General report on sanitary conditions likely to affect the health of the troops in cantonments and encampments in South Africa / [W.G. MacPherson].

GENERAL REPORT

ON

SANITARY CONDITIONS

LIKELY TO AFFECT THE

HEALTH OF TROOPS IN CANTONMENTS

AND ENCAMPMENTS

IN

SOUTH AFRICA.

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General Report on Sanitary Conditions likely to Affect the Health of Troops in Cantonments and Encampments in South Africa.

The instructions under which I proceeded to South Africa are contained in War Office letter No. 55677/70 of 20th August, 1902.

They had reference to the establishment of the new garrisons on a sound sanitary basis; and had special reference to the selection of sites, as regards cleanliness of ground, water supply, drainage, sewage disposal, and civil surroundings; to the construction and plans of cantonments, and to other sanitary considerations affecting the health prospects of the new garrisons.

In connection with these instructions, the following localities were visited between the date of my arrival in (24th September, 1902) and departure from (the 6th May, 1903) South Africa, and reported upon to the local authorities in detail:—

Natal.—Newcastle, Pietermaritzburg, Mooi River, Howick, Nottingham Townlands.

Cape Colony.—Modder River, Burghersdorp, Naauwpoort, Middelburg, Stellenbosch.

Orange River Colony.—Bloemfontein, Ladybrand, Kroonstad, Harrismith.

Transvaal.—Standerton, Pietersburg, Barberton, Middelburg, Potchefstroom, Pretoria.

Some minor reports were also made at the request of the Principal Medical Officer, South Africa.

With the exception of the stations in Natal and Cape Colony, and Ladybrand and Kroonstad in the Orange River Colony, the sites had been selected, and the erection of the new cantonments commenced before I had an opportunity of submitting reports upon the localities. Indeed, some of the new cantonments, namely Barberton, Potchefstroom and Bloemfontein, had been allready completely or partially occupied by troops. Under these circumstances, it seemed that I could carry out the object of my instructions best by submitting reports, which would indicate in detail the actual sanitary conditions present, their prospective effect on the health of the troops, and the changes necessary to remedy defects already existing or likely to arise from the nature of the constructions that had been placed on the sites or of the sites themselves. In connection with this it was necessary to take notice of the conditions existing in standing camps, and my recommendations extended eventually to them.

In submitting these reports my object was to avoid recommending changes that involved great expenditure, unless these changes were essential for the maintenance of recognized principles of hygiene that would otherwise have been violated. In every case the points involved were discussed with Officers Commanding Stations and Officers Commanding Districts, Senior and Principal Medical Officers, Officers Commanding Royal Engineers, and others concerned in establishing the cantonments. As far as possible too, and in some cases by special invitation, questions affecting the civil sanitary surroundings of troops were gone into with representatives of the civil authorities; and, in all cases, the reports were submitted to the Principal Medical Officer, South Africa, for the information of the General Officer Commanding-in-Chief.

A memorandum has already been submitted showing the abnormal prevalence of enteric fever amongst troops in South Africa as compared with other commands at home and abroad; and in that memorandum it was

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Vide Appendices II. and III.

pointed out that this cannot be altogether attributed to the war. The same abnormal prevalence existed in certain localities year after year long before the outbreak of war, and the more radical changes recommended in my local reports have reference to the existence of sanitary conditions in South Africa which are intimately associated with this abnormal prevalence of enteric fever, at any rate in its endemic aspect. It is this aspect of enteric fever upon which sanitation has permanent effect, and one may expect the disease to continue, as at present, unless the more important recommendations, especially those affecting water supplies, prevention of soil pollution, and disposal of waste products, are carried out. A general indication of what these conditions are may be obtained in the form of a summary of the observations which were made in connection with the detailed local reports, and I have accordingly prepared this report as a series of notes summarizing the facts that came under my notice under the following headings :—

I.—Public Health Administration—
- (*a.*) Civil.
- (*b.*) Military.

II.—Water Supplies—
- (*a.*) Sources—
  - (1.) Rain.
  - (2.) Rivers.
  - (3.) Surface dams.
  - (4.) Wells.
  - (5.) Springs.
  - (6.) Borings.
- (*b.*) Collection and conveyance.
- (*c.*) Storage.
- (*d.*) Purification.
- (*e.*) General conclusions.

III.—Removal of Waste Products—
- (*a.*) Latrines and sewage disposal.
- (*b.*) Ablution rooms and disposal of slops.
- (*c.*) Dry refuse.
- (*d.*) Stables and manure.

IV.—Milk Supplies.

V.—Aerated Water Supplies.

VI.—Slaughter Houses.

VII.—Bakeries.

VIII.—Laundries.

IX.—Management of Infectious Diseases.

X.—Sites of New Cantonments.

XI.—Planning and Construction of Cantonments.

XII.—Standing Camps.

XIII.—Railway Sanitation.

XIV.—Civil Surroundings of Camps and Cantonments.

Finally, I have added to these a summary of the main general recommendations made with regard to the new cantonments, and, as an appendix, a series of rules drawn up for guidance in connection with the sanitary organization of standing camps.

A few photographs are appended to illustrate some of the conditions that have been noted.

A comparative statement of the enteric fever prevalence in South African garrisons, as compared with commands at home and abroad, is also appended.

I.—Public Health Administration.

(a.) *Civil.*

Each of the four colonies has at present a sanitary administration peculiar to itself. Until quite recently there were no Public Health Acts in the older colonies in any way similar to the Public Health Acts in force in the United Kingdom. In the newer colonies such Acts are only now being prepared.

In Cape Colony the first Public Health Act was promulgated in 1883, but it was concerned only with matters affecting notification of infectious diseases, vaccination, and quarantine. The "Public Health Amendment Act," promulgated in 1897, is the first Act in the Colony that provides for wider sanitary control. It has scarcely yet had time to operate.

In Natal a similar Public Health Act was promulgated in 1901, so that it, too, has not had time yet to operate. Under Section 8 of this Act a series of general sanitary regulations was also promulgated in the same year. The Act has to be renewed annually, and cannot therefore be regarded as a permanent instrument.

In the Transvaal there is no Public Health Act as yet, and sanitary action is carried out under a Government Proclamation (Proclamation 28 of 1901) for the establishment of Health Boards, for defining their duties and powers, and for laying down certain sanitary regulations on the lines of municipal bye-laws.

In the Orange River Colony there is, as yet, no Public Health Act, or Proclamation similar to that in the Transvaal to take its place. Sanitary work is carried on under the old municipal regulations of the Orange Free State and the old Contagious Diseases Act of the State, with additions and alterations made locally under martial law.

The machinery for carrying on sanitary work and administration also varies in the four colonies, but in all the colonies there is a Colonial Medical Officer of Health, who is the head of the sanitary service of the Colony.

In Cape Colony the chief local authorities for administering the Acts are the Chief Commissioners of Districts, the village boards, and the town councils. These latter are elected by popular vote. The district surgeons, who are at the same time general practitioners, act as Health Officers to these bodies. The maximum annual rates which village boards and town councils are allowed to levy for sanitary purposes are 3*d.* per 1*l.* in villages, and 2*d.* in towns, on the assessed value of property. Town councils have, as a rule, their own bye-laws.

In Natal there is a similar form of local administration under local municipal bye-laws, and with district surgeons, who are at the same time general practitioners, as Health Officers.

In the Orange River Colony there are also municipal councils, with their own bye-laws.

In the Transvaal elected municipal councils do not exist. Their place is taken by health boards, of which the resident magistrate is chairman; but, in addition to the district surgeons, there are three special appointments of Medical Officers of Health—one for the Western, one for the Eastern, and one for the Central or Northern Transvaal. These officers work under the Medical Officer of Health for the Colony, and do not engage in private practice. Their head-quarters are Potchefstroom, Middelburg, and Pretoria, respectively.

There are also one or two exceptional appointments for special sanitary work in South Africa, such as that of the Medical Officer of Health for Johannesburg, the Port Surgeons at Durban and Cape Town, the Medical Officer of Health for Kimberley, and the Medical Officer of Health for Bloemfontein. The last named, however, engages in consulting practice and is the surgeon to the Civil Hospital.

Each town has one or more sanitary inspectors. In the larger towns, such as Pretoria, Kimberley, and Maritzburg, the staff of inspectors is good and efficient, but in practically all the smaller garrison towns the duties are carried out by men without any special training or knowledge. As a rule, this sanitary inspector is the sole executive sanitary authority.

The general conclusion that may be drawn with regard to civil sanitary administration is that the Colonial Medical Officers of Health are fully alive to

the necessity of carrying out the provisions of sound Public Health Acts, but that the machinery for putting them into practice is weak and, in fact, will never be sufficiently strong to effect real reform until the people themselves realize the need of reform. Of the four colonies, the municipalities in Natal seem the most advanced in this direction, while the more or less independent town of Johannesburg is beginning to make marked progress under its present administration, with Dr Charles Porter as its Medical Officer of Health.

An article in the Sanitary Inspectors' Journal for May, 1901 (No. 12, Vol. VI., New Series), by Mr. J. S. Dunn, at present Chief Sanitary Inspector for Kimberley, gives a good picture of the state of affairs in Cape Colony. It is too long to quote, and the picture would be incomplete unless it were given in full. I can, therefore, only refer to it here.

(b.) *Military.*

Military sanitary organization in South Africa is based on the existing regulations, by which the Principal or Senior Medical Officer of a district or station is the responsible sanitary adviser of the General or other Officer Commanding.

This system of sanitary administration has not been sufficient to create anything like a uniform standard of sanitation in camps or cantonments. The Senior Medical Officer has been, as a rule, the Officer in charge of a large hospital, and sanitation has been more an act of inspection than one of organization and administration.

At any rate, whatever may have been the real cause, there was much in the condition of standing camps and cantonments—*i.e.*, in the arrangements for water supply, sewage and refuse disposal, ablution and disposal of slop water, siting of huts and so on—to indicate need of reform.

As a result of the representations I was obliged to make in Natal, an Officer was specially told off, as Sanitary Officer, to deal with the general organization of camps, &c., from a sanitary point of view, and no camps were afterwards established until they had been prepared by him, in conjunction with the Commanding Royal Engineer. The result was a complete and satisfactory change in the general sanitary aspects of camp life in that Colony. He was relieved of other duties, and his services were available for all stations in the command.

In other places where Sanitary Officers were appointed, as, for example, at Pretoria and Potchefstroom, the Officers had other duties to perform, and they were not senior responsible Officers in close touch with the Head-quarters Staff; while at most of the other stations the sanitary work was carried out by the Medical Officers in charge of units, who were, as a rule, Civil Surgeons or young inexperienced Officers of the Royal Army Medical Corps.

Sanitary organization, therefore, was not carried out on any broad uniform lines throughout the country, and too much was left to individual efforts in isolated localities. Thus, the recommendations of the Royal Army Medical Corps, as regards sanitary arrangements and siting of camps, were liable to be overridden by other considerations in a way which would not have occurred had there been more special knowledge of hygiene on the part of Officers outside the Royal Army Medical Corps; while, on the other hand, in some cases a Royal Army Medical Corps Officer might push his own ideas of sanitation unnecessarily far on minor points and create considerable embarrassment and friction.

The same state of affairs appeared to me to exist in connection with the sanitary aspects of the new cantonments. They were left, to a great extent, in the hands of the local authorities instead of in the hands of a strong expert Head-quarters Board. The result has been considerable lack of uniformity in the standard of sanitation as regards siting, planning, and construction.

But the main conclusion which I arrived at with regard to military sanitary administration was that its efficiency was greatly hampered by financial considerations, and by inadequate appreciation of some of the more important health problems, on the part of those Officers outside the Royal Army Medical Corps who had a voice in determining expenditure.

II.—Water Supplies.

(a.) *Sources.*

The best classification of the sources of the South African water supplies, would be to divide them into surface and underground waters; the former being liable to all impurities of surface soil; the latter being, theoretically, free from such impurities, but liable to derive such subsequently from imperfect means of protection.

The surface waters may be further divided into rain, dam, and river waters; the underground supplies into waters derived from springs, wells, and borings.

A general idea may be formed, of the extent to which the garrisons depend upon each of these sources of supply, by taking them in detail:—

(1.) *Rain.* At none of the stations is much use made of this source of water, although it is, after all, the safest of the surface waters, and might be made a valuable adjunct in places where supplies from other sources are specially impure or precarious. At Bloemfontein this has been recognized to some extent, and two to four 600-gallon rain-water tanks are being placed in connection with the roof of each barrack hut. Objections have been raised to rain-water tanks on account of the expense of providing them, the ease with which they get contaminated with dust or dirt from roofs, and their liability to become breeding places for mosquitoes. None of these objections should have weight if there is reason to demand a better or safer supply of water than the local supply from other sources, for their is no difficulty in constructing tanks which are practically dust-proof and mosquito-proof, and there are several methods of carrying away the first washings of the roof automatically. The construction of rain-water tanks in the railway settlement at Naauwpoort is an example of what can be done by intelligent construction in this direction. The quantity of water that can be obtained from roofs is considerable. Thus, from the roof of each barrack hut of the A type (114 feet by 21 feet), as much as 1,500 gallons can be collected in each inch of rainfall. This is sufficient to give 1 gallon of drinking water per diem for 50 days for each of the 30 inmates of the hut. 20 inches may be taken as an average yearly rainfall in most of the garrison localities in South Africa, and it is obvious, therefore, that, so far as water for the domestic purposes of drinking and cooking is concerned, each garrison could, if necessary, be independent of any other source of supply. In certain places, such as Pietersburg, where the question of quantity as well as quality of drinking water is serious, or Barberton, where the quantity is liable to fail, or Standerton, where the quality is bad, and in fact in all places where there is a risk of water being scarce or bad, it would be wise to provide for the collection and storage of as much rain water as possible from the roofs of the huts; and the description and construction of water tank, which I most strongly recommend, is that seen at the railway cottages at Naauwpoort.

Vide Report on Standerton.

Vide report on Naauwpoort.

(2.) *Surface dams.*—Common as this source of supply is in connection with civil habitations, it must be condemned as most unsafe, unless the collecting area of the dam is a clean upland surface, that can be fenced off and kept from pollution by men or animals.

The proposal of the Pietersburg Water Supply Commission is to obtain water from such a dam. Similar proposals have been made in connection with Harrismith and Maritzburg. All these schemes are good on the understanding that the collecting areas are clean and are kept clean, but, in South Africa at present, the chances of this being done are still remote, notwithstanding the clauses in Public Health Acts regarding the prevention of pollution of water-collecting surfaces. Such waters, at their best, must be regarded as water demanding purification before distribution; and this has been recommended in the reports submitted on those places where the proposed water supply has been of this nature.

Appendix IV., Photograph 1.

Vide Report on Pietersburg.

(3.) *Rivers.*—None of the river waters in South Africa can be considered pure, and most of them are muddy either constantly or intermittently. The only clear river waters seen were at Potchefstroom and Pietersburg, but their

liability to intermittent contamination was greater than that of some of the less attractive-looking waters. In addition to these two places Standerton, Kroonstad, Bloemfontein, Kimberley, Ladysmith, Modder River and Mooi River all depend on river water for their main supply. At Bloemfontein, Kimberley, Kroonstad and Ladysmith there are municipal waterworks on a more or less large scale for purifying the water before distribution, but at Kimberley alone is the method of purification carried out, at present, according to principles, which may be expected to render the water safe for drinking purposes. The defects, however, in the methods of purifying water supplies in South Africa are beginning to be realized, and schemes are being prepared for the construction of waterworks on more scientific principles, as, for example, at Standerton and Kroonstad. There is also a proposal for new waterworks and filter beds in connection with the Bloemfontein supply. Administrative action for the prevention of the pollution of rivers, used as sources of potable water, is a dead letter at present, and it seems somewhat hopeless to expect it to be otherwise for a long time to come; not, in fact, until the people themselves demand this protection.

Vide local reports.

The general recommendation, which has been made in all cases where water must be obtained from river sources, is that provision should be made for sound scientific filtration, at a rate not exceeding 3 vertical inches per hour, with a sufficient area of settling tanks and filtering beds, for the purpose of enabling the essential slime formation on the surface of the beds to be maintained without interruption of supply.

(4.) *Wells.*—Few of the garrisons depend on well waters. In fact, Pietersburg and Burghersdorp are the only stations where a well water supply had been contemplated as a permanent supply for the garrison. Many of the civil habitations, however, of garrison localities have well supplies, notably Standerton, Middelburg (Cape Colony), Middelburg (Transvaal) and Potchefstroom. Both the Middelburg and Potchefstroom wells are, to a great extent, supplied with water from the irrigation canals soaking into the subsoil. In Standerton the wells are sunk near old cesspits. The wells in Pietersburg are either surface water soaking through the ground to the granite, or else water derived from fissures in the granite. In no place are the wells of the nature of deep or artesian wells. In some cases, single isolated analyses have shown the water in them to be pure for the time being, and much importance has been attached to such analyses. I had, consequently, to point out somewhat strongly that the danger in using such waters is their liability to intermittent contamination*; that single analyses, which may or may not give good results, are of little value in determining the safety or otherwise of the waters; that constant results should be obtained throughout a series of periodical analyses; and that the general sanitary significance of the source of supply should be determined by the nature of the soil in which the well is sunk, and by its surroundings and construction, before sources of this kind can be declared safe.

Vide local eports.

(5.) *Springs.*—A few of the garrisons are in localities where spring water can be obtained in sufficient quantity to supply all requirements. Pretoria, Middelburg (Transvaal), Newcastle, and Ladybrand come under this category. As a rule, the water of these springs is excellent. The Middelburg springs, for example, show on analyses a remarkable degree of purity.

The error, however, that appears to be invariably committed is that of collecting the water from springs after it comes in contact with the surface soil. As a rule, the springs emerge into bogs, and these bogs, or at least their immediate neighbourhood, have become the resort of cattle, many of whom die and rot on the surface near the spring. Evidence of this form of contamination is produced by the analyses of some of the spring supplies. Thus, Lieut.-Colonel Birt found the coli bacillus in the spring water of Middelburg (Cape Colony), and I found a similar organism in the Newcastle spring water. In both cases the water had been in contact with the surface soil.

See Appendix IV., Photograph 7.

In all these spring water supplies the essential point is to open up the springs and cement them down to the stratum from which the water emerges,

* Correspondence in Principal Medical Officer's Office, Head-quarters, Army, South Africa, on the well waters of Pietersburg.

thus avoiding at the outset all possible contamination from the surrounding surface, and this was recommended in the local reports submitted on localities dependent on spring water. *Vide* Report on Newcastle for details.

(6.) *Borings.*—Partial supplies are being obtained from boreholes for the garrisons at Standerton, Kroonstad, Stellenbosch, Middelburg (Cape Colony), and Naauwpoort.

The water from deep bores is more likely to be safe than the water from any other source, but the quantity is disappointingly exhaustible in many cases.

It is only in some of the sandstone and shale formations, where there is much intersection of the district with dykes of basalt, and where there are extensive and well-defined collecting areas above these dykes, that any constant supply of water from bores may be expected. The districts where these physical features were most marked were the districts in the north-east of Cape Colony, *i.e.*, Burghersdorp, Naauwpoort, and Middelburg. In fact, it is expected that the water supply for the Middelburg garrison will be entirely drawn from such a source, and there is every reason to believe that an extensive area of underground water exists in a portion of the War Department land there. *Vide* local reports.

The question of the exhaustion of water supplies from bores depends greatly on whether pumping is resorted to or not. An ideal method of avoiding exhaustion in this way is that adopted by the Railway Department at Naauwpoort, where cuttings are made into the sandstone to 2 or 3 feet below the level of saturation, and bores sunk in the floor of the cutting. The water wells up from the bores and flows into the cutting, while the cutting itself is converted into a closed reservoir, and the water is led from it in pipes by gravitation. This method avoids any possible lowering of the level of saturation by pumping. It may be said, however, that, on the whole, the geological formations of garrison localities do not appear to lend themselves well to this method of obtaining water supplies. *Vide* local report.

(b.) *Collection and Conveyance of Water Supplies.*

At Newcastle, Modder River, Pietersburg, Middelburg (Cape Colony), and partly also at Middelburg (Transvaal), Kroonstad, and Potchefstroom the water was, or is, pumped by hand, and conveyed into watercarts by hand pumps and hose. In some cases the hose is carried on a trestle* and kept from contact with the ground, but in others the hose was found buried in the ground or lying in a dirty bog† when not in use.

At some places water is pumped into pipes to reservoirs, and the water distributed from these by gravitation. This is partially the method at Burghersdorp,‡ Stellenbosch, Mooi River,§ and Standerton, and it is also the method of municipal supplies, which feed the garrisons at Kimberley and Bloemfontein, where water is pumped long distances from the river source to reservoirs in the town. At Pretoria, Barberton, Middelburg (Transvaal), Harrismith, Newcastle, Ladybrand and Naauwpoort there is a piped water supply led by gravitation from its source to town reservoirs, and from there conveyed to the garrisons. At Middelburg (Cape Colony) municipal water supply is distributed in open water furrows, but is only indirectly used by the garrison there. At Potchefstroom a furrow water supply is being pumped up in pipes to the garrison. Pipes are, as a rule, satisfactorily jointed, a lead and yarn socket joint or screw joint being commonly used, but in one or two instances the joints were seen to be leaking, notably at Stellenbosch. Where watercarts are used for the conveyance of water to camps and cantonments, they usually go out under the charge of the native drivers, and apparently without any definite arrangements as to time of collecting the water. Thus, at Newcastle, a spring yielding only some 400 gallons an hour was being made to supply some half-a-dozen watercarts in the hour, and, as a matter of course, ran dry for the time being. Appendix IV., photograph 4. *Vide* Report on Stellenbosch.

The necessity of maintaining a strict organization for the collection and

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* Appendix IV., photograph 11.
† Appendix IV., photographs 8, 10.
‡ Appendix IV., photograph 3.
§ Appendix IV., photograph 17.

conveyance of water by watercarts was noted in a series of recommendations submitted in connection with the camps in Natal. (*See* Appendix I.).

(c.) *Storage of Water.*

The usual storage for camps was the watercart or corrugated-iron tanks of 50, 100, 400, or 1,000 gallons capacity. In one or two places, large earth reservoirs, some lined with corrugated-iron, have been used, as, for example, at Middelburg (Transvaal). Provision is being made in the new cantonments for storage tanks; and where municipal supplies are being used, the water is, as a rule, stored in well-constructed reservoirs. In one or two places the reservoirs are, however, open reservoirs, and are insufficiently protected, as, for example, at Standerton and Newcastle. The chief defect in the camp storage tanks is the absence of good covers, and frequently the amount of storage capacity is insufficient to store as much as 1 gallon per head daily.

Vide local reports.

The storage arrangements in camps, generally, have been left to Commanding Officers, with the result that there is a marked want of uniformity in the capacity of the tanks, in methods of keeping them clean and cool,* and in the nature of the tanks themselves. Thus, at Kroonstad, one battalion was storing water for drinking in 4-gallon rum casks sunk in the ground along the line of tents.

(d.) *Purification of Water.*

Apart from the municipal sand filter beds at Kimberley, Bloemfontein, and Kroonstad, there is no water purification of any of the supplies on a large scale, except at Mooi River† and Ladysmith, where the water is sterilized by steam, and laid on to cookhouses and standpipes. At other places water is purified, regimentally, by boiling in Soyer's stoves, or by boiling and filtration through Berkefeld field service filters; but at Potchefstroom a special arrangement has been made for sterilizing water by boiling in the Infantry lines of the new cantonment. The best arrangements made for this on any uniform scale were made in the camps at Modder River, each unit having a more or less uniform installation, with one or more men told off to manage and work it. Latterly, a Waterhouse-Forbes sterilizer has been in use at the hospital at Bloemfontein. It is working admirably and giving much satisfaction. Officers Commanding units are being shown the working of it, and the Senior Medical Officer there is anxious to have one or more working in every camp.

Appendix IV., photograph 16.

The purification of storage tanks and watercarts has not been satisfactory. Washing with permanganate of potash solutions, once or twice a-week, was the usual method of cleansing them. In order to introduce a more efficient means of purifying the watercarts, an arrangement was made at Newcastle, on my recommendation, for steaming the interiors by filling them with water, and then passing steam into them under pressure.‡ This method gave much satisfaction. At other places, where the means of passing steam into the carts were not available, it was recommended that the carts should be cleansed by scalding with boiling water. It was also recommended that the watercarts of each unit should be kept clean and freshly painted with the name of the unit on the cart. It was hoped that units would thus learn to take a pride in the smart and cleanly appearance of their watercarts.

The chief difficulty experienced in connection with purification of water supplies, lay in the fact that purification by individuals or by individual units, involved an amount of labour and supervision that was not commensurate with the supply of sterilized water produced; and, so far as more or less permanent camps and cantonments are concerned, the only satisfactory plan, where water purification is essential, is to establish water purification works on a larger scale, and to lay on the purified water for all purposes; or, where this is impracticable, to lay on the unpurified water under pressure to installations of sterilizing filters, according to the system adopted in connection with barracks in France, or to sterilizers, constructed on the principles of the Maiche, Desmaroux-Vaillard, or Waterhouse-Forbes apparatus. The working of the

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* Appendix IV, photograph 15. † Appendix IV., photograph 17.
‡ Appendix IV., photographs 18 and 19. *See* also Appendix I., A. (4).

sterilizing-filter system does not, however, involve any expenditure in fuel as in the latter sterilizers, and is, therefore, more economical.

(e.) *General Conclusions on Water Supplies.*

The general conclusion which I formed regarding the sanitary aspects of water supplies in South Africa was that enough was not being done to keep the sources of the water supplies of towns, &c., free from pollution, even when this could have been effected readily enough and at little expense. In fact, I can only recall one place where the preservation of the source from pollution is well planned, namely, Naauwpoort. At Barberton,* owing to difficulty in obtaining access to the source, there is also freedom from pollution, and, to a certain extent, the same may be said of the Harrismith supply; while at Burghersdorp, Pretoria, and Newcastle the municipal spring supplies have been more or less enclosed at the source. But at places such as Pietersburg, Potchefstroom, and Middelburg (Cape Colony), good clear water is simply allowed to run in irrigation furrows, without any attempt at tracing it to its source and there conserving it and laying it on to the town. Indeed, at Pietersburg the Government Land Settlement authorities have added to the pollution of an existing water supply by settling farms along the banks of the stream above the intake. At Potchefstroom the conditions in this respect are, if possible, worse; while at Middelburg (Cape Colony) an excellent supply, which could be readily conserved, is allowed to run to waste. The neglect to realize this aspect of a water supply can only be described as a marked defect in the sanitation of some of the towns in South Africa.

Vide Report on Middelburg, Cape Colony.

In places where it is practically impossible to prevent pollution of the water supply at its source, as, for example, where the water is obtained from rivers draining large areas of inhabited country, the municipalities are beginning to realize, as already stated, the necessity of constructing waterworks on scientific principles.

Finally, the question of quantity is one that will become acute in many places if the population of the localities for garrison purposes increases to any great extent. Already Water Supply Commissions have been appointed by the Transvaal Government to consider this question in some localities, such as Pietersburg, Standerton, and Middelburg, and large and important schemes for impounding surface waters or springs are likely to be features in the water supply of many localities in the future.

Vide local reports.

III.—Removal of Waste Products.

(a.) *Latrines and Sewage Disposal.*

The pail or bucket system is universal, except in one or two towns, such as Ladybrand and Potchefstroom, where cesspits still exist to a greater or less extent. As a rule, the pail privy is a corrugated-iron building placed outside the dwelling, with a flap door at the back for the removal of the pail, the construction generally being of a rough-and-ready description, without any special sanitary construction of floor or seat. The method of removing the pails and disposing of the contents varies in different places and under different conditions.

Generally speaking, the pails of hotels and other public establishments are removed nightly at an extra charge, while the contents of private establishments are removed only twice or three times a-week; in two towns, Burghersdorp and Middelburg (Cape Colony), only once a-week.

In the majority of towns a dual system of pails exists, *i.e.*, each pail on removal is replaced by a clean pail, but in one town only (Middelburg, Cape Colony) was there a system of numbering pails and returning the same pail to the same house.

In Naauwpoort, where the civil community is under the management of the railway officials, the system of removal of contents of pails is that of the military camps and cantonments, *i.e.*, the contents are emptied into carts on

* Appendix IV., photograph 2.

the spot, and the pails replaced in the privies without removal to any depôt for cleansing. In Middelburg (Transvaal), Pretoria and Kroonstad the dual system is incomplete, the pails being insufficient in number for a regular supply of a clean pail for each pail removed.

Vide local reports.

Many variations also exist in the class of cart used for removing pails and their contents. In some cases they are specially designed, in others they are more or less improvised. As a rule they are large and cumbrous.

The contents of pails are almost invariably deposited in deep pits, measuring usually 6 feet wide by about 6 or 10 feet deep, and varying in length.

At Pretoria only was there any attempt at sewage farming; while at Pietermaritzburg, and, in a very minor degree, at Harrismith, *poudrette* factories are being worked as a means of disposing of the sewage. In some towns the work is carried out departmentally, that is to say, by a municipal staff, in others by a contractor. The departmental work seemed, in all cases, to give the most satisfaction, but the condition of the filth pits was never good.

Vide report on Pietermaritzburg.

In camps and cantonments the work is carried out by a contractor, or by municipal authorities; and the disposal of night-soil is carried out on methods similar to that of municipalities. In the Mooi River camps, however, the system of trenching in shallow trenches, covered up immediately, was being employed, with results markedly in contrast with the system of deep pits; that is to say, there was no offensive appearance or smell as in the latter system.

At Kroonstad, the old filth trenches were being planted with trees; a sanitary measure which was recommended for adoption in all places. As a rule, little consideration has been given to the site and soil of the filth pits. The deep alluvial soil on the banks of rivers and near watercourses has had the greatest attractions, as being the most simple for digging the pits in. The position of the filth trenches of the Burgher camp at Standerton is a case in point. No more insanitary position could well have been selected. Light sandy loam soils are difficult to obtain, and few such soils have been used for sewage disposal.

Vide report on Standerton.

One or two towns are considering the question of water-carriage systems with biological installations at the outfall, Bloemfontein, and Pietermaritzburg, for instance. But the experiments that are being conducted at the former place by the municipal authorities to determine the advantage or otherwise of this system are, in my opinion, useless. Water-carriage systems and biological outfall installations are being designed for some of the cantonments, notably at Pretoria, Potchefstroom, and Standerton. In others, such as Pietersburg and Bloemfontein, an American trough system is being introduced, at any rate temporarily; but the vacuum carts sent out are not of a suitable pattern, and the system has not yet been properly tried.

Vide report on Bloemfontein.

In other cantonments and in camps, with the exception of Ladybrand, where trench latrines exist, the pail system is at present in use.

The cleansing and disinfecting of pails follow no uniform plan. In some places each return pail of a dual system is returned clean and disinfected, in others the processes are carried out at irregular intervals. In camps, &c., which have the single-pail system, cleansing and disinfecting is usually done twice monthly, according to contract.

The general conclusion which must be formed regarding this subject of latrines and disposal of sewage in South Africa, is that, in the existing state of affairs, that is to say, in the absence of water supplies having any degree of permanency as to quantity, in the absence of any system of house drains and municipal sewers, and in the absence of suitable soil for the disposal of sewage effluents, a pail system has been the inevitable step between cesspits or no system at all, and more modern methods. At the same time, the manner in which the pail system is being worked and the contents of the pails disposed of, is primitive, and admits of very considerable improvement by more extensive organization, increase of staff and equipment, and systematic trenching and farming of the depositing grounds. Unless improvement in these directions is seriously considered and actively pushed, the existing systems will lead to grave health problems affecting garrisons and civil communities, as towns increase in size, and, even without this increase, as time goes on.

Vide report on Harrismith.

As regards the management of pail systems in camps, the chief defect was in the construction of latrines, and in the arrangements for cleansing and disinfecting pails, although, in some places, other defects exist in consequence of the primitive arrangements that are made for the conveyance of the contents to the depositing grounds. The American trough system has not yet had a fair trial, chiefly on account of the difficulty in obtaining satisfactory vacuum carts.

The water-carriage systems are also untried, and will require very careful consideration in connection with the quantity of water likely to be available in time of drought, and in connection with the laying of drains in a country where such systems are practically unknown, and the care and skill demanded may be difficult to obtain.*

The system of sewage treatment on biological principles also requires the presence in the country of men acquainted with the practical details and methods of construction and working of the systems. I found a general tendency to regard this treatment as capable of rendering sewage safe enough to discharge direct into streams of potable water, and also a general tendency to select sites for the installation of the biological tanks and filter beds without reference to the question of the offensive conditions likely to prevail during the maturation of the filter beds, and, again, to ignore the question of dominating a sufficient area for subsequent land treatment of the effluent by irrigation and cultivation.

On all these points detailed recommendations have been made in the local reports. *Vide* report on Pretoria.

(b.) *Ablution Rooms and the Disposal of Slops.*

There are practically no complete arrangements in civil communities for the sanitary disposal of slops. Thus, in such places as Potchefstoom, Standerton, Pretoria, Ladybrand, Newcastle, and Middelburg (Cape Colony), no provision is made by the municipal authorities for removal of these waste products, and householders throw them out into their gardens or into any gutter or channel conveniently near. In other towns there is a more or less partial removal; Barberton, where slops are removed daily, having perhaps the best system. In Maritzburg there is a special service for the purpose, but a considerable quantity is carried away in a system of drainage which is partly surface and partly underground. At Burghersdorp slops are removed by cart only, as required. Elsewhere, where there is any provision for removal, it is a bi-weekly or tri-weekly service, as in the case of night-soil. For the purpose of removal, tank carts, tumbril carts, night-soil carts, or wooden barrels are used in various localities, and the contents are deposited, as a rule, in the night-soil pits. At Maritzburg, however, there is a special arrangement for emptying the contents of the carts on to a concrete basin, which discharges by a short pipe direct into the river below the town. *Vide* local reports. *Vide* report on Pietermaritzburg.

In the military camps there has generally been some arrangement for the removal of urine in tumbril or tank carts, or, as in the case of Stellenbosch and Pietersburg, in wooden barrels; but other slops, such as the dirty water from kitchens and ablution places, have been very imperfectly dealt with. In fact, in no part of the sanitary organization of camps and garrisons has a greater lack of uniformity been observed than in the arrangements for ablution and disposal of slops. Some units, for example, were found without any special arrangements for this; others had wooden stands for ablution basins placed in the open air, but without channels for the removal of the dirty water. Some had partial arrangements for removing the water by means of a concrete channel under the stand. At one or two places, such as Kroonstad, these channels led to a sump, from which the water was pumped to carts and removed. The Mooi River camps, on my recommendation, had ablution stands placed under cover and on concreted surfaces, with channels leading to cultivated areas. At Pietersburg and Harrismith pits were dug in the surface soil to make bathing ponds, and supplied at the former place by water from irrigation channels, and at the latter by water from standpipes. In fact, ablution and Appendix IV., photograph 20. Appendix IV., photograph 24. Appendix IV., photographs 21, 22 and 23.

* *Vide* Correspondence in Head-quarters Office, Army, South Africa, on laying of drains at Standerton.

disposal of dirty water were practically left to the ingenuity or demands of the units themselves. In all the new cantonments provision is being made for ablution rooms with concrete channelled floors, and for body baths in connection with them or with the kitchen.

Vide report Barberton.

The method of disposal of the dirty water is not definitely decided for all cantonments, but at Barberton, which is the only new cantonment fully occupied, it is carried off in an underground system of drainage to coarse stone filter beds. Amongst the older cantonments, Wynberg and Maritzburg, the disposal of the foul water is into concrete and brick surface channels, which lead to surface soil in the neighbourhood, or to soakage pits, without any definite plan of irrigation, cultivation, or enclosure of plots.

Vide Appendix I., B 4.

The general conclusion formed with regard to this section of sanitary organization and action was that, with the exception of the Mooi River camps, which were established in Natal on a definite sanitary scheme, the subject of ablution and disposal of slops and dirty water has not received sufficient consideration. There was no definite procedure by which standing camps were provided with properly prepared plots of ground for the reception and sanitary disposal of foul water by irrigation and cultivation, while the disposal of such foul water from the new cantonments is apt to be carried out in accordance with the imperfect methods adopted in the older garrisons at Wynberg and Maritzburg. In a word, the proposed schemes are not sufficiently comprehensive or detailed to prevent subsequent trouble.

(c.) *Dry Refuse.*

In most of the civil communities, dry refuse is being removed by the municipal authorities in a more or less systematic manner. Ladybrand was the only town visited where no provision had been made for this.

Yet in none of the towns was any regulation enforced for the provision of sanitary dust bins in connection with habitations, although bye-laws had, in some instances, been promulgated with a view to this. The vehicle for removal was, as a rule, the open Scotch cart. At Maritzburg and Bloemfontein only, were well-constructed special carts employed for the purpose. The frequency of removal varied from a daily removal to a bi-weekly or weekly removal. In Middelburg (Transvaal) removal was carried out only when the accumulation of refuse was creating a nuisance, or a special application for its removal had been made.

In many towns, *e.g.*, Burghersdorp, Pretoria, Harrismith, Kroonstad, the refuse was being deposited in dongas in the neighbourhood, with a view to filling them up and reclaiming the land. At Maritzburg the refuse was deposited in the pits of the brickfields; and at Naauwpoort it was being used to widen a railway embankment. In no place was there any form of destructor, or burning of refuse, under civil authority. On this point, the consensus of opinion is that destruction of refuse in South Africa will not have the same economic results as in England, and the Medical Officer of Health for Johannesburg has calculated that the fuel value of South African refuse is considerably less than that of corresponding refuse in England, on account of the smaller quantity of unburnt coal and coal ash, and the larger quantity of old tins, &c., found in the former. Civil communities, therefore, that have been considering proposals for refuse destruction are abandoning them, because they see no prospect of making it pay expenses by working electric light dynamos, &c.

In military camps and cantonments, removal and disposal of dry refuse have been carried out according to no uniform plan. In several places the work is done regimentally, each unit being allowed to select any spot near at hand, and to deposit the refuse over the surface or in pits. The effect of want of sanitary organization in this respect is a marked feature in the sanitary surroundings of camps in South Africa, and several good camping areas, or areas for cantonments, have been spoilt by the neglect to select and enclose, at the very commencement, definite spots to which all camp refuse could be removed and there burned. In some cases, such as Stellenbosch and Naauwpoort, where the military camps are on farms rented by Government, the farmer has made it a condition that the refuse should not be removed from

the farm. So far as Naauwpoort is concerned the condition has not been unfavourable, because the refuse has been deposited in an enclosed cultivated garden some distance from the camp; but at Stellenbosch it has resulted in large areas close to and around the camps being spread over with more or less putrefactive organic matter. Stellenbosch is also the only place where no provision was made for removing kitchen refuse from the camps. The refuse there was being thrown into pits dug close to the kitchen and to the lines of tents. *Vide* local reports.

At the Mooi River camps, a destructor of a simple and effective character was erected. It was dealing satisfactorily with the whole of the kitchen refuse of the camps. This was the only place where such destruction of refuse was being carried out according to any definite system. Appendix IV., photographs 30 and 31.

As regards cantonments, the construction of refuse destructors has been considered in some cases, but apparently has not been made essential in all. Thus, a destructor is in process of erection at Potchefstroom, but at no other place.

The general conclusion formed by me on this subject, is that the neglect to deposit refuse in definite enclosed areas and then to use it for cultivation purposes, or to cause it to be burned, has had, and will have, an important bearing upon health, inasmuch as these irregular and ever increasing deposits of organic matter favour the production of flies, and other possible producers or carriers of disease; besides making it more and more difficult to select thoroughly clean and satisfactory sites for camps and cantonments at the more important centres. *Vide* report on Newcastle. Also Appendix I., B. 5.

The consideration of these points was urged upon the local authorities, both civil and military.

(d.) *Stables and Manure.*

So far as sanitary administration and sanitary action are concerned, these are negligible quantities in all the civil communities, and in military camps the removal of manure and stable litter is carried out under the same conditions as that of dry refuse.

The chief sanitary point affecting stables in camps was the question of picketing the horses of mounted corps within the line of the men's tents. During active operations in the field this was no doubt essential, but many units continued the practice in their standing camps after peace was declared. The result was not satisfactory, and the condition of one camp, at any rate, (that of the 14th Hussars at Kroonstad), arising out of this practice was sufficient to account for an exceptionally low standard of health in that unit, as compared with other units in the same locality. *Vide* report on Kroonstad.

With regard to stables and removal of stable refuse from new cantonments, the prospective conditions are not, to my mind, satisfactory. The system of flooring stables with beaten earth or "dagga" is the system for which provision has been made. It has not yet had sufficient trial in South Africa, but what was seen of it at Potchefstroom was not good from a sanitary point of view. It does not prevent constant soakage into the soil and foundations, and it does not admit of efficient removal of waste products. These defects in stables constructed, as they are being constructed in the new cantonments, in alignment with and in close proximity to the barrack huts, will not help to maintain a good general sanitary condition. At Barberton the stables are well constructed, and at Pietersburg the flooring is being prepared with the more solid foundation of broken stone and cement instead of beaten earth; while at Standerton the Officers' stables are floored with a mixture of hard stone and cement, but these are exceptional cases. *Vide* local reports.

A suggestion has been made to kraal the horses, as has been done in the Remount Depôts. If the kraals are erected at a good distance from the barracks, the system would be better than that of dagga-floored stables close to barracks. *Vide* report on Kroonstad.

My general conclusion is that these latter will lead to constant complaints in the future history of the new cantonments.

IV.—Milk Supplies.

The sanitary control of milk supplies is also a negligible quantity. The universal custom is to sell milk in old wine or spirit bottles* at so much per bottle. Anyone possessing a cow can sell milk in this way. The bottles are washed anywhere and anyhow by Kaffirs, men, boys, or women.* They are corked with ordinary corks, and anyone who has seen the stack of old bottles† and corks in South African yards will understand the danger of this system of milk storage and distribution.

Vide report on Pietermaritzburg.

It is true that at some places, Maritzburg for instance, there is some municipal sanitary control over cowsheds, but it does not amount to much in the matter of real sanitation as regards milk supplies. The Public Health Acts are also drafted with a view to controlling these supplies, but, as already noted, they are more or less a dead letter.

Appendix IV., photograph 34.

Some attempt has been made to establish "creameries" and to pasteurize milk supplies. The Mooi River Creamery is a case in point, and, although the equipment of the creamery is fully up to modern conceptions, the building and its surroundings are far behind even a modest dairy in this country, so far as its sanitary aspects are concerned.

It is, of course, all a matter of expense and of what will pay and what will not, but the conclusion on this subject is that milk supply schemes in South Africa are not as yet being conceived from any true hygienic standpoint. They would pay equally well if they were.

V.—Aerated Water Supplies.

Although these also have come under no sanitary control from the civil administration point of view, the effect of the military occupation, and the pressure brought to bear on manufacturers to improve their premises, and generally to consider questions of purification of water used in the factories before permission could be obtained for the sale of their aerated water to troops, has had considerable results, both educational and practical.

In many factories examined there were installations of sterilising filters, and in several the manufacturers had intelligent conceptions as to their use.† In three factories, one at Naauwpoort, one at Bloemfontein, and one at Potchefstroom, there were arrangements also for boiling the water.

At the same time there were also many factories where conceptions as to purity of water supply,§ methods of cleansing bottles, and the hygienic aspect of the question generally, were very backward. The presence of troops generally led to factories of aerated waters being established anywhere and anyhow, by men with no previous knowledge of the processes, and simply because it was a paying business. The best instances of this are the factories at Modder River, Naauwpoort, Bloemfontein, and Middelburg (Cape Colony), specially noted in the detailed reports on these places, as having been established without conception of their sanitary bearings.

Recently questions have been raised as to the need of any great precaution in connection with the sanitary control of these factories, on the assumption that pathogenic organisms are destroyed under the pressure in the bottles, or by the charge of carbonic acid gas. We do not yet know enough with regard to this, and it was always my policy to discourage the establishment of factories under obviously insanitary conditions, connected with their water supplies and surroundings, or, if already established, to avoid encouraging their maintenance by giving them facilities for supplying troops.

My general conclusion on the subject is that the manufacturers are now so accustomed to come under sanitary control, since the military occupation of the country, and to carry out in detail the recommendations of the Officers of the Royal Army Medical Corps with regard to the arrangements of the

Vide report on Pretoria.

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* *Vide* Appendix IV., photographs 32 and 33.

† *Vide* Report on Bloemfontein and Kroonstad (aerated water factories).

‡ *Vide* reports on Bloemfontein, Pretoria, Middelburg (Transvaal), Standerton, &c.

§ *Vide* reports on Middelburg (Cape Colony), Naauwpoort, Modder River; also Appendix IV., photographs 34 and 35.

factories, that it would be an easy matter to establish and rigidly apply definite regulations on the subject in the form of municipal bye-laws. In this respect there would be less disturbance, less dislocation of established customs, vested interests, &c., by stringently applied bye-laws than perhaps in any other form of trade affecting the health of garrisons in South Africa.

I have made no mention of regimental aerated water factories. There was one at Stellenbosch, and one belonging to the military hospital at Standerton. The latter was worked under the direction and supervision of the Senior Medical Officer, and the sanitary points connected with purification of water and of bottles were correctly carried out and conceived. The former was not so good. *Vide* report on Standerton.

In many of my local reports the establishment of garrison aerated water factories, run on the lines of the Standerton Military Hospital factory, was recommended for new cantonments, and, in some instances, steps have been taken for putting the recommendation into effect.

VI.—Slaughterhouses.

At present a large proportion of the meat being used in South Africa is being supplied by the "Cold Storage Company," and the slaughtering of animals for the market does not take place to any large extent in the several localities where the troops are stationed. But no doubt the quantity of butchers' meat obtained from local supplies will steadily increase, as farming and stock raising become restored to normal conditions. The sanitary conditions under which slaughtering will then take place are not likely to be good.

At Pietersburg, Barberton, Middelburg (Transvaal), Potchefstroom, Ladybrand, Newcastle, and Naauwpoort, for example, the slaughterhouses are little else than slaughtering poles in the open veldt, without water, and with no means of disposing of the offal, &c., except by burying on the spot. Slaughterhouses constructed of masonry, more or less supplied with water and with paved or concrete floors exist at Standerton, Middelburg (Cape Colony), Burghersdorp, Harrismith, Maritzburg, Kroonstad, but the general conditions do not indicate a very high standard of sanitation, as may be gathered from the detailed reports on these places. There were no slaughtering places for military purposes at any of the localities. *Vide* Appendix IV., photograph 26.

VII.—Bakeries.

The condition of affairs as regards bakeries is very much the same as the condition of affairs as regards slaughterhouses. That is to say, the construction of bakeries and their surroundings do not indicate any marked standard of sanitation. I can only recall one bakery, namely at Harrismith, where the conditions approached the conditions of a bakery in any similar small township in England. Attention, however, was not specially directed to bakeries, as the influence of their sanitary condition on the health of the troops may be regarded as practically nil.

VIII.—Laundries.

So far as civil communities are concerned there were no establishments of the nature of public laundries, except at Harrismith, where a shed was constructed and equipped with washing stands and with water laid on, for the use of the washerwomen living in the native location. The use of it, however, was not compulsory, and the women preferred to use the pond they had always used. In Pretoria there was a steam laundry, and at Pietersburg a similar laundry was contemplated, but at other places the washing of clothes was without sanitary control, either as to the selection of places where clean water could be obtained,* or of places where the washing did not pollute

* *Vide* Reports on Standerton, Newcastle, Harrismith.

water supplies. As a rule, the washing places were generally below the intake of the local water supplies, but at Potchefstroom, Pietersburg, Middelburg (Transvaal), and Standerton, the washing of clothes was seen going on above these sources, not necessarily sources of direct supply to the troops, but sources of supply to some section of the local community.

Appendix IV., photograph 27.

The worst conditions as regards places selected for washing were at Newcastle, where the washing places were in the river alongside the depositing place for refuse, and at Harrismith, where the washing was done in a surface pond into which refuse and filth pits drained, and in which it was strongly suspected that the latrine pails were being washed.

Linen coming back clean from such places had a distinctly putrescent smell, and the need of sanitary control over, and sanitary construction of, washing arrangements and laundries must be considered a health problem of the first importance in South Africa.

Appendix IV., photograph 3.

As regards the arrangements for troops, in some places, *e.g.*, Kroonstad, Harrismith, Naauwpoort and Bloemfontein, special arrangements were made and constructions put up and equipped for the washing of military bedding and clothing, while at Barberton an admirable establishment was constructed in connection with the hospital. At Burghersdorp and Pietersburg some minor arrangements were made, but at the former place the site selected for washing hospital bedding, &c., was close to and above the wells supplying drinking water. At other places the military washing was done under the same conditions as to selection of place and method as the washing for the civil community; and, as a general conclusion, the establishment of laundries for the military population, equipped for the washing of hospital and other bedding and clothing under hygienic conditions, and under sanitary control, must be regarded as urgently demanded in the existing state of affairs in South Africa; just as much as it has been considered necessary in India.

IX.—Cemeteries.

In no instance can it be said that the condition of cemeteries for the white population was such as to affect the health of troops unfavourably. None of those seen affected water supplies, or showed evidence of fouling of ground or air near habitations. Those that were overcrowded were being closed, and fresh cemetery ground was being prepared

The soil, however, was not always suitable. Thus, the cemetery at Newcastle is on ground that is apt to be swampy in the rains; and in other places rocky strata come near the surface, and some of the graves were consequently not deep enough.

Vide report on Modder River.

Native cemeteries on the other hand are apt to become a danger to health. Thus, at Modder River a large number of graves from a neighbouring refugee camp was found to be situated on the edge of the river draining into the section impounded as an intake for the water supply of the troops.

The absence of mortuaries is a noticeable feature in the public health arrangements of South African towns. It was exceptionable to find a mortuary either at the cemetery or elsewhere. The question of cremation as a method of disposing of the dead does not appear to have been considered as yet.

X.—Management of Infectious Diseases.

Systems of notification, isolation, and disinfection are very imperfect in connection with the civil communities. As a rule, infectious diseases are required to be notified; but the notifications do not come direct to the Medical Officer of Health. The usual procedure is to send them to the Secretary to the Health Board or Resident Magistrate in the Transvaal, or to the Town Clerk in the other Colonies. From these offices they are sent in weekly or monthly lists to the Medical Officer of Health to the Colony; and action is taken by the local officer of health apparently only when requested. As a rule, outbreaks of smallpox and plague are the only occasions when any active preventive measures are contemplated. In the absence of reliable birth registration, vaccination is also an imperfect instrument of prevention. The sanitary management of enteric fever and other infectious and contagious diseases does not exist, except in the military communities.

Isolation hospitals are provided by the civil authorities at Pretoria, Middelburg (Transvaal), Pietermaritzburg, and Potchefstroom; but in other places means of isolation do not exist, and in all the localities just mentioned, with the exception of Pretoria, the arrangements of the isolation hospitals are very imperfect. Further, these isolation hospitals are intended to be smallpox lazarettos, rather than hospitals for dealing generally with notifiable infectious diseases. *Vide* report on Middelburg, Cape Colony.

As regards disinfection, in Potschefstroom and Pretoria there were steam disinfecting apparatus, in the former place at the isolation hospital, in the latter in the civil hospital.

At Middelburg (Cape Colony) arrangements were made for disinfecting houses by burning sulphur and by lime washing; and at Kroonstad disinfectants were sold at cost price by the municipality.

At no place was there any sound public system for disinfecting houses, bedding, and clothing, and for the special treatment of infectious discharges. An attempt has been made, however, for dealing with the latter point at Bloemfontein, where special night soil pails were supplied to houses from which notifications of infectious diseases were received.

The general conclusion one is obliged to form on this subject is that there is practically no proper public system in good working order amongst civil communities in South Africa for dealing with infectious diseases by means of notification, isolation, and disinfection; and, that where any attempt at such exists, the number of weak links in the chain of efficiency is very considerable.

As regards military communities the sanitary regulations are strictly enforced, and the means of isolation and disinfection are sufficient, and are carried out well.

XI.—Sites of New Cantonments.

Generally speaking, the sites selected have been good, but some are considerably better than others. Amongst the good sites may be mentioned Pretoria, Standerton, Barberton, Bloemfontein. These are good sites in so far as the possibility of introducing sound measures for the removal and disposal of waste products are concerned, and from the fact that the ground has been kept clean. As regards their water supplies, however, neither Standerton, Bloemfontein, nor Barberton can be considered altogether satisfactory, the two former because of the quality of the water, and the latter because of the quantity.

The sites at Middelburg (Transvaal) and Harrismith would have been classed amongst the best sites were it not for the fact that they both present difficulties in connection with the removal and disposal of waste products, except at considerable expense and with considerable length of drainage. At the former, too, the ground allotted for the site is cramped for the size of the garrison. *Vide* reports on Harrismith and Middelburg, Transvaal.

The sites at Middelburg (Cape Colony) depend on questions of water supply and drainage, which have not yet been fully worked out. The amount to be spent on the cantonment there in these two directions will make all the difference between the sites being good or bad; in other words, any attempt to save money in connection with the water supply and drainage, and there are many temptations for doing so in this particular locality, will have a bad effect. *Vide* report on new cantonments, Middelburg, Cape Colony.

As regards other stations, viz., Pietersburg, Ladybrand, Modder River, Mooi River, Kroonstad, Naauwpoort, Burghersdorp, Maritzburg, the question of retention of troops there was somewhat indefinite; but Pietersburg, Ladybrand, Naauwpoort, and Burghersdorp could not at present become, sanitarily, localities for any large garrisons on account of their water supply being so limited. Modder River, Mooi River, and Kroonstad might be made good localities on the sites proposed, provided a system of purifying river water were established on a large scale and in accordance with sound hygienic principles. *Vide* local reports.

The question of new sites for a garrison at Maritzburg was specially considered. The best locality would undoubtedly be the Foxhills, but only if the water supply and drainage of the site could be connected with the prospective municipal schemes. *Vide* report on Pietermaritzburg.

XII.—Planning and Construction of Cantonments.

Most of the cantonments have been planned, so far as the actual placing of huts is concerned, on much the same principles. The various constructions, too, are generally similar.

But in the sanitary details of planning and construction there are considerable differences; for example, in the positions of latrines, stables, kitchens, and ablution rooms, relative to the barrack huts, as also in the construction of some of these.

The type of hut for barrackroom purposes is the corrugated-iron hut, known usually as the A type, War Office pattern, with verandah of 6 feet on one side only, and with ridge ventilation. In most respects this form of hut is good and suitable, but it might be greatly improved by having higher walls and wider verandah. Many Officers have expressed a desire for double verandahs, but this is scarcely necessary if the aspect is well selected, *i.e.*, if the verandah faces north or north-east. A verandah with any degree of west in its aspect is practically useless in the summer months, as the afternoon sun sweeps it from end to end. This point has been attended to in most instances in planning and constructing the hutments. But where considerations of site, configuration of ground, &c., prevent this, double verandahs must be considered essential.

Appendix IV., photographs 37, 38.

At Barberton and Middelburg (Transvaal) a local design for mess and hospital huts was adopted. The chief features of this design are height of walls, raised and louvred ridge ventilation, and verandahs on all sides. They were excellent huts for the purpose, picturesque in appearance, and well adapted to the climate.

Appendix IV., photograph 39.

At Middelburg (Cape Colony) there is a proposal to use a form of portable hut, known as the "section hut." It is not well adapted for cantonments that are likely to be permanent. The flooring and walls are of a construction likely to collect dirt of all kinds and to harbour insects, and there is an absense of proper ventilating apertures either along the ridge or eaves. Huts used for Officers, Officers' servants, and non-commissioned officers are known as the B and C type huts. In the latter the chief feature is the absence of the means of perflation, and, in some huts which I saw, of ridge ventilation.

The construction of kitchens, latrines, and ablution rooms was generally satisfactory—that is to say, the floors were prepared of concrete, channelled to drains or sumps, and the light and ventilation were good. The best construction of latrine seen was at the Naval Hill cantonments, Bloemfontein. The construction was for an American trough system, and there were specially-arranged louvred panels for ventilation. The ablution rooms of this cantonment were also good, and admitted of the introduction of a system of shower baths. The American trough system of latrines was also being constructed at Pietersburg. At Barberton, Middelburg (Transvaal), Potchefstroom, and Standerton a bucket system has been provided, at any rate, temporarily. At Pretoria it is intended to use water-carriage systems of latrines from the time of occupation, and it is proposed to introduce them in time into the cantonments at Potchefstroom, Standerton, Middelburg (Transvaal), and Harrismith. It is intended to have septic tanks and aerobic contact beds at the outfall of all water-carriage systems. A question arose in connection with urine tubs and night urinals. In some places, *e.g.*, Bloemfontein, special slabs were prepared for these outside and close to the barrack hut. In other places, *e.g.*, Barberton, compartments are constructed off the verandah or entrance to the hut, so that the men may have access to the tubs during the night without having to go out into the open. From the point of view of convenience and climate during the winter months, and heavy rains, the latter arrangements have been recommended, provided the floors are concreted and channelled to outside sumps or gulley traps and drains.

Vide report on Bloemfontein.

Questions have been considered in connection with the space occupied by units, and the distances between huts and lines of huts. The general rule has been to allow 35 feet between huts, end to end, and 50 feet between lines. Cantonments that showed this form of spacing, such as Pietersburg, Standerton, and Middelburg (Transvaal), had the appearance of being too crowded, except where, as in Standerton, the blocks of buildings were divided by wider spaces

between half battalions and between lines of accessory buildings and huts. The Barberton cantonment had the best open space arrangements between huts, and there was, as a result, an absence of any appearance of being cramped. The space which I found it best to recommend for these corrugated-iron hutments was 50 acres for each unit of Infantry, Cavalry, or Mounted Infantry, the space being calculated to include Officers' quarters, and regimental parade ground.

For hospitals, a maximum of 2,000 square feet per bed was taken as a guide, but this, I think, is insufficient for the corrugated-iron hut type of construction, if quarters for Royal Army Medical Corps Officers, nursing sisters, and administration buildings are to be included. It is found preferable to base the requirements on a space of 10 acres per 100 beds, or more than double the space allowed in hospitals of masonry construction, with single and double-storied pavilions, such as the garrison hospital at Tempelhof near Berlin.

In these corrugated-iron cantonments the necessity of covering large areas of ground makes it difficult to arrange drainage and prevent soil pollution, as economically as in brick or other masonry constructions, and the chief consideration, at present, is the question of raising the huts a specified height above the soil, and concreting underneath and around each.

In none of the cantonments have these sanitary points been provided for. Huts are seen placed directly over the soil, in some cases with 4 inches between the surface and the floor, in others with 4 feet, and in a few with the soil cut away and banked up against the floor. In one case the grass from underneath was seen growing through the flooring into the hut. Appendix IV., photographs 37 and 38

The sanitary aspect of this condition of affairs is not favourable, and in every instance the necessity of raising the huts on piles, or plinths, to a height which would enable every part of the surface underneath to be seen, and to be readily accessible, was urged; and, equally too, the necessity of preparing the soil under and around the hut, in such a way as to ensure its being kept clean, clear of rank vegetation, and free from soakage of organic matter into its superficial layers. *Vide* local reports.

The chief argument against measures of this kind was expense; but the matter is of as much importance from the sanitary point of view as the erection of walls and roofs is from a constructional point of view.

The construction of stables also raised an important sanitary point. They are of corrugated-iron, generally well ventilated; as, for example, the stables described in the Pietersburg report, but the principle that has been adopted is to provide them with "dagga" or beaten antheap or cowdung flooring. A fairly hard floor is obtained, but it is readily broken up by the horses and has constantly to be renewed. This, however, is not the main point. The main sanitary point is the fact that, where these floors exist, and where there is no proper channelling and draining to a definite system for the disposal of foul water, the organic matter of stables soaks into the soil in and around the stable. So far as the troops are concerned, this might not be of great importance, if stables were at considerable distances from the barrackroom huts; but in the planning of the cantonments they have been placed within 70 to 120 feet of the huts, and in the same alignment. In one instance, Harrismith, they were placed in the plan on the higher part of the slope, so that whatever soakage did take place would in time gravitate to the soil underneath the huts. Appendix IV., photograph 36.

The recommendations made on this point, were that stables placed in such positions, should be constructed, as regards flooring and drainage, with the same regard to sanitary details as is demanded in stables at home.

XIII.—Standing Camps.

There was a great want of uniformity in the standard of sanitation in these camps, mainly in the organization for collecting, conveying, storing, purifying, and distributing water; in the arrangement and construction of latrines; in the arrangement for ablution and disposal of waste water; in the removal of dry refuse; and in the general siting and comfort of the camps. Most of these points have been noted in the various headings already dealt with.

One point, however, not touched upon is the question of the number of men occupying bell-tents, and the provision of proper dining accommodation. It was usual to find six to eight men in each tent, but under peace conditions there is no object in crowding tents in this manner.* The spread of disease is much favoured by doing so, and the facts noted in the report on Kroonstad indicate that a better condition of health is obtained by reducing the number to three or four. The provision of dining tents is also important, and, in some camps, neglected.

Appendix IV., photographs 40, 41.

The condition of the first group of standing camps visited, namely, Newcastle, led to my drawing up a series of notes as a guide to the formation and management of the camps there (Appendix I.), and eventually standing camps were formed at Mooi River on the lines laid down in these notes.

The general impression formed was that standing camps had grown up without any general sanitary organization; that units marched in and formed their camps on whatever site seemed most suitable at the time, and that the sanitary arrangements and accessories followed.

In establishing the standing camps at Mooi River the principle adopted was to prepare the sites, lay on and arrange for the sterilization of drinking water, construct latrines, kitchens, and ablution rooms, and have everything ready for the disposal of waste products, under the supervision of the Royal Engineers and Royal Army Medical Corps, before the troops moved in. This was the principle urged for adoption, subsequently, in connection with all peace movements of troops into camp, the object being to enable them to start their camp on a sanitary basis and maintain it on the same basis even after prolonged occupation.

The arrangements of many of the general hospitals, which are now carrying on the work of military hospitals on the same sites and practically under the same conditions as during the war, without any outbreak of illness amongst their establishments, indicate the standard of sanitation that should be obtainable in all standing camps under systematic sanitary organization.

XIV.—Railway Sanitation.

It was impossible to make a complete enquiry on this point without taking it up as a special investigation, but, wherever the opportunity occurred, the water supply arrangements, latrines, lavatories, &c., used by troops passing through, and by the general public, were examined. As regards latrines and lavatories, where they exist, the conditions, although not in any way approaching the conditions of railway stations in England, were fairly satisfactory so far as the present standard of sanitation in South Africa goes; that is to say, the floors were well constructed of concrete, generally channelled to an outside sump, and kept clean by lime-washing. The bucket system, however, is universal, and the condition of the bucket is apt to become very insanitary.

Vide report on Standerton and Appendix IV., photograph 14.

As regards water supply, a serious condition of affairs is present, inasmuch as water is frequently laid on to the railway stations for the use of the general public from the most impure sources. It may be stated generally that the supply intended for feeding the engines is also the supply which the railway authorities lay on to taps at the railway stations for the travelling public. If the source is a pure source, well and good; if not (and in many cases, as at Standerton, Modder River, and Kroonstad, it is pumped from the nearest point on the river without any reference to sources of pollution up stream), it is about as dangerous as a water supply can well be. In this respect the railway authorities, unintentionally, have shown a disregard of sanitary principles, and the conditions under which troops travelling by train obtain water are sufficient to account for outbreaks of disease subsequent to the journey.

Finally, an insanitary type of filter is fixed in the railway carriages, namely, the old pattern carbon filter. These filters, moreover, cannot be readily removed for cleansing; in fact, it is impossible to say how often they are cleaned or recharged, and they must be regarded as a distinct danger to those of the travelling public who, in their ignorance, may use them.

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* *Vide* Report on Stellenbosch, Report on Kroonstad, &c.

Reform in the sanitary conditions of supplies of drinking-water at railway stations and in railway carriages I consider essential in connection with all the South African railways.

XV.—Civil Surroundings of Camps and Cantonments.

Most of the sanitary aspects of these have already been touched upon under previous headings. Generally speaking, the construction of civil habitations is fairly good, but the absence of any form of drainage, and the fact that, in many cases, they are placed directly on the soil, render them unsatisfactory for the purpose of affording accommodation to married families. The conditions too, as regards latrine accommodation, ablution arrangements, and water supplies are, in most localities, primitive, and likely to lead to ill-health amongst people occupying such habitations.

The native locations vary much in regard to sanitary conditions. In some places, as at Ladybrand, they are without any sanitary arrangements whatever, even without a water supply. In others, as at Bloemfontein, they are very much under the same sanitary conditions as the rest of the town; while in the majority of places they occupy a position somewhere between the standard of sanitation, adopted for the town, and no sanitation at all. *Vide* report on Ladybrand.

The recommendations made on this point were generally to the effect that, as the native population suffer greatly from enteric fever, and may be regarded as important disseminators of the disease under existing conditions, the maintenance of a high standard of sanitary organization in the location near camps and cantonments, as indeed everywhere, is as necessary as, in a sense even more necessary than, amongst the white population. The native of South Africa mixes freely with the soldier, to a much greater extent, for example, than does the native of India, and his sanitary conditions are likely to affect the health of the troops more.

In some places, as at Maritzburg, Potchefstroom, Middelburg (Transvaal), efforts are being made to improve the construction of dwellings, and the tin shanty and corrugated-iron type of construction, are likely to disappear in well-managed townships in the future.

GENERAL SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS.

In the reports, which I submitted locally in South Africa, a series of conclusions and recommendations were noted with regard to permanent cantonments, existing camps, and civil surroundings. Many of these have been repeated in the preceding notes, but it may be convenient to summarize them here.

I.—Public Health Administration.

(a.) *Civil.*

(1.) The civil administration meets the requirements of public health, so far as enactments or prospective enactments are concerned.

(2.) The machinery for carrying out these enactments is weak, and the tendency is for public health work to remain more or less in abeyance, except when urgent questions of quarantine, &c., in connection with plague and smallpox, arise.

(3.) The division of Colonies into public health districts or areas, and the appointment of specially qualified Medical Officers of Health, without private practice, to these districts, such as is done to some extent in the Transvaal, appear to be the first essential step towards strengthening the machinery.

(4.) General education of the people, and the production of a desire for a higher standard of sanitation in habitations, surroundings, water supplies, and

methods of disposal of waste products will follow any step of this kind, and the administration of the public health will then become less and less of a dead letter.

(b.) *Military.*

(1.) The appointment of one or more specially qualified sanitary officers, who can devote their whole time, under the Principal Medical Officer, to the sanitary organization of cantonments and standing camps is essential.

(2.) In addition, it is recommended that a Sanitary Board should be appointed at Head-quarters to consider the main questions of establishing new cantonments and standing camps, according to some uniform standard of sanitation; such a Board to consist of—

A representative of the Royal Engineers.

A Sanitary Officer, Royal Army Medical Corps.

A representative of the General Staff.

A representative of the Army Service Corps.

A representative of the Army Ordnance Department.

(3.) The local Senior Medical Officers and Medical Officers in charge of units, Commanding Royal Engineers and Regimental Commanding Officers, under the Officer Commanding the Station or General Officer Commanding a District, should be responsible for maintaining in their own station or district the sanitary organization laid down by the Sanitary Officers or the Head-quarters Sanitary Board. They should, in fact, form local boards, and meet periodically to determine the existing state of their sanitary organization, and consider steps for its improvement, should it appear to be below the standard of requirements.

(4.) The formation of these boards will widen the interest in, and knowledge of, the sanitary requirements of standing camps and cantonments, and ought to dispel much of the friction and delays, which are bound to arise when Officers representing different interests do not discuss these matters together, but deal with them, as is frequently the case, in paper minutes written from one to the other.

II.—Water Supplies.

(1.) Where the quantity is precarious or the quality doubtful, it is recommended that rain should be collected on the roofs of the barrack huts and stored in tanks of the same pattern as those at the railway cottages at Naauwpoort.

(2.) Where the water supply is dependent on surface dams or rivers, as in the contemplated supplies of Pietersburg and Standerton, the construction of waterworks on a large scale is essential, with filtration through sand at a rate not exceeding 3 vertical inches per hour, under scientific management of the beds, and with arrangements for laying on the purified water for all purposes.

(3.) Where a combined municipal and military scheme of purification is not practicable for such supplies, it is recommended that the smaller clarifying filter bed installation, such as that originally proposed at Standerton, be employed when the water is apt to be muddy, and that, in addition, there should be sterilizing apparatus on the Maiche or Waterhouse-Forbes principle, or sterilizing filters on the French principle, to give a full supply of water for drinking purposes to each barrackroom. One must not forget, however, that there will always be the danger of men getting unpurified water elsewhere, wherever there is only a partial supply of purified water.

(4.) Protection and conservation of springs and of their immediate surroundings are essential in supplies derived from springs, but water from springs, so conserved, and proving pure on analysis, needs no special purification, if stored in well constructed reservoirs and laid on in pipes.

(5.) Water from deep borings also requires no purification, and the chief danger in supplies from this source is the exhaustion of the supply that is likely to occur after constant pumping.

(6.) Well water requires purification as a rule, and, where dependence has to be placed on such a supply, systematic and periodic analyses are necessary to detect when the intermittent contamination, to which wells are liable, is occurring. A single analysis should be regarded as of little value, and cannot be quoted as evidence of permanent purity.

(7.) For cantonments and towns nothing short of good storage reservoirs and laid-on pipe supplies can be regarded as satisfactory, but for standing camps the conveyance of water by carts has to be contemplated.

(8.) Where this is the case the carts should be periodically cleansed by boiling water or by steam, as was done at Newcastle, and they should be kept under the supervision of Officers and in the care of a responsible non-commissioned officer. The collection and conveyance of water supplies should not be the concern of Kaffir labourers. They may be required to look after and drive the mules or other transport animals, but they should have nothing to do with the water.

(9.) Arrangements for storing and purifying water in camps should be made a regimental organization on definite plans laid down by a Head-quarter Health Board or by Sanitary Officers. The system likely to prove most suitable is that worked at the Military Hospital, Bloemfontein, with a Waterhouse-Forbes apparatus.

(10.) The installations in camps for purifying and storing water should be under cover in specially-constructed sheds such as those at the hospital at Harrismith. Wire-gauze protected doors and windows, as far as possible dustproof and flyproof, are recommended.

III.—Removal of Waste Products.

(1.) In the construction of latrines there should invariably be a concrete base, channelled to a sump or to drains, both in cantonments, standing camps, and private houses.

(2.) The seat should not be boxed in, and, where a pail or bucket system exists, it should be made to fit close on to the top of the pail or bucket.

(3.) The use of solutions of disinfectants, such as chloride of lime, izal, &c., is preferable to dry earth or earth mixed with lime.

(4.) Cleansing the pails by lime-washing and by burning old papers or rags inside them is a better method than cleansing by tarring.

(5.) The provision of specially-constructed sanitary carts is essential for the removal of pails and pail contents. The wooden barrel arrangements on buck wagons should not be permitted.

(6.) Removal by daylight should take the place of removal by night. The latter system admits of many abuses, insanitary conditions and imperfectly-supervised work.

(7.) Municipal arrangements for bi-weekly and tri-weekly removal should be replaced by daily removals, and the equipment and staff required to effect this reform should be regarded as a necessary expenditure.

(8.) The system of numbering the pails as at Middelburg (Cape Colony), so that each house may always retain its own, and of having special pails for houses where there is infectious disease, as at Bloemfontein, is recommended.

(9.) A dual pail system is also recommended in all places where a pail system must prevail.

(10.) Radical reforms are required in the methods of disposal of night-soil, and the system recommended is that of enclosing a definite area, equal to four times the annual requirement of the community; trenching the soil to a

depth of 6 inches, in long narrow trenches 1 foot wide by 1½ feet deep, and covering up each trench daily; cultivating each plot of trenches with a rotation of crops; planting the enclosure round with trees; establishing at the depositing area a park for the sanitary carts and for the cleansing and disinfecting of pails, and forming this park of a concrete surface channelled to drains leading to the cultivated trench areas or belt of trees. A system of sewage disposal of this kind is essential both for civil and military communities where pail systems exist.

(11.) A similar method of disposal is necessary also with the American trough system.

(12.) With a water-carriage system a septic tank and contact bed installation is recommended, but on a site which dominates for irrigation and cultivation at least 3 acres for every 1,000 of population. Men with practical scientific knowledge of these systems are needed in the country.

(13.) At all septic tank and contact bed installations there should be a small destructor for incineration of the screenings and any organic matter that may form a sludge on the contact beds.

(14.) The construction of ablution rooms and kitchens should be similar to that of latrines as regards flooring, *i.e.*, concrete floors channelled to sumps or drains.

(15.) The slops from these should be run in drains to gardens or other irrigated and cultivated enclosures, both in cantonments and camps unless there happens to be a water-carriage system, in which case they would pass into the general drainage system.

(16.) There should be covered sanitary bins for dry refuse, and the refuse should be eventually disposed of by burning.

The construction of a simple and inexpensive incinerator such as that constructed in connection with the camps at Mooi River is recommended for all camps and cantonments.

(17.) The immediate removal of stable manure to cultivated fields at a distance from camps and cantonments is essential in order to minimise the production of flies. In cantonments, well constructed manure pits are essential unless immediate removal can be carried out systematically.

IV.—Milk Supplies.

(1.) The establishment of creameries in Natal has been a useful advance in connection with milk supplies, but reform is needed in the general sanitary construction and surroundings of these establishments.

(2.) Radical reform is necessary in connection with the municipal milk supplies, especially as regards methods of storage, cleansing of vessels and sale. Until proper cowsheds and dairies are insisted upon under the existing Public Health Acts and Municipal Byelaws, with good drainage and ventilation and an unimpeachable water supply and means of cleansing vessels, the health problems in South Africa connected with milk supplies are not likely to improve.

(3.) For cantonments and camps a milk depôt such as that at the Military Hospital, Pretoria, with facilities for sterilizing the milk, cleansing the vessels, &c., and for preventing flies entering the building is strongly recommended.

V.—Aerated Water Supplies.

(1.) As a rule the sanitary aspects of these supplies are better than other sanitary conditions in South Africa.

(2.) The suppression and discouragement of factories dependent on water from unsafe sources such as at Modder River and at one of the factories in Naauwpoort and Middelburg, Cape Colony, are recommended.

(3.) The use of sterilizing filters on the main feeders, as in many of the factories, should be made universal, and the use of charcoal filters, except for clarifying water, prohibited.

(4.) The most radical reform needed is in the method of cleansing the bottles. Cleansing by steam sprays or by purified water sprays, instead of by hand in troughs and tubs, is essential.

(5.) The sanitary construction of the factories and their surroundings also requires attention.

(6.) The establishment of garrison aerated water factories under sanitary supervision and control is recommended, where the local factories are not made sanitarily perfect.

VI.—Slaughterhouses.

(1.) A more rigid application of Public Health Acts and Municipal Bye-laws is necessary to create reform in the method of slaughtering animals for food.

(2.) The construction of the slaughterhouse is in special need of attention as regards concreting and channelling of floors and yards, disposal of offal and other foul matter by destruction or burial in definite enclosures, and also as regards provision of an ample supply of clean water.

(3.) Inspection of carcases is also a matter that appears to demand attention.

(4.) Disposal of the carcases of animals that have died is best effected by incineration, as is done at Middelburg, Transvaal.

VII.—Bakeries.

No recommendations were made as regards these. The provision of pure water supplies, and sanitary inspection for the purpose of maintaining cleanliness, and preventing the use of bakeries as dwelling places for Kaffir and other labourers, are the main requirements.

VIII.—Laundries.

(1.) In cantonments and standing camps the provision of military laundries or, at any rate, the sanitary supervision of all washing arrangements for military hospitals and for the troops is considered essential.

(2.) In the construction of laundries, the arrrangements made in connection with the military hospital at Barberton are recommended, as being the best seen in South African stations.

(3.) Means of boiling or disinfecting should be provided at all laundries.

(4.) The custom of washing bedding and clothing in polluted water, as at Standerton, Newcastle, and Harrismith, should be prohibited. The reforms, that were in recent years considered necessary in connection with "dhobies ghâts" in India, are just as necessary in South Africa.

IX.—Management of Infectious Diseases.

(1.) Radical reform is necessary in connection with this, as regards municipal sanitary control.

(2.) The direction, in which reform is essential, is the necessity of notifying direct to the local Medical Officer of Health; and of action being taken by him to investigate causes; to isolate, if necessary; to control the sanitary disposal of infectious matter, and to disinfect.

(3.) The construction of isolation hospitals, where they do exist, is faulty. Means of isolation can readily be provided in tents, and the direction in which reform can best be made in the matter of construction, is to have proper enclosed spaces kept ready; to construct in them the necessary sanitary accessories such as kitchen, latrines, disinfectors and ablution rooms; and to have

specially prepared areas for the erection of tents as wards. An administrative shed in which the necessary tentage and ward furniture could be stored, when the hospital is not being used, would be a useful addition to the enclosure.

X.—Sites of New Cantonments.

(1.) A consideration in selecting sites appears to have been to get near water supplies, and avoid pumping, if possible; in other words, to get the water on to the site as cheaply as possible.

(2.) A more important consideration should have been to select sites from which the removal and disposal of waste products could be easily and effectively carried out; but, where these two considerations clashed, the question of water supply seemed to have most weight.

(3.) Generally, however, the selection of sites has been good as regards questions of soil and exposure.

(4.) The selection of locality has not always been satisfactory so far as water supplies are concerned. In this respect recommendations had to be made with a view to limiting the size and extent of new cantonments on account of the water being likely to prove insufficient in quantity.

XI.—Planning and Construction of New Cantonments.

(1.) The chief sanitary defect has been the lack of provision for preventing pollution of soil under and around the huts. It has been strongly recommended that the huts should be raised sufficiently to enable the surface underneath to be readily examined and accessible; and that the surface should be concreted and channelled to surface drains, not only under the hut, but for 3 feet round.

(2.) Another recommendation, which it was necessary to urge, is that the stables should be constructed with impervious flooring, channelled to drains or sumps.

(3.) A system of shower baths has been recommended for the ablution rooms.

(4.) Fly-proof doors and windows are recommended for kitchens, messes, dining-rooms and hospital wards.

(5.) The construction of good roads and paths, and covering intervening spaces with trees or grass, or converting them into gardens, are important measures in South Africa, where dust is so prevalent.

(6.) An area of 50 acres for each regimental unit has been recommended inclusive of parade ground, officers' quarters and other regimental accessories. A much smaller area would be sufficient, if two-storied brick or stone barracks were built, and this form of construction is recommended in future in preference to the corrugated-iron hut barracks, as being more economical from the sanitary point of view.

(7.) The distance of units from one another, of huts from one another, stables from huts, latrines from huts, &c., in cantonments already planned and partially constructed, are the minimum distances permissible. Even with these distances there is a tendency to overcrowd.

(8.) The position of latrines relative to kitchens and huts has not always been the best. With an earth or pail system, they should be placed in positions which are accessible to filth carts without these having to go through the lines of hutments.

(9.) Occupation of hutments has been deprecated until all the accessories for water supply and for removal of waste products are complete and in working order; and it has been strongly urged that the accessories should be the first works to be undertaken, and the barrack huts, recreation rooms, &c., the last.

(10.) Provision of dining-room huts has been recommended.

XII.—Standing Camps.

(1.) Rules regarding these are given in detail in the succeeding appendix. (Appendix I.).

(2.) The chief sanitary points concerned are—

(*a.*) General sanitary organization.

(*b.*) Preparation of camps, water supply and sanitary accessories *before* troops move in.

(*c.*) Good sanitary construction of latrines, ablution places and kitchens.

(*d.*) Enclosing irrigation plots for disposal of foul water, and converting these plots into gardens or cultivated areas.

(*e.*) Destruction of refuse or its removal to a definite enclosed site.

(*f.*) Removal of nightsoil to definite enclosed cultivated areas, or areas planted with trees.

(*g.*) Detailed organization of water supplies.

(*h.*) Reduction of number of men in each bell tent to 3 or 4.

(*i.*) Provision of dining tents.

XIII.—Railway Sanitation.

(1.) Thorough investigation and improvement, if necessary, of the water supplies at all stations used by the public or by troops passing through are essential.

(2.) Abolition of old fixed charcoal filters from railway carriages is strongly urged. They should be replaced with modern sterilizing filters.

(3.) Similar sterilizing filters should be used for supplying drinking-water at refreshment rooms, &c.

(4.) A general sanitary service, with special sanitary officers, is advisable in connection with the railways in South Africa.

XIV.—Civil Surroundings.

(1.) Reform in the sanitary aspects of civil surroundings of garrisons in South Africa is necessary in order to diminish enteric fever amongst the troops.

(2.) The lines which should be followed are indicated in the preceding headings, I. to IX.

(3.) The Kaffir locations should receive as much attention as, and be under even greater sanitary supervision than, other surroundings. The tendency is to neglect them.

In concluding this report, I am aware that many of the conditions noted are inevitable; that some of the recommendations are at present perhaps impracticable; and that the rapidity with which changes may be effected in the sanitary aspects of South Africa must necessarily depend upon considerations of local administration and finance.

At the same time, I am convinced that it is only by constantly keeping in evidence the essential features and defects of sanitation in the country that movements in the direction of reform are likely to be made. The abnormal prevalence of enteric fever in the country is sufficient to justify any efforts that may be made to effect this in the interests, not only of the troops generally, but of the community at large.

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68, Victoria Street,
29th July, 1903.

APPENDIX I.

RULES FOR THE SANITARY ORGANIZATION OF CAMPS, AS RECOMMENDED IN NATAL, AND ADAPTED FOR STANDING CAMPS GENERALLY.

(*a.*) Water Supply.

(1.) *Source.*

A source for each unit or for the whole garrison must be selected. If the source is a spring, an endeavour must be made to have it conserved. Deep borings may be regarded as a safe source, but the quantity is often unreliable. River and surface waters, however clear, must be regarded as unsafe and as requiring special means of purification. Piped or other town supplies must be thoroughly investigated, and the source ascertained and inspected.

(2.) *Collection.*

If the source is a fairly pure or safe source, and the collection of water can only be effected by filling watercarts, the following methods should be adopted:—

Vide Appendix IV., photograph 13.

(*a.*) If a pipe cannot be led by gravitation direct from the source into the cart a pump must be used, but, if gravitation is possible, a pipe should be led direct into the cart. In most cases this can be done by leading a pipe or hose along trestles to some point at a distance which will enable the cart to come under the pipe discharge, or the ground may be cut away for the cart nearer the source.

(*b.*) If a pump has to be used, one or other of the following methods may be employed for filling the cart:—

(i.) Erect a 1,000-gallon tank at a level sufficiently high to lead the water by pipe direct into cart, and have a man told off to pump into the tank in anticipation of the arrival of the carts, so that the carts may be filled by gravitation, without delay, direct from the tank.

Appendix IV., photograph 11.

(ii.) If there is a likelihood of time being wasted in arranging such tanks at the source, arrange to pump into the cart through hose, but have trestles put up to support the hose in such a way that water may be led direct into the cart without the necessity of having the hose touched, *i.e.*, there should be no necessity for lifting the hose from the ground to place it into the mouth of the cart, and afterwards of letting it lie on the ground again. The use of a trestle avoids contamination of the hose and any danger of pollution through its loose joints.

(3.) *Conveyance.*

Get a sufficient number of watercarts for each unit, *i.e.*, sufficient to supply each unit with a 24-hours' supply of water equal to, say, 2 gallons per head for 24 hours, or, if the source is close at hand, a supply equal to 2 gallons per head for 12 hours.

In the former case let the carts go out once daily to collect water. In the latter, twice daily, morning and evening.

(4.) *Purification of Carts.*

Let each watercart be disinfected as follows:—

Appendix IV., photographs 18 and 19.

Take it to a steam boiler, fill it with water. Then get up steam under pressure, and lead the steam into the water in the cart, and let it play for at least 15 minutes after the water has been brought to boiling point.

Have the purified cart painted a clean bright colour, or whitewashed on the outside, and paint the name of the unit to which it is to belong on it. Let the unit take a pride in it.

Let this disinfection of carts take place at regular intervals, according to the capacity of the steam boiler, &c., but the carts should be disinfected, if possible, at least once a week, or more frequently if there is an epidemic likely to be connected with water supplies.

(5.) *Storage in Camp.*

Provide storage in each camp for a 24 or 12 hours' supply at 2 gallons per head, according to the distance of the camp from the source *i.e.*, if the carts make one journey only to the source, a 24 hours' storage is required. Paint the storage tanks white or whitewash them, and paint the name of the unit on them. Let them take a pride in their tanks as well as in their carts. See that the tank is kept covered, and the water drawn off by taps.

(6.) *Purification of Water in Camp.*

Water taken from a spring direct from the rock, and conveyed in a disinfected cart, needs no purification unless laboratory analysis shows that pollution is present. But if the source is liable to pollution, or if water comes into contact with surface soil, and if the cart or storage tanks are not satisfactory, the water should be boiled or passed through a sterilizing filter.

If either of these processes are necessary, an additional storage tank or two additional storage tanks of similar capacity to the first will be necessary, *i.e.*, if the water is boiled it will have to be passed into a tank to cool, and afterwards to another for distribution. The tanks could be arranged at different levels, so that the water can be passed from one to another by gravitation.

(7.) *Method of Boiling.*

A sufficiently large installation of tanks should be formed, and a steam boiler erected for conveying steam under pressure to the tanks. But a satisfactory and simple apparatus for sterilizing water by boiling is the Waterhouse-Forbes' sterilizer, one or more of which would be found useful in the camp of each unit.

Appendix IV., photograph 17.

(8.) *General Organization.*

Having selected the source, ascertain its yield. If it yields, say, 24,000 gallons in 24 hours, this would be equivalent to a supply for 1,000 troops at 2 gallons per head, if the collection was carried on continuously during 2 hours; or for double that number, if collection were continuous for 4 hours, and so on, provided the pump or trough yielded at the same rate as the spring. Suppose you find that allowing for the rate of pumping, and inevitable delays, it will take 4 hours to supply 2,000 gallons from any given source, then arrange a time-table for the arrival and filling of the carts from different units, and place the carts under the supervision of a responsible non-commissioned officer both for convoy and collection. In this way you ensure that the carts come in sequence, one after the other, and that there is no exhaustion of supply. It is useless and harmful to attempt to collect more water from any spring in an hour than it is estimated to yield in an hour.

As already noted, continuous filling of carts, without any delay, can be obtained by provision of tanks at the source, equal to the supply required in a given time. The tanks can be filled by pumping overnight, and in the early morning; the water can be turned into the carts by gravitation without any delay.

The water organization in camp must depend on the necessity or otheswise of purification there. If purification is necessary, a staff of men under a non-commissioned officer should be appointed to keep carts, tanks, &c., clean and disinfected, to work the filters, sterilizers or boilers, and to attend to the distribution of drinking water to the men.

(*b.*) Removal of Waste Products.

(1.) *Nightsoil.*

The pail system is no doubt inevitable. Have the pails, therefore, kept on concrete bases channelled to a sump, and arrange to have placed in each pail one small scoopful of chloride of lime and one half gallon of water, or half a gallon solution of izal or other disinfectant. The soil must be removed daily in tumbril carts, or by some other suitable method to prevent spilling.

(2.) *Disposal of Nightsoil.*

(*a.*) Map out or fence a plot of ground for trenching. A light soil is the best, and the site should be where the ground does not drain into sources of water supply, and where prevailing winds do not blow over it to the camps.

(*b.*) Have a furrow dug daily, 1½ feet deep by 1 foot wide, and long enough to receive the contents of the whole of the camps. Roughly estimated, the soil of every 100 individuals, inclusive of urine, is equal to 8 cubic feet, and 8 cubic feet, in order to fill 6 inches of a furrow, 1 foot wide, would require a furrow 16 feet long. A garrison, therefore, of 4,000 would require a furrow equal to 16 feet × 40 feet = 640 feet daily. Calculate your labour for preparing such a furrow daily, and also calculate the dimensions of your enclosure accordingly. The area required for 1 year, multiplied by 4, is a guide to the size of enclosure required.

The furrow should be filled in as the soil is deposited, and the furrow for the next day prepared parallel to the previous furrow, and 1½ to 2 feet distant.

Deposit nightsoil and urine in these trenches, the length of the trench being calculated for both urine and soil.

(*c.*) Have the trench enclosure fenced round with barbed wire, planted with trees and cultivated, whenever the plots of filled-in trenches are large enough.

(3.) *Urine.*

Place urine tubs on slabs at intervals along the lines of the tents for night use, and remove them to the latrines during the day. Keep chloride of lime or other disinfectant solution in them, as in the pails. Calculate the number required for groups of men, estimating the urine pail at a 4-gallon capacity, and the possibility of 16 men filling one during night and morning. Dispose of urine as noted above. It is advisable to place some shelter over the tubs to prevent them being flooded by rain.

(4.) *Slops.*

Collect slops in wheeled slop tanks similar to those used in hospitals, and run them when full into gardens or spruits, so long as the latter are not used for bathing, or do not drain into potable waters. Such spruits should have their channels cleared for some distance below camp, so as to avoid stagnation of foul water near camp. Keep disinfectants in the slop tanks. Water from ablution places or laundries should be run by surface channels or pipes on to plots of ground, fenced in and suitable for cultivation. Arrange for the plots to be irrigated systematically and cultivated as gardens, for growing lucerne, vegetables, &c.

(5.) *Dry Refuse.*

Adopt the following method of incineration :—

With regard to existing refuse heaps, have a mound built round them. If there are several heaps near one another, collect them all into one such enclosure.

Prepare a ring of combustible material, *e.g.*, coal, coaldust, or coke, round the outside of the mound, the slopes of which should be about 45 degrees, and the height about 3½ to 4 feet.

Get labourers to work with stable fork, rake, or shovel, and rake the refuse over the mound on to the fire outside. In this way all the refuse is in time consumed. Tins or clinker should be then collected and stored neatly inside the enclosure for anyone who likes to take away.

With regard to dry refuse in the future, arrange to have refuse bins at fixed places around camps, estimating the size of the receptacle required for each kitchen or line of tents, &c.

Have the contents of these bins removed daily to a central incinerating depôt. Form this depôt of a mound as noted above, but with a horseshoe opening into which the carts can be backed in order to tilt their contents inside the enclosure.

Have sufficient labour to keep raking the refuse over the mound on to the fire.

Calculate the size of depôt by the cubic contents of the carts, and the number of the carts required.

Suppose a cart carries 50 cubic feet dry refuse, and this when deposited inside the enclosure covers about 20 superficial feet, it will be easy to estimate a diameter for a suitable enclosure according to the number of cartloads to be deposited daily.

(6.) *Stables.*

Endeavour to get farmers to take stable litter away as manure, and insist on the construction of cement pits, or other suitable receptacles for the litter, pending removal. In any case chloride of lime or other disinfectant must be thrown over the stable manure in order to diminish the breeding of flies. It is advisable to take this precaution also in connection with kitchen refuse.

(*c.*) General Organization.

Place the whole organization for carrying out the above sanitary measures in the hands of one Officer. Give him full power and authority and a free hand to work up the various units into a definite organized system of sanitation, and insist upon a sufficient number of non-commissioned officers and men being placed under him for carrying out details, native labour being employed under those non-commissioned officers and men as required. Spare no expense or men in this connection, because for each man struck off duty to carry out such work, probably two or more men will be saved from hospital.

(*d.*) Details for Sanitary Officer's Special Attention.

(1.) Collect statistics of disease incidence from each camp and unit, and work out periodically comparative ratios; this will enable you to direct attention to localities where there are worst results.

(2.) Carry out laboratory work as required to throw light on the condition of the water supplies, &c., and the necessity or otherwise of altering or purifying these.

(3.) Endeavour by personal influence to work up the civil sanitary authorities to adopt regulated systems for sewage disposal and for incinerating refuse.

(4.) Bring pressure to bear on the owners of aerated water factories, dairies, &c., to adopt sanitary methods of cleansing vessels, bottles, &c., and purifying water supplies. The washing of aerated waterbottles requires detailed consideration; the establishment of a method of washing in tanks of running water or by spray washers fed by sterilized or permanganated water being recommended.

(5.) Go over all the old camping and existing camping grounds, mark down the old filth pits and have chloride of lime dug into them, or water them well with solutions of chloride of lime or other disinfectant. A water tank with a solution of this kind could be taken out for this purpose.

(6.) Let each detail be taken in turn, completed and put in working order, before going on to the next, commencing with the organization for removal and disposal of waste products, as being the most important, and the most in need of good sanitary organization.

(*e.*) Arrangement of Camps, &c.

(1.) Camps on foul ground should be moved as early as possible, but it is no good moving them until good clean camping ground is selected and planned; latrine, urine, slop and refuse receptacles ready, and the systems indicated above in working order.

(2.) Movements to other stations should not be made until an advance party has gone on and reported everything ready for their reception from a sanitary point of view, in accordance with the above recommendations. A good and energetic Medical Officer should accompany the party and see that the sanitary details are properly arranged.

(3.) It is important to calculate the exact number of watercarts, nightsoil pails, urine pails, slop and refuse receptacles required for each unit, as well as to estimate the number of labourers needed to keep the work going, and to see that they are adequate in number.

The regulation watercarts are of 108-gallon capacity, pails are estimated at 7 per cent. of the strength, urine tubs also at 7 per cent., and refuse bins must be estimated according to requirements.

It is essential also to estimate the number of carts required to remove adequately the various waste products daily, and to see that a sufficient number is maintained, and a time-table arranged to prevent them crowding to the depositing places at the same time.

W. G. MACPHERSON, *Lieut.-Colonel,*
R.A.M.C.

Newcastle, Natal,
November, 1902.

APPENDIX II.

AVERAGE Admission and Death Rates per 1,000 for Enteric Fever, for Decennial Period 1891-1900, in Commands outside South Africa.

(For Comparison with corresponding Rates in Stations in South Africa during year—1st June, 1902, to 31st May, 1903.)

Command.	Admission rate, enteric fever.	Death rate, enteric fever.	Remarks.
Egypt	23·9	5·98	
Bermuda	23·6	4·23	
India	23·6	6·26	
Mauritius	17·1	5·98	
Malta	8·2	2·87	
Ceylon	6·4	1·36	
West Indies	5·1	1·97	
Gibraltar	3·5	·95	
Hong Kong	2·0	·61	
Straits Settlements	1·8	·88	
United Kingdom	1·3	·24	
Canada	·3	·07	

APPENDIX III.

ADMISSION Rates per 1,000 of Strength for Enteric Fever and S.C. Fever amongst Troops in South Africa for the Year—1st June, 1902, to 31st May, along with the Death Rates for Enteric Fever.

(N.B.—There were no deaths from S.C. Fever.)

Station.	Admission rates per 1,000 average strength.			Death rates per 1,000 average strength, enteric fever.	Remarks.
	Enteric fever.	S.C. fever.	Total, enteric and S.C. fever.		
Stellenbosch ..	94·7	7·2	101·9	7·68	Standing camps and remount depôt, with excessive and constant pollution of soil. Water supply partly from borings, partly open streams and dams. No town or village within 4 or 5 miles.
Bloemfontein ..	74·1	22·1	96·2	2·82	Partly standing camps, partly cantonments. Water supply municipal—river water with defective purification. Unfinished cantonments occupied by troops.
Pietersburg.. ..	66·6	Nil	66·6	7·24	Standing camp. Small garrison. Water supply partly wells, partly upland clear stream, liable to pollution from settlers' camps and farms.
Newcastle	66·0	Nil	66·0	8·85	Standing camps; broken up in December, 1902, on account of severe outbreak of enteric fever. Most of the troops sent to Mooi River. Water supply partly springs, partly wells insufficiently protected. Soil pollution around camps excessive.
Potchefstroom ..	63·7	55·2	118·9	9·26	Standing camps and cantonments. Water supply from clear irrigation stream, liable to pollution from farms, cattle and washing. Unfinished cantonments occupied by troops.
Pretoria	57·1	7·0	64·1	5·80	Standing camps. Water supply municipal—from clear dolomite springs Liable to intermittent pollution.
Middelburg.. .. (Cape Colony.)	43·5	2·3	45·8	7·70	Standing camps. Water supply, surface springs or wells, liable to pollution. Soil pollution considerable.
Mooi River.. ..	42·4	7·4	49·8	7·37	Standing camps with special sanitary organization. Water supply, river water, sterilized by steam for drinking. 19 out of 32 cases of enteric fever occurred amongst the troops shortly after arrival from Newcastle (*see* Note above). This reduces the direct admission ratio to 17·2 per 1,000.
Middelburg.. .. (Transvaal.)	34·8	6·2	41·0	1·76	Standing camps. Water supply partly from pure sources, but not sufficiently protected, and partly from sources liable to contamination.
Kroonstad	32·9	36·9	69·8	8·33	Standing camps. Water supply partly from borings, partly municipal from river with defective purification.

APPENDIX III.—*continued.*

Station.	Admission rates per 1,000 average strength.			Death rates per 1,000 average strength, enteric fever.	Remarks.
	Enteric fever.	S.C. fever.	Total, enteric and S.C. fever.		
Standerton	28·6	7·9	36·5	3·95	Standing camps. Water supply partly from boring, partly from river without purification.
Harrismith	28·2	5·9	34·1	4·11	Standing camps. Water supply from municipal piped supply, an upland surface water at source, liable to intermittent contamination.
Naauwpoort ..	15·6	Nil	15·6	2·08	Standing camps. Small garrison. Water supply mainly from pure sources and not liable to contamination, but partly from well or boring liable to intermittent contamination.
Modder River ..	10·0	9·0	19·0	3·00	Standing camps. Water supply from river liable to pollution. Special organization for sterilizing water in each regiment.
Barberton	2·2	6·7	8·9	Nil	Cantonments. Small garrison. Water supply municipal and piped; from sources not liable to contamination. Underground drainage system for removal of dirty water: but pail system of latrines.

APPENDIX IV.

PHOTOGRAPHS, ILLUSTRATING GENERAL REPORT ON SANITARY CONDITIONS IN SOUTH AFRICA.

Nos. 1 to 19	Water Supplies.
„ 20 to 24..	Ablution Arrangements.
„ 25	Latrine.
„ 26 and 28 to 31	Disposal of Waste Products.
„ 32 and 33	Milk Supplies.
„ 27	Washing Arrangements.
„ 34 and 35	Aerated Waters.
„ 36 to 39..	Constructions, Cantonments
„ 40 and 41	Standing Camps.

N.B.—Photographs Nos. 11, 12, 13, 18, 19, and 29, were kindly taken for me by Major Eckersley, R.A.M.C.

Photographs Nos. 5, 6, 7, 8, 26, 27, and 28, were submitted with the detailed report on Newcastle, and photograph No. 35 with the detailed report on Modder River.

W. G. MACPHERSON,
Lieut.-Colonel, R.A.M.C.

68, VICTORIA STREET,
29*th July*, 1903.

Water Supplies.

A.—*Sources.*

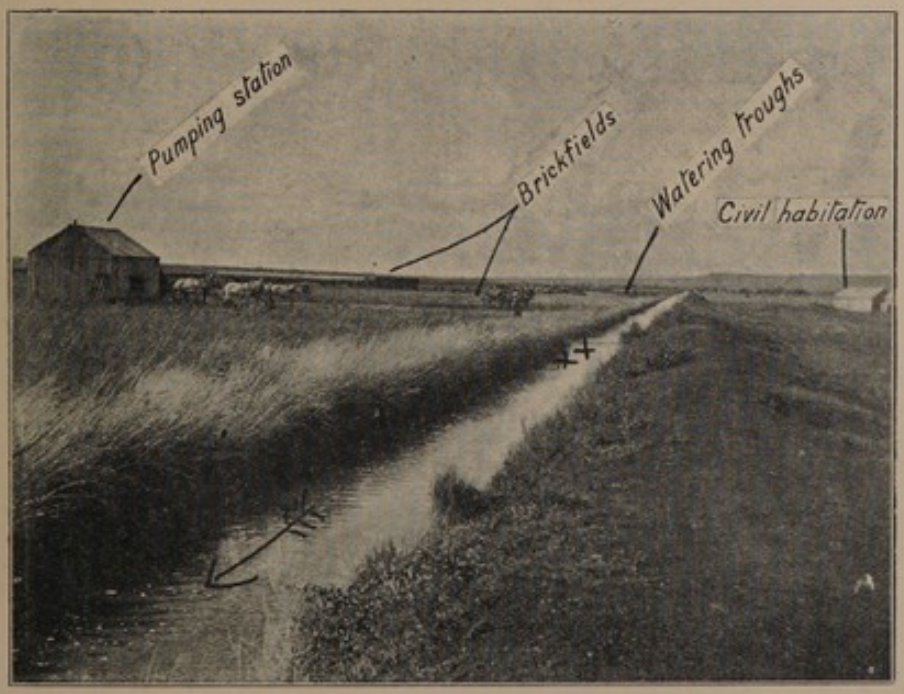
(1.) Proposed collecting areas and valley to be impounded as a reservoir. Edendale and Zwartzkop location, Maritzburg.

(2.) Collecting area of main portion of water supply of Barberton. Rimer's Creek.

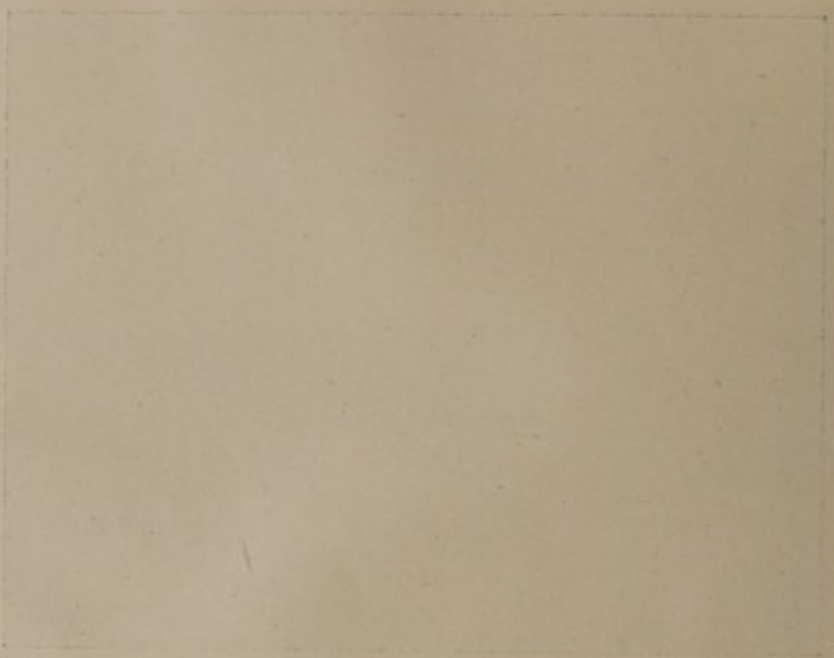
WATER SUPPLIES—*continued.*

A.—*Sources*—continued.

(3.) Wells and their surroundings, from which water supply of troops at Burghersdorp was being derived.



(4.) Irrigation furrow, Potchefstroom, from which the temporary water supply of cantonments and standing camps was being derived. × × is position of intake, down stream, from watering troughs and brickfields.



WATER SUPPLIES—*continued.*

A.—*Sources*—continued.

(5.) Carcase in donga leading to river. (Newcastle.)
The animal, a horse, is shown just below the cross in centre of donga.

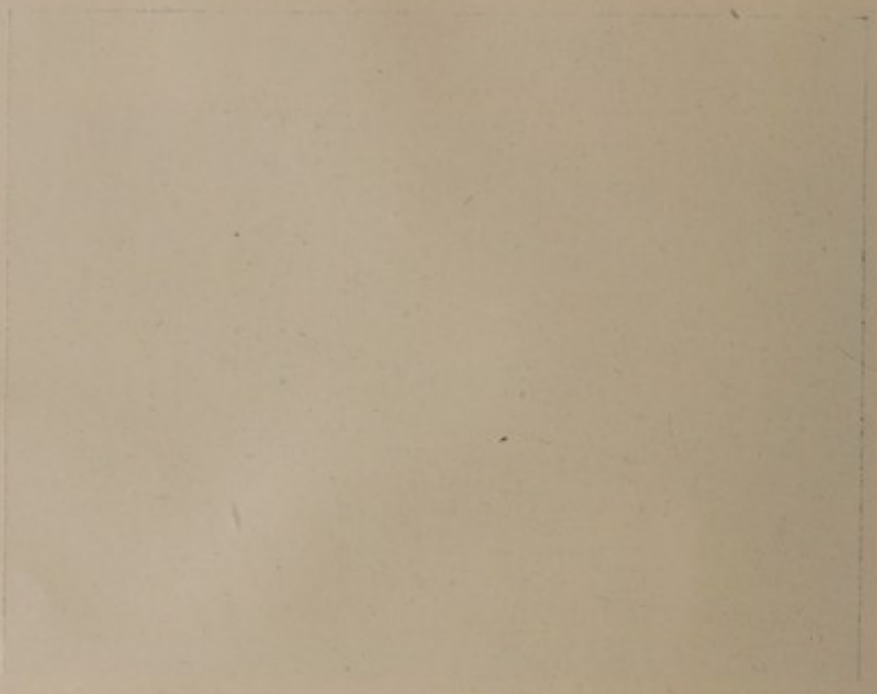
(6.) River just above town bridge. Watering Cavalry horses. (Newcastle.)
One of the screen and trench latrines for natives is shown on the bank above.

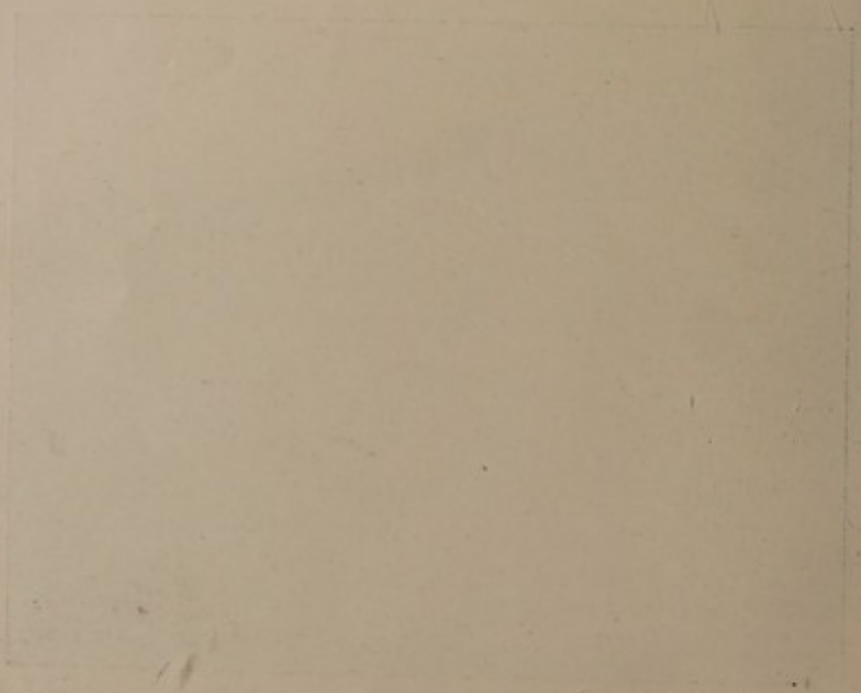
WATER SUPPLIES—*continued.*

B.—*Collection and Conveyance.*

(7) Surface pond, artificially formed, to collect water from springs. The water is pumped from the pond into the water-carts for conveyance to camps. (Newcastle.)

(8.) Overflow from above, showing an unused pump and hose in the bog formed by the overflow; also Kaffir filling water-carts. (Newcastle.)

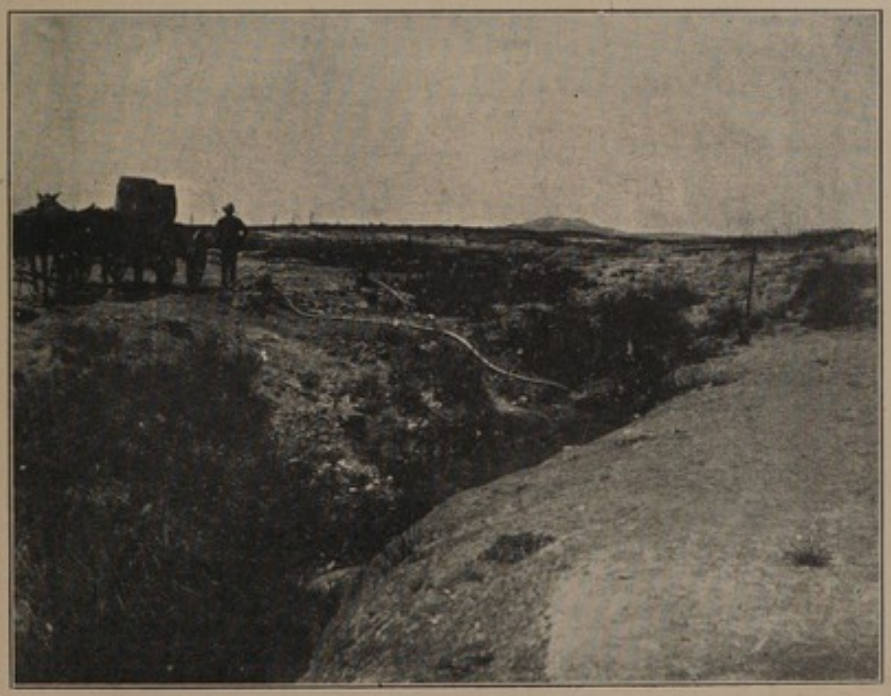




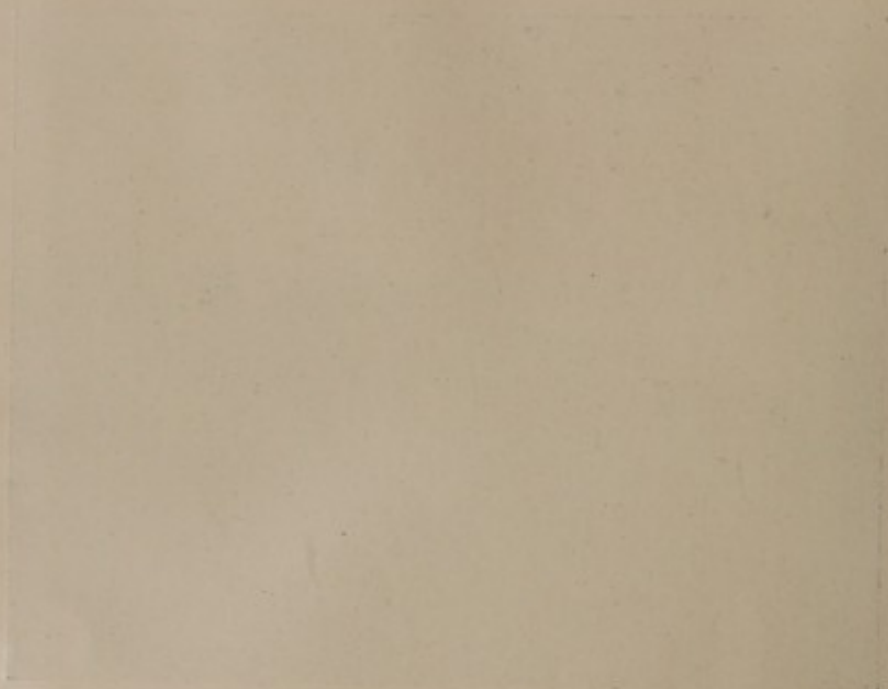
WATER SUPPLIES—*continued.*

B.—*Collection and Conveyance*—continued.

(9.) Collection of water by Kaffirs, from standpipe. (Harrismith.)



(10.) Collection of water by pump and hose on ground. The water is pumped from a pool in an upland stream, below the fenced-in portion of the stream. (Pietersburg.)



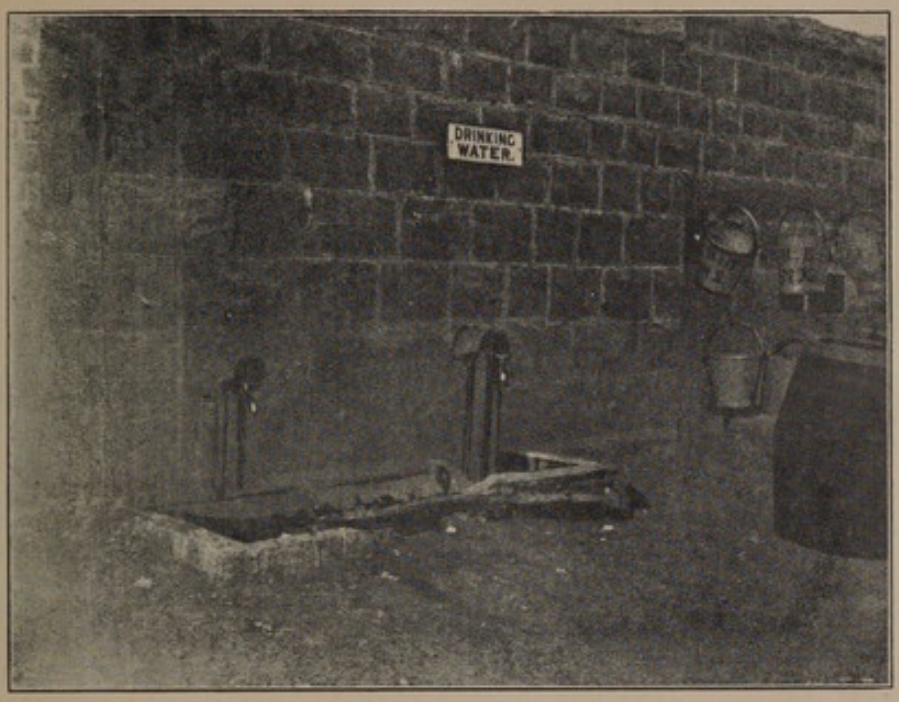
(11.) Collection of water by Kaffirs from hose on trestles. (Newcastle). Photographed by Major Eckersley, R.A.M.C.

(12.) Collection of water by Kaffirs. Photographed by Major Eckersley, R.A.M.C.

(13.) Collection of water by Kaffirs from pipe fed by spring on mountain side. (Mooi River). Photographed by Major Eckersley, R.A.M.C.

WATER SUPPLIES—*continued*

C. – *Distribution and Storage*

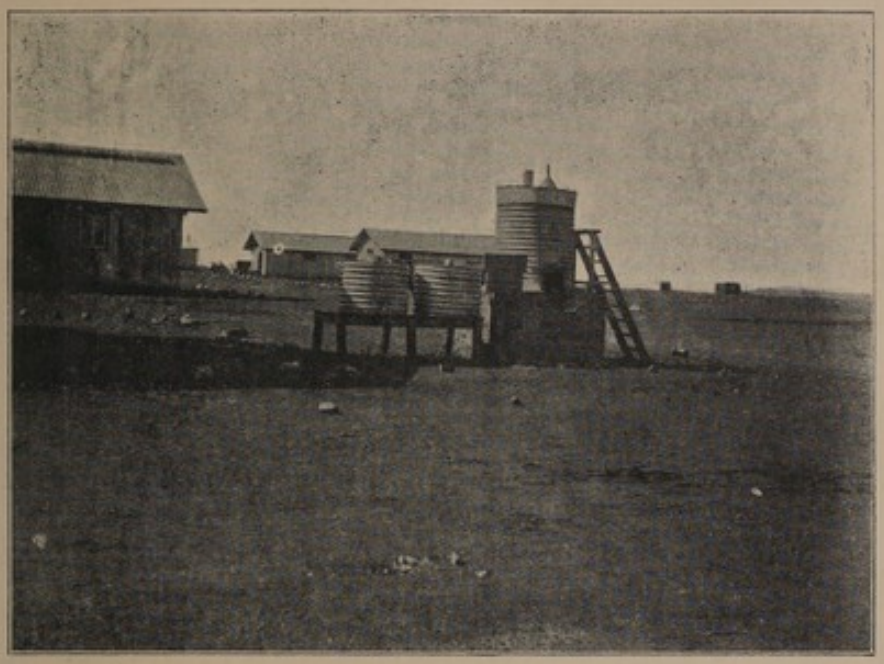


(14.) Water laid on to taps from different sources at railway station, Standerton. The tap on left yields what is practically sewage; the tap on the right yields unpurified river water collected above the town.

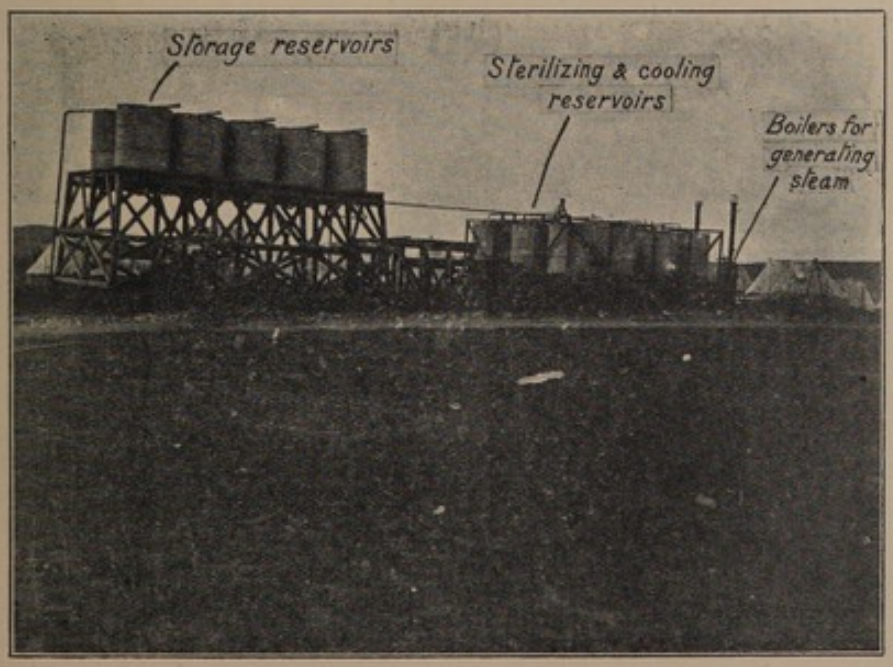
(15.) Method of storing water and protecting the storage tank from the sun in standing camp. (Potchefstroom.)

WATER SUPPLIES—*continued.*

D.—*Purification.*



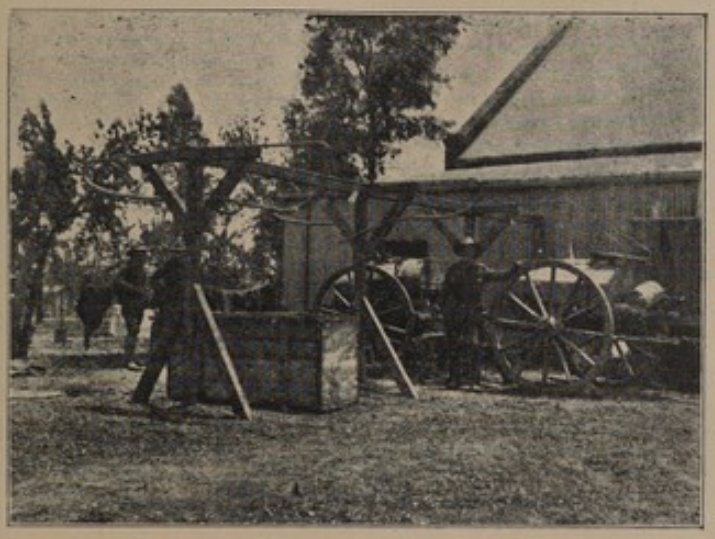
(16.) Method of boiling and storing boiled water in cantonment. (Potchefstroom.)



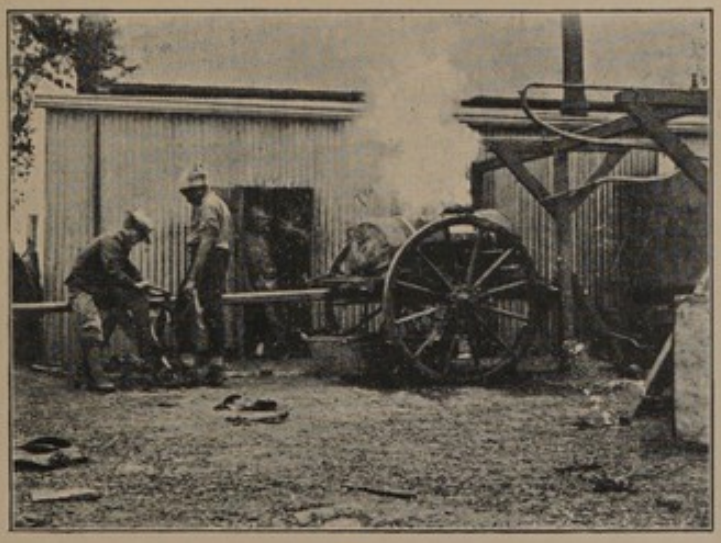
(17.) Installation of tanks for storing river water, and afterwards sterilizing by steam. (Mooi River.)

WATER SUPPLIES—*continued.*

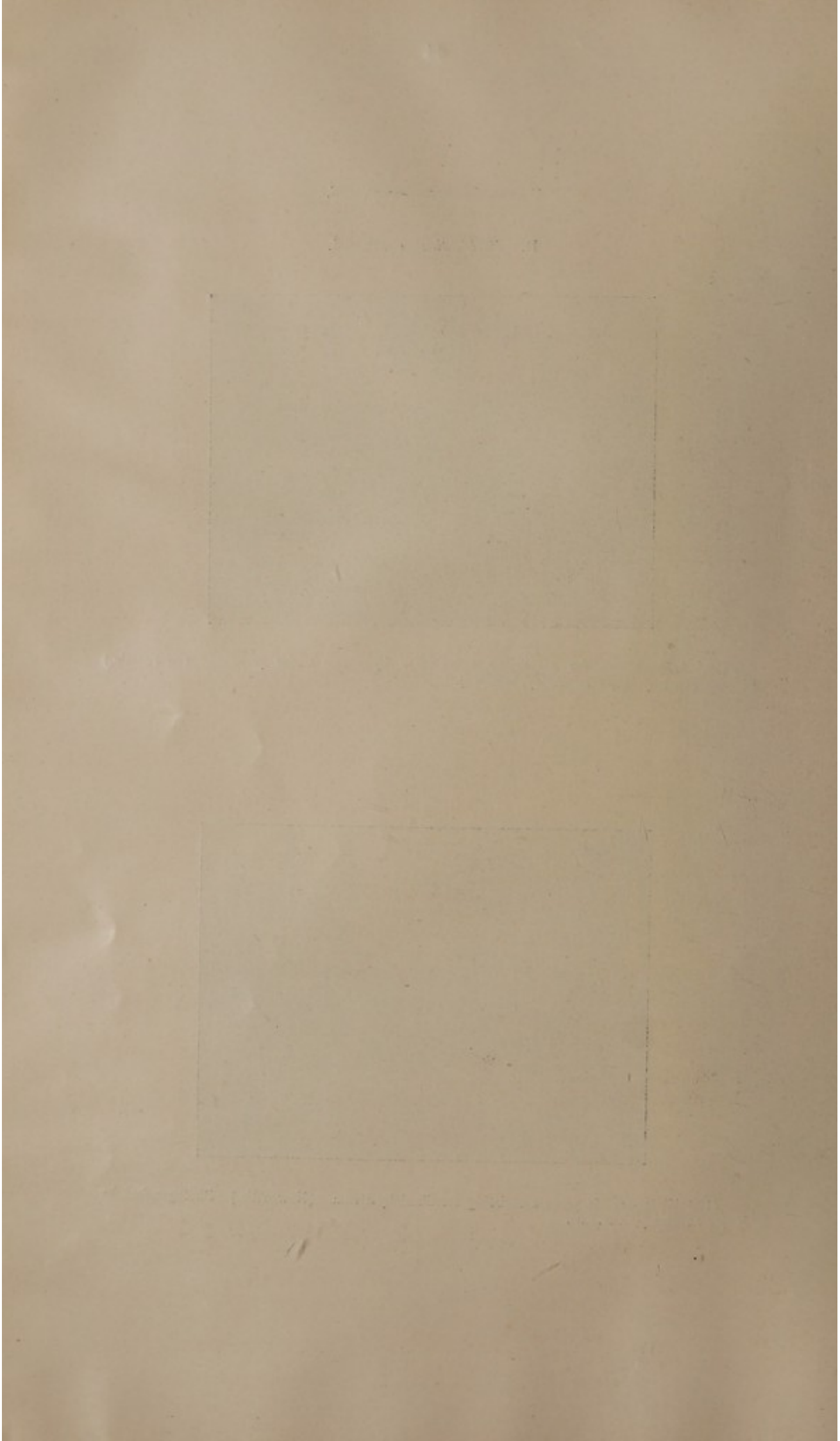
D.—*Purification*—continued.



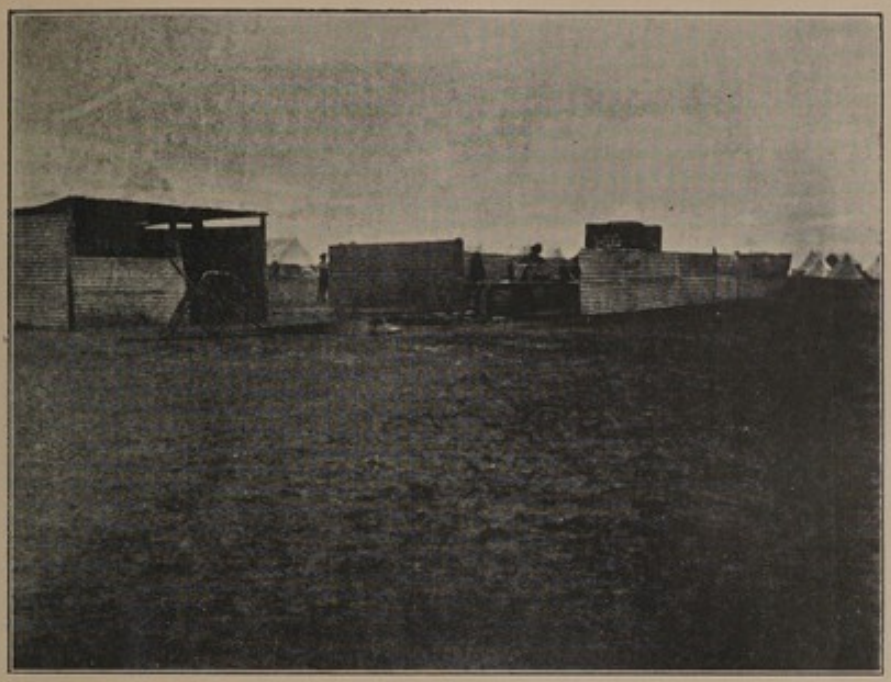
(18.) Arrangement for sterilizing water-carts by steam under pressure. (Newcastle.) Photographed by Major Eckersley, R.A.M.C.



(19.) Water-cart in process of being sterilized by steam. (Newcastle.) Photographed by Major Eckersley, R.A.M.C.

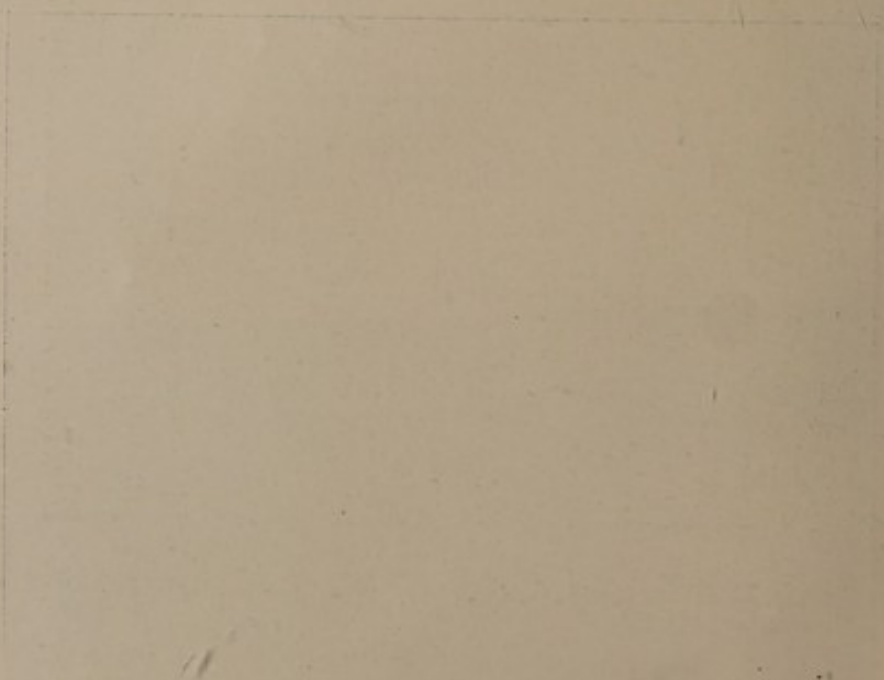


Ablution Arrangements.

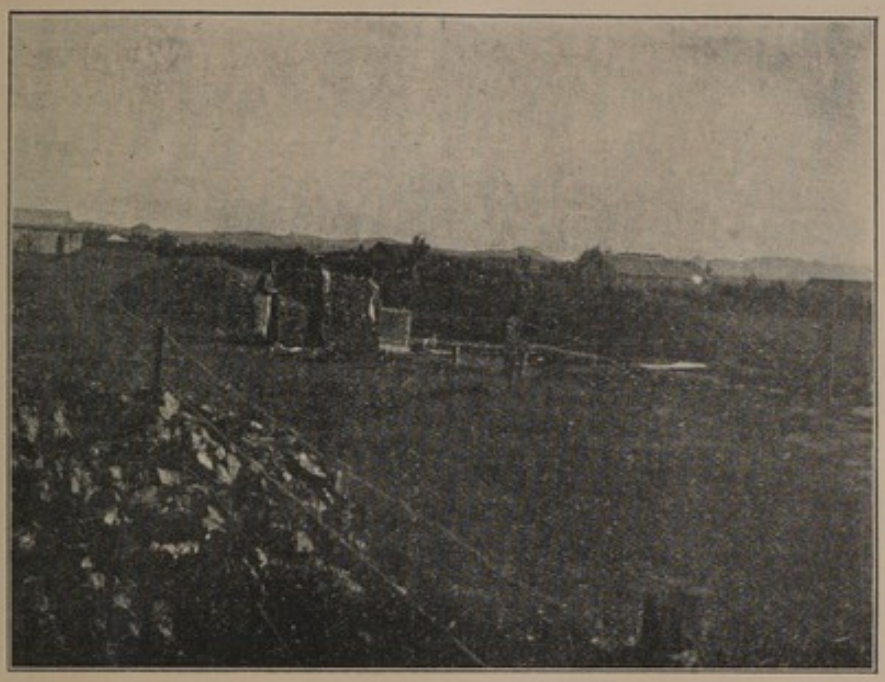


(20.) Corrugated-iron sheds. Concrete channel to large concrete sump; but no concreting of soil within enclosure. The covered shed contained wooden tubs for body baths, placed on unprepared surface soil. (Kroonstad.)

(21.) Earth pits, lined with sailcloth. Water supplied from standing pipes at edge of pits. (Harrismith.)



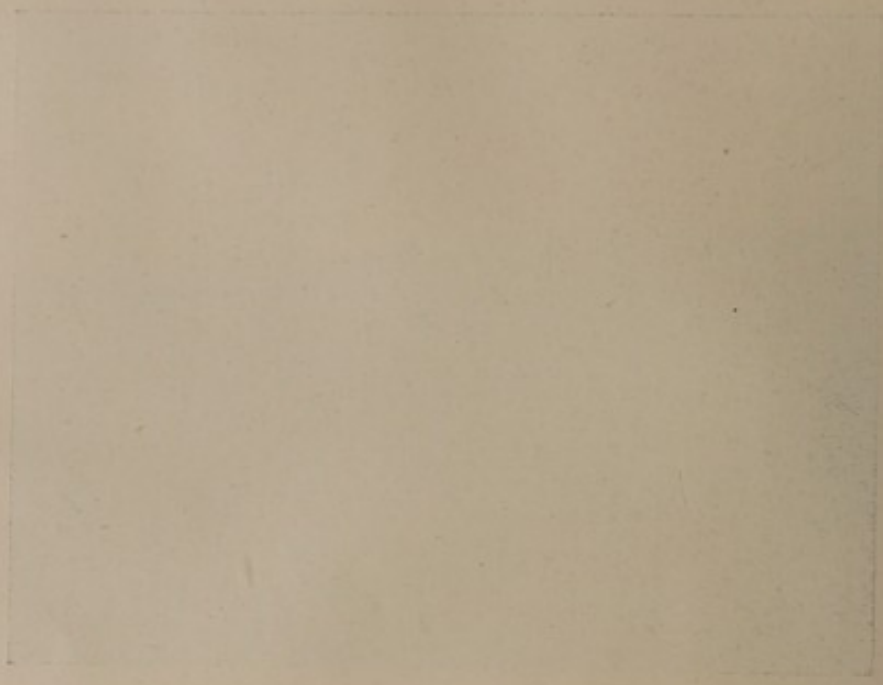
ABLUTION ARRANGEMENTS—*continued.*

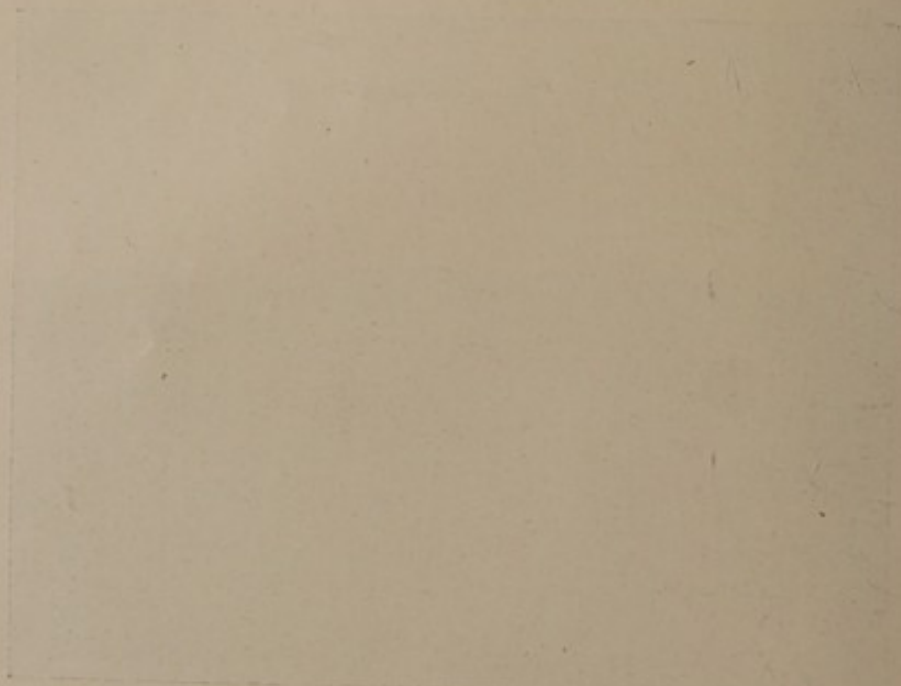


(22.) Earth pit, fed by irrigation furrow. (Pietersburg.)

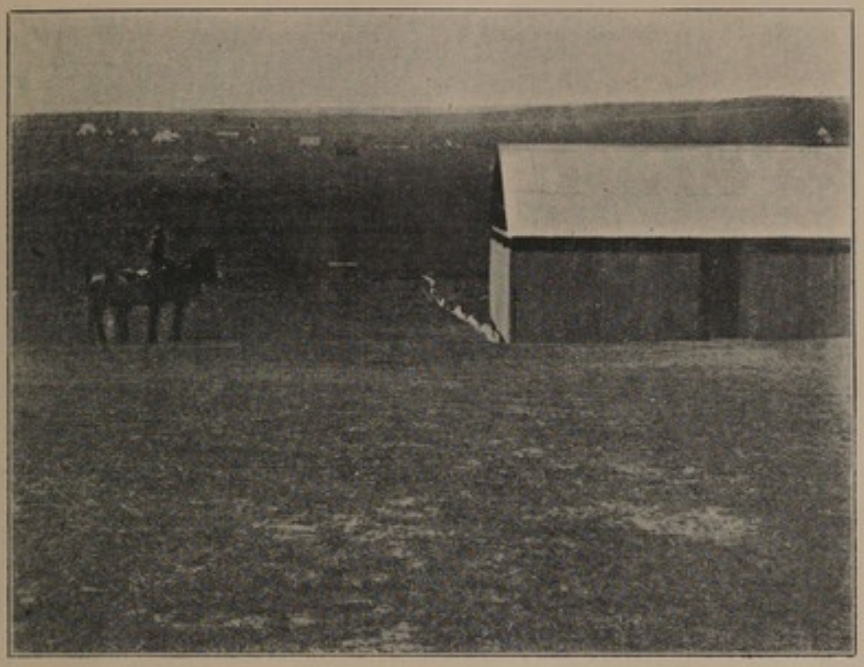
(23.) Earth pits, fed by irrigation furrows. (Pietersburg.)

The mules in the photograph have just come out of the water and the pigs are entering it.



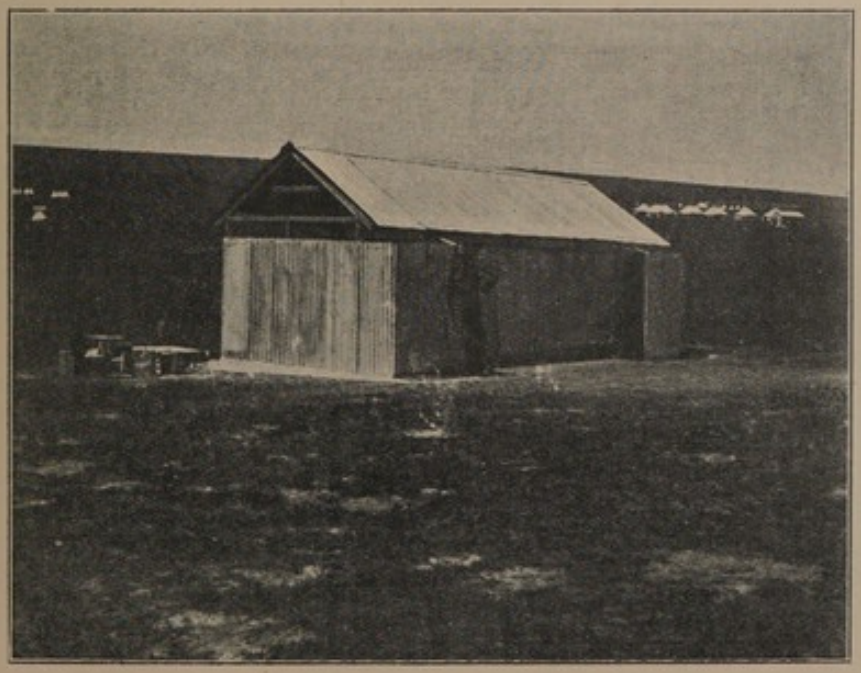


Ablution.



(24.) Ablution room of camp at Mooi River, showing improvised surface channel of corrugated-iron, leading to gardens. The floor of the ablution room is concreted.

Latrine.



(25.) Latrine with concreted and channelled base. (Mooi River Camps.)
A native, not well shown in the reproduction of the photograph, is in constant attendance.

Refuse Disposal.

(26.) River below public laundry at "Stink Drift." (Newcastle.)

The old filth pits are the mounds on the bank, and latrine pails are seen on the sides of the bank. The gallows arrangement on right horizon is a public slaughterhouse.

Washing Arrangements.

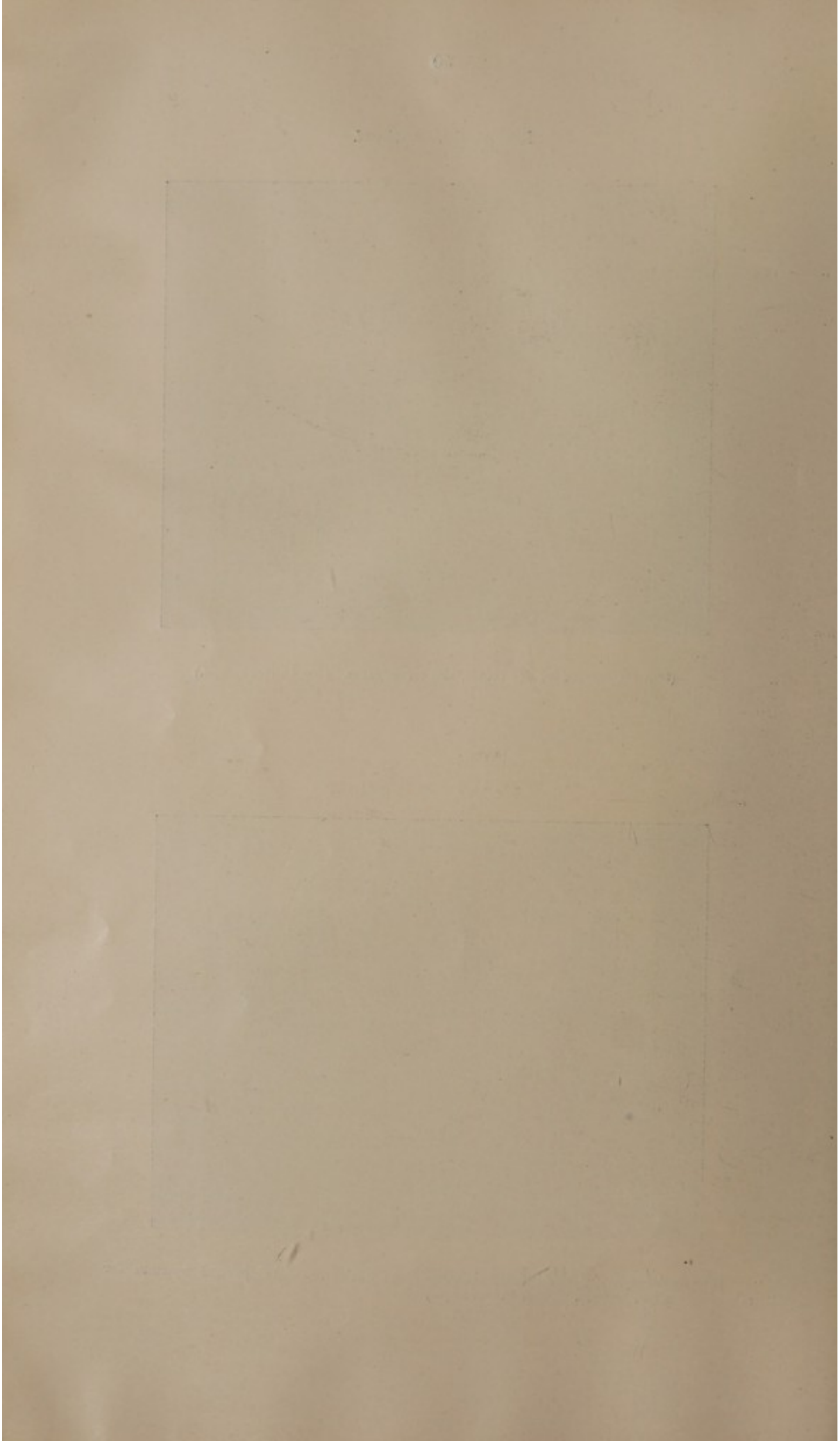
(27.) Arrangements for washing hospital linen, bedding, &c., in river. On the left bank are the refuse dumping grounds of the town. (Newcastle.)

(28.) Disposal of carcases on the veldt. (Newcastle.)
The carcases have been disembowelled and dried up in the sun.

(29.) Refuse dumping ground. (Newcastle.) Photographed by Major Eckersley, R.A.M.C.

(30.) Incinerator for dry refuse, also refuse carts. (Mooi River camps.)

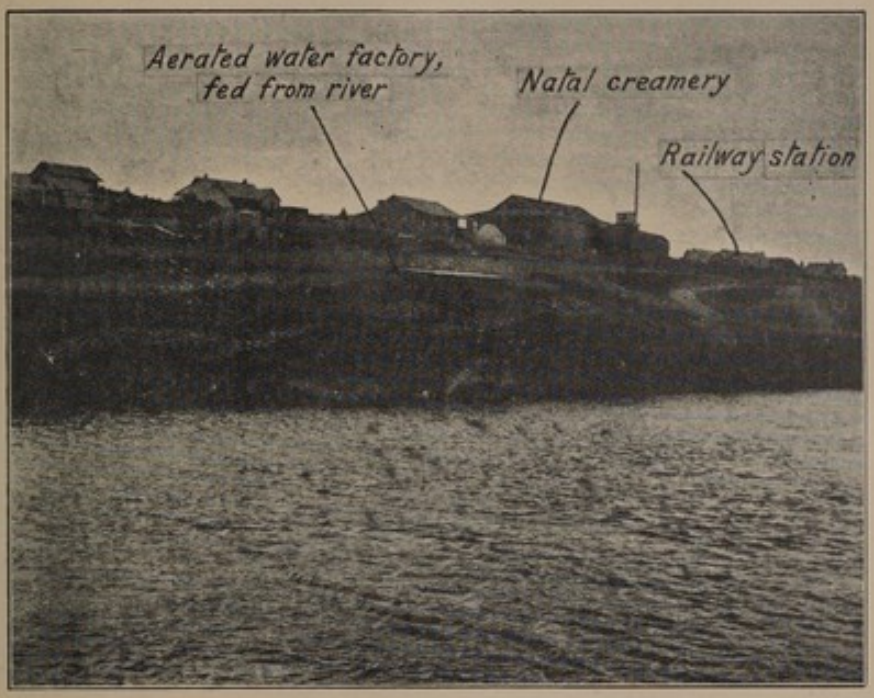
(31.) Incinerator for dry refuse, showing stone enclosure, stokehole, and aperture for raking refuse into furnace. (Mooi River camps.)



Milk Supplies.

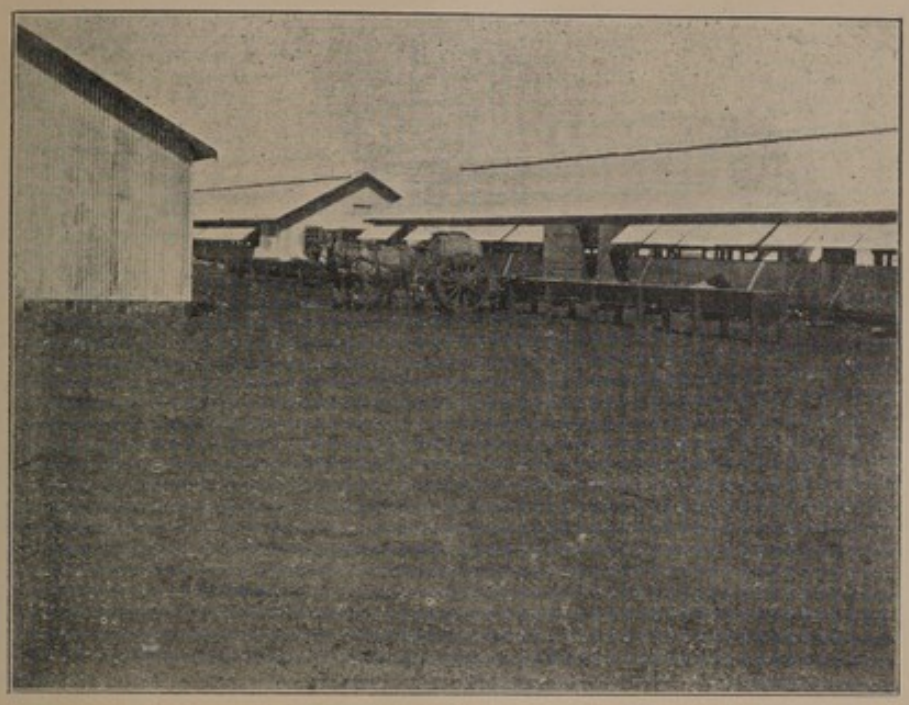
(32.) Milk vendors. Shows the method of selling milk in bottles. (Pietermaritzburg.)

(33.) Kaffir girls washing milk bottles in irrigation furrow at farmhouse. (Middelburg, Cape Colony.)



(34.) Mooi River Railway Station and surroundings, showing relative position of creamery to railway, and an aerated water factory started by the side of the river after the camps were formed.

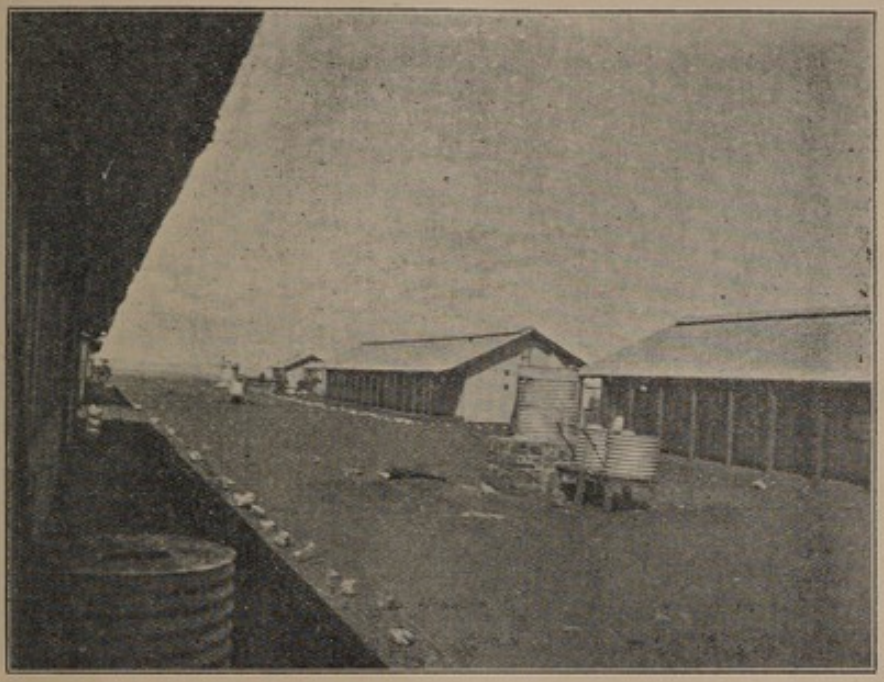
(35.) Surface well, feeding an aerated water factory at Modder River. Note insanitary surroundings of the well and the absence of any protection of soil, &c., to prevent surface water percolating into the well.



(36.) Watering trough and stables, showing absence of paving, concreting and channelling of surface soil. (Potchefstroom.)

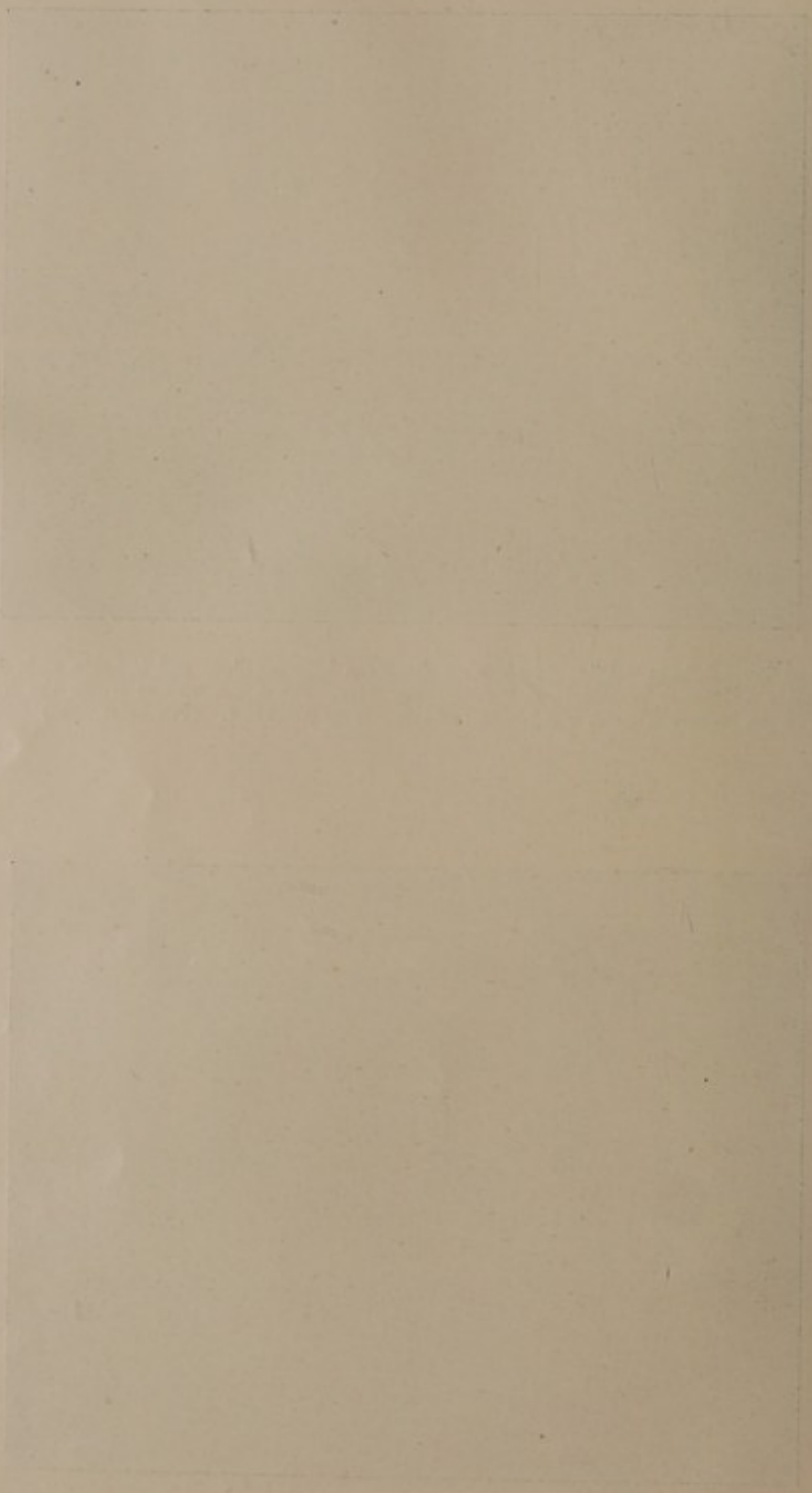
(37.) Barrack huts, "A" type, showing narrow verandah; absence of concreting under and around huts, and method of placing huts on the surface soil without raising them sufficiently for examination of and access to soil underneath. A latrine and refuse receptacle are also shown, illustrating construction and relative distances from huts. (Potchefstroom.)

CANTONMENTS—*continued.*

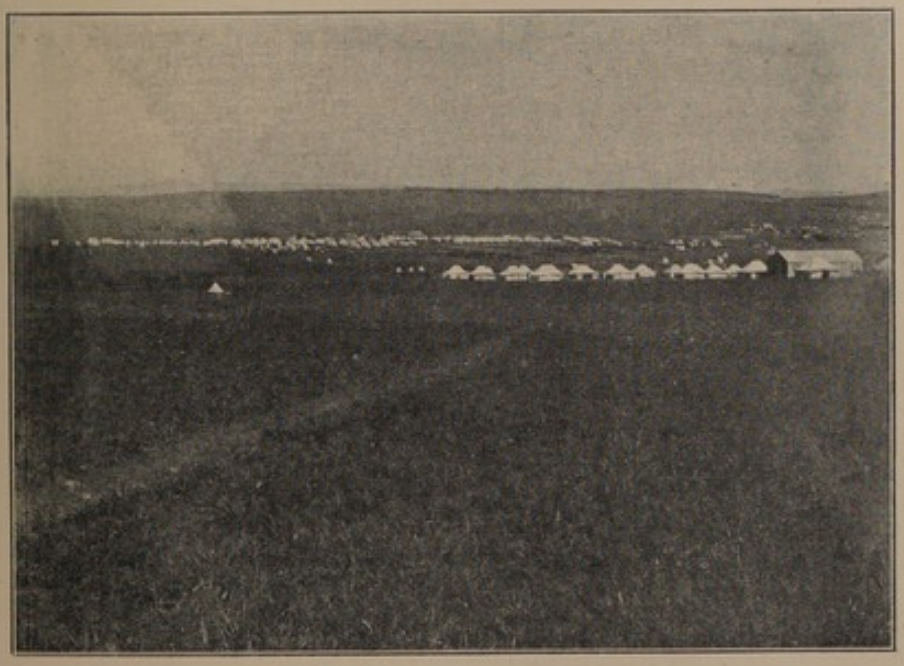


(38.) Barrack huts, "A" type, showing distances between lines and between ends of huts, also water sterilizing arrangement between the lines. Note the way in which the huts are placed on the surface without being raised or the surface concreted. (Potchefstroom.)

(39.) Hospital hut (Barberton), showing local type of hut, with verandah all round and with raised louvred ridge ventilation.



(40.) Camps of Cavalry and Artillery at Mooi River; showing horse lines outside and below men's lines; ablution room and latrines, below the horse lines; and gardens at the bottom of the slope, irrigated by ablution-room water.



(41.) Another view of the above; with hospital camp in foreground.