the putrefactive power of water or its organisms, it must not be used alone, since it may give alarm when there is really no danger. On the other hand, it will not fail to give alarm when there is danger of putrefactive matter.

The cold permanganate reaches the matter which may become decomposed, the hot process that which may decompose. It is well to add new processes, they always give more knowledge. I certainly would recommend a fuller examination of the organic matter. These are the most important methods of doing so.

It is, perhaps, well to give along with the hardness as a whole, the permanent and removable, but it is not of great importance in India at present, where it is not probable that Clark's process of softening will be adopted. I should prefer to see stated the amounts of sulphate of lime and the amount of carbonate. These results are distinct, definite, and of value for future time, and have a more scientific meaning, in other words, a value of wider application, the mere softening or hardening as a relation only to empirical processes of limited use.

Volatile matter is important. It is, however, good to state if the matter is entirely organic. If, for example, there is much nitric acid, the organic matter is oxidized by the acid, and both go off, leaving a very white ash.

The magnesia water has been mentioned as being considered hurtful. If there is any suspicion of this, the amount of the base ought always to be given in the analysis in full, indeed it is better to have the analyses full under any circumstances. We know, however, that no injury

arises from three or four grains of carbonate of magnesia in a gallon in England. At least we infer this, as that amount is so common.

Of silica we know little, in a sanitary point of view. It is probable that no amount will be injurious. I generally find from a third to half a grain in a gallon. It is well to give it in those cases in which the analysis is carried so far as to bring it easily into the hands, but not to evaporate much for the purpose.

Of the inorganic substances none have been so capable of indicating the quality of a water as the chlorine. The chlorides, or we may say "common salt," is almost universally found in bad waters, showing sewage. The attention to this substance has been successful. I always take abundant care that no inorganic sources of this salt will mislead. There ought, however, to be some waters which give little chlorine, and which are still hurtful, viz., marshy waters. It would be well to give some attention to this subject, it is new and unknown; such water has bad qualities, of a vegetable origin wholly, as I suppose.

As to the mode of retailing the analyses a little license, of course, must be allowed, since there are various ideas, but as much uniformity as possible ought to be sought. I should prefer to see the words "permanent" and "removeable hardness" replaced by a careful statement of the carbonic and other acids, with all the bases. The most complete way is the statement of the salts, but some theoretical difficulties prevent it being fully carried out. These might be got over if we could estimate the potash precisely, but that is a very troublesome operation, at least chemists generally avoid it. If any objection is made to it, it might be left out, and soda allowed to stand for the alkalies. In this country the amount of potash in waters is extremely small, and is generally omitted in analyses; it is, however, always present in the waters. In a country comparatively new to these inquiries, it would be well to inquire if there are any waters with a considerable amount of this alkali. I do not see it mentioned.

The question may be asked,—"Is it well to make the examination with the greatest minuteness at once, or to leave the fuller inquiry to a future time?"

I am inclined to think that attention to organic matter ought to be given first for all specimens, whilst selected specimens are examined with all the minuteness which chemistry can give.

There is a want of peculiarities among the waters. I should have expected in India something not the same as here, but this may be groundless fancy.

Careful examination for rare bodies would be of great value. Such examinations of inorganic bodies as Frezenino makes of the bath waters of Germany, which would occupy a chemist many weeks. An analyst might have one of these continually on hand whilst going on with the less minute and more practical inquiries on other specimens.

The following headings might be given, or a selection, according to circumstances:—

When the Water is collected.

1. Physical properties.
2. Vegetable and animal life visible to the naked eye.
3. Vegetable and animal life seen by the microscope.

When the Water has been kept a week.

- a. Physical properties.
- b. Vegetable and animal life visible to the naked eye.
- c. Vegetable and animal life seen by the microscope.
- d. Appearance.
- e. Reaction.
- f. Hardness, permanent and removable, if desired.
- g. Oxygen required by a million parts of water.
- h. Nitrogen from nitric acid, old organic matter.
- i. Nitrogen from nitrous acid, recent organic matter.
- j. Nitrogen from ammonia, recent organic matter and rain.
- k. Nitrogen by Wanklyn's process, present organic matter. (Boiling with caustic soda and permanganate.)
- l. Organized organic matter by description.
- m. Probability of much animal matter.
- n. Probability of much vegetable matter.
- o. Gases from organic matter decomposing cold permanganate.

We cannot expect one analysis to go over all the ground, but I think we have in the preceding list a certain goal to which we may attain, sometimes perhaps when a water must be perfectly examined, filling up actually every space.

There may be added also as a mode of comparison,—

1. The best Indian waters take of oxygen.
2. The best Indian waters give of ammonia.

The ammonia got by boiling with the carbonate of soda consists of that which is inorganic, the rest has been formed by the boiling process from organic substances containing nitrogen. Every one of ammonia is equal to ten of albumen.

I think it would be better to introduce a decimal amount of water instead of the partially decimal gallon. The French introduce 1,000. This gives rise to too many fractions. I have

been using a million for air for some time, and whenever it is decided to abandon the gallon I think it will be better to take a million parts. Continental nations will then find it more convenient to read our analyses than their own.

It was my intention to send a specimen of the full analysis. At present I am not ready, and am considering modes of shortening the work considerably, whilst at the same time the results are increased.

Frankland's process for nitrogen is unnecessary when Wanklyn's is used. I could not recommend the first for India, as it is complicated. I know the second to be valuable; time will show the extent of its accuracy.

I do not consider it necessary to divide the organic matter in all cases into such a great number of portions, but in all cases one or more of these portions are wanted, and there may be cases which are worth such a full examination that all will be taken into account.

The inorganic analysis follows.

Some day the relation of the oxygen to the nitrogen of the air in the water must be added as a regular part of the analysis. There is a good deal before us in perfecting and shortening the work.

(Signed) R. A. S.

No. 8.

MEMORANDUM by the Army Sanitary Commission on a "Report and Order of the Madras Government upon the Dry-earth System of Sewage in the Madras Presidency."

There are several points of interest closely connected with the ultimate results of public health improvements of Indian stations, raised by a perusal of this report on the dry-earth conservancy system, which appear to call for remark.

1. In considering any single proposal for improvement, such as the dry-earth conservancy, it is necessary to bear in mind that the objects to be attained by public health works and measures are a sufficient supply of pure water, together with the removal as speedily as possible of all causes of impurities, solid, liquid, and aeriform, away to a safe distance from human dwellings, and an innocuous, and, if possible, a profitable application of such refuse.

2. It is not a sufficient adaptation of this great principle to remove only one class or cause of impurities and to leave the others, and no sanitary proceeding which does not deal effectually with all of them can be considered as sufficient for health.

3. The following sources of impurity require to be continuously removed from inhabited buildings in India, as elsewhere,—

- (a.) Solid kitchen refuse, including *débris* of food.
- (b.) Rain-water which would, if left in the subsoil, tend to generate malaria.
- (c.) All the water brought into the station, except that which accidentally evaporates. This water is used for drinking, cooking, washing, baths, and lavatories. The amount cannot be taken at less than 12 gallons per head for every healthy man, woman, and child, including servants, from 30 to 35 gallons per head for every sick man per day, exclusive of water for horses.

Although these quantities give the estimate made by the Commission in their suggestions for improving the sanitary state of Indian stations, it may be well to mention that a special inquiry since made in England and Ireland for the purpose of saving water has shown that Infantry regiments require 15 gallons a head per day at home, including about 2½ gallons for laundry and married soldier's quarters.

Practically this water in all climates, but especially in India, becomes, if not safely disposed of, an inevitable source of disease and ill-health. It contains a large amount of putrescible matter, and, if urine were mixed with it, it would become so noxious that it would matter very little whether or not the contents of latrines were added to this other sewage.

- (d.) The matter from latrines, including solid and fluid excreta at about 1 lb. per man per day, or in round numbers half a ton per day per 1,000 men.

4. The first of these classes of impurities, viz., solid *débris*, are removed by hand labour or by carts.

The rainfall must be removed to a large extent in India by improving the surface and by impervious surface drains, while the subsoil must be freed from excess of water by subsoil drains.

The refuse water must, under present arrangements, either be passed into cesspits, or it must be carried away, or it must be allowed to find an outlet where it can by surface drains, probably into the subsoil.

It is with the last of these impurities, namely, latrine matter, that the dry-earth system proposes to deal.

5. The latrine matter to be dealt with is to the fluid refuse of barracks, hospitals, cook-houses, &c., as 1 to 190. That is, for every pound of human excreta removed under the dry-earth system there are, in every well regulated establishment, about 190 lbs. of fluid refuse which must be otherwise disposed of.

6. In estimating the influence on health of the dry-earth system of conservancy, it is necessary to bear in mind distinctly what it professes to do and what it professes not to do. For it is evident that, whatever advantages to health may accrue from the dry-earth conservancy, it deals only with one part out of a hundred and ninety-one of the total injurious barrack and hospital refuse, while it makes no provision for the removal of surface or subsoil matter.

Bearing these facts in mind, we proceed to remark,—

7. That there is no doubt of the deodorizing power exerted by dry-earth, especially if it contain vegetable mould or humus. There is no doubt also that this deodorizing power is exerted on both solid and fluid excreta. The only questions, therefore, to be dealt with are those of practical application, cost, and subsequent disposal of the deodorized matter.

8. On these points the papers referred to the Commission afford much interesting experience. They show that the quantity of dry-earth required for latrines alone is about $2\frac{1}{2}$ lbs. per man per day, proportionately increased if the latrine is used oftener than once.

For 1,000 men, 2,500 lbs. of dry-earth must therefore be carted into the station, and distributed to the latrine seats every day, and 3,500 lbs. of mixed deodorized matter must be collected from the latrines and carted away every day.

9. But the urine from day and night urinals has still to be dealt with, and the papers appear to show that the amount of dry-earth required to absorb and deodorize the urine of one man is about 7 lbs. per day, or 7,000 lbs. per day for 1,000 men.

For this purpose it would be necessary to cart into the station and to distribute 7,000 lbs. of dry-earth, besides collecting and removing 8,500 lbs. of saturated earth every day.

10. The total daily amount carted into the station and distributed would thus be 9,500 lbs., and the amount to be collected and carted away would be 12,000 lbs. The daily movement of earth and soil would thus be nearly 10 tons for 1,000 men.

11. The further papers show that great care and constant attention are required in adapting all the parts of the process to each other. Mechanical difficulties have been experienced in the use of hoppers for throwing in the earth; scoops for throwing in the earth after using the latrine are imperfectly applied. Native servants have had to be appointed to this duty.

12. And the whole system on which the dry-earth conservancy is based, namely, the immediate and regular application of earth, has in one or two cases been departed from, apparently on account of nuisance or difficulty in application of the system, and a wooden mill has been contrived, into which excreta and earth are poured, and ground or mixed together by labour, with the view of more efficient prevention of nuisance.

13. Leaving aside the cost for the present, and its prospective increase as the value of labour rises in India, it is evident that the mere cartage, distribution, collection, and removal of so much earth would present many practical difficulties, and hence Dr. Ranking, the Madras Sanitary Commissioner, proposes to limit the use of the dry-earth system solely to the latrines, and to deal with the urine separately by MacDougal's disinfecting powder.

14. The cost of latrines alone without the urinals is apparently the same as on the old system of conservancy, about 25% a month, or 300% a year, for a regiment of 1,000 men.

If the dry-earth system were used for urinals it would add 120% a year to the cost, equal to 420% per annum for 1,000 men, equal to a capital sum at five per cent. of 8,500%.

15. The chief method in use for disposing of the deodorized excreta of stations is by burying them at a distance from the station. But it is evident that in the course of time such a practice must result in fouling large areas of ground, and for this reason that the quantity of earth with which the excreta are mixed is much too small to absorb permanently the products of decomposition. Hence in these papers it is stated that, even after careful mixture of excreta with earth, the mass when buried gives out offensive vapours in rainy or damp weather.

16. It further appears, that when a small quantity of the deodorized and buried excreta is taken up and diffused in water, the resulting fluid is found under the microscope to teem with vibriones and other forms of organic life, the very forms which some writers have included among the causes of Asiatic cholera.

17. Without laying undue stress on this fact, it still may be taken as showing that in India the earth process and subsequent burial are inadequate for the requirements of health, at least in the case of large fixed populations, and that if this process is to be continued for such populations, it may be modified and brought more in accordance with natural laws.

18. There is no doubt that earth is the assimilator and neutralizer of all decaying organized matter. It incorporates the organic elements with itself, and renders them useful for the nourishment of living vegetation. It is through the medium of earth that the entire cycle of life and decay is completed.

19. But every agriculturist knows that for practical purposes decaying matters must bear a very small proportion to the whole body of earth, otherwise the earth becomes unwholesome. With some manures this amount is almost infinitesimal. The true principle, therefore, in applying excreta to soil is to do this as an agriculturist would do it. Not to bury it in a hole to the danger of poisoning both water and air, but to plough or dig it in so as to bring the decaying matter into immediate contact with a large body of earth, and then to convert it into living useful produce by agriculture.

20. This being the case, the only question is, how to bring about this union of decaying substances with the soil most easily, continuously, and cheaply.

21. It is evident that the dry-earth system, as at present carried out according to these papers, can at the best only act as a means of deodorizing in the intervals between daily removals of the latrine matter, and at a time preceding the disengagement of putrid emanations. (That is on the assumption that the latrines and urinals are cleansed daily.) But that a much better and safer method of disposing of the matter after removal is required than any hitherto in use.

22. There is at present the cost of carriage and labour, and the labour must be so organized that no break in the arrangements can take place. To complete the process, there must be means of applying the refuse to the soil otherwise than by burial.

But if the deodorized latrine matter were used for agricultural purposes, it must be borne in mind that all manure must be in solution before it can be taken up by plants, and if it must be in solution it may as well be conveyed in water. Now, conveyance by water in England costs only a tenth part of conveyance by cart.

23. Foul water already containing manure in solution exists at the stations, and is not removed by the dry-earth system. But it is absolutely necessary that this foul water, derived from the water supply carried into stations, should be removed from them. By far the cheapest way of doing this is by drains, and if there be drains for foul water there is no reason why the latrine refuse should not be carried away in the same drains.

It is true that the cost of water latrines and drainage must be considered in any comparison of outlay.

The first cost of trough latrines or soil pans may be taken at 1*l.* sterling for every 10 men. The first cost of drains will vary according to the site and distance of outfall, but in any case there must be foul-water drains unless the foul water is carted out of the station.

24. To have two systems of cleansing stations, a foul-water system and a dry-earth system, would simply be paying double, where one payment would answer, or, if all the excreta, solid and liquid, are to be carted away, this must be done at a cost ten times greater than that which would be necessary if all the excreta were removed by drains.

25. We shall conclude this part of the subject with a few remarks on the methods adopted for carrying out the dry-earth system as shown in the papers.

In the first place, if this cannot be done without the aid of mills and such like apparatus, the system ceases to be the dry-earth system and becomes something else, while it may be safely asserted that of all the systems hitherto contrived for dealing with excrementitious matters, this one, in which excreta and earth are ground together in a mill, is least in accordance with civilized habits.

Secondly. If the dry-earth system is to be carried out it should be in strict accordance with the methods laid down by its advocates, who are responsible for its results.

Third. The dry-earth system as applied to latrines and urinals is nothing more than a temporary expedient for deodorizing the matters, but whether the matter becomes injurious or innocuous thereafter depends, not on the dry-earth system, but on the use to which the deodorized excreta are put.

Fourth. Excreta in the fresh state or mixed with earth should never be disposed of by burial. They should be ploughed or dug into the ground simply as manure, and the manured ground should be cropped. In this country (England) application of saturated earth to agriculture is part of the dry-earth system.

Fifth. Whether the dry-earth system be used or not for latrines and urinals, the health of stations will be only partially improved unless provision be made for removing away from stations all the foul refuse water as well as the malaria producing subsoil water of the station.

26. It will be seen from what has been stated above, that the removal of latrine matter is simply an incident in the drainage of a station, and that in draining a station we have only to consider the population and the amount of water supply brought into the station and fouled by domestic use. The real question is, how this foul water can be most easily and cheaply removed. It is necessary to enunciate this principle broadly, because the amount of nuisance from imperfect latrines in such a climate as India, has naturally drawn the attention of Medical and other Officers to the necessity for abating this nuisance, to the possible underrating of sources of disease from the foul water of stations of equal if not of greater importance.

27. At all stations in India where there is sufficient fall and water properly provided, there can be no doubt whatever of the greater economy of removing the foul water, or rather of allowing the foul water to remove itself by drains to an outlet where it can be applied for irrigation.

If this be not done, a system would have to be organized for collecting and carting away the foul water at stated periods (leaving it to become putrid in the intervals of removal) at a cost probably ten times as great as would be required if it were allowed to flow away by properly constructed drains.

28. Again, the construction of latrines to be cleansed by water, as already stated, would probably not exceed 1*l.* for ten men, against which would have to be placed the cost of dry-earth latrines; while, if foul-water drains were laid down, the contents of these water latrines could be permitted to flow away as often as needed to prevent all decomposition. This proceeding would involve no additional cost, as the same tube drain would serve for both purposes.

29. Cases in which there is deficient fall might be supplemented by raising the latrines and other drainage heads above the level of the ground, or the sewage might be run into a watertight tank at a distance from the station, and lifted by a pump worked by a steam-engine or otherwise to the level necessary for disposing of it.

There is, however, scarcely a plan which has come before the Committee showing a fall in the ground which would render natural drainage impossible.

30. Practically, very small falls are required, and drains laid level may be flushed at short intervals by comparatively small volumes of water.

This subject has been considered in the Commission's Suggestions for the Sanitary Improvement of Indian Stations, and the leading principles are there stated by which unfavourable levels may be rendered more available for drainage.

31. We have already shown that a station, say for 1,000 troops, would require 12 gallons per head per day for every healthy man, woman, and child, including servants, and from 30 to 35 gallons per head for every sick man. Now, in practice it is found that a two-feet sewer, laid with a fall of five feet per mile, or 1 in 1,000, will remove three millions of gallons of water silently and continuously in a day of 24 hours. In other words, it would drain away to an outlet the foul water, including the latrine drainage, of 150 stations with 1,000 men in each of them, if they were all within reach of such an outfall sewer.*

* Refuse water is discharged at unequal intervals during the day. In calculating the capacity of outlet sewers the entire daily volume of fluid refuse should be provided for in eight (8) hours. An outlet sewer of two feet diameter, having a grade of 1 in 1,000 would therefore serve 50 stations with 1,000 men in each station.

32. It may be useful to append the accompanying Table prepared by Mr. Rawlinson, showing the amount of water which can be removed by drains of different sizes at different uniform velocities.

The lowest velocity in the table is one foot per second, and the smallest drain pipe is four inches in diameter. A main drain with these elements would remove twice the water supply of a station for 1,000 men. Suppose that a pipe sewer nine inches in diameter were used, this would drain away the water supply of ten stations for 1,000 men each, and even if laid for a station of 1,000 men, it would cost, according to the table, 4s. 6d. per lineal yard, equal to 396l. per mile, or not much more per mile for a permanent self-acting work than would be necessary for a single year's cost of the dry-earth system for latrines alone, excluding the whole foul water of the station.*

33. It can never be predicated of any station, unless it is below the level of a river or the sea, that it has not sufficient fall for drainage. The eye is no guide. It is almost certain, wherever rain falls on apparently flat alluvial country, that it has hollowed for itself outfall lines, the position of which can be determined by survey. Without levels nothing can be done in deciding on the drainage peculiarities of a flat country.

34. But supposing that the station were at the lowest point of a flat district, it could still be drained. Almost the whole of the South District of the metropolis is at or below the River Thames level, and it has, nevertheless, been sewered. The same may be said of West Ham and its neighbourhood, and of Worthing. The outlets in these instances are obtained by pumping. This auxiliary agency of pumping is used to a much greater extent than is generally supposed even where fall exists, because it is found to be less costly than a distant natural outlet.

In Cornwall and in Staffordshire clay mixed in water is pumped and transmitted through pipes several miles in length.

In great dredging operations sand and silt are dredged into pipes, through which they are transmitted to shore.

All the sewage of the town of Worthing, about 700,000 gallons per day, water supply and subsoil drainage, with the excreta of 12,000 persons, are pumped and transmitted through a pipe one mile in length and 12 inches in diameter. The low level sewage of the metropolis on both sides of the Thames is pumped and transmitted through sewers.

The sewer which drains the barracks and station at Hounslow is laid nearly on a dead level, and the sewage is pumped on to the land.

35. But perhaps the most useful data are those supplied by Aldershot, because they include the application of sewage to agriculture in a purely military district.

The area of the permanent barracks and south camp actually sewered amounts to 331 acres.

The maximum population on this area is 12,458 persons, together with 2,286 horses.

The amount of water supplied from reservoirs, exclusive of a large amount drawn from wells, is 210,000 gallons a day.

36. For the removal of part of this water from the barracks to the outlet, after it has been used for domestic purposes, there is a sewer 18 inches in diameter, with a fall of 1 in 100 at the higher end and 1 in 980 at the lower. For the camp there is a sewer 18 inches in diameter, with a gradient which varies, but the average is only 1 in 1,000.

37. The ordinary depth of sewage in the 18-inch barrack mains, including 2½ inches of deposit at certain points, is 6½ inches for wet weather and 6 inches for dry weather, showing a section of 54·17 inches in dry weather.

The depth of the sewage in the South Camp 18-inch main is 3 inches in dry weather and 4½ inches in wet weather, exclusive of deposit of 3 inches at a point where there are difficulties of level. The dry weather flow has a sectional area of 27·7 inches.

38. The local rainfall at Aldershot averages about 28½ inches per annum. This rain water escapes over the surface and by underground pipes (which are kept perfectly distinct from the sewage pipes), into the nearest stream or ditch, and so into the Blackwater river.

39. The sewage and rain water systems are thus kept distinct, but a small quantity of rain nevertheless finds its way into the sewers proper. An inch of rainfall throws about 47,000 gallons of rain water on the irrigated land with the ordinary sewage.

40. The Aldershot Sewage Farm contains 130 acres, 77 of which have been under irrigation, some of it for several years.

When the sewage was first applied there was no vegetable soil, properly so called, on the common. The surface consisted of reddish and yellow Bagshot sand, with layers more or less dense of iron sand, locally termed "pan," which required to be broken up before the ground could be prepared for crop. The ground contained 95 per cent. of silica, 3 per cent. of protoxide of iron, and a trace of vegetable matter. The surface to a depth of 4 to 6 inches was in many places nearly as hard as concrete.

41. Perhaps the very worst possible soil has in this experiment been brought under successful irrigation and culture. All the elements of the question have been dealt with, and the result has been, that the offensive barrack and South Camp latrines have been abolished, the station drained, all the refuse water rendered innocuous by irrigation, and the fertilizing matter removed out of it, and applied to the production of food on ground which had previously yielded nothing in the form of useful vegetable produce.

* It will not be advisable to adopt 4-inch pipes for outlet sewer drains for several reasons. It will cost as much, or nearly as much, to excavate a trench for a 4-inch pipe as for one of 9-inch diameter, and the slightest inequality or obstruction in a 4-inch pipe would tend to block and choke it. As set forth in the "Instructions" tributary drains should join mains of larger diameter, as 4-inch into 6-inch, and 6-inch into 9-inch. As there will necessarily be tributary drains in all cases, outlet sewer drains should therefore be not less than 9-inch diameter; and there should be man-holes for inspection and flushing at each 100 yards in length.

Mr. Blackburn, the lessee of the Aldershot Farm, has been so good as to afford us some interesting information regarding the method of cultivation adopted.

42. The ground under irrigation is square in form on plan, and has a fall of 25 feet from the point where the sewage is admitted to the lowest point in a distance of 550 yards, the fall being unequally distributed; the average is 1 in 66.

43. Out of such material as that mentioned above, a ferruginous sand, which, in its natural state, was destructive to vegetation, a true vegetable soil had to be formed. The iron concrete crust, or "pan," had to be disintegrated by trenching and breaking up, and then drenched with sewage, for almost a year before any crop was sown. Surface trench drains were put in where necessary, and sewage drains, 160 yards in length, formed by the plough, and finished by the spade, were carried across the line of fall for distributing the sewage.

Mr. Blackburn estimates the amount of water supply at 790 tons, or about 177,000 gallons a day, of which two-thirds reach the farm during 12 hours of the day as sewage, the other third as water during the night.

44. The whole of the sewage is absorbed by the land during nine months of the year.

45. During the very hot summer of last year, the amount of sewage was scarcely sufficient to keep the plants alive, showing that, in hot climates, small areas of ground would be sufficient for absorbing the barrack refuse water.

46. The whole sewage of the South Camp and barracks was not turned on to the farm until 1866, scarcely three years ago, and the following have been the results as regards produce raised per annum on each acre:—

Potatoes	-	-	-	-	-	4 to 5 tons per acre.
Swedes	-	-	-	-	-	12 " "
Mangolds	-	-	-	-	-	18 " "
Garden turnips	-	-	-	-	-	300 bushels.
Cabbages	-	-	-	-	-	16,000 plants.

There is, besides, a large area under Italian rye-grass cultivation, which is cut five or six times a year for cows, and four times a year for horses. The lowest cutting averages six tons per acre, the highest 14 tons per acre. The maximum produce is 40 tons of rye-grass per acre per annum.

47. As the culture advances, the number of articles is increased.

The usual cropping of the farm is as follows:—

Potatoes	-	-	-	-	-	26 acres.
Italian rye-grass for food	-	-	-	-	-	29 "
Ditto, for hay	-	-	-	-	-	15½ "
Green crops	-	-	-	-	-	6¼ "
						77 "

This absorbs the whole summer sewage of the camp and barracks.

48. The crops to be raised this year will be Italian rye-grass, potatoes, mangolds, swedes, turnips, cabbages, tares, onions, carrots, and haricot beans.

49. There has been no smell from the farm; the earth deodorizes the sewage as soon as it touches it. There are no complaints of nuisance from the irrigated land, nor of injury to health. All the plants grown are healthy looking and wholesome for consumption, although at first there was some prejudice against the produce, now, however, removed.

50. With this experience before them, and in order to ascertain how far this method of disposing of barrack sewage would be applicable in India, the Commission would beg to suggest whether some one Indian station might not be improved on similar principles, and the sewage rendered available for supplying troops and horses with farm produce.

51. But, of course, no system of station drainage, including the application of sewage to agriculture, can be carried out until the station is properly supplied with water.

52. Already the question has excited attention in India, in consequence of the recommendation in Mr. Rawlinson's report on the drainage of Bombay, which has been concurred in by Captain Tulloch, R.E., that the entire sewage of this great city be applied by irrigation to agriculture.

In conclusion. The Commission has thought it might be advantageous to discuss the whole question of the drainage and cleansing of Indian stations, with the view of directing attention to its several bearings. It will be seen that the fundamental point in the question is the removal out of the station of all water brought into it for domestic use.

The cheapest way of doing this is by drains laid to an outlet, and if drains be provided, there is no reason why the latrines should not be connected with them. But if, from local circumstances, it be impracticable to remove refuse water by drains, then the other alternative of collecting it carefully and carrying it away will have to be adopted, and, in this case, the latrine matter might be separately dealt with for agriculture.

Army Sanitary Commission, War Office,
March 8th, 1869.

Earthenware Pipe Drains will deliver Water or Sewage at rates as under:—

Diameter of Pipe in Inches.	Gallons at One Foot per Second.	Gallons per Minute.	Gallons per Hour.	Gallons per Day of 24 Hours.
4 inches - -	0·5	30	1,800	43,200
6 " - -	1·2	72	4,320	103,660
9 " - -	1·7	162	9,720	233,280
12 " - -	4·8	288	17,280	414,720

Gallons at Two Feet per Second.

Diameter of Pipe in Inches.	Gallons at Two Feet per Second.	Gallons per Minute.	Gallons per Hour.	Gallons per Day of 24 Hours.
4 inches - -	0·10	60	3,600	86,400
6 " - -	2·4	144	8,640	207,320
9 " - -	3·4	324	19,440	466,560
12 " - -	9·6	576	34,560	829,440

Gallons at Three Feet per Second.

Diameter of Pipe in Inches.	Gallons at Three Feet per Second.	Gallons per Minute.	Gallons per Hour.	Gallons per Day of 24 Hours.
4 inches - -	1·3	90	5,400	129,600
6 " - -	3·6	216	12,960	310,980
9 " - -	5·1	486	29,160	699,840
12 " - -	14·4	864	51,840	1,244,160

N.B.—Cost, including the pipes laid complete, about sixpence per lineal yard for each inch in diameter.

No. 9.

MEMORANDUM by the Army Sanitary Commission on the " Report and Order of " the Madras Government, regarding the control of Pilgrimages, in the " Madras Presidency."

THIS report contains facts of great interest and importance regarding cholera in India. It shows not only that breathing foul air and drinking foul water lead to a development of cholera among bodies of pilgrims apparently in good health, but that with very moderate care in preventing the atmosphere being fouled by human excreta spread over the country, or by other nuisances; by providing free ventilation, and by protecting water sources from impurity, large bodies of people may come together, hold their fairs or pilgrimages, and return home without taking cholera.

The experience of Congeveran and Humphi is most important to the future management of pilgrimages as well as to the future prevention of cholera everywhere, for it indicates the direction in which efforts for the prevention of cholera should be made in India. On comparing the experience at Congeveran and Humphi, with that at Hurdwar, the necessity of removing all excrementitious and other noxious matters away from camps and towns instead of burying them among or near the population is clearly shown.

It is most satisfactory to know that an arrest can be put on cholera by these simple and easy measures of prevention, which have, moreover, the experience of all past epidemics in Europe to sustain them.

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

J. J. Frederick, Secretary, War Office,
February 11, 1869.

No. 10.

**MEMORANDUM by the Army Sanitary Commission on the "Report upon the
"Sanitary condition of Ootacamund by the Sanitary Commissioner for
"Madras."**

THIS report shows how much more difficult it is to remedy sanitary evils than to prevent them. Ootacamund occupies a healthy locality, specially selected on this account as a sanitarium at an elevation of 6,000 feet above the level of the sea.

It has nevertheless become so far used up that fatal typhoid fever has appeared among the residents as an endemic disease.

Medical Officers assert that the conditions have progressed from bad to worse, culminating in a state of matters which threatens not only to rob the station of the character it has so many years enjoyed as the leading sanitarium of India, but "to make it dangerous for invalids to resort to it at all."

The causes of this rapid deterioration are clearly stated in the report, and they are :—

Absence of healthy plan and construction ; as also, of proper arrangement of houses.

Absence of efficient drainage and cleansing, so that the ground has become soddened with filth.

Pollution of water sources.

The report is too restricted in details to enable us to form an opinion in regard to the engineering works required for the station ; but so far as we are enabled to judge, the only course to be adopted at present (unless the houses were removed to a new site) is the course proposed in the report, viz.,—

To organize an efficient sanitary service for the daily removal of all filth and offal.

To protect the lake from pollution, and,—

To improve the surface drainage.

J. HOPE GRANT, Q.M.G.
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W. G. BAKER.
J. R. MARTIN.
ROBERT RAWLINSON.

J. J. Frederick, Secretary, War Office,
February 11, 1869.

No. 11.

**MEMORANDUM by the Army Sanitary Commission on the Report of the Madras
Cholera Committee.**

IN this report is opened up the whole question of cholera as it occurs in India in relation to opinions set forth authoritatively by the late Constantinople Conference.

There is much in the report that is true, and which can be safely assumed as a basis for preventive measures. None of the views or practices enunciated by the Conference are novel. All have been long before the public. They naturally divide themselves into two classes :—

1. Those which are more or less hypothetical.

2. Those which are strictly practical.

The hypothetical views on which the Conference proposes to rest one branch of sanitary procedure have not met with universal acceptance ; they belong to points still under discussion and inquiry, such, for instance, as the relation which cholera excreta bears to the spread of cholera, and the part which movement of the population plays in spreading the disease.

This department of the inquiry must be followed out to a much greater extent before all the questions connected with it are settled, and it will be included in our instructions for investigating cholera in India.

The practical measures have been more or less in successful use ever since cholera was known as an epidemic, and just in proportion as these measures have been carried out has cholera become less prevalent and fatal.

Up to the present time experience has shown that the disease can be best prevented by cleanliness, fresh air, pure water, and wholesome personal regimen. The Madras Commission places due value on these methods of prevention, and they have not been undervalued by the Constantinople Conference.

In the present state of the question no greater service could be rendered than by the Madras and other commissions being allowed to carry out in well-marked endemic localities measures of a similar class to those so successfully adopted at Congeveran pilgrimage.

For instance, let a well-marked endemic locality be selected in each presidency, and let a thorough inquiry be made into its sanitary state, including—

(a.) Surface and subsoil drainage, marshes, malaria.

(b.) Surface cleanliness, and cleanliness of compounds and houses.

(c.) State of adjacent country and underwood, nuisances.

(d.) Habits of the natives, especially as regards food, disposing of excrementitious matter, and the like.

(e.) State of the water used for drinking and cooking.

(f.) Amount of cholera.

Then let a rigid system of sanitary police be adopted to ensure that the people have the use of pure air and pure water by removing everything which interferes with these requisites, and let the results to health be recorded.

Points of this kind are included in our instructions referred to; but if special cases be selected and dealt with, many of the questions would be at once put in the way of being solved.

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J. J. Frederick, Secretary, War Office,
February 11, 1869.

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