Sanitation incoolie locations.
with special reference to the diagnosis treatment
and prophylaxis of ankylostomiasis, and
diseases likely to be associated with it.

Prefatory note.
The following is an account of the method
employed by me while conducting an investigation for the
Vindion Immigration Board of Natal, into the causes of
an excessive mortality among the indentured coolies in the north
coast of that colony, together with a detail of the measures
taken to check the spread of its principal factor, ankylostomiasis.
The district under consideration is hot and
malodorous. The conditions of labour and housing for
these coolies (some 10,000 in number) was in many cases extremely
bad, while at the same time it was necessary to take into con-
sideration the economical conduct of the labour of the sugar plant-
ations; inspections and examinations had to be regulated to avoid
interfering with the regular working of the mills, and sanitary
measures largely influenced by the restricted resources of
the companies concerned, and more especially so by the
labour supply at the particular time. Accordingly these
measures are far from ideal. They have proved strikingly
successful, however, and I venture to assert that they
represent a degree of efficiency, below which it would be
unsafe to go, but which is unlikely to be excelled without an expenditure of capital, certainly justifiable, but quite disproportionate to the extra efficiency attained.

The principal endemic diseases of estate, of which the Natal coast are malaria, ankylostomiasis and to a lesser extent dysentery. The treatment of the first and last of these will not be touched on; we can take up the hospital treatment of advanced cases of ankylostomiasis. The present monograph is mainly concerned with the diagnosis of early ambulant cases of these diseases whether single or combined, existing in colonies perhaps still at work and the sanitary measures detailed below are instituted mainly with a view to diminishing the risk of infection by paying special attention to the

1. Site and construction of barracks.
2. Sanitation and protection of water supply.
3. Arrangement of latrines.

rather than by attempting the almost impossible task of instituting rigid personal hygiene among Indian colonies, and relying on its efficient administration by non-professional and perhaps disinterested European overseers.

Ankylostomiasis depends for its existence on a high temperature plus earth contamination and is by no means confined to the tropics. These conditions characterise sugar and tea plantations all over the world.
and are also found in mines in various countries unice in
termediate climates as evidenced by the classic outbreak in the
St. Gotthard tunnel, and later in the Canadian tin mines.

The adult form of the *Dicylostomum chaoense* was discovered by Linton in 1838, and it is curious at this
date to go into the morphological characteristics of a worm
which has been known for some eighty years.

Recently, however, our ideas as to its life history, and
especially its mode of entry into the human host, have been
profoundly altered by the brilliant researches of Shaw, and it is
only with a clear conception of these that we can hope to put
prophylaxis on a satisfactory basis: add some valuable
diagnostic signs to a complicated clinical diagnosis, and
obtain a true indication of the best modes of sanitary
procedure against it.

**Habitat** The adult worms live for the most part
in the upper part of the jejunum. In some infections
they inhabit the duodenum and ileum also, and I have
been seen them in situ below the ileocaecal valve. They live
by abstracting blood from the mucosa of the gut to
which the bluish family by their hooklets, they in all probab-
ility secretes haemolytic toxin, and when in large numbers
produce intense local irritation, all three being important
factors when we come to consider signs and symptoms.

The eggs are passed directly into the gut, and
are excreted with the faeces in which they can readily
The ovum of ankylostomum duodenale measures 55-65 m by 52-62 m. It is oval in shape and is enclosed in a beautifully clear transparent capsule, through which its granular light grey segments can be clearly seen. At the time the egg is hatched, division into four main segments has usually occurred, but if the soil is kept a larger number of segments 16-48 will be present, according to the time and temperature, and in from 24-48 hours a well formed embryo will be found free or enclosed in the capsule. An important point with reference to latrine arrangements may be here noted. In a series of tests I found that if feces be kept unmixed with earth for three days all the embryos within, or without, their capsules will die, and also that if freshly passed eggs be mixed with water most of them will swell up and die. The admixture with fresh earth therefore is necessary to their development, and a latrine system by which feces are conserved is fatal to their existence. The subsequent history of the embryo has been clearly demonstrated by Hov (1841). The old idea was that after acquiring digestive organs and molting twice, it became tapped, ceased to eat, and lived in damp earth or muddy water until swallowed in food or water by a human being, when the adult sexual cycle was reproduced. This may be possible but is unlikely. More or less young embryos are killed by gastric juice, and so to this mode of evolution...
and entry this is no proof. Lows has shown that if earth containing embryos, which have completed their
mucous exogenous phase, be applied to the skin, the embryo can penetrate it, and will be found lying inside the epidermis
in less than an hour. Entrance is made through some
follicle after which the anthrax stoma embryo passes
into a blood vessel and so via the heart to the lungs.
Here it undergoes a further resting-stage to enable it to
resist gastric juice, after which it enters an air vesicle, then
in a branch, and so by way of the trachea, esophagus
and stomach to the jejunum where it buries itself to the
mucous and proceeds to the evolution of its mature
sexual existence.

It will be remarked that, like all its constitution
while in the small intestine, our only time to kill
it or to arrest its development is in the exogenous phase
between the time it is passed as an egg in the
feces and the time it enters the skin.

It can be effectively destroyed by the convulsion
of fever.* It can be absolutely prevented from
entering the skin by suitable applications to the
latter, and the likelihood of infection with it can
be diminished to vanishing point by preventing
earth from being infected with it, in short, by
cleanliness and the use of latrines; earth already
infected can to a certain extent be sterilized by roasting.
with grass fires and turning over with the plough.

The entry of anhydostome embryos causes a certain amount of irritation and in many cases sets up a sort of haematopoietic dermatitis popularly known as "cooke itch" or "ground itch". This is a very common complaint on the Natal plantations and from its secondary infections alone e.g. suppuration, phagadenae etc. it is responsible for a good deal of invalidism.

Bently in 1885 first demonstrated the embryos of the anhydostome worm in the lesions of cooke itch. In conjunction with the more recent discovery of floro, the conclusion is inevitable that cooke itch is, in many cases, merely a phase in the general disease anhydostomiasis and in the same connection I would point out what I consider an important symptom of the latter, namely a history of burning feet with or without a skin eruption. I have never failed to find eggs in a case of cooke itch, I have never failed to find eggs in a case of burning feet which had been going on for over three weeks. The tingling I can personally vouch for having experienced it in the fingers in which a small splinter of infected froes had remained unnoticed a half hour a mere. The skin irritation is not a necessary concomitant of the entrance of anhydostome embryos. Some of the most marked
cases I have ever seen Iguana who had worked
two months a man on an infected sugar plantation.
They complained bitterly of burning feet but they
soon showed any sign of an eruption a circumstance
probably accounted for by their unhealthy habits as compared
with Indian coolies.

The pathological changes pro-
duced by the adult worms are the conditions one expects
to find in a more or less pronounced anaemia plus those of
intestinal irritation. The question as to whether
they produce a term or not is debatable.

Postmortem one finds fatty degeneration
of the liver and of the heart in every long standing
case, and usually acute as well. Manson states that
fatty degeneration occurs in the kidney (Ref). This I
have not seen in uncomplicated fatal cases, all of
which however showed evidence of nephritis. Manson
believes that the action of the parasite is solely abruption
of blood and has his attention to Dr. Brown Rodhe's conclusions
from the fact that in cases examined he found the total blood
in the liver below normal. Daniels on the other hand
finds pigment grains like those of malaria in both
liver and kidney, a condition pointing to a haemolytic
due to some pyaemia. His observations were made in Fiji. Having
worked with both these strophes I find it difficult to
believe either capable of making a grossly erroneous statement.

But taking into account the variability of the total blood in
the body, especially when much blood is in addition markedly
anaemic, I have no difficulty in imagining cases where a charge of anaemic blood plus a moderate
deficit of iron in the blood would fail to bring the
total amount in that organ up to normal. It
is also remarkable that not only do we find anaemia
but in addition there is a diminution of the haemoglobin
value of the surviving corpuscles as in malaria, and the
joint which follows toxic absorption. I am therefore
inclined to believe with Danielis, and my own cases bear
me out, that there is a certain amount of haemolysis, but
it is after all a trifling factor in the disease and cannot
compare in importance with the loss of blood caused directly by the
parasites. They may be little by no means. In three of
my fatal cases the stomachs were fat and thick was a lot of parasites.

In the others there was trifling emaciation due firstly
round worms which went in bunches in the intestines.
There is always a coexistent enteritis and in
places the wall of the gut may be so thin as to
be almost transparent, and recent haemorrhages
may be seen in it. In a chronic case there
may be peritoneal adhesions, some enlargement
of the mesenteric glands, and a colloid condition
of the peritoneum.
The anaemia may be very grave, the red blood corpuscles falling to 1,500,000 per cubic millimetre or even less, and the haemoglobin be 15%. The fall in the circulatory haemoglobin value has been noted. There is usually leucocytosis, the whites standing at 10-12,000 per cu. mm. but this is much more marked when enteritis is a prominent symptom in the case. The differential leucocyte count shows a marked degree of the diagnosis.

The Symptoms.

A typical uncomplicated case of ankylostomiasis is not difficult to diagnose from the symptoms and physical signs alone provided one is on the lookout for it, the essential symptoms being those of a progressive anaemia generally associated with digestive trouble, but not in uncomplicated cases characterized by wasting.

The patient complains of weakness, giddiness, heartburn, nausea, and palpitation. He may or may not complain of burning feet and could, or may or may not be present. There is usually aiguastic tendency, an early and important symptom.

Dehydration is sometimes decreased, sometimes increased, sometimes anuric. Taste is said to be preserved in some cases leading to the habit of Gastrology (Kienan) but this is a symptom.
I have never noted in my case, constipation is sometimes present, looseness and irregularity of the bowels is more frequent, however. In advanced stages one notes a state of lassitude, mental apathy, diminution of sight, vertigo, etc., while the heart action may be very feeble and irregular.

**Physical Signs.**

The most important are those of anaemia. Pallor of the venous surfaces is as a rule marked. Swelling of the feet and legs, and marked ascites is often present. All the acute cases I have seen have been waterlogged, even the eyelids being drooping. The liver may not be enlarged and the same applies to the spleen. There may or may not be a raised temperature. Irregular fever is common but many cases now show any rise of temperature whatever and it may even be subnormal. The stools often have a reddish tinge from admixture with half-digested blood. Pure blood is rarely passed. The urine may contain albumen and usually casts. The circulation is irritable. Haemic limits the heart in advanced cases and in such the typical signs of fluid in the pericardial sac are present. Towards the end...
Diagnosis.

A small particle of feces is put on a slide. If not thick enough, a dash of distilled water is added to it and the feces triturated with a glass rod or a piece of stick, and a cover-glass is put on. Eggs are best seen with a 4th objective and a No. 1 eyepiece. Their characteristics have been described. Should the feces have stood for more than twenty-four hours it is often quicker to examine the embryo with a lower power, as by their rapid movements they instantly catch the eye. The embryo measures 2 mm. by 0.14 mm. It has a blunt anterior and pointed posterior end, is beautifully clear and transparent and the body cavity is filled with light gray granular matter. It must not be confused with the tadpole form phase of the Akechobema intestinale whose dimensions are somewhat similar and which is often seen in feces.

The following eggs must be distinguished from those of the Thelastomum intestinalis:

I. Those of the common round worm Ascaris lumbricoides.

II. Those of the Tricocephalus hexagonalis.

III. Rarer eggs as those of I. Bilharzia hematobium—

1. Tape worms.

2. Oxyurus ovinnuculus
of the distinctive feature of each of these is unnecessary and
with the aid of illustrations there is not the slightest
difficulty in recognising any of them at first sight.
The appearance may give some trouble. Thus when
the patient has been eating cane, particles of it
appear in the feces and may resemble any of some
eggs very closely; in fact it is only when a large piece
of cane containing several of these egg bodies imbedded
in a cellular matrix, is compared with the supposed
egg that the identity of the latter is made manifest.
When feces have stood three or more days and
have not had some preservative as formaldehyde added
there may be great difficulty. The eggs become
hydrated and swollen. Embryos die and must
be carefully distinguished from cotton fibers.
All however can be easily differentiated with a
little practice, and except in the sugar cane which
bears the closest resemblance it will often be
unnecessary to stop the motion of the mechanical
stage while the slide is under examination. One
should examine two slides each for five minutes
before giving a negative diagnosis, and in a case presenting
markedly the symptoms detailed under cycloid
infection, or showing the leukocytic reaction about
as described, it is as well to examine the feces
a few days later.
The differential diagnosis of uncomplicated anhydrostomiasis from diseases as malarial cachexia, beri beri, chronic Bright's, and from the cachexia of chronic dysentery or bilharziasis disease, all of which bear a superficial resemblance to it, is simplicity itself. But has only to suspect. It is unnecessary to go into voluminous detail as regards symptoms, etiology and intaminateable proceeding with a case specially if attempted during a furnace inspection, nor unless the patient is favorably situated as in hospital so it easy to conduct a thorough physical examination.

A microscopic examination of the feces will in most cases settle the existence or absence of parasites. In the few cases where the disease exists but is not evidenced in a careful examination of the feces a differential leucocyte count will settle definitely whether or not parasites exist in the intestinal tract.

In all instances where eggs are not found in the feces on first examination, and in every case where the possible existence of some other intestinal condition cannot be definitely excluded, it will really be found quicker to make a differential leucocyte count in the first instance to get an idea as to what the leading features of the condition are, than to attempt an exhaustive differential diagnosis in the first combinations of these conditions in the same individual
are almost the rule, and can at least be indicated by the method detailed below— from an intelligent appreciation of which, one can almost reconstruct the physical signs and symptoms. I have these remarks in the following postulates which are almost universally admitted:

The percentage of eosinophil leucocytes in normal blood is 2-4. When worms exist in the gut, particularly ascaris lumbricoides, trichoschistus dispar, and ankylostomum duodenale the percentage rises above 5.

This condition also occurs in syphilis and in some other disorders but if seen in a circling anyone from the itching invariably justifies an examination of the faeces and is always present in ankylostomiasis.

11 Stephens and Chirstophes pointed out (Ref 11) that in malaria there is a relative increase of the large mononuclear leucocytes. The classification used by Stephens was:

1. Polymorphonuclear leucocytes 65-70%.
2. Large mononuclear \(4-10\%\),
3. Intermediate \(4-10\%\),
4. Small mononuclear lymphocytes 20-25%.
5. Eosinophil 2-4%.

The above is for normal blood.

Stephens regarded a percentage of 15% more of the large mononuclear and intermediate together, as certain...
evidence of past or present malarial infection, and
20% or more as evidence of present infection even in
absence of parasites in fragmented leukocytes in the
peripheral blood. That at least was the teaching in
the laboratory in 1902 and was also accepted by
Major Donald Ross. While working in the Sudan
Epidemi in 1905 I modified this classification as
I found the "intermediate" to indeterminate to have
such a weight in the diagnosis. Tested on 400 con-
secutive cases of fever, none of which recovered without
quinine, and all of which at some time showed
either a quotidian periodicity and in all, except
some of thoseaneously cured with quinine, malarial
parasites were demonstrated. I found that an
increase of over 15% of large mononuclears (i.e.,
or 20% large mononuclears plus intermediate as
positive proof of a present or recent protozoal infection
in the blood, and if combined with a positive reaction
to quinine is absolute evidence of malarial whether
parasites or fragmented leukocytes are present or not.
In practical procedures under these as rea-
sions to infused some of the various parasites as
the Leishman-Donovan body etc. (the parasites
in Kala-azar) the large mononuclear leukocytes
can be regarded as sufficient evidence of
malarial infection.
The lymphocytes normally constitute 20-25% of the total leukocytes in the blood. Their percentage is markedly increased in certain systemic conditions in typhoid fever and in leucemia in dysentery, and in most cases of chronic enteritis. In typhoid fever, leucocytosis is the rule and the lymphocytes may be 50% of the whole. The increase is relative not absolute. If regard absolute increase as is seen in chronic dysentery, it is a usual accompaniment of bowel irritation and this increase is well marked in long-standing cases of enteritis tumians.

The polymorphonuclear leukocytes are increased above their normal 60-70% in certain of the exanthems, particularly in pneumonia, and in most cases of suppuration and abscess including liver abscess.

In summary: I have noted four types of relative leukocytic toxins. None of them can be regarded as pathognomonic of any one specific disease but each is a coexistent of certain groups of diseases which its absence practically excludes. This is absolute as regards malaria and anthrax tumians. In addition, these leukocytic toxins can occur in combination while the lesions are confined and of punctured is a table showing results of blood and fecal examinations of 128 cases together with the principal symptoms and it is shown how each toxin is indicated in each case by the differential leukocytoses.
<table>
<thead>
<tr>
<th>Blood Examination</th>
<th>Fecal Examination</th>
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| Charcot-Leyden Cell | Egg of undetermined species or eggs of *Anoplocephalaenas*
| Schistosome Eggs | Numerous anhyd. eggs.
| H. V. G. | H. V. G. | H. V. G. |
| None | None | None |
| None | H. V. G. | None |
| H. V. G. | None | H. V. G. |
| None | None | None |
| None | None | None |
| None | None | None |
| None | None | None |
| None | None | None |
| None | None | None |

I. Mild malaria and bloody stools. Infection with schistosoma. Many eosinophils, lymphocytes, and eosinophils in the stool.
II. Simple tetric malaria uncomplicated.
III. Malaria by schistosomiasis, cleared up under quinine injections.
IV. Slight liver in the blood. Child in exhausted state, resting.
V. Somewhat similar case. Condition very grave and life would have been endangered but treated as described.
VI. Ordinary mixed worm infection. Not percentage of lymphocytes as an index of sexual infection.
XII. Case of pneumonia in Indian 2 day.

If the above T - VI are children, VII - XII are adults. Not marked sent to and treated in hospital. The important

leucocytes in the differential count is underlined in each case and the agreement between the results of focial examination
and the presence or absence of parasites on them hand and the corresponding leucocytes in the sputum can be noted.

I do not here concern myself with the indications afforded by a total enumeration of leucocytes (per cmm) of total
count combined with the differential is of course most satisfactory, but when one inflicts 500 coccies in a day and exam-
ined the blood of 40 or 50 it is far too lengthy a process to employ and the extra information gained is in many cases
not worth the trouble. Blood for a differential count can be taken at any time all that is required being a

needle and a slide; the slides can easily carried, the films

kept well, they can be stained with Rishmuni's modification

of the Romanowsky stain in 5 minutes, and the enum-

eration of 200 cells takes about 5 minutes. While
daily observation is impossible and one has to

detect the change in persons who will not repeat sick,

I claim that by it one gains far more information.
Then is afforded by very minute inspection in the grow in under the usual conditions. It can
be absolutely trusted to pick out malaria and ankylostomiasis, and combined with a fecal
examination on suspected ankylostomiasis to
differentiate between them and other worm diseases
of the intestine. Indications of other diseases
are given by it. Their diagnosis may not be absolute
but is facilitated and is certainly greatly assisted
in certain circumstances by the exclusion of malaria
and ankylostomiasis.

Fearing the epidemic referred to every
facility was given to cotton to shoot sick daily.
The early stages of ankylostomiasis however are so
insidious, the first symptoms so slight and protracted
of so little inconvenience that one cannot expect an
cognizant nature to voluntarily undergo what is to
him an ordeal, namely a visit to hospital with the possible
chance of being imprisoned and kept in a ward. It was
necessary to find the cases for myself and by far the
majority of infected persons were detected during
regular banana inspecions conducted on Sunday mornings
and whose blood was tested as detailed above.

In inspecting a gang of cooties I make
a practice of Turning everyone in the banana out
men, women and children, any who wish to
report with one soon as while the other man feels out.

V. Those who show to have had recurring, non-officially

speech which have not been amenable to quinine.

VI. Those who complain of lassitude, decided palpitation

(excepted especially if accompanied by a feeling of

falshion hair in theластун

IV. Those who need to eat and are getting thin.

V. Those who report of burning feet.

VI. Those who complain of diarrhea, dysentery or

from irregularity of the bowels.

VI. They walk down and kick out those with:

VII. Well developed malarial itch.

VIII. Signs of anemia or edema of the legs.

IX. Signs of emaciation

X. Distended abdomens

XI. Enlarged spleen.

From each of them I take a blood smear

and each day give a bottle to contain a sample of feces which

is collected and delivered at the laboratory next day.

The blood smear of those giving a history of malaria

Dexamin first if the large mononuclear leucocytosis is

present without an eosinophilia; quinine can be introduced

once and it is unnecessary to search the feces for eggs.

In some this case it is best to examine the feces first

with monosodium mupina and may be used when both methods should be used
Treatment

The drugs most in vogue for the treatment of anthelminticis are male fern and thymol and of these the latter is more dangerous. It is much more effective and is to be preferred.

In simple uncomplicated anthelminticis, treatment with thymol can be carried on without the admission of the patient to hospital provided certain precautions are taken.

1. He must be under observation during and for 6 hours after its administration.
2. It must be given on an empty stomach.
3. The patient must be prevented from having access to alcohol for some hours before administration of thymol and for at least 6 hours afterwards.

Accordingly I proceed as follows:

Those discovered to harbour anthelmintics and also those showing a marked infection with round worms, are placed with catarrh one evening and are instructed to eat nothing the following morning when they are marched down to a hospital yard provided with shelter, where they can be kept under observation and where no alcohol can be obtained. Those with ascarides only are placed with male fern or a saltpetre in the usual amounts. Those with anthelmintics are given three 15 grain
drops of thymol made up in an emulsion at intervals of one hour. They are given a little milk during the day and a cold a full dose of castor oil is given in the evening when they are sent back to Sanado in casts. At the end of one week, the face is again examined for and if necessary, the dosage is repeated. In 400 cases so selected, I had no accident from the thymol administration. It must be noted however, that none of these cases were in an advanced state of the disease. Such patients were sent to and treated in hospital, but I do not propose to go into their medication as it had to be modified to suit the severity and complications of the case. In some it was quite impossible to employ thymol at all and several ended fatally being admitted in an almost moribund condition. Hansson recommends three 300 grams of thymol. Unless however one has the patience to leave the patient in bed in hospital, I consider it too unsafe.

I found that one in five of my cases treated with the 15 grams, when repeated, required further treatment with thymol. No side effects were observed in the faces of any of those treated twice in the same manner. It is advisable to order a tonic after the treatment to combat the anemia. One containing iron and quinine plus a saline and an intestinal antiseptic as tartrazine a cresote.
Prophylaxis

This is summed up in one word, cleanliness. The avoidance of contact with infected earth is the most certain preventive, but among cows in infected plantations, until sanitary measures specially provision of latrines, are instituted, this is almost an impossibility. It will be remembered however that the entrance of the anthrax spore embryos into its host is by the skin, and since its previous habitat has been in damp earth, especially by the skin of the feet and legs, should one have to deal with a densely infected barn, whose surroundings cannot be cleaned up at the moment, it is quite justifiable to turn the feet and legs of the cows. Then carried this out on a small scale. The feet and legs are washed, immersed in a weak solution of carbolic acid which they are carried up to the calf. It must be thoroughly done especially between the toes, and if there is no skin disease present and the washing here has well done no ill effects are produced and the process can be repeated after a week. It is best to make the cookie stick into a bundle of ten and then walk through some sand. This prophylactic method was introduced first in the West Indies by which it was used most successfully by a planter who treated cows with it quite unconscious of the relation of that disease to anthraksis.
Sanitation

It is impossible to lay down a hard and fast scheme for the sanitation of quarters for employees on mines and plantations in various countries, tropical and temperate. Arrangements must be modified to suit the local conditions, and a scheme suitable for one particular set of conditions cannot be expected to prove unanimously adaptable to all circumstances. I have laid down the general principles on which we must conduct ourselves and it now remains for me to incorporate these principles in a general scheme of sanitation suitable for our given community. The following is abridged from a memorandum issued by me to the Indian Immigration Board of Nald, adopted in toto by them in the guidance of planters in that colony and issued under government recommendation. It was first put into operation in one district of the colony under my own supervision.

I have found it necessary to replace some recommendatons with the reasons for their suggestion in order to make them more comprehensible to the lay mind, and in the present extract I have refrained from omitting certain of them as they indicate in many instances the type of conditions to meet which they were designed.
The indentured Indian in Natal lives for the most part near the coast, in hilly country, at present highly material. His barrack are mostly grass hovels with iron roofs, situated near water at the bottom of precipitous valleys, and are in almost every case indescribably dirty and insanitary. He labors on the plantations from morning to night and has little time to keep himself clean, even if he wanted to. He is provided with hospital accommodation and there is a dispensary in every plantation for his immediate wants, but neither of these quite inadequate in the face of a serious outbreak of malaria, which bacteriologically is a true epidemic disease. He is well fed and paid and usually comes a strong disinclination to return to India at the end of his indenture. Due to the limited employment of European women and also to the fact that in the large plantations barracks are situated on the estate, efficient supervision of the cocchi in his hands is impossible. Any scheme which required such supervision on the part of the cocchi, and detailed application on the part of the cocchi will certainly fail, but at the same time the following memorandum was made: employers were only too willing to make a radical change in the arrangements of their barrack provided reasonable freedom from crippling epidemics could be arranged for the future.
Memorandum

as to arrangement of cootie locations

General Remarks.

In the choosing of sites for, and in the construction of, cootie locations, there are certain factors which must always be the guiding principles of such undertakings.

1. The indentured cootie in Natal is an Indian of the lowest caste, without regard for his own health, in personal cleanliness, and for decency, and has to be prevented by natural and artificial means from harming himself. He will drink the putrid water to save himself the trouble of going 100 yards further to obtain a pure supply, and in the same reason will fold his house and even his own clothing to obviate the necessity of going outside the former to relieve nature on a cold night.

It will be found therefore that the easiest, the cheapest and in fact the only way of keeping him healthy, and his surroundings in a sanitary state is to pay the greatest attention to the original choosing and arranging of his tent, to make a supply of filthy water impossible for him to obtain without trouble or his food, to make the most convenient place for him to throw refuse in-
on ashpit, and the place easiest of access in them to developer nature in a latrine.

In my opinion these conditions can only be obtained with due regard to proper siting on a certain type of site, and I therefore consider the selection of a suitable site by far the most important item in the arrangement of 200 acres locations.

It is a known fact that on low levels near water, a much greater extremes of temperature (hotter during the day, colder during the night) is met with than on levels only a couple of hundred feet up, and away from water, and in addition other circumstances prejudicial to health are apt to characterise the low level. The principal of these are:—

1. Pools of water and rank vegetation

   Mosquitoes and malaria as an almost certain concomitant.

2. A high level of underground water and swamps occurring in shallow

   Seasonal, stagnant entailed microbe pneumoniae

   And the development of the anthrax-tome

3. Proximity to the water supply and

   Encourage a greater likelihood of fouling it.

4. Insufficient cleansing of the ground

   Is mutating the germicidal effect of daily washing.
(5) A difficulty of the forms of refuse, conditions which if not satisfactorily filled, bring in their train anopheles tonomius, scabies, jiggers, lice and other disease producing insects, all of which can be seen for excellence among Natal cookies.

Bearing qualifications of a good site

Such sites for barracks should therefore be chosen with a view to:

1. Securing an equitable temperature and an absence of night mist.


3. Securing a situation in which a low level of underground water is constant.

4. Being at a safe distance from the water supply or from possible mosquito breeding places.

5. Easy disposal of refuse, the latter being always at a lower level than the buildings.

6. Portion of latrines, which may and are better placed near but at a lower level than the barracks.

The ideal site

The above conditions are only fulfilled by placing all buildings on high ground on the slope of a ridge. A ridge on the skyline is not recommended if there is a choice.
in the matter, but it is certainly to be preferred for low level. It is better that the houses occupy
the whole lot, so that there is no waste ground there, and only the earth on the lower
levels can be used to throw rubbish on.

The buildings are best run in lines across
such a ridge as this makes the latrines more
accessible to the houses, but the primary consideration
here is to prevent the ends of the houses to the
prevailing wind.

The low level has not one single point to recommend
it, and facility of access to water supply is a disadvantage
until such water place is undred incompatible
with mosquito life. Such can only be done without
expense in very exceptional instances.

Buildings
Sanitary desiderata in all such.

The following conditions should
be fulfilled in every case:

1. No rooms to be back to back.

2. Floors to be raised above the ground level
and to be of some impervious material as cemented
brick, earth covered with a layer of a mixture of
cement and tar or a basis of screened ash or coke.

This is most important as a protection against anthractomis.
The floors to be level or have a slight slope to the door.

(3.) No rooms to be less than 10 feet square.

(4.) The lowest part of the roof to be not less than five feet above any part of the floor.

Temporary and Permanent Huts.

To accommodate the varying population huts have to be temporary and permanent.

Temporary.

The best temporary building is a grass hut with a grass (not iron) roof. Such a roof requires a slope of at least 45° and only dried grass should be used. The floor must be covered and 2 inches thick and washed down at least once a week and no other type of dwelling is suitable for this type of dwelling. Which in earth huts is proposed.

Permanent.

1) The permanent dwelling to be of brick with an iron roof. A space of 6 inches to be left under the eaves at the higher side and eaves to project at least 4 inches beyond the wall.

2) The roof to be not less than 9 feet above the level of the floor at any part of the room.

3) A proper door, window and chimney to be provided.

4) The inside to be disinfected and limewashed once every six months and after any case of filthiness, dysentery, anhydrotic eczema, scabies, yaws, leprosy and any infectious disorder has occurred in the room.
To provide latrines for a corps is an easy matter, but once they are in a very dirty and unsightly condition and such a latrine must be incapable of being fouled, it must allow of disfacing it in the settling pasture, and must be placed as near his quarters as possible to obviate the chance of a price of waste ground proving a serious attraction. The following pattern I have found most useful:

A series of spans (AA) 3 feet long, 14 inches broad and 14 inches thick are separated from each other by a space of nine inches. Two battens of stout timber cannot these. One batten (B) is nailed to the ends of the spans, the other (C) is placed 18 ft. 6 in. from the opposite end. To this batten (C) a series...
of uprights 9 inches high is nailed, and the upper end of these are connected with a light battlement to form a handrail E. A trench (F) is made 30 inches wide and four feet deep, and the structure placed so that the handrail is just over the edge of the trench. The whole is then trenched by means of a spade (G) is run round the latrine and placed so close to the trench that there is just room to pass on the side opposite the handrail and none on the other.

One space should be allowed for each 16 men in the banches, and one space for every 25 women and children, and with banches built across a ridge, the latrines should be placed at the end of the line just below the banches.

The trenches should be filled in when half full, and the woodwork placed over a new excavation. The woodwork should be reinforced once a month, then must be separate latrines for the men and for the women and children.

It will be noted that this latrine conserves the facing and that it is almost impossible for a person to assume a position in it which will admit of the woodwork or approaches becoming fouled. A spade is shifted every 3 months, and latrines for a banch of 500 persons can be dug, erected, and fenced by two men in two days while the old one is simply filled in.
Ash and refuse pit

The open pit should be provided close to the kitchen and the abattoir made responsible for any sullage found in the pits.

In making the pit clean up it is as well to collect the manure of the ground, then for the manure, better turn it over with the plough. Such a proceeding will tend to destroy eggs and larvae already contaminating it.

Water supply and washing places

The ideal water supply is from a spring, but even if spring water comes from a hole in the ground it is very liable to gross pollution. Should it arise from sloping ground it is best treated thus:

1. Clear it out, and round it build a brick or cement tank with an in-passage for an and a fixed cover.
2. Provide a short out at least 2 feet off the ground and make the short from the ground into a louvered long run away.

The next best supply is from a stream provided no filth from pollution can be got.

1. Two small dams should be made so as to provide two pools close together. The upper is for drinking and washing, the lower for washing. When both together the arrangement will defeat its own ends, as the cistern will wash in and drink from the same one i.e. that nearest the teakum.
(2) The stream should be well fenced a few yards from the banks for some distance above and below to prevent water from entering. Only wells in wet places should be considered for obtaining water except from the nearby wells.

Wells may be much larger if metallic water cannot be obtained from other sources and the following are essentials in their construction:

1. The well should be sunk as deep as possible in the water table layer on which the water lies; if that is impossible, to a depth of at least 4 feet below the water level.

2. It should not be more than 3 feet in diameter.

3. The lining of the well must pass below the water level and at least 2 feet above the ground level.

4. The outside ground should be raised to form a good slope from the well spout for a distance of four feet all around, and should be faced with an impermeable layer of concrete cement, a mixture of tar with screened coke washed.

5. It should have a cover.

It is needless to remark that a "deep" well is the most desirable of all. Their construction is beyond the scope of this monograph; however, and the above requirements are intended to apply to "shallow" wells. Where water supply is situated below and at some distance from buildings, special precautions against mosquitoes are needless.
Barack Dispensaries.

If barracks are separated from each other and away from the main hospital, it is desirable to have two central clinics set apart for use as a temporary dispensary and nursing station. Here a few simple remedies can be kept under the charge of the overseas medical officer. A suitable solution I would advise: quinine mixture, carbolic, chrome salts, sulphur mixture, iron tonic, and in surgical practice, a simple ointment, an antiseptic, carbolite, steel bandages (in lieu of bandage) and lint. It is as well to keep a few tests which can be improvised from drop cloth to the surface of treating such conditions as rabies, pigger itch, etc. by Emancipate and should it be necessary to gain a systematic training of feel for anthraxonias it can be done here. Such a station will save much time, trouble and expense, which would occur if treating cases were sent to hospital. It must not contain however any powerful drug as a preparation of opium as the usual result of the use of such medicis by laymen is to mask symptoms of serious disease as dysentery, with consequences disastrous to the patient and in addition to add difficulties to diagnosis by the medical officer. Think of many cases cough, rhumatism, venereal disease and
References.

I. Lectures on tropical diseases being the Lane lectures 1905. Pp. 16. 
   Sir Patrick Manson. (Pub. G. Constable.)

II. Tropical diseases. Manson, p. 654.

III. " " " 652.

especially occurring fever, should not under any circum-
stances have their treatment undertaken without a
medical man, and no drug mixture should be
kept in those dispensaries which has not been ordered
as a stock by the medical officer.
I do not intend to take up the hospital re-
quirements of cubic locations, on account of its being a
subject outside the sanitary measures developing in the
plants individually, under estate bri very large instal-

In conclusion, therefore, I would point out
that the above scheme cannot be considered ideal, and
it must be borne in mind that it merely constitutes what
I would term, an irreducible minimum of efficiency
with a minimum of expense. In designing it. I was
at special pains to avoid trouble and expense in admin-
istration. For reasons I have explained, that it is con-
istent with the health of the cubic. I am confident, and
its practical trial has proved its worth in stamping
out the disease it was primarily intended to control,
and in furnishing a relative immunity from that dis-
eease since the time of its adoption.