A PUBLIC HEALTH SURVEY OF RURAL BRITISH GUIANA.

by

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OF RURAL BRITISH GUIANA.

INTRODUCTORY.

Rather more than two years ago the writer was appointed to the staff of the Government Public Health Department of British Guiana and after only three months found himself at its head. It was early apparent that both the physical conditions of the country, the political constitution and social organisation of the people were peculiar if not unique.

A general study of the public health problem seemed a necessary preliminary to effective discharge of responsibilities. The results of this study are set down here, and form an account of the public health matters in Rural British Guiana as at present existing. While there is recorded some small progress both in administration and practical sanitation, the survey is more of a look around before starting than an account of improvements carried out.
I. THE COUNTRY.

The colony of British Guiana is little heard of in Britain and there must be many unaware that such is the proper name of Demerara from which the sugar comes. The latter name strictly applies to only one county of three and that the smallest.

In size about equal to England, Scotland, and Wales together, the Colony is unusual in many things and unique in its being British territory on the continent of South America. The colony's situation, within ten degrees of the equator, stamps it at once as tropical in climate, but many features distinguish this corner of the Empire from our country's other Tropical possessions.

A glance at the map shows the country's situation and saves tedious references to degrees of longitude and latitude.

The Atlantic coast line is some 270 miles long and the coast lands form a broad belt mostly over four feet below the level of Spring tides. Except in the North West District, appreciably rising ground is scarcely met with nearer to the sea than 40 miles and it is on these extensive mud flats, liable to inundation by the sea and flooding by the overflowing rivers/
rivers that most of the population of the colony live.

The map readily shows the sub-division of the country by its great rivers, the best known perhaps the Demerara, but the mightiest the Essequibo, whose course is 600 miles and whose mouth is fourteen miles across.

The coast lands consist of a fluvio-marine deposit of various coloured clays with intermediate layers of sand and peat and when protected from salt water are fertile. Large parts of the coast are protected from the sea by a concrete wall or by earth dams, but many miles are still unguarded.

A cultivated belt stretches along most of the seaboard and is of varying depth, not more than a few miles for the most part, but stretching inland up the river banks for twenty to thirty miles.

In this area and mostly near the sea are scattered the towns and villages and in this inconsiderable fraction of the country live the bulk of the population.

Inland of the coastal belt or "aback" of it in local parlance lies swampy savannah, or primaeval forest with underlying swamp when the ground is flat. Where the land is hilly, hill and dale are for the most part covered by dense forest but there are also large grassy areas suitable for stock raising.
The density of S. American jungle has to be seen to be realised. The perpetual twilight and the dampness of the forest, the peculiar forms of growth, the silence and apparent absence of animal life convey a sinister impression, and this feeling may be heightened by the gliding of a snake among the undergrowth.

In truth there is something sinister about the rank and fleshy vegetation which in a few months will cover a neglected house or obliterate a clearing.

Still further south in the colony are mountain ranges forest covered, and great grassy savannahs and more mountains and more savannahs until three or four hundred miles from the coast are reached the boundaries of Venezuela and Brazil.

This hinterland can be reached only with much difficulty. The great rivers form the chief means of access but all are interrupted by dangerous rapids, round which a portage must be made.

The scanty population of the huge undeveloped portion of the colony can only be estimated. Aboriginal Indians of migratory habits live in the forests, but the lure of diamonds and of gold is drawing an increasing number of fortune seekers into the interior and as the timber accessible from the river-sides becomes exhausted, new and more distant areas are being opened up.

So far only the coast lands have come under any efforts/
efforts towards health improvement and that area presents problems of the greatest difficulty to the Sanitarian.

The situation below sea level alone provides some pretty problems. Add to that a clay soil, a rainfall of 100 inches (sometimes several inches in an hour), mosquitoes, a poorly educated and rather thriftless population and the cup of difficulties seems to run over without adding that the Colony's finances are straitened and its form of government not the most effective.

No high ground is available for building or for roadways, and sites for such must be made up by making borrow pits and trenches, - robbing Peter to pay Paul.

No stone metal is available (until quite recently in small quantities) for road-making and the substitute is burnt clay obtained by digging more holes.

Thanks to the difficulties in connection with levels, gravity drainage of the coast lands can only be carried on between tides and the sea wall is provided with sluices or kokers which are opened and shut according to the tides, but drainage from half ebb to half flood is about the maximum ever obtained.

The sea is not the only agency of inundation. The cultivated lands are bounded on their landward side by a polder or back dam to prevent the storm water/
water from the hills and savannahs from flooding the crops when the creeks and rivers are not adequate to cope with heavy rainfall. Behind these dams too water is conserved in artificial lakes to provide for irrigation in times of drought. In heavy weather these back dams sometimes break down.

The coast lands of British Guiana are a maze of trenches and canals, some for drainage water and some for sweet water from the conservancies mentioned, and in many of the latter trenches the water is maintained at a high level to permit of transportation of sugar canes by large punts.

Much of the land close to the coast has been abandoned for sugar growing owing to former inroads of the sea and these lands are often used as a reservoir for excess storm water until the kokers open, the estates pumping the surplus from the cane fields on to the front lands.

In the rainy season the coast lands with the exception of the parts actually under sugar canes form a vast swamp in which cows may be seen up to their necks in water, grazing on water lilies, where lambs and pigs swim almost from birth and where many houses are accessible only by boat. At such times domestic animals, alligators and a boa constructor have/
have been seen together on the public high road - the only dry place.

A new-comer to the country finds the greatest difficulty in distinguishing the difference between drainage and sweet water canals and the use of the local names of side-line and middle-walk trench makes confusion more confounded though giving the key to the lay out of the canals.

Broadly speaking each cultivated section of land has a drainage trench at each side - the side-lines - and an irrigation trench down the centre - the middle walk; and connected to each of these are the necessary subsidiary trenches.

On the abolition of slavery many plantations went out of cultivation and a recent slump in sugar has caused more to do so. Villages have sprung up on the sites of former cane fields and still have the same system of drainage and water supply. On an actively working plantation canals, trenches and sluices are properly maintained and water is confined mainly to its intended channels. But there are huge areas of land now fallow where the original trenches exist only as stagnant, weed grown reservoirs. Outflows are silted up and wet weather converts these lands into lakes.

The villages are mostly on abandoned estate property and often the villagers are too poor or too indifferent/
indifferent to maintain the drainage of their district. On the other hand the villagers may be able and willing to look after their trenches well, but the outflow may be via the trenches of some property falling into decay whose proprietors are bankrupt and quite unable to keep their waterways open.

In the amalgamation of small estates with others, in the squatting of rice farmers on abandoned lands, and in the supersession of old Dutch methods by more modern and frequently changed British plans the whole inhabited part of the Colony, not even excepting Georgetown the capital, has become a confusing maze of ditches and canals in dry weather, and too often an extensive swamp after rain.

The communications of the country are very limited. There is a good coast road along about two-thirds of the sea frontage, and some distance up the banks of the Demerara and Berbice rivers.

About ninety miles of railway runs along the Demerara coast connecting the Essequibo and Berbice rivers, and some 60 miles inland a small privately owned railway of narrow gauge runs between the easily navigable Demerara river and a point on the Essequibo above the most dangerous rapids.

The barometer scarcely varies from year's end to year's end, the temperature is almost monotonously 76°F.
76°F. by night and 86°F. by day, and the atmosphere is humid at all seasons.

The prevailing winds are Easterly and North easterly and blow all the year except in August and September, making the climate not unpleasant. There must be few territories so near the equator and so low lying whose climatic conditions are so tolerable.

Such then is the country and such are its present day conditions and the difficulties in the way of sanitary work are obvious.
Old Dutch outlet "Koker".
Modern outlet sluice or "Koker". This is an 18 ft. outlet and was built in 1923 to replace a 6 foot sluice which earlier engineers had considered large enough to discharge a 40 foot canal.
Digging and burning clay for road making. Note the pools left by former digging.
Church and cemetery at Plaisance Village in the wet season.
Plaisance Village street in wet season.
Boating in Plaisance in the wet season.
Police compound at Plaisance in the dry season.
Police compound at Plaisance in the wet season.
II.

THE PEOPLE.

The people of the colony are mixed, both in the sense that many races are represented in the population and also in the sense that many combinations of races may be found in individuals.

The census of the colony in 1921 gave the population as numbering 297,891, and estimated that to this total should be added 9,700 uncounted Aborigines.

The uncounted aborigines are excluded from all tables and calculations in the Census Commissioners' report which divides the enumerated people as follows:-

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europeans other than Portuguese</td>
<td>3,291</td>
</tr>
<tr>
<td>Portuguese</td>
<td>9,175</td>
</tr>
<tr>
<td>East Indian</td>
<td>124,938</td>
</tr>
<tr>
<td>Chinese</td>
<td>2,722</td>
</tr>
<tr>
<td>Blacks</td>
<td>116,984</td>
</tr>
<tr>
<td>Other Africans</td>
<td>185</td>
</tr>
<tr>
<td>Mixed</td>
<td>30,587</td>
</tr>
<tr>
<td>Aboriginal Indians</td>
<td>9,150</td>
</tr>
<tr>
<td>Not stated</td>
<td>659</td>
</tr>
</tbody>
</table>

In the fifty years from 1871 to the census of 1921 the natural increase of the population was 5,258
while owing to immigration the actual increase was
greater by nearly one hundred thousand (98,942).

The distribution of the enumerated people in
1921 was as follows:

In the 2 Towns 22.84% in 1891, 22.9%
On Sugar Estates 22.22% in 1891, 32.5%
In Villages 37.71% in 1891 (not available)
In Farms and
Settlements 14.41% in 1891 (not available)
In Forest districts 2.82% in 1891, 2.48%

There is a marked drop in the population of sugar
estates while that of villages and in farms and
settlements is increasing and there is an appreciable
rise in the number in forest districts.

The rise in the figures for Forest Districts has
been maintained since 1921 owing to the development
of the diamond mining, while the collapse of the sugar
market in the census year has reduced the area under
cane and has greatly diminished the number of people
resident upon plantation.

In the Colony of British Guiana with a huge
sparsely occupied hinterland it is valueless and in¬
deed misleading to state that the density of the
population is 3.32 per square mile.

In Georgetown, the capital, the density is 39.82
per acre, the 96 acres of the cemetery being excluded
from/
from the calculation; if the suburbs are included the
density is reduced to 32.65 per acre.

New Amsterdam returns a density of 12.53 to the
acre but as less than half of the municipal area is
built upon, the figure is not very useful.

A consideration of the sex constitution of the
population brings to light some interesting informa-
tion.

As is the usual case where immigration is mainly
responsible for the increase in population, we find
that in British Guiana males outnumber females, while
more stabilised countries, with few exceptions, show
an excess of females.

In 1881 the percentages were Males 55.6, Females
44.4, immigration exerting its maximum influence in
that year, the influx exceeding the outgoing by 60,605.

The percentages in succeeding decades with the
excess of immigration over emigration were as follows:

1891. Males 54.5. Females 45.5. Net Immigration 26,314
1901. No census.
1911. Males 51.92. Females 48.08. " " 29,748
(2 decades)
1921. Males 50.81. Females 49.19. " " 11,152

From 1911 to 1921 the Males have decreased by
2,456, while Females have increased by 4,106.

With diminishing immigration the disparity in
the/
the proportion of the sexes is diminishing.

The difficulty of census officers in obtaining accurate information as to age is well known and in British Guiana the difficulty is accentuated to the point of making it impossible to place great reliance on recorded figures.

A large proportion of the East Indians have no idea of their own or their children's ages, and among the Blacks there is sufficient difficulty in knowing whose children are whose, without troubling about details such as age.

In endeavouring to get at a person's age use has to be freely made of any reference to historic dates which an individual's memory may enable him or her to make. "The Cholera year", "The arrival of Governor Irving", "The fire in Charlestown", and similar local events afford starting points for an approximate calculation of ages.

The 1921 census shows that contrary to the usual experience, the males living in the "under 1 year" period exceed the females and the influence of immigration is seen in the large number in the groups between 25 and 40, which preponderance is falling with diminished influx of adults.

Another departure from the common features of vital statistics is that no abnormal proportion of adults in the prime of working life is found resident in/
in the towns. Taking both sexes of between 20 and 45 together, an exactly equal proportion per 1000 of the population is found in the towns and in the rural districts. In the age group 20 to 45 it is seen that in the urban districts the females outnumber the males to an unusual extent, while in the same age group in the rural districts males are largely in excess of females. This last fact being without doubt due to the preponderance of males among the immigrants who are located almost entirely in rural districts.

The urban districts show a markedly less proportion of young children than do the rural districts.

It is of interest too to note that statistics reflect the fact that the county of Essequibo is the site of most of the mining, balata bleeding and other forest industries in which males only are engaged.

As regards marriage there has been a noticeably steady increase of recent years in the marriage rate.

Fifty years ago married males were 171 per 1000 of the male population and married females 208 per 1000 of the total females. In 1921 those figures were respectively 305 and 310 which must be regarded as very satisfactory.

An apparent discrepancy appears in the census returns of the number of husbands and wives, the former outnumbering the latter by 2,847 in 1911. The Census Commissioner of 1921 pointed out that this disproportion/
disproportion occurred only among the East Indians and suggested very reasonably that the disparity is due to the custom of East Indian males (the older ones excepted) of describing themselves as married after the death of their wives. This explanation is borne out by the very small number of widowers returned among the East Indians.

Among other races collectively there is an excess of wives to the extent of 1049 wives to 1000 husbands. Absence of husbands from the colony accounts for most of this disparity and it is probable that not a few women claim the name of wife who have no real title to the description.

Of the total East Indian population 40.9% are returned as married and in considering this high figure it must not be forgotten that this race in British Guiana has the highest proportion of persons of marriageable age. The low figure - 23.4 per cent - for all other races collectively, is largely accounted for by the prevailing custom among the black and coloured people of living as man and wife without going through any legal or religious ceremony. In this connection it should be noted that of all births registered in Georgetown in 1922, 48.3 per cent were illegitimate.
The Aborigines merit first consideration, being the true natives of the country. They are of many tribes, some of which occupy fairly distinct territories and are mostly nomadic within a rather circumscribed area. These Indians are on the whole shy and retiring, clinging to their tribal customs and their primitive mode of life, and withdrawing into their unexplored forests before the advance of civilisation. Only a very few have been drawn into the modern life of the colony and while many act as boatmen, guides and porters in the river districts, the aborigines for the most part go naked or near it, and live the same life as they did before Raleigh sighted the country's shores. At the last census 9150 Aborigines were counted and the remainder were estimated at 9700.

It is probable that the estimate is reasonably correct since those chiefly responsible for it were Mr Melville and the Rev. Father Carey Elwes, the former a gentleman whose knowledge of the Aboriginals' country and languages is unsurpassed, and the latter a missionary in intimate touch with them for many years. The names of the tribes are strange and with the exception of Carib and Arawak, probably unfamiliar to English ears.

There/
There is much that is fascinating about these Indians who still use Gurari as an arrow-poison and their folk-lore is worthy of fuller study than it has yet received.

The time has not yet come for even pioneer sanitary work among them, but the quiet disposition of those encountered on the fringes of civilisation makes it probable that they would be pleasant to work among, and teachable.

THE NEGROES.

The Blacks of the Colony are of course quite as much foreigners as the whites, although the present day attitude of many of the negroes is to regard the Whites as usurpers of their birthrights.

Most of the negro population are descended from the old time slaves, and it is possible that there are still a few old people whose parents were slaves.

The language of the British Guiana negro is English, or what passes for such, but even a school master becomes incomprehensible when excited, and a new-comer would fail to pick up more than a word or two in a crowded street.

Physically, the negroes are on the whole rather poor, with the exception of those from Berbice, and even/
even these are not up to the standard fixed for them by local tradition.

The ravages of malaria, filaria, hook worm and in towns, of venereal disease, are only too easily seen, and the wonderful teeth associated with the negro race are far from being universal.

The children of this race are nearly all pot-bellied and umbilical hernia is common. The protruding abdomen seems to be associated with a starchy diet and is locally called "cassava tummy", but enlargement of the spleen plays its part.

The standard of education is low, and the degree of civilisation cannot be called exalted. If politics means the loud and wordy discussion of one's own and other people's affairs without much idea of sacrificing personal interest for the public good, then the political instinct flourishes among the British Guiana negroes.

The most vigorous Marcus Garveyite could hardly describe the negro as industrious and provident. High wages for a few days work, followed by several days spree, is much more to his taste than daily toil on his farm. This remark applies much more widely to the younger men and women than to their elders, among whom are still many quiet level-headed and hard-working people.

After the abolition of slavery the negroes' dis-like/
dislike of steady employment was very apparent, and for that reason the negro has never made a good agricultural labourer. It is a racial characteristic that a man prefers working for himself for a pittance to earning good wages from an employer. Thousands of black men are now working diamonds in the forests under conditions of extreme hardship, usually for a very moderate gain, and often times losing everything, including health. The attractions are the possibility of sudden affluence and the freedom from restraint which make tolerable conditions that under an employer would be found unbearable.

In the country districts there is a happy-go-lucky carelessness and a laughing indifference about the black people which make work among them pleasant if sometimes tantalising. When it comes to getting something done the negro is more approachable through sentiment than through sense, and if he knows and likes you is more likely to carry out an improvement because you ask it than because sense, science or the law demand it.

Country life in the tropics is so simple and poverty does not apply the same sharp spur, as in cold countries.

House building materials may be had for the cutting; clothing is worn for decency rather than for warmth, and for children may be omitted with the law's/
law's approval. Plantains, coconuts and cassava cannot help growing and provide the necessaries of life, and fish abound in rivers, creeks and trenches.

It is easy to get along with the minimum of exertion, and this fact goes a long way to make the negro what he is. Sheer ignorance and superstition are very wide-spread.

The presence of "mosquito worms" (larvae) in water is often regarded as desirable evidence of purity. All windows are tightly shuttered at night for a variety of reasons. Fear of burglars is perhaps well founded, but fear of night winds and miasmas plays its part, to say nothing of vampire bats and less real flying terrors.

The practice of obeah still continues, and is a mixture of superstitious practices to which East Indian magic, African Voodooism and even Christianity contribute. The aid of the "obeah man" is much sought in sickness, and unemployment, to avoid detection in crime and to obtain revenge against enemies.

The crudest materials and ceremonies are employed and a white "fowl cock" seems to have special virtues. Occasionally in the past child-murder has figured among the rites performed. Persons of surprisingly good education and position have been discovered, even of recent times, in communication with an "obeah man".

The most discouraging factor to a sanitarian working/
working among the negroes is that while they readily assume a veneer of civilisation - smart clothes, church going and politics - they have little instinct of tidiness or cleanliness, and a filthy mass of garbage under the kitchen window gives no qualms whatever to the housewife.

The East Indians form a very large and very important part of the population, and may well be described as the back bone of the colony.

Sugar cultivation has always been the staple industry of British Guiana, and as an agricultural labourer the East Indian immigrant is facile princeps here. There are now no labourers under indenture, but many thousands still live and work upon the plantations. Others have taken up rice growing and it is not too much to say that the immigrant Indians established the paddi industry and built up an export trade in rice. Still others have taken up land for farming and as a market gardener the coolie here is unsurpassed.

Naturally the East Indian did not come from the upper ranks of Indian life, but the sons of not a few immigrants have become doctors and lawyers, and some have reached positions of influence in the Colony's Government.

Physically the majority of the East Indians are sparsely built, the men on the whole below average height/
height and the women always small. It is uncommon to see elephantiasis in an East Indian, a circumstance attributable to the fact that by far the greater number are resident in rural districts.

In the neighbourhood of towns and villages most Coolie people can talk a sort of pigeon English, but can only with difficulty understand what would pass for English at home, and there are many in more isolated districts who speak only a native language. Strangely enough there is growing up in the towns a generation of young East Indians who speak and understand nothing but English.

"Cassava tummy" is common among the children, but the Aryan blood is seen in the beauty of face and figure of many a naked "pony" along the road sides and in the trenches.

The standard of education among the East Indians is low, as is to be expected among people drawn from the lowest grades of Indian life and engaged almost wholly in pastoral pursuits. There are some however who display considerable ability and those who take up occupations involving study display the same industry as the workers on the land.

There can be no doubt that the East Indian is thrifty and industrious, and black men may be heard to reproach the coolies for saving their money while the negroes keep theirs in circulation.

In/
In sanitary matters the East Indian is a curious proposition. The root of the matter is in him for he is fundamentally clean and tidy, and many a coolie trash house though offending against most other canons of hygiene is scrupulously tidy and clean.

The East Indian seldom argues that he knows better than the sanitary officer, and he respects the law and the better education of the inspector.

This may cause him to comply with instructions as to the building of a latrine and to continue to use the bush because he is accustomed to do so. False pleading of poverty is common as a means of avoiding the expense of complying with sanitary requirements, and the game of "no savvy" while comprehending perfectly is not uncommonly tried.

Racial customs, religious prejudices, ignorance and a good deal of superstition are all obstacles in the way of health work among the East Indians, but work among them does bear fruit. Love of children, family life, and respect for age and education are factors which have made and will maintain the East Indian people as a most important section of the population of this colony.

The Portuguese are of more doubtful value to the country. Imported from Madeira as agricultural labourers they made a failure of field work, rapidly became traders and now hold almost a monopoly of the drink trade. With the exception of a few who are in the/
the professions and in large businesses in the towns, most tend to be dirty and slovenly.

Active opposition to health work is not encountered among the Portuguese until the expenditure of money is involved and then the difficulties are serious. The importation of Portuguese has long ceased and the nine thousand odd who still remain are not a very important factor in public health matters.

The Chinese are only a small fraction of the population, .91%, and it is worthy of note that they show a natural increment of 4.01 per cent. The mixed or coloured people also show a natural increment, but with these exceptions in all races in the decade 1911-1921 the deaths exceeded the births.

In 1921, of the Chinese in the colony, 86.19% were born in British Guiana which reflects the cessation of arrivals from China since 1881. In the decade 1851-1860 the Chinese immigrants numbered three thousand in round figures, in the next decade nine thousand and the next one thousand, and during these three decades the number of Chinese leaving was almost negligible. Up to 1913 only such immigration and emigration as passed through the official Immigration Department was recorded, but after that date all arrivals and departures were noted, and while the records show no Chinese arriving or leaving from 1881 to 1911, the period 1911 to 1921 shows the incoming and/
and outgoing Chinese nearly balancing in the neighbourhood of three thousand.

The Chinese here, as elsewhere, are a quiet, industrious people. They are chiefly employed in shopkeeping, and in the towns do most of the starched laundry business, although the ubiquitous black "washer" successfully contests anything like the monopoly which the Chinese hold elsewhere.

Market gardening does not figure among Chinese activities to any great extent, although in other parts of the world they excel in that business.

The Chinese are satisfactory to deal with in public health work. They are clean, thrifty and intelligent, and their general standard of education above that of most other races here.

Physically they are perhaps above the average for this colony, for although racially small in stature they manifest a certain toughness not shown by other races.

The Europeans other than Portuguese are chiefly Government servants, the senior staffs of sugar plantations and of large business houses. The total has been diminishing for many years. The number in 1921 was 3291, which is less by 1247 than that recorded thirty years previously. This very rapid rate of decrease is not of course due to dying out of Europeans in the colony, though the belief is common enough in England/
England that the climate is pestilential and that Yellow Fever abounds. The fall is due in large measure to diminution in the number of sugar plantations and still more to the employment of coloured people in situations which in the older days were held and could only be held by Europeans.

The physique of the native born European is only average, and that of the home-born deteriorates. Infants up to a few years of age grow rapidly and thrive, but those who do not get away after 5-7 years become weedy. Incoming Britishers generally lose their fresh colour very soon if employed indoors, and among women the well known high Scottish colour, amounting almost to telangiectasis, seems alone to be proof against the hot-house atmosphere.

It has not been possible to obtain figures from which to estimate with any accuracy the effects of prolonged residence in British Guiana upon the longevity of Europeans. Some, if not all, British Insurance Companies call for an additional premium on account of residence in the Colony, but local companies accept British born lives in the same terms as Creole-born. This, and the list of Government pensioners and the many robust old stagers still in the service and in plantations, seem to indicate that the harmful effects of the Colony's climate and diseases have been over-estimated.
Typical Chinese Shopkeeper.
East Indian plantation labourers (Immigrants)
The census of 1921 showed that 178,351 persons were engaged in some definite occupation, which total is 66.8% of the population of 5 years and upwards. Forty per cent of the total population or 119,340 persons were returned as "of no occupation" but this figure includes all returned as scholars, the occupants of prisons, Almhouses, Lunatic and Leper Asylums and wives "of no occupation" although the last might be engaged in the rearing of children and ordinary domestic affairs. Many young children are employed in the performance of the lighter work about sugar estates, and among the East Indians especially, child labour in the home and in the rice fields is the general rule.

The number unemployed had increased between 1911 and 1921 by 2,730, a rise of 5.8%, but in this colony it is impossible to take the number unoccupied as an index of the position of the labour market.

There are constantly large numbers who could find employment if they would, but who prefer idleness with poverty to regular employment and better conditions. It was mentioned earlier that climatic and other local conditions are such that the dictum "if a man shall not work neither shall he eat" is not/
not applicable to British Guiana.

Classes of employment with the numbers engaged are as follows:

<table>
<thead>
<tr>
<th>Class</th>
<th>Numbers Engaged</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Professional</strong></td>
<td></td>
</tr>
<tr>
<td>Public Service</td>
<td>2210</td>
</tr>
<tr>
<td>Clergy, Professions and Teachers</td>
<td>2937 5147</td>
</tr>
<tr>
<td><strong>Commercial</strong></td>
<td></td>
</tr>
<tr>
<td>Merchants, Shopkeepers, Agents</td>
<td>3359</td>
</tr>
<tr>
<td>Clerks and Shop Assistants</td>
<td>4251</td>
</tr>
<tr>
<td>Boatmen and Mariners</td>
<td>2011 9621</td>
</tr>
<tr>
<td><strong>Industrial</strong></td>
<td></td>
</tr>
<tr>
<td>Woodcutters, Gold seekers, Diamond diggers and other labourers</td>
<td>5800</td>
</tr>
<tr>
<td>Mechanics and Artisans</td>
<td>18013</td>
</tr>
<tr>
<td>Balata Bleeders and other labourers</td>
<td>24792 49605</td>
</tr>
<tr>
<td><strong>Agricultural</strong></td>
<td></td>
</tr>
<tr>
<td>Landed proprietors, Agriculturists and Cattle Farmers</td>
<td>7271</td>
</tr>
<tr>
<td>Agricultural labourers</td>
<td>77699 84970</td>
</tr>
<tr>
<td><strong>Domestic Servants</strong></td>
<td>30008</td>
</tr>
</tbody>
</table>

In the decade 1911-1921 the class "Agricultural" decreased from 39.8% of the "over 5 yrs" population to 31.83% of the same total, while during the same decade the/
the "Industrial" class showed an increase of 6,878 as a whole, there being in that period a decrease of 328 among those occupied in mining, and of 1298 among Balata workers. The greater "Industrial" total being accounted for by some 9000 "labourers variously employed".

Since 1921 however further marked changes have taken place. The continued depression in the sugar trade and the boom in the local diamond industry have altered the balance of industrial and agricultural labour.

The Department of Lands and Mines issued various mining permits to 28,000 persons in 1923, which figure alone is over 4 times the 1921 figure for "Wood cutters, gold seekers and other labourers".

These rapid changes of large sections of the population from one form of employment to another reflect the unstable position of an undeveloped colony which has for many years been dependent on one main business. There is also reflected the general lack of training in any skilled work and the shortage of population which would be acutely felt in the event of any extensive development schemes being started.

As regards the effects of occupation upon health, no very helpful figures are obtainable. It is noteworthy that about 40% of the population are employed mainly/
mainly out of doors and the 40% who specify no employment undoubtedly live mainly in the open air.

No table showing occupational mortality has ever been prepared for the colony, nor would such be of any value under present conditions.

It is of interest to note an average day's work for some of the main occupations.

**Balata Bleeder.** (one who taps the Balata trees).

- Rise daybreak, about 5 a.m. Small meal.
- Leave camp 6 a.m.
- Walk to work - about ½ mile.
- Tapping or collecting till mid-day.
- Rest for meal.
- Tapping or collecting till sundown, about 6 p.m.
- Return to camp. Evening meal.
- In hammock 7.30 or 8 p.m.

**Gold and diamond digger.**

- Rise daybreak - 5 a.m. Small meal.
- Leave camp 6 a.m. Work close to camp.
- Shovelling, stripping, washing and jigging up to 11 a.m. 1 hour for meal.
- Working to 5 p.m. Evening meal and bed by 7 p.m.

**Sugar estate labourer.**

- Rise day break - 5 a.m. Small meal.
- Walks to work; up to 4 miles.
Sugar estate labourer (continued).

Weeding, forking, digging, cane cutting etc. up to 4 p.m. with $\frac{1}{2}$ hour rest for meal. Return to lines. 5-6 Evening meal. Bed by 8 p.m.

Shop Clerk.

Rise about 6 a.m. Small meal. At shop by 7 or 7.30. Work till 4 p.m. with 1 hour away for meal. Walk, football etc. to 6 p.m. Meal 7 p.m. Bed 10 p.m.

Civil Servant.

Rise about 7 a.m. Small meal. Office 9 a.m. - 4 p.m. with $\frac{1}{2}$ hour for meal on premises. Return home for tea. Walk, golf, tennis etc. to 6.30 p.m. Dinner 8 p.m. Bed 10 p.m.

The forest occupations involve long hours of arduous work and the conditions are on the whole severe. Long hours of work in the sun in this colony are not/
not attended by the same risk of sunstroke and heat exhaustion, even for the European, as is the case in countries where the atmosphere is dryer. Frequent heavy rain storms are always experienced in the bush and the alternate wetting and drying tell more hardly on the even partially clad than upon the naked aboriginals.

The rice planting season with its work in water is responsible for an increase in the pneumonia rate among the East Indians who are the chief paddi growers.

Occupation influences the incidence of Malaria and Filaria in so far as certain employments involve living in the country and others town residence, but the more frequent Malaria of agricultural workers and Filaria of domestic servants is attributable to environment rather than directly to occupation.

The standard of workmanship in the various trades is very poor and the craftsmanship of the unlettered Aboriginals suggests that with some training they would excel all the others in work requiring manual dexterity and skill.
III.

HOUSING.

The houses of rural British Guiana vary from the shacks of aboriginal Indians to the commodious residences of plantation managers.

Except at the Penal Settlement in the interior, where prison labour is available and granite lies to hand, there are few if any stone buildings in the Colony. The Dutch in their time made bricks and there remain some old houses built of them, but with these exceptions, and one or two modern concrete structures, wood holds the field among building materials.

Galvanised corrugated iron is much used for roofing, but shingles, slates and asbestos tiles are preferable and are often employed.

In the poor people's houses, described and illustrated later, all sorts of material are pressed into service.

Most of the better houses are raised 8 - 10 feet from the ground on pillars, and the space below serves as garage, garden tool shed, workshop or children's play ground.

In a few houses, and nearly all shops, concrete is laid down and the ground floor utilised.

The first floor of a typical house consists of one/
one large apartment with a verandah or gallery on one
or more sides, and is often divided by louvred screens
into drawing room and dining room, while the gallery
always forms the main living apartment. Kitchen and
pantry are on the first floor in a projecting wing.
Very few houses have more than two storeys and it is
exceptional to find a gallery on the upper floor.
The bedroom flat is subdivided by partitions some
eight feet in height, and only rarely is there a
ceiling. The gable roof is of wood overlaid with
one of the materials mentioned.

The sides of the house are made of roughly
finished boards weather-proofed by shingles of wallaba
(a local hard wood) and are painted all over inside
and out.

Bath rooms are often such as to make cleanliness
a virtue very near indeed to Godliness. A less
inviting place of ablution than the average British
Guiana bath room is hard to imagine. It is often
half dark, or may be lit by an electric bulb shining
through frosted glass from the next door W.C. and is
not seldom well peopled by mosquitoes.

The floor area of many bath rooms is about
8 feet square and two-thirds of this area is occupied
by the "bath" which consists of lead, zinc or galvan-
ised iron laid on the floor and continued up the
walls and upon a board which separates the "bath" from/
from the remaining tiny area of the room. Water is supplied from a shower overhead, and the outflow is by a hole in the floor most often without any trap. A greasy wooden grid on which to stand completes the horrors.

The better houses are very adequately ventilated, a mean annual temperature of $82^\circ F$, rendering free circulation of air as pleasant as it is desirable. There are a multitude of windows which need never be shut save for driving rain, and in addition permanent openings above the wall-plate and near the floor. Besides glazed windows and indeed more commonly are found the usual tropical jalousies.

The lighting by day in such houses is all that can be wished for. At night, except in the towns or upon large plantations, resort is had to lamps and candles, but rural British Guiana retires early to bed.

The great bulk of rural houses, however, are less pretentious than the type described. The one storey cottage is very common and often very good, but when one comes to the poor and the improvident the most tumble down and insanitary homes are the rule.

There must be many hundreds of houses in the Colony which are built on the surface of the ground with no flooring material whatever, save a smoothly laid/
laid layer of mud and cow dung.

When funds do not permit of the purchase of proper timber, poles are cut in the bush for the frame work and though there may be boards for the walls and even a floor, the roof is almost certain to be of "trash". This term is widely applied and includes grass, straw, cocoanut leaves, leaves of the troolie palm and similar material. Often a would-be house builder cannot afford boards at all. In some districts slips of the bark of the manicole palm are cheap and easily available and form a neat though not durable wall. Or cleverly interwoven branches of the cocoa nut may be used and rendered weather-proof by means of mud and cow dung.

The mud and wattle house placed on the ground and with a trash roof and no windows is a favourite with the East Indians, and very neat and tidy such a house is in its early days. When dilapidated these shacks do not resemble a dwelling at all and it is common to find them so covered with creepers as to be nearly invisible.

It is a general rule that the poorer the class of house the less ventilation it has, and the more certain are the occupants to block up at night such apertures as exist. Windows, if any, are provided with shutters which are bolted nightly and openings for permanent ventilation/
ventilation are plugged up with rags or sacking. The fear of robbers is more genuine than justified, but blood sucking bats are a reality in some areas.

Bath rooms for the poorer houses hardly exist. One often finds a tiny apartment of rough boards or of wattle placed over a small drain in which some privacy is possible while splashing water from a pail with a calabash. Sometimes the privy is used but very frequently male adults and children of both sexes bathe in a large trench.

Lighting is very inadequate in nearly all the poorer dwellings and the exclusion of the sun perpetuates the dampness of the houses on the ground.

It is very noticeable in this Colony that all classes of house property are badly maintained and this is true from Government buildings down to "trash" houses. It is to be doubted if there is any British possession where buildings belonging to the Government are in such disrepair as in British Guiana. Among the poor people houses are inhabited until literally falling to pieces, and the only maintenance attempted is a prop or strut to postpone the inevitable collapse.

Perhaps the majority of the houses in rural districts are of one apartment only, in which lives and sleeps a whole family with no personal privacy whatever.

It is by no means uncommon to see houses built of/
of any odds and ends that can be procured; kerosene tins, barrel-staves, soap-boxes and the like are valued for building purposes and so quickly do these wretched cabins go up that a Sanitary Inspector may on Monday morning find a settlement of squatters where no dwelling existed when he stopped work on Saturday. It is clearly out of the question to issue a set of closing orders and condemn wholesale the houses manifestly unfit for habitation although, so far ahead of the colony's civilisation are its laws, such could be done. An improvement is none the less being gradually made, and while existing bad houses must be left to natural decay, successful efforts are being made to improve the class of all new buildings.

The law demands that all houses built or altered after 1917 shall be at least one foot above the ground unless the floor be made of concrete, and at the same date the provision of certain permanent ventilation as well as 2 windows each of 6 sq. feet per room was made obligatory. The cubic space per occupant was fixed at 300 cubic feet for adults and 150 cubic feet for children.

At first even these moderate demands were only applicable to certain districts, but in 1922 the writer succeeded in having these and all other sanitary Bye-laws applied to all districts.

The earlier Bye-laws (1911) had prohibited the roofing/
roofing or re-roofing of buildings within a township with "trash, straw, troolie leaves, or other like material", but such materials are still freely employed except in the more populous areas which have been declared "townships". The 1911 Bye laws also enacted that buildings must be four feet from the boundary of a lot of land, 12 feet from a drainage or fresh water trench, and eight feet from any other building; and also that not more than two-thirds of the area of a lot may be covered by buildings.

Before 1911 there seems to have been little if any regulation of the places or manner in which houses might be built, or of the materials which might be employed, and there are to be found all over the colony the most primitive and unsuitable conditions.

The laying out of land for building is regulated by the Local Government Ordinance of 1907 amended in 1913, which provides for submission of plans showing the boundaries of house lots, the streets, and the drainage. The provisions are satisfactory though difficult to enforce with a small staff in a very wide area; very little attempt was made to enforce this law before 1920.

The need for these regulations is acutely felt at present when large areas of cane land are going out of cultivation and when proprietors or liquidators of estates not unnaturally attempt to save something from the/
the wreck by letting out their lands for building but are unwilling or financially unable to put the land in order. Unless proper laying out is insisted upon, there would rapidly spring up settlements which from the first would be doomed to bad health. Subsequent improvements are a bad substitute for a good primary lay out.

The Bye laws as to spacing of houses on the land require alteration. A space of only eight feet between buildings is quite inadequate to permit of free circulation of air. While it sounds reasonable to reserve one-third of each building lot unbuilt upon, such a restriction is very inadequate in practice.

If a visit is made to a lot so grossly overcrowded with houses as to draw comment from the most ignorant and indifferent and the actual area covered by buildings is then measured, it is invariably found that less than two-thirds of the surface has been built upon. Indeed on the average lot, if the enforced distance from boundaries and trenches is observed, then even though every inch of the remainder was built upon, more than a third of the area would be vacant.

At the end of this section appears a scale drawing of an average sized lot built upon in accordance with the existing law, and it can be imagined how little air can circulate in a village with streets composed of/
of such lots in two or three depths.

It would be a great advantage to have the law altered to provide that houses without concrete floors must be built more than one foot above ground as at present demanded. Such a small space as one foot gives no access for cleaning purposes while permitting of the accumulation of refuse and is easily blocked up to the exclusion of air and sunlight when the soil becomes damp and unwholesome.

To demand a height of not less than three feet and not more than seven would not be unreasonable, and besides largely obviating the conditions mentioned above would prevent the common but undesirable practice of building rooms under an already existing house which happens to be sufficiently raised to permit of it. One large firm (Curtis, Campbell & Co.) who have laid out La Penitence estate for building purposes, have made their own regulations and refuse permission for any house raised less than 5 feet, and where a house is originally upon high pillars the same firm as a rule decline permission to construct rooms underneath.

With these alterations the existing law affords sufficient powers to materially improve housing conditions.

The machinery for using the law is unfortunately defective, as indicated in the section upon administration.

There/
There are 99 rural areas with their own Local Authorities who from ignorance, indifference or it may be interest, do not or cannot administer the powers conferred upon them. In 1922 there fell to the writer the task (inter alia) of regulating the erection of buildings in all Rural Sanitary Districts covering some hundreds of square miles. While complete control has hardly been obtained as yet, owing to limitation of staff, it is possible to say that a real grip has been obtained upon this problem in these districts. In 1923 there passed through the writer's hands 170 applications to erect or alter dwellings. In each case full details of the proposals were obtained, a rough plan was submitted and before permission was granted the details were checked and the site was inspected by a Sanitary Inspector.

The pity is that the same cannot be said of the villages which are really of more importance, but in the meantime village authorities are more concerned with dialectics and the powers and dignities of office than with their responsibilities and duties. It is worth mentioning that in the course of administering the Building Bye laws in Rural Sanitary Districts in 1923, only 4 cases were taken before a magistrate.

There is a type of dwelling known as a "range" which is almost the rule in coolie lines on sugar estates/
estates but which is also found in cases where estates have been abandoned and the buildings sold out. Similar buildings are sometimes erected for the purpose of letting rooms. A "range" is a long building upon or just off the ground, one room in depth and its length divided into perhaps ten rooms. There is a gable roof prolonged downwards in front to provide a shaded verandah. There is generally, but not always, a ventilating opening in each gable-end, providing a through and through current of air as the room partitions do not reach the roof. In many old ranges each room has a door but no windows, and a window back and front is something of a rarity. There are still a few very old ranges of two storeys, but these are built no longer.

In more recent times better dwellings have been provided for labourers and the shortage of people here and the conditions demanded by the immigration authorities have not been without influence in this respect.

Some ranges as well as the more modern substitutes are illustrated, but it must be admitted that many East Indian labourers are fond of "range" dwellings and live very happily in them.

All plantations in themselves form Rural Sanitary Districts, for which the Local Government Board is the Local Authority, and by an arrangement referred to above, all building plans pass through the hands of the/
the Medical Officer of Health. In this way not only can the law be enforced but the writer has found estate managers very willing to adopt ideas which could not be insisted upon.

Certainly the task of future sanitary authorities can be very much lightened by a wise control of building activities at the present day.
Typical one storey bungalow.
Good class village house. Well off ground, roof of shingles and galvanised iron. Usual dense vegetation all round.
Model dwellings for estate labourers.
Small house of coconut branches roofed with galvanised iron. No windows of any sort.
Village house. Roof of grass, walls of coconut branches, raised from ground.
Village house. Roof of leaves of "troolie palm", walls of strips of bark from "manicole palm" rendered waterproof with mixture of mud and cow dung. House standing on ground.
Range of several rooms. Roof and walls of coconut branches. Note the three apertures to admit light and air.
Dilapidated village dwelling occupied by eight people.
Dilapidated house (inhabited). Note props at back.
A freak house. This old East Indian has lived in this tree for years. It was possible to photograph him as he had just burnt his "house". The burning is done periodically to get rid of centipedes and other pests.
Ground plan of four houses and a privy crowded on an average size lot of land. All regulations as to spacing have been observed.
Area of lot 3380 square feet.
Area required to be free from buildings 1126\(\frac{3}{4}\) sq. feet.
Area actually free in this case 1224 square feet.
Similarly built up lots are often three deep on each side of the road. Scale \(\frac{1}{8}\) inch = 1 foot.
The position of British Guiana as regards water supply is paradoxical. In many respects the coast-lands may be said to have an excess and almost every issue of the daily press contains some reference to the necessity for drainage. None the less there are often times of severe shortage and in the dry season, apart altogether from conditions amounting to a drought, there are parts of the coast where water has to be fetched many miles.

The Director of Science and Agriculture, after more than 40 years in the colony, has stated that the problem of quantity is more difficult than that of quality.

The available sources of supply are as follows:
Stored rain water collected from roofs; deep well water; shallow well water; bush water or savannah surface water. The omission of rivers and streams from the list seems strange, but the rivers are tidal and salt beyond most of the inhabited lands and creek water is savannah surface water.

Stored Rain Water.

The average annual rainfall is 90-100 inches, so that if sufficient roof area and storage capacity are/
are available adequate quantities may be readily obtained. The better classes of the population usually collect rain from their roofs in wooden vats or in iron tanks of from 2000-10,000 gallons capacity, but small houses have vats of perhaps 600 gallons and the municipal and government tanks receiving water from large public buildings often hold as much as 30,000-70,000 gallons.

In country districts storage vessels are small. One barrel or several may be used, while in the poorest houses some vessel simply receives roof dripings without any gutters and pipes. Such barrels are seldom properly protected, and form breeding places for myriads of mosquitoes. All sorts of make-shifts for storage of water are to be found. Old boiler casings are commonly employed, old iron vessels from dismantled sugar factories and old Dutch stoneware jars. Each of these presents peculiar difficulties in the matter of protection from mosquitoes.

The large storage vats and tanks provide a fair opportunity for purification by simple storage, but the barrels and jars are too small, and water drawn from them contains whatever impurities have been washed off the roof. It is quite unusual to employ any form of separator to discard the first washings from the collecting area, though in government compounds there are one or two of simple pattern which reject the first few/
few gallons of water. The desirability of employing separators is shown by the table below. (Wise & Minett).

<table>
<thead>
<tr>
<th></th>
<th>Total organisms per cc.</th>
<th>Faecal organisms per cc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>First water of shower</td>
<td>200,000</td>
<td>1,500</td>
</tr>
<tr>
<td>after dry weather</td>
<td></td>
<td></td>
</tr>
<tr>
<td>After 40 gallons</td>
<td>160,000</td>
<td>1,000</td>
</tr>
<tr>
<td>had run to waste</td>
<td></td>
<td></td>
</tr>
<tr>
<td>After 60 gallons</td>
<td>80</td>
<td>Absent from 10 cc.</td>
</tr>
<tr>
<td>had run to waste</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

One small village has been provided with a communal tank supplied from the roofs of a church and school. The tank is concrete, mainly below ground, and of 16,000 gallons capacity with two pumps fitted on top. The water contained is chlorinated from time to time by the Sanitary Inspector. In wet weather the villagers can draw freely from this tank, but in times of drought careful regulation is required. The supply however has been appreciated and other villages have asked for similar tanks. Sufficient collecting area is seldom available in small places and in a village of any size sufficient storage capacity is difficult to arrange and the tank is necessarily a long distance from many houses. The usefulness of these tanks is limited to places of 300 inhabitants or fewer. Collecting areas become fouled/
fouled by smoke and dust, and in a more serious manner by the droppings of birds. A form of vulture, locally known as a carrion crow is common in many places, and these birds having extracted filthy pieces of carrion from a decaying carcase, show a preference for house roofs on which to perch and eat the unsavoury meal. When frightened these birds will fly away leaving the carrion on the roof. Bacteriological examination of the faeces of these vultures gives the following results. (Wise & Minett.).

<table>
<thead>
<tr>
<th>Specimen (1)</th>
<th>Organisms per gram of faeces</th>
<th>B. Coli per gram</th>
<th>Streptococci per gram</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10,000,000</td>
<td>1,000,000</td>
<td>10,000</td>
</tr>
<tr>
<td>Specimen (2)</td>
<td>10,000,000</td>
<td>1,000,000</td>
<td>100,000</td>
</tr>
</tbody>
</table>

Analysing the water taken from the upper layer of 9 large iron storage tanks, the same investigators found an average chemical constitution as follows:—

<table>
<thead>
<tr>
<th>Grains per gallon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Solids</td>
</tr>
<tr>
<td>Calomine</td>
</tr>
<tr>
<td>Free NH₃</td>
</tr>
<tr>
<td>Alb. NH₃</td>
</tr>
<tr>
<td>Phosphates</td>
</tr>
<tr>
<td>Lead</td>
</tr>
<tr>
<td>Nil to trace</td>
</tr>
</tbody>
</table>

In such large tanks considerable self-precipitation takes place and on emptying for cleaning, deep sludge is found. The traces of lead should cause the prohibition of that metal for covering roofs intended as catchment areas. The bacterial content of stored rain/
rain water varies very greatly, and the self-purification going on in really large tanks is again apparent as is the value of protecting the roof from fouling by carrion crows.

In 12 vessels of 3000 gallons capacity or under, Wise & Minett found the following average:

<table>
<thead>
<tr>
<th>Total organisms growing in agar at 37°C.</th>
<th>Bacillus Coli.</th>
</tr>
</thead>
<tbody>
<tr>
<td>200,000 per cc.</td>
<td>195 per cc.</td>
</tr>
</tbody>
</table>

In 6 vessels of 20,000 gallons capacity or over:

<table>
<thead>
<tr>
<th>Total organisms growing in agar at 37°C.</th>
<th>Bacillus Coli.</th>
</tr>
</thead>
<tbody>
<tr>
<td>29,000 per cc.</td>
<td>185</td>
</tr>
</tbody>
</table>

In each group there was considerable variation, but in general the findings were in favour of the larger tanks. The vessel of 70,000 gallons, whose collecting area was protected, gave results as follows:

<table>
<thead>
<tr>
<th>Total organisms in Agar at 37°C.</th>
<th>Bacillus Coli.</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 per cc.</td>
<td>Absent from 8 cc.</td>
</tr>
</tbody>
</table>

The method of protecting roofs from large birds is to stretch a tight wire between slender uprights and about a foot above each ridge of the roof.

European residents almost invariably boil rain water before use, but boiling as carried out by native cooks is not very reliable, and systematic chlorination of the water would be preferable. It is however/
however not easy to sufficiently treat but not over-
chlorinate the water in a vat whose supply is inter-
mittent and irregular.

In rural areas rain water collected in small
quantities is still the best quality of water obtain-
able. It is rapidly used up in dry weather and
favours mosquito breeding. The country people, far
from thinking the larvae harmful, regard them as
desirable evidence of the water's purity, or even as
active purifying agents.

Deep Well Water.

The droughts which occur from time to time have
compelled the Government to consider sources of water
supply not immediately dependent upon rainfall.
Accordingly a number of well borings have been sunk
at different times.

Somewhat varying success has attended these
efforts, but to-day there are a number of wells still
flowing and giving plentiful good water.

Silting up of the tube has been a fruitful source
of trouble and sometimes efforts to clean out the
silt have ended in disaster for the water in the
ground at comparatively shallow depths has a serious
corrosive action on the casing. In one case at least
the cleaning tube passed through the casing.

In/
In a recent report by Mr Beeby Thomson, it was recommended that grouting with concrete should be carried out round the upper part of the casing, but there is some doubt if grouting to a sufficient depth is an engineering possibility.

So far as corrosion and perforation of the well tube is concerned, it would be possible to prolong the life of a well by sinking eight inch casing in the first place and passing one of six inch bore within it in case of need.

No two of the existing wells give identical analyses but they are all very similar and that at Nabaclis, East Coast, Demerara, may be taken as a sample. This well has been chosen because a generous though anonymous donor of £1000 has made it possible to treat the water and distribute it throughout the village.

The troublesome factor in all deep wells in this colony is the presence of iron in the water, rendering the taste disagreeable, staining clothes and sometimes deranging digestion.

The analysis of Nabaclis well water by the Government Analyst before and after treatment is quoted:

Samples/
Samples taken by the Government Medical Officer of Health and the Director of Science and Agriculture on 9th December, 1921.

---

**Elements and Ions.**

<table>
<thead>
<tr>
<th>Elements</th>
<th>Parts per 100,000 of Water</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Water flowing from casing.</td>
</tr>
<tr>
<td>Iron</td>
<td>.56</td>
</tr>
<tr>
<td>Calcium</td>
<td>.55</td>
</tr>
<tr>
<td>Magnesium</td>
<td>.56</td>
</tr>
<tr>
<td>Sodium with traces of potassium</td>
<td>2.67</td>
</tr>
<tr>
<td>Chlorine</td>
<td>1.84</td>
</tr>
<tr>
<td>Sulphate ion</td>
<td>.08</td>
</tr>
<tr>
<td>Nitrous ion</td>
<td>.007</td>
</tr>
<tr>
<td>Silicate ion</td>
<td>.95</td>
</tr>
<tr>
<td>Carbonate ion</td>
<td>3.96</td>
</tr>
<tr>
<td></td>
<td><strong>11.157</strong></td>
</tr>
</tbody>
</table>

**Sanitary Examination.**

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Parts per 100,000 of Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissolved oxygen, percent of possible.</td>
<td>58.2</td>
</tr>
<tr>
<td>Relative proportion of free carbonic acid in solution.</td>
<td>100</td>
</tr>
<tr>
<td>Oxygen absorbed from acid potassium permanganate at 82°F.</td>
<td>Parts per 100,000 of water.</td>
</tr>
<tr>
<td>In 3 minutes</td>
<td>.08</td>
</tr>
<tr>
<td>In 4 hours</td>
<td>.15</td>
</tr>
<tr>
<td>Free Ammonia</td>
<td>less than .001</td>
</tr>
<tr>
<td>Albuminoid ammonia</td>
<td>.001</td>
</tr>
<tr>
<td>Nitrogen in nitrates</td>
<td>.002</td>
</tr>
</tbody>
</table>

The water of the Nabaclis water-supply scheme, as delivered from the main, is brilliantly clear, colourless, tasteless and odourless; it is well aerated and palatable; while it exceeds in purity that of any other water-supply known to me in the West Indian Islands or in British Guiana. It is quite free from iron, while the origin of the water from aquifers, 770 to 850 feet below the surface of the ground, ensures its freedom from all organic pollution.

24th December, 1921. (Sgd.) J.B. HARRISON.
The water rises in the casing to a height of four feet above ground and issues through perforations in the tube into wooden trays from each of which it splashes to the tray below, and finally on to an inclined plane provided with baffles and large stones.

During this stage free aeration takes place and ferrous iron is converted into insoluble ferric salts which are deposited. From the inclined plane the water falls on to a concrete plate and flows gently on to the surface of an ordinary sand filter, passing through into a storage reservoir and leaving all the insoluble iron on the sand surface. From the reservoir mains are led throughout the village and pumps are provided at intervals. In such a country as this it is useless to provide a pressure supply of good water with draw taps. Spring taps would be broken and others would be left running. Even the stoutest pumps get smashed.

In this installation the well casing was tapped just above ground level and a pipe was led to the under surface of the filter so that by shutting the cock leading from the filter to the tank and opening that on the by-pass, a flow of water could be directed upward through the filtering materials. In practice this was a failure. Sufficient pressure for effective cleaning was not obtained and the admission of iron-containing water to the deeper layers/
layers of the filter defeated the ends of the plant. The writer has found that by limiting the water flowing on to the filter to that required for the village supply, no undue deposit of iron occurs on the sand, nor does the iron penetrate to any serious extent.

Only a few wells project their water to a height readily permitting of free aeration without the use of power, but a well at Lichfield, West Coast, Berbice, has recently been treated by a modification of the Nabaclis method designed by Messrs Pudsey & Whittaker of the Public Works Department, in conjunction with the writer.

At Lichfield only a small head was available, and to make the plant compact the aeration device and the filter were constructed around the well casing. The water falls in a thin circular curtain on to a concrete splash ring and then in a finely divided state on to the filter. When the tank is full, excess water passes away from the filter surface and in practice carries with it much of the flocculent precipitate. The amount of water being treated is limited by a by pass.

Analysis after treatment shows only a negligible quantity of iron.

The Nabaclis plant is illustrated by photographs and plans.

One sugar estate, whose well just brings its water/
water to the surface, has for long been pumping the water to a storage tank by windmill. The manager readily accepted a hint that he might do more, and with the help of the estate chemist put into use an aeration and filtration plant and the treated water is now piped all over the coolies' yards to their great satisfaction. Aeration in this case is by percolation through a perforated drum filled with charcoal and freely exposed to the wind, and results are excellent.

It has been suggested by members of the Government and by the daily press that one well might serve more than one village, the purified water being carried by pipes. This is an attractive idea but the cost of piping is such that it is cheaper to provide a new well and treatment plant than to lay pipes for more than three quarters of a mile.

While analysis of the water from the Nabaclis mains showed no iron at first, it must be admitted that small amounts of iron came through after some months of working. The filter was dug out and renewed and the amount of water treated was restricted to actual needs and analysis now shows only a negligible amount of iron, Bacillus coli absent and total organisms less than 100 per cc.

There can be no doubt that deep wells so treated afford the most satisfactory means of water supply for all villages of the colony save the smallest.
Distribution of water throughout each district can well await more prosperous times. People are the more willing to go some distance to fetch their water since the well, like the parish pump, becomes a convenient centre for the exchange of gossip.

**Shallow Well Water.**

There are very few shallow wells in the colony. The heavy clay soil found throughout most of the inhabited parts does not yield sufficient water to make such wells useful. On the sand reefs of the Essequibo coast there are a few wells made by sinking three or four 40 gallon casks and from these fairly clear water is obtained which is open to the objections usually levelled at such sources of supply.

When such wells as the above are possible there would appear to be an opportunity to employ the Abyssinian tube well with success. A few such have been used on the sandy parts of the Corentqui coast and owing to their cheapness and portability they merit a trial in the scheme for village water supply shortly to be placed before the legislature.

**Bush water.**

By this term is meant the brown peaty water which flows in most creeks and rivers, and which collects in the conservancy behind the empoldered lands and in wet seasons covers a very large area of
of savannah country.

This class of water is by far the most commonly used for domestic purposes in country districts and it is the water which without treatment is pumped through the mains of Georgetown. In colour this water varies from dark brown to pale sherry, and it is well known that certain creeks have much darker water than others.

Besides the peaty matter in suspension and in solution this water contains ferrous iron. In the savannah and creeks, in the conservancy and distant parts of the service canals the bush water is very free from animal pollution. Human beings are very scarce and scattered in the catchment area and faecal organisms are generally absent from 10 cc. of water. In the lower reaches of the canals where they pass through sugar estates and villages and are used for navigation, the animal contamination is greatly increased.

It is specially noteworthy, though not affecting directly the rural areas under review, that the canal supplying the Georgetown waterworks is remarkably pure up to the point where it enters the municipal boundaries and thereafter shows greatly increased chemical impurities. The increase of impurities cannot be fully accounted for by dust, road washings or other contamination/
contamination inseparable from the passing of an open canal through a city, for the canal is very well protected and not open to gross pollution. Rather must an explanation be sought in the fact that the portion of the canal within the city has never been dredged out since its construction, and all water passing through comes in contact with the deposited impurities of former times. The purer part of the canal outside the city boundary is regularly dredged.

Further pollution occurs before the water reaches the houses via the pumping station and mains, the water as it arrives at the taps being really unfit for any purpose save flushing lavatories. Even this use causes unsightly staining of white porcelain. The piped supply is used for bathing throughout the poorer parts of the city, and a good deal even in the best quarters. There are many people who find the brown water irritating to the skin even when finally washed off with rain water.

In Georgetown and even more widely, the bush water is called Lamaha water from the name of one of the contributing creeks. It is both plumbo-solvent and ferro-solvent and deposits much vegetable matter in pipes, causing considerable obstruction.

As outlined in the early part of this thesis, the supply of bush water to the villages is by open canals often used for navigation purposes. Generally one/
one or two of such canals run straight through each village, but occasionally off-shoot trenches are dug so that sweet water is more widely distributed. Sometimes the main sweet water canals have blind ends and the water is them stagnates. More commonly however a "blow off" sluice is provided so that where water is plentiful the supply may be changed from time to time. Only in rare instances is any attempt made at protection from the grossest pollution in the villages, and it is common to see pigs pass directly from scavenging in a privy to swim in the sweet water canal.

On the sugar plantation bush water is the general supply. The main sweet water trenches are, however, always provided with a "blow off" and the water is regularly changed. Some estates have a regular system of running a large quantity of water through the supply trenches and then damming them off so that purification by settling may take place and no further contamination from the navigation canal occurs. This process is repeated at intervals. A somewhat crude method it is true, but with careful banking of the storage trench and fencing to exclude animals, capable of yielding a very fair water. A B. Coli count of nil in 6 cc. has been obtained from such a fresh water trench. (Wise)
In 67 analyses made of bush water from village and plantation supply trenches Wise & Minett found as follows:

<table>
<thead>
<tr>
<th>Total organisms in 1 cc.</th>
<th>Overgrown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below 1000</td>
<td>1000-5000</td>
</tr>
<tr>
<td>17</td>
<td>39</td>
</tr>
<tr>
<td>Above 5000</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Faecal organisms in 1 cc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absent</td>
</tr>
<tr>
<td>from 1 cc.</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>1-10 per cc.</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>10-100 per cc.</td>
</tr>
<tr>
<td>31</td>
</tr>
<tr>
<td>100-1000 per cc.</td>
</tr>
<tr>
<td>14</td>
</tr>
<tr>
<td>1000-10000 per cc.</td>
</tr>
<tr>
<td>12</td>
</tr>
</tbody>
</table>

Repeated chemical examinations of the peaty waters of this colony have made it clear that to apply the chemical standards employed at home would be very misleading as to the value or danger of any particular supply. The enormous amount of vegetable material present in the bush water makes it impossible to apply as a test any arbitrary figure for the Ammonias, more especially for the Albuminoid Ammonia. The high figures for Ammonia obtained when faecal contamination can be excluded make it difficult to detect by this means any subsequent excremental pollution unless of the grossest character. The Ammonia figures fall after the original water has stood for some time and got rid of some vegetable matter, and a rise would follow either from animal pollution or from the addition of new unpolluted water which has not stood.

Indication/
Indication of sewage pollution may be had from the chlorine figures and from that for phosphates when such are above those prevailing in the district.

Oxidised nitrogen is very scarce even when survey upon the spot and bacteriological analysis prove faecal contamination, and the invariable presence of ferrous iron must be remembered in this connection. Wise & Minett have suggested that under the influence of sunlight it is possible that denitrifying organisms may reduce nitrites and nitrates. Whether or not this be so, the very large number of examinations made by the same observers show that in the peaty waters of this colony oxidation of sewage matter to nitrites or nitrates seldom if ever occurs to any great extent.

The quantity of phosphates present in bush water may afford some indication as to pollution. Only the minutest traces are found in the original water and any increase means either animal contamination or the access of surface water from cultivated land.

Microscopic examination of the deposit after centrifugalising the bush water near its source shows nothing of importance from the health standpoint. If the water taken from village trenches is examined, animal hair, protozoa and the ova of parasitic worms are found.

From time to time attention has been given to the question of pure water for villagers, but up to/
to the present day bush water such as has been described is the main source of supply to the population outside Georgetown.

Indeed there exists a definite prejudice, more especially among the East Indians, in favour of water of a brownish tint. Long before 1880 attempts were made in the Colony to clarify creek water, and the earliest practice of anything of the sort seems to have been the use of alum and wood ashes by laundresses when rain water was scarce.

Francis, a former Director of Science and Agriculture found that the colour could not be removed by simple filtration either mechanical or by gravity, and that charcoal, spongy iron and magnetic oxide of iron would remove the colour, but very quickly became clogged and then decolourisation ceased.

Francis on 5th Aug. 1880 reported to the then Governor on a process of employing 2,143 lbs. of potash alum and 1857 lbs of washing soda to each million gallons of Lamaha water, estimating the cost at £12: 1: 9½.

The same writer's annual report for 1881 describes experiments with Alumino-Ferric cake, calculating that by using that material along with crude carbonate of soda the cost for clarifying 1 million gallons of Lamaha water could be reduced to £5: 16/-.

In/
In Timehri, Vol. II, 1883, Francis showed that the brown colouring was due to what he called "humous" bodies in solution, the chief being a brown acid substance soluble in alkalies and precipitated by acids. He also noted that the mere application of heat or the passage of a galvanic current did not precipitate these substances while several months of mere standing exposed to light brought down a brown flocculent matter.

In the same report Francis showed that the colouring matter could be completely separated from the water by means of acetate of lead, hydrate of iron, or of alumina.

Later experiments showed that by using lime in place of soda with alum, the cost per million gallons came down to £3: 4: 7.

For some years nothing further appears to have been done about this subject, but in 1892 Sir John Harrison the present Director of Science and Agriculture along with a collaborator now deceased, found that materials capable of acting as carriers of oxygen to the ferrous iron and organic matters of bush water acted as good decolourising agents, producing a water of a high degree of chemical purity. In laboratory experiments manganese dioxide operated perfectly and retained its efficiency very long if exposed at intervals to the air while damp. High cost however prevented/
prevented large scale usage. Polarite was also found to be effective.

About 1895 experiments were made with the process of passing the water through a cylinder filled with scrap iron. While the process was fairly successful with water containing small quantities of vegetable matter in colloidal solution, the quantities in the average bush water are too great for satisfactory removal by this means.

The employment of Potassium Permanganate and Manganese Chloride in the presence of an alkali (lime) was experimented with on one sugar estate in 1897. A voluminous precipitate was produced but complete clarification of bush water was not achieved.

The severe drought of 1899 focussed attention on rural water supplies once more, and use was made of Alumino Ferric cake with lime. This drought however forcibly brought home the fact that in times of very deficient rainfall the real problem in this Colony is the supply of sufficient water, and not the treatment of any existing supply. This was the position when the Mortality Commission of 1905 considered the question and reported as follows: "Para 114. We recommend that in districts where it is not feasible to store sufficient supplies of unpolluted rain water or to obtain properly conserved creek or river water, wells should be sunk either to tap deep-seated supplies/
supplies of organically uncontaminated water or preferably artesian flows of water derived from the higher lands of the colony."

Attention was thus directed to the question of obtaining potable water from below ground, but not until 1913 did there follow the sinking of the wells now existing, whose characters have been described.

Bush water still continued to command attention. In 1909 the Government Analyst found that very small quantities of Iron Perchloride added to the brown water resulted in the rapid rendering insoluble and throwing down of the colouring matter, and it was noted that the best results were obtained when the water remained very faintly acid after the precipitation.

In the intense drought of 1911 and early 1912 Minett employed Ammonia Alum and subsequent chlorination for the treatment of Lamaha water with which he filled the depleted rain water vats and tanks. In these covered receptacles the process was successful, but when tried upon trenches and ponds the sulphate of ammonia produced an amazing growth of green algae.

This drought quickened the interest in wells and with the obtaining of water from underground sources less attention was given to bush water.

Soon/
Soon after his arrival the present Governor of the Colony called for a report upon Drainage, Irrigation and Water supply on the coast lands and in connection with the last a pure water supply committee was appointed consisting of Sir John Harrison, Director of Science and Agriculture, Mr. J. Pudsey, Director of Public Works, and the writer.

The low state of the colony's finances and especially the inability of small communities to raise funds caused the Committee to consider very carefully the question of comparative cost of any recommendation they might wish to make. Having regard to the high cost of well-boring, the possibility of failure to find water, the necessity for plant to remove iron from the water when found, and the very high cost both initial and for maintenance of any distribution the Committee gave further consideration to the bush water which is obtainable and well distributed in so many villages.

New experiments have been made by Sir John Harrison and we soon found that the higher price of Iron-Perchloride than that of Aluminium sulphate was offset by the much smaller quantity of the former salt required, and the time required for complete precipitation was much less. Another advantage from the standpoint of wholesale use is the much smaller amount of sludge produced by the iron salt. Comparative results are as follows:-
Wet sludge as deposited in water.

Aluminium Sulphate
(Alumino ferric & lime) 125 parts per 10,000 by vol.

Ferric chloride, minimum amount found effectual. 52 " " 

Do. medium amount found effectual. 65 " " 

Do. highest amount required. 68 " " 

Do. excess. 68 " " 

Lamaha water purified in this way is brilliantly clear, palatable, without taste of iron, and no iron is detectable by sulpto-cyanide. The precipitate is such as to entangle and carry down the great majority, if not all, of the organisms present.

This method has therefore been gone into fully, and a series of experiments arranged so that the most effective method possible might be arrived at.

It was reported in the Colony that samples of Lamaha water sent to England had been effectively treated at the London School of Tropical Medicine by means of lime. It is possible that the method employed at the L.S.T.M. has been incorrectly reported, but Lamaha water treated here, as said to have been treated in London, though admirable in appearance is anything/
anything but potable, tasting very strongly of lime. Such water after transference to England in bottles would in any case afford no real criteria by which to judge of treatment when fresh.

The amount of lime stated to have been used in London was .05%.

Further experiments with lime have been performed here and .035% have been found to be the minimum amount which will clarify the water, but even then the taste of lime persists.

The lime can be removed by a current of CO₂ and a potable water results, but the cost and complications rule out the method for large scale use.

To return to the working out of the Ferric Chloride method, Sir John Harrison found that the bulk of sludge is by this process 75% less than using aluminium sulphate but that unless very skilfully conducted the method leaves a trace of iron in the water. This can be removed by addition of a minute amount of alkali, but then a trace of colouring matter passes back into solution. This defect may be remedied by passing the decolourised water through polarite or a similar filtering medium, or secondly by adding a small amount of finely divided calcium carbonate (chalk).

A more efficient and more practicable method has been found by Harrison to be the use of a mixture of ferric chloride with a very small proportion of aluminium/
aluminium sulphate followed by the addition of calcium carbonate. The sediment by this method is 78% less in volume than that obtained by aluminium sulphate alone.

The cost of the ferric chloride method (at present wholesale prices) varies from 12 - 15 cents per 10,000 gallons of bush water according to the amount of vegetable matter present, while the approximate cost of materials in the aluminium sulphate method is 50 cents per 10,000 gallons of water.

Practical details for larger scale application of these methods still form the subject of research by the committee.

On visiting an out of the way village (Mocha) on the east bank of the Demerara river, the writer was greatly struck by the fact that the water in trenches, save where actually muddy, was quite colourless. Enquiries among the villagers elicited the statement that they do not use this "white" water because it is "sour" and that they are accustomed to walk some distance to the brown water canal.

On discussion with Sir John Harrison it appeared that he had observed this colourless water near Peter's Hall, a few miles from Mocha, and attributed the people's dislike to the presence of magnesia.

Sir John kindly analysed a sample of the Mocha water/
water for me and reported the presence of considerable quantities of the salts of both magnesium and aluminium.

The members of the Pure Water Supply Committee are agreed that the most satisfactory water supply for the main centres of population on the coast lands will be obtained by sinking an artesian well in every place of any size, the storage of rain water in places of three hundred inhabitants or less, and possibly in certain other small places a plant for purification of bush water.

It seems likely however that the knowledge now gained as to methods of clarification may be of great service when the time is ripe to put forward plans for the supply of purified water to Georgetown.

The Colonial Government has adopted the Water Supply Scheme which has been put forward and has voted funds to carry it out.
Plantation hospital showing old boilers etc. for storage of rain water.
Artesian Well at Nabaclis. Water is aerated by pouring over trays. Note by pass cock referred to in text.
Nabaclis artesian well, showing inclined plane with baffles on which aeration is completed and much deposition of iron takes place. Filter is under wooden cover in foreground.
One of the pumps by means of which the purified water is drawn.