

# Health Survey of the Gilbert and Ellice Islands

WITH SPECIAL REFERENCE TO HOOKWORM INFECTION.

---

BY S. M. LAMBERT, M.D., OF THE INTERNATIONAL HEALTH BOARD OF THE  
ROCKEFELLER FOUNDATION.

---

## TABLE OF CONTENTS.

	PAGE
INTRODUCTION .. .. .	2
PART I.—GENERAL SURVEY—	
1. Early History .. .. .	2
2. Modern History .. .. .	3
3. Physical Features .. .. .	4
4. Population and Customs .. .. .	4
5. Government .. .. .	5
6. Education .. .. .	5
7. Industries .. .. .	6
8. Transport and Communication .. .. .	6
9. Economic Life .. .. .	6
PART II.—PUBLIC HEALTH ACTIVITIES—	
1. Medical Department .. .. .	6
2. Public Hygiene .. .. .	6
3. Water Supply .. .. .	7
4. Milk Supply .. .. .	7
5. Vital Statistics .. .. .	8
6. Transmissible Diseases .. .. .	8
PART III.—HOOKWORM INFECTION SURVEY—	
1. History of Hookworm Disease in the Gilbert and Ellice Islands .. .. .	9
2. Methods employed in present Survey- .. .. .	9
3. Technique of Examination .. .. .	9
4. Degree and Distribution of Hookworm Infection .. .. .	9
5. Infection by Age .. .. .	10
6. Infection by Sex .. .. .	10
7. Severity of Infection as shown by Hemoglobin Index .. .. .	10
8. Degree of Infection as shown by Worm Count .. .. .	11
9. Infection with Parasites other than Hookworm .. .. .	11
PART IV.—CONCLUSION AND DISCUSSION .. .. .	
	11



# HEALTH SURVEY OF THE GILBERT AND ELLICE ISLANDS

## WITH SPECIAL REFERENCE TO HOOKWORM INFECTION.

### INTRODUCTION.

IN 1923, Sir Cecil Hunter Rodwell, K.C.M.G., High Commissioner for the Western Pacific, extended an invitation to the International Health Board to make a health survey of the Gilbert and Ellice Islands with special reference to hookworm infection. This is the third of the High Commission Groups to be surveyed in this manner under the comprehensive plan inaugurated by him. In February, 1924, the Board representative was given the opportunity to join the Government yacht "Pioneer" which was taking the Resident Commissioner through the Colony. We left Fiji on 17th February and returned to Suva on 18th April, a trip of sixty-one days covering 6,500 miles, crossing the equator six times and passing through portions of the Northern, Southern, Eastern, and Western Hemispheres. This is the only possible way that such a survey could be made with the present means of communication unless a year or more were taken, and the work while naturally hurried yet represents, I believe, a fairly accurate picture of health conditions, and little would be gained by the greater outlay of time except in establishing the extent of Filariasis in the Gilberts. The survey had the advantage of the escort of Mr. Arthur Grimble, the Acting Resident Commissioner of the Groups and the authority on Gilbertese anthropology. The section on early history is Mr. Grimble's. Experience in the Gilberts and in the Solomons confirms the impression that administrative officers of a native race and missionaries to them should have a knowledge of the basic principles of anthropology.

We thank His Excellency Sir Cecil Rodwell, for extending us the ample facilities for making the survey, and His Excellency the Acting High Commissioner, the Honourable T. E. Fell, C.M.G., who so kindly arranged for our departure in the absence of Sir Cecil Rodwell on leave. Great thanks are due to the officers of the Colony who so kindly placed every means at the disposal of the survey for its success. We especially thank Captain Macfarlane and Doctor E. C. Gould of the British Phosphate Commission for their entertainment and assistance at Ocean Island.

The party consisted of the writer, who had with him Malakai Veisamasama, graduate native medical practitioner, who is an expert microscopist, and a Fijian assistant.

### PART I.—GENERAL SURVEY.

1. *Early History.*—According to the evidence of tradition, which is to a great extent substantiated by an examination of the social organisation, there formerly lived in the Gilbert Islands (and probably also in the Marshalls to the north and the Ellice Group to the south) a small black-skinned, large-eared, flat-nosed race, much addicted to magic, whose society was divided into exogamous moieties, and whose system of descent was matrilineal. The deities of this people seem to have been the spider and the turtle; they also appear to have conserved some socio-religious memories of a creature called Te Kekenu, which, from its description as "a lizard as long as two men," was probably a crocodile or other saurian.

It is impossible to say when the peace of these people was first disturbed by invaders, or how long they had been in occupation before that epoch. But it is certain that in very early times they were overrun by an immigrant folk that came from the west. The physical type of the immigrants was utterly different from that of the autochthones. They were of great stature, red-skinned (*i.e.*, light-brown), with bushy hair standing high on the head and curled at the ends. They seem to have been tremendous fighters, but in their struggle with the spider folk were handicapped by their ignorance and horror of magic. They practised the cult of the ancestor, in conjunction with the preservation of skulls; had probably been kava drinkers; and possessed a social organisation based upon totemic, exogamous clans, in which descent was patrilineal. That they were essentially a marine race, may be gathered from the constant commentary of tradition and song, which call them variously "Children of the Sea," "Fierce Fish of the West," and "Fighting Sea-birds." They came from Bouro, Gilolo, Ceram, S. Celebes and other islands by the Macassar Passage.

That these invaders did not, in such small islands as the Gilberts, utterly annihilate the dark-skinned and puny autochthones is a matter of surprise, until two points are considered: first, their horror of the indigenous sorcery probably to a great extent discounted their superiority in war; and secondly, it is extremely likely that, like the majority of migrant races in Oceania, they brought no women with them, and so had to take wives from among the spider-folk. In the fusion of religious beliefs, and the modifications of social organisation that followed the immigration and settlement, it is certain that the matrilineal spider-folk left many traces of their system embedded in that of the patrilineal invaders.



Of the brown-skinned sea-folk that came from the west it seems that only a fraction stayed to win a foothold in the Gilberts; the majority of what must have been a mighty swarm turned southwards down the chain of islands, sailed coastwise through the Ellice Group, took Rotuma in its stride, and pushed forward to Savaii and Upolu of Samoa. This is not an imaginary itinerary. It is shown by the evidence of tradition and genealogy.

The invasion of Samoa by a migrant swarm from the north, in the manner indicated, has an important bearing upon the history of race movements in Nuclear Polynesia. Fornander and Percy Smith have shown that great immigrations into Samoa and the neighbouring groups came out of the West by way of the large Melanesian islands, leaving colonies of Polynesian speech or type settled upon the fringes of Melanesia. Churchill, arguing upon philological data, has supported this theory, but has left on record a surmise that people of Polynesian type also impinged upon Samoa from the north. Thilenius disbelieves in the western migration track, and without furnishing his reasons decides upon a northerly route. Rivers shows conclusively that races having a kava-culture must have traversed Melanesia, to arrive ultimately in Polynesia; there can therefore be very little doubt about the western stream. But the Gilbertese evidence very roundly substantiates the American and German conjectures that there was also an important movement along the Micronesian islands.

In Samoa the invaders from the Gilberts remained for many years. Genealogical evidence of that period is too scanty to estimate the length of their occupation; but it must have been considerable, for the immigrant people, while retaining the memory of the migration-track, nevertheless built up for themselves a tradition which arrogated to Samoa the honour of being the "Navel of the World," and stigmatised as ghosts and slaves all races living beyond the confines of Upolu and Savaii.

Nevertheless, during this period of settlement, there seems to have been a considerable amount of intercourse between the Samoan immigrants and their kinsmen in the Gilberts. Canoe voyages between the two places are described in detail by tradition.

Then came the cataclysm. In the language of tradition, "The Tree of Samoa, the Ancestor, was broken, and its people were scattered over the islands of the sea." In other words, the immigrants were driven out of Samoa. We cannot tell the reasons of the catastrophe, for just as the Rarotongans and Maoris attribute the expulsion of their ancestors from Hawaiki (Savaii) to "internal dissensions," so the Gilbertese euphemistically refer to the flight from Samoa as the result of a "family quarrel." What we do know is, that the flight took place between twenty-four and twenty-eight generations ago, and that a great horde of fugitives came back northwards along the old migration track, and fought for a foothold in the Gilberts, where their ancestral kin had settled on the southward course, so many centuries before.

The number of generations given agrees with the tally kept by the Rarotongans, and again with that of the Maoris, since the flight of their respective ancestors from Savaii. Furthermore, the three races: Gilbertese, Maori, and Rarotongan, claim as ancestors in Samoa persons of exactly the same name, and attribute to them exactly the same exploits. And lastly, we have it from Samoan tradition that, twenty-five generations ago, an invading race called the Tongafiti, after many years of oppression, was driven out of Samoa by the national chieftain Savea, the first Malietoa, thus freeing the island from bondage.

From the above summary of tradition, it may, I think, be fairly conjectured: (a) that the last immigrants into New Zealand, Rarotonga, and the Gilbert Islands belonged to the same fugitive race; (b) that this race was the so-called Tongafiti folk driven out of Samoa by Savea; (c) that the Tongafiti came into Nuclear Polynesia not only by a western route, but also by a northern route that touched the Gilbert Islands.

Regarding the matter now from a local viewpoint, it may be said that the Gilbertese type is the product: (a) of the fusion of black-skinned autochthones with a large-bodied, fair-skinned people from the west; and (b) of a later reflux from Samoa of the fair-skinned race upon this hybrid type.

To summarise, in the Gilbert and Ellice Groups are to be found two separate and distinct races. First, the Gilbertese, a Melano-Polynesian stock as indicated above, and second the Ellice race who are typically Polynesian, and have a physique, a language, and a social organisation differing entirely from the Gilbertese. Until seventeen generations ago, it is probable that the Melano-Polynesian race occupied both groups. But then the Ellice Islands were struck by a fresh invasion, or series of invasions. This time, it was the Samoans themselves who were the aggressors. Having driven out the Tongafiti invader, they now began to expend, with the result that they cleared the Ellice Islands (and probably also the Unions) of their ancient enemy, who retired northward to the Gilberts, leaving the Samoan stock in possession. This accounts for the differences of population that exists between the Gilbert and Ellice Islands.

2. *Modern History.*—Captain Byron discovered the easternmost of the Gilberts in 1765. The northern islands were discovered by Captains Gilbert and Marshall in 1788, and by 1824 the whole group had become known. Stevenson has written some of his most stirring stories and travel essays about the islands of this group. Mendana is supposed to have first sighted one of the Ellices in 1567, but authentic information begins with Maurelle's discovery of Nanomea in 1781. Captain Porter discovered Funafuti in 1819. In later years Duperre, Chiamtschenke, and Wilkes completed the exploration. From that time on the islands were increasingly visited by whalers and traders.

The Gilbert and Ellice Islands Colony comprises Ocean Island, the headquarters of the Colony as well as the headquarters of the British Phosphate Commission, the islands of the Gilbert Group, the islands of the Ellice Group, the islands of the Union or Tokelau Group, and



the islands of Fanning, Christmas, and Washington. The Gilbert and Ellice Group came under British protection in 1892 and were incorporated into the Empire. They became a Colony by His Majesty's Order in Council of 10th November, 1915, which came into operation on 12th January, 1916. Ocean Island, Fanning and Washington Islands were included in the boundaries of the Colony from 3rd April, 1916. Christmas Island came into the Colony on 10th November, 1919. Fanning, Washington, and Christmas are remote and of no interest in this survey. The Union Group we were unable to visit.

3. *Physical Features.*—The Gilbert Islands are cut by the equator and the 175 meridian of east longitude. They consist of the islands of Butaritari, Makin, Marakei, Abaian, Tarawa, Maiana, Abemama, Aranuka, Kuria, Nonuti, Tabiteuea, Beru, Nukunau, Onotea, Tamana, Arorae, with a number of smaller islands dependent. The group is one of the most remarkable of the Pacific archipelagos, the islands are so small, their total area being not more than 170 square miles, and the hard coral rock being covered with about eight feet of hard sand and a scant soil so that scarcely anything can be grown. And yet some of these barren islets are more densely populated than the most fertile islands in the Pacific.

The rainfall in the Gilberts varies. Butaritari, the most northerly, which is three degrees north, has an abundant rainfall which varies little from 150 inches a year. Then there is a drought belt which extends from one degree north of the line to about three degree south where at intervals of a few years severe droughts prevail. The rainfall of Ocean Island may be taken as typical for this belt:—

*Rainfall Ocean Island.*

1909	..	..	..	..	19 inches
1910	..	..	..	..	28 "
1911	..	..	..	..	141 "
1912	..	..	..	..	136 "
1913	..	..	..	..	77 "
1914	..	..	..	..	154 "
1915	..	..	..	..	80 "
1916	..	..	..	..	14 "
1917	..	..	..	..	16 "
1918	..	..	..	..	100 "
1919	..	..	..	..	174 "

The rainfall disappears in a few hours from these hard coralline islands. The islands of the Gilberts are separated from each other by great stretches of water, none of them is in sight of any other. The southernmost of the Gilberts are separated from the most northern of the Ellices by 300 miles. The Ellices comprise the islands of Nanomea, Nanomaga, Nunitao, Nukulaelae, Vaitupu, Nui, Nukufetau, Funafuti, and Nurakita. They differ from the Gilberts only in the fact that they have a greater amount of soil and consequently are more fertile with a greater supply and variety of foodstuffs. The rainfall is abundant. The temperature is subject to few variations ranging between 78 and 80, on rare occasions falling to 68 or rising to 95.

The Gilbert and Ellice Islands are mostly atolls, being narrow strips of land from a few yards to half a mile wide and enclosing a lagoon, which may be ten to twenty miles in length. Many of these lagoons have navigable entrances. Possibly nothing gives a more lasting impression on the mind of beauty and peace and freedom from all care than these islets. Here is all the romantic atmosphere that Stevenson has taught us to see—the blue lagoon with its waving crest of palms, the lighter and varying colours that deepen in tone over the fringing reef to the great depths of the Pacific. But for its remoteness, this would be the mecca of the beach-comber.

4. *Population and Customs.*—The Gilbertese men average about five feet seven inches with women smaller in proportion. The average chest measurement is about forty inches. They are fine upstanding men with no superfluous fat. Their skin is a dark to medium copper colour a few shades darker than the typical Polynesian of the Ellices. Their hair is from straight to a stiff crinkly character reminding one of the Melanesian strain in their blood. The Ellice islanders are a bigger finer physical type though not so active. The Ellice islander has the straight hair of the Polynesian. The nose of the Gilbertese has a tendency towards the flattening reminiscent of the Melanesian. The nose of the Ellice islander is more aquiline. The eyes of both races have a slight slant upward at the outer corners. The lips are fairly thick and fairly full, this being especially noticeable among the Gilbertese, where it becomes at times almost negroid.

The population of the Gilberts is about 28,000, while that of the Ellices is only 3,000, a very small number when compared with the swarms on the islands of their neighbours. The manner in which South Sea populations are sometimes affected by immigration is illustrated by the following:—A man named O'Brien deserted from a black-birding ship and falling in love with a maiden of Funafuti constituted himself the protector of the island. He had a large family who in turn had numerous progeny. To-day 54 of the 230 residents of Funafuti and some on other islands proudly bear the name of O'Brien. They all have high cheek-bones and other Hibernian features of the original ancestor.

*Dress.*—The pre-white dress of the native women was the short grass skirt, the riri. The men wore only the mat about the hips. Now the men wear singlet and lava-lava and the women that aesthetic and hygienic abomination of the Pacific, the Mother Hubbard. This clothing which is not suited to the people either by climate or custom, is responsible for the spread of diseases by contact and also by the fact that since their adoption the native is losing his habit of bathing and oiling his body daily because his dirt is covered by his clothes.



*Houses.*—The original house of the Gilbertese was simply a thatched roof resting on four corner posts so low that the eaves touched the ground, which was covered with shingle from the beach and mats over the shingle. These buildings were clustered in random groups in the bush, each cluster to a clan. With Government control houses were collected into ordered villages along the lagoon shores. These houses were built on an improved plan with eaves some six feet from the ground; they have open sides and raised floors of coconut midribs. Attached to each of these sleeping houses is a cook and eating house, a store house, and a bathing shed. There must be a space four fathoms long between each building. At Funafuti the floors are concreted and easy to clean but at the other Ellices the floors are of coral shingle and impossible to clean. They must be prolific of disease and should be altered to the style of the Funafuti houses or to those of the Gilberts.

*Religion.*—The whole of the Gilbertese life was dominated by the fear of and practice of magic. On the contrary the Polynesian Ellicè islander did not practice magic but observed the ancestral cult which is religious in type. They both believed in a life after death, the Gilbertese soul returning to the ancestral land, that of the Ellice man mounting to a last home in the skies. Modernly two-thirds of the Gilbertese and all the Ellice islanders are nominal Christians.

*Marriage.*—Both races were polygamists, the underlying principle of marriage being the strong aversion to consanguineous unions. Modernly, no man has more than one wife, but he still practices in secret his ancient right to relations with his concubitants, *i.e.*, the polygamous wives of the pre-Christian days. The standard of morality in the old days was high inasmuch as the natives had a definite code and lived up to it strictly. Almost any infraction of the moral code was punished by death, generally in a terrible form. So that fear held them in the bounds of strict social morality. With the advent of white civilisation and humane ideas of British justice, the death penalty was revoked, and the native being released from his fear of death has fallen away from his high primitive standard of life and has become promiscuous. Not alone has the abolition of the penalty been responsible for this promiscuity, but the endeavour of the civil and religious authorities to enforce monogamy has been an added factor of the decay of continence. For thereby all the ancient and traditional landmarks of sexual morality were uprooted and the native was launched by sudden legislation without suitable preparation by education upon conditions utterly strange to him and with a conscience entirely unfitted to grapple with the problems that arose. Since the advent of the white man much of his education in the new morality has been received from the beach-comber and the whaler with the result that in the Central Gilberts vices prevail which are known only to the most effete civilizations. These practices are said to be spreading to the other Gilberts and to the Ellices.

*Canoes.*—No account of the Gilberts would be complete without a description of their canoes. The most fascinating theme of anthropology is the migration of the Polynesians. It has been said that the Gilberts are the neck of the bottle through which these migrations or an important part of them poured south. The most difficult part of these migrations to understand is the manner of vessel that carried these wandering multitudes over thousands of miles of strange seas. We know that they navigated by the stars. To-day in the Gilberts the problem is made clear. There has been a revival of canoe building in two or three islands. On the island of Tabiteuea I saw a canoe building 108 feet long and 8 feet beam, with a proportionate outrigger. I saw just launched a canoe 90 feet long which was carrying 93 people and had three sails. These are used to carry whole villages to a distance for communal work. I would have no hesitancy in starting for any place on the globe in one of these provided I knew navigation. Smaller canoes are built for fishing and for racing. The speed they attain is incredible to one who has not seen. They can go at 14 to 18 knots under favourable conditions and can steer closer to the wind than any European-made sailing craft. The exhilaration of sailing in one of these with a good wind that lifts the outrigger is not comparable to any other form of sport.

5. *Government.*—The Colony is under the administration of His Excellency Sir Cecil Hunter Rodwell, High Commissioner for the Western Pacific, and Governor of Fiji, who resides in Suva, Fiji. The Resident Commissioner for the Colony resides in Ocean Island. There are District Officers located in Butaritari, Tarawa, Tabiteuea North and South, and one at Funafuti. In each island a native magistrate and a chief kauberi are appointed by the Government with a salary. In each village a kauberi or mayor is appointed. Each month these kauberi meet with the magistrate to administer law and justice or formulate new regulations. These people are largely self-governed.

6. *Education.*—There are two systems of education, one under the Missions which is subsidized by the Government if they teach English, and the other entirely supported by the Government.

The Mission schools are the usual Mission schools of Oceania. One in each village and taught by a Samoan preacher in the case of the Protestants and by a lay Brother or a Sister in the case of the Roman Catholics. Most of this instruction is of a semi-religious type and has been the only available education up to the present within the Colony.

The Government schools are a new departure only two years old. There are three of them, one located at Ocean Island, one at Bairiki on the island of Tarawa, and one at Funafuti in the Ellices. These each have a European master. There are in all 180 pupils. The purpose of these schools is to educate boys to fill Government positions and later on it is to be expected that they may be masters of Government village schools.

I made a careful inspection and examination of the school and pupils at the Bairiki establishment which is one of the very best in the Pacific. They are obtaining extraordinary results in this school. Some of these fine boys would make splendid candidates for a training as native medical practitioners and also as teachers in establishing the same system in other groups if the number gets to be more than required in this Colony.



7. *Industries.*—The only agricultural work to be done is in cultivating the babai, a coarse taro, and the coconut, upon which considerable care is expended. Aside from the collection of shark fins for export fishing is confined to food-getting. About 800–1,000 natives are indentured for labour on Fanning Island and Ocean Island. Women are not indentured. Ocean Island is the centre for the British Phosphate Commission which annually exports up to 200,000 tons. The export of copra for the Colony averages 5,000 tons. At least half of the available coconuts are used as food.

8. *Transport and Communication.*—These islands run north and south through 13 degrees of latitude and east and west through 10 degrees of longitude. They are connected at Ocean Island with the outside world by the frequent service of the phosphate ships of the British Phosphate Commission. Through the Gilberts there are the infrequent and irregular trips of the trading schooners of the On Chong and the Burns Philp Companies. The Ellice Islands are in communication with Apia and Sydney at irregular intervals of many months from Funafuti. There have been periods once of fifteen months and once of nine months when there was no communication between Ocean Island and Funafuti. The High Commission plans to send the "Pioneer" each year to the Group for periods of two months for the use of the Colony.

On each island there are good roads made originally under Mission influence throughout the whole island. The wealthier natives have bicycles. The lagoon makes a highway for the excellent canoes of the native. These canoes also maintain communication with neighbouring islands. This inter-island traffic has an element of danger on account of the strong currents that run as much as seven knots at times and which may change their direction frequently. Many lives are lost each year by canoes drifting away. The younger generation of natives has lost the old art of steering by the stars.

9. *Economic Life.*—Both races live a communal life, the social unit being the patrilinear clan, on behalf of which the individual buried his personality. Roughly we may say, that all goods were held in common by the clan. Except during rare periods of prolonged drought food supplies are ample. These islands are not very fertile because they have no natural soil except sand. The only food which it will produce are the coconut, the pandanus, and a species of calladium called the babai in the Gilberts and pulaka in the Ellices. Some of the Ellices are a little more fertile and can produce the *Calladium esculentum*, the true taro. Apart from these the staple food of these people comes from the sea.

One of the peculiar and interesting foods of the Gilberts is "toddy" which is the sweet sap of the coconut spathe. The spathe is cut and bound round and the sap collected in a coconut shell night and morning. When drunk fresh this is a most excellent food for babies being a fair substitute for cow's milk, but when it is allowed to ferment more than a few hours it is a most pernicious intoxicant. From this sap as well is obtained by boiling a most delicious molasses. There are no cows in these groups.

The scarcity of food in the Gilberts and the constant effort on the part of both men and women which is necessary to obtain and prepare it, is one of the great reasons of their resistance to the effects of white civilisation. For these, the Pacific Islands poorest in natural gifts, are alone in having maintained a dense population after years of contact with white men and their customs. The Ellices are richer in soil and in its products, life is less strenuous and here we have the familiar picture of a slowly declining race.

## PART II.—PUBLIC HEALTH ACTIVITIES.

1. *Medical Department.*—The Medical Department is under the direction of a Senior Colonial Medical Officer, a post just now vacant by death. Under him are three native medical practitioners, a senior native medical practitioner and two others. Money is allotted on the budget for one more native medical practitioner. One native medical practitioner is located at Tarawa, one at Funafuti, and one in the Union Group. All three of the present native medical practitioners were educated in the native medical school at Suva, Fiji, and are a credit to their school. They retain to a surprising degree the confidence of the native and European. The work done by one of these men is truly remarkable. In addition there are native dressers to the number of forty-two. They are taught by the native medical practitioner.

There is a central hospital at Tarawa under the charge of the Senior Medical Officer and one on every other small island and two on the larger islands. They are in charge of dressers where there is no native medical practitioner. There are said to be twenty-eight of these island hospitals. They are quite satisfactory for their purpose as regards buildings. There is a central leper hospital on a small island some miles from Tarawa. Here are only a few lepers collected. They are in charge of a dresser. It has been intended to gather them all here but transport has not been available. On each island lepers are isolated but not otherwise cared for.

On Ocean Island, the British Phosphate Commission maintains a modern hospital to care for white and native employees under the administration of Dr. E. C. Gould, who has a Matron, a trained nurse, to assist him. Dr. Gould acts as Government Officer on Ocean Island.

2. *Public Hygiene.*—Soil sanitation reaches a high standard for a native race in the Gilberts. The following account of hygiene and sanitation in the Gilberts written by Mr. Arthur Grimble is most interesting in the light of the intestinal parasitic findings in this group. While the same governmental regulations are enforced equally well in the Ellices the resultant in worm infection is quite different. These simple regulations for a simple people are the only ones in this Colony of a public health nature.

*Native Hygiene before the White Man.*—The Gilbertese national habit has always been to evacuate the bowels twice a day; just before dawn and just after sunset. Though it is probable that individual natives on the larger islands occasionally evacuated in the bush, the established custom before the coming of Europeans was to go to the sea when nature called.



The native name for the planet Venus (when an evening star) offers a good commentary on the habit. It was called *Ten Tarai-ki* "The Man who looks at buttocks," because the evening evacuation was accomplished on the lagoon shoals, with the back turned towards the setting planet (*i.e.*, out to sea, for decency's sake).

Another matter of native record on Tarawa Island offers confirmatory evidence of the habit of going to the sea. In February, 1892, a faction war was in progress. One of the parties has been beaten back to a single islet of the Tarawa chain, and was awaiting extermination. Just before dawn on the decisive day, the warriors trooped down to the ocean beach to perform the morning duty. It was while they were thus occupied that the sun rose, and some one spied out at sea the smoke of H.M.S. "Royalist," which by arriving that day and establishing the British Protectorate, saved them from extinction.

There seems to be little room for doubt that the fear of sorcery has been mainly instrumental in driving the native to evacuate in the sea. I have myself come across several forms of magico-religious ritual connected with excrement, all of which are still greatly feared by the people. The principal (widespread in the Micronesian and Melanisean areas) is, that if a man is able to obtain something so closely associated with the person of his victim as his hair, nail-parings, urine, or excretæ he can, by means of magic, visit him with all sorts of disability. The concrete examples of this kind of ritual known to me are devised to procure ill-success, dumbness, death, and the submission of women.

On larger islands it is probable that the fear of such sorcery would not of itself have been enough to drive a people to adopt the habit of evacuating in the sea. Where large tracts of bush or rock existed, there would be many places where a man could conceal his excretæ, or where, if found, they would not necessarily be identified as his. But there are no geographical accidents in the Gilbert Islands, and the bush land is rarely more than two or three hundred yards wide from beach to beach. Consequently, a native would find it exceedingly difficult to elude a persistent enemy's eye, and could never feel safe from magic unless he had resort to the sea.

In view of the above facts, I think that the sanitary habits of the islanders may be regarded as a secondary product. They are due rather to the reaction of sorcery upon physical environment, than to concerted thinking along lines of social hygiene.

The Ellice islanders have never had this fear of magic to restrain soil pollution.

*Sanitation since the coming of the White Man.*—The Government has endeavoured, where possible, to group native villages beside breaks in the land, where tides flow freely in and out of the lagoons.

Part of the communal work of the Colony consists of the erection and repair of village latrines. These are thatched edifices standing on piles well below high-water mark, and connected with the shore by gang planks. They stand in the current where there is one, but in any case are flushed daily by the tides.

To evacuate or urinate anywhere within the village precincts save in the latrines is an offence punishable under local regulation by a fine of from 5s. to £1, or imprisonment from one week to one month, according to the number of previous convictions.

Between villages, the native is enjoined to obey nature below high-water mark, on either the lee or weather beach. Offences are punished by a fine of from 2s. to 10s.

*General Cleanliness.*—Leaves and rubbish of all kinds are cleaned up by the women every day between 5 and 6 p.m., in and about the village houses. They are buried on the lagoon foreshore, where they gradually form new land. Cleaning is done under the supervision of the village policeman. On Saturday morning there is a general clean-up by men and women. The village headman inspects at noon. The standard of cleanliness is very high. A small piece of rubbish by a dwelling or out-house renders the occupant liable to a fine of from 1s. to 5s. A belt of fifty fathoms depth on the landward side of every village is kept clear of fallen coconut leaves and other rubbish by communal work. The lagoon foreshore is similarly cleared.

*Present condition of Soil Sanitation.*—O'Connor speaks of the sanitation of the Ellices as being indescribably filthy around the outskirts of the villages. The annual medical report for 1922-23 speaks also of dirt and filth. Between the times of those reports and my visits great changes have taken place. For careful examination did not show filth of any kind in any quantity around the villages. It was rare to find soil pollution. The conditions speak well for the administration of the District Officers and Medical Department. In general, the villages are clean and well kept in both the Gilberts and Ellices.

*Flies and Mosquitoes.*—Mosquitoes are bred in the hollows of trees and in old coconut husks that litter the ground. They are also bred in large numbers in the tanks used commonly now for conserving drinking water. The babai pits, which are situated near the village usually, are prolific sources. Since O'Connor's visit pigs in the Ellices have been placed in yards at a distance from the villages. Flies are not a great nuisance. The eradication of mosquitoes from these islands in the face of indenture of young men and women and the difficulty of food-getting in the Gilberts and considering the relatively small population on some of the islands, will be a difficult proposition. The first effort should be to keep an area near the village clear of them.

3. *Water Supply.*—The water supply comes from shallow wells. These must be a source of infection in times of epidemics of intestinal diseases. Before Government came in times of drought the scarcity of water caused great suffering and much death. Now most of the islands have tank reservoirs which conserve the water that falls on the public buildings.

4. *Milk Supply.*—Most of the milk supply comes out of tins. There are a few goats on some of the islands. The place of fresh milk for children is taken by "toddy," the partially fermented sap of the coconut tree.



5. *Vital Statistics*.—Unfortunately owing to the short period spent in the group and the death of the Senior Medical Officer I was unable to get good statistics of births and deaths for the group. The birth-rate is very high but so also is the death-rate. Births exceed deaths. The deaths are largely among infants. One hears much of abortion in the Gilberts where it is said to be produced largely by "rubbing-out" in the early months. This is a process of kneading the abdomen from above down into the pelvis. Women rarely die during this common practice.

6. *Transmissible Diseases*.—*Leprosy*.—There are twenty-eight known cases of leprosy in the Gilberts and Ellices. There is a central leper station a few miles from Tarawa in charge of a dresser but these receive little treatment. Only a few lepers are here as there has never been a boat to collect them around the group. On some of the islands these are in a distressful condition. A survey of the island for other lepers has not been made in years. Dr. Gould says that on Ocean Island there are five cases of leprosy. All but one of these served a period of indenture in Tahiti and the disease appeared seven to nine years after their return. Previously it was unknown.

*Tuberculosis*.—Tuberculous adenitis is common in the islands. Many thousands of operations for this condition have been made in the past few years with the result that pulmonary tuberculosis is not now so great a cause of death as it was twenty years ago. On many islands the examination of hundreds of children showed that cervical adenitis is almost universal. With a larger more mobile medical department it would be possible to give better care to these children by treatment in the early stages and prompt operation on failure of treatment. The people are probably too primitive to understand modern educational prophylactic methods. While tuberculosis may be the greatest direct cause of death in these islands, the death-rate from it might be largely reduced by attacking indirect causes.

*Yaws and Syphilis*.—Yaws is so common among Pacific islands that its presence is accepted as a matter of course and its disastrous effects are too often overlooked. The problem of its eradication until the recent introduction of arsenicals for treatment has been too stupendous for consideration.

In 1896, a most notable report was published in Fiji, entitled: "Report of the Commission to Inquire into the Decrease of the Native Population," Government Printing Office, Suva, Fiji. Unfortunately this book is so long out of print that it is not easily accessible. It should be a text-book for anthropologists and others who have to handle Pacific races for the knowledge of them that it summarises. The conclusions of these men of thirty years ago are so important and so modern that I quote them verbatim.

The Fijian Commission attached great importance to yaws as a factor tending to the deterioration of the race. Their conclusions were:—

- "(1) that yaws is a serious constitutional disease, the severity of which is lost sight of from the fact that it is almost universal among Fijians;
- "(2) that yaws and its sequelæ are not alone responsible for many infant deaths, but that they sap the vitality of the whole native race;
- "(3) that from its resemblance to syphilis we think it possible that it has an enervating effect on the child-bearing functions of native women;
- "(4) that, through familiarity with it the natives have no fear of it as a disease of childhood; that they dread its appearance in adults; and that this has probably originated a universal belief that unless children acquire the disease they will grow up weakly and dull;
- "(5) that yaws in the first year of childhood is almost invariably fatal;
- "(6) that the natives do nothing towards curing the disease except when it is passing off, their idea of treatment being practically to allow it to saturate the system of its subjects;
- "(7) that the natives have no well defined idea of its inoculability, but imagine it to be a disease that 'grows out of a child.' That almost all native children suffer from the disease for a period varying from three months to two years or longer; and that during that time no care is taken to cover or prevent the exposure of their sores which thus serve as founts of infection;
- "(8) that the natives have no idea that the *sucuve*, *soki*, or *lovo*, and *kakaca* (diseases that affect the feet) of adult life are the sequelæ of yaws."

Yaws is almost universal in the Gilberts and Ellices. The tertiary form with large ulcers was seen by me among adults and then only the scars except in one case at Funafuti. Cracking of the soles of the feet is very common, with accompanying pain on excessive use of the limbs. When the tertiary symptoms take the form of large ulcerations they are known as syphilis by the native. There is a definite history of yaws arriving in these groups from Samoa, Fiji, and Tahiti carried there by returned Gilbert labour about sixty years ago. On the island of Nui it was said to have been imported by a Samoan teacher fifty-seven years ago. As all the children and most at least of the adults have yaws and as this is said to confer immunity to syphilis it may be said that now at least syphilis is not being propagated. An examination of a number of males said to have syphilis revealed no history of a chancre nor was a scar on the penis seen. The treatment of this condition with arsenicals has been thorough so far as the limited medical facilities have been able to reach.

Among thousands of people I saw only three cases of gangosa.

*Filariasis*.—The Ellice Islands have been shown by O'Connor to be a hotbed of filariasis. In recent years this condition has been spreading slowly up through the Gilberts. No survey has been made for this condition in the latter group. Only in the southern Gilberts does one begin to see the elephantiasis which is the sign of its presence. Filarial fever also is uncommon in the Gilberts. Some years ago a regulation was passed which established a strict quarantine between the Gilberts and Ellices on account of this disease. Unfortunately this quarantine



has never been enforced. It is a matter of regret that this is not strictly enforced till the time when active measures can be taken against this enemy to public health. Those islands to the north which are still free should be isolated from the infected ones so that the work of the future sanitarian shall be limited.

*Dysentery.*—Dysentery is endemic but not so frequent in epidemic form in latter years. The distance separating most of the islands from each other forms a natural quarantine.

*Ringworm.*—The people of both groups are clean-skinned. There is less ringworm than I have seen in the Pacific. Among hundreds of natives examined I have a record of only five cases of ringworm and these were minor infections.

*Leucoderma.*—This is a very common condition indeed. It is considered by the natives of both groups as a mark of great beauty.

*Scabies.*—Scabies called Tikinaka is common in both groups. It is said to have been imported from Rotuma more than sixty years ago.

### PART III.—HOOKWORM INFECTION SURVEY.

1. *History of Hookworm Disease in the Gilberts and Ellices.*—In the year 1920, Dr. F. W. O'Connor in a survey of the Samoan, Tokelau, and Ellice Groups for disease conditions made a survey of the island of Funafuti for hookworm. He examined 96.5 per cent. of the entire population and found 85.5 per cent. of them infected. He also found 90.9 per cent. infection with *Trichuris trichiura*. He thought that though the hookworm here does not seem to be causative of much disastrous anemia, its presence is obviously reflected in the general pallor and dyspepsia of the people, in their somnolence and listlessness, in their incapacity for prolonged exertion, and in their want of stamina. Considering the heavy weight of hookworm infection, the hemoglobin index was not remarkably low.

Dr. O'Connor found in pigs in the Ellices hookworm which morphologically resembled *Ancylostoma duodenale* of man, though they were somewhat smaller. Unfortunately he lost these; but in any case Colonel Clayton Lane pointed out that they were more probably *Ancylostoma ceylanicum* since *Ancylostoma duodenale* is rare in the Ellices. He found also in pigs ova of a *Trichocephalus* but no ascaris ova were found.

2. *Methods Employed in Present Survey.*—When an island was reached and there was sufficient time lectures were given from the standard hookworm chart through an interpreter and a display was made of hookworms and the eggs and larvæ of the parasite. Specimen containers were then distributed. After the lecture the audience was asked to come forward one by one and an inspection was made for signs of syphilis, yaws, filariasis, glandular enlargements, skin diseases, and the hemoglobin of each was estimated. On other islands where the stay lasted only a few hours in many cases, Mr. Grimble gave a talk to the magistrate and dresser and containers were distributed and specimens obtained which would be carried on to the next island for examination.

3. *Technique of Examination.*—The method of examination was the Willis Levitation Method. A small portion of the contents of the tin container is thoroughly mixed with saturated sodium chloride solution, the tin then filled with the solution, and a glass slide placed over it and allowed to stand for fifteen minutes to half an hour when the eggs are found floating on the surface of the few drops of solution that adhere to the slide. Second slides on this survey gave us no extra positives. This is the quickest, most accurate method in our opinion for a field survey and requires little equipment. A supply of carbon tetrachloride was left at Tarawa and at Funafuti for the treatment of positives discovered by us.

4. *Degree and Distribution of Hookworm Infection.*—The infection with hookworm in the two Groups was so different that they have to be considered separately to be intelligible. In Table 1 we see that the findings are uniform in the Gilberts except on Tarawa and Bairiki school which is near Tarawa and has only young boys. Tarawa examinations had to be made from a village adjoining the Government Station where a high standard of sanitation is maintained. At first thought one might say that the low rate of infection is due to a low rainfall, but Butaritari with a rainfall of 150 inches per annum is no higher than the others. Everywhere in the Gilberts, however, is rainfall sufficient for a heavy infection, other conditions being favourable. I can see no other conclusion than that the native fear of magic being performed in connection with their excretions has maintained this high standard of sanitation. The islands are atolls, very narrow in most cases, and with little undergrowth, so that they have been compelled by their fear of magic for ages to defecate in the sea or below the high tide mark so that twice each day it is carried away. The fear of magic remains to this day. On these people it has not been difficult to graft the habit of using the water latrines.

The number of worms per head must also be very low as only an egg or two at the most were ever found on a slide in the Gilberts. In the Ellices we have a greater soil pollution where there has never been fear of magic. In addition they have here a heavier undergrowth due to greater soil fertility and a more consistent rainfall. One might judge from the difference in the infection rate of Funafuti, the port of entry, from the other Ellice Islands that hookworm infection in the Ellices has not reached the stage of equilibrium encountered in the Gilberts and is still spreading and increasing infection. Here the examination showed more eggs to the slide and the condition attains to the standard of hookworm disease in contrast to the Gilberts where it is probably not an economic problem and one would rank the condition as a hookworm infection only.



TABLE 1.—HOOKWORM INFECTION.

<i>Gilbert Islands.</i>						
	<i>Examined.</i>	<i>Infected.</i>				<i>Per cent.</i>
Ocean Island .. .. .	224	28	.....	.....	.....	12
Butaritari .. .. .	186	25	.....	.....	.....	14
Marakei .. .. .	61	5	.....	.....	.....	8
Maiana .. .. .	115	14	.....	.....	.....	12
Tarawa .. .. .	226	4	.....	.....	.....	2
Bairiki School .. .. .	60	—	.....	.....	.....	—
Kuria .. .. .	25	5	.....	.....	.....	20
Tabateuea .. .. .	55	9	.....	.....	.....	16
	— 952	— 90	.....	.....	.....	— 9
<i>Ellice Islands.</i>						
Nanomea .. .. .	101	42	.....	.....	.....	41
Nui .. .. .	100	45	.....	.....	.....	45
Vaitupu .. .. .	101	48	.....	.....	.....	47
Funafuti .. .. .	102	78	.....	.....	.....	76
	— 404	— 213	.....	.....	.....	— 52
Total whole Group ..	1,356	303	.....	.....	.....	22

5. *Infection by Age.*—In Table 2 we have the examinations and infections again arranged by islands to show infection by age. Among these primitive people it is impossible to get exact ages so we resort to children and adults as divisions for age grouping. In the Gilberts we see that men and women have about the same infection rate and that boys have a somewhat heavier infection than girls. The group of adults shows twice the infection of the children. When we remember that Gilbertese men and women have in past years signed on in great numbers for periods of indenture in Samoa, Tahiti, and Fiji, and still sign on in great numbers for Ocean Island and Fanning Island, the thought comes that a large part of Gilbert Island infection may be imported.

In the Ellice Islands the infection seems to be a general one distributed among all ages.

TABLE 2.—INFECTION BY AGE.

<i>Gilbert Islands.</i>						
	<i>Examined.</i>	<i>Infected.</i>				<i>Per cent.</i>
Adults—						
Men .. .. .	403	45	.....	.....	.....	11
Women .. .. .	297	30	.....	.....	.....	10
	— 700	— 675	.....	.....	.....	— 11
Children—						
Boys .. .. .	138	8	.....	.....	.....	5
Girls .. .. .	53	2	.....	.....	.....	3
	— 191	— 10	.....	.....	.....	— 5
<i>Ellice Islands.</i>						
Adults—						
Men .. .. .	147	83	.....	.....	.....	56
Women .. .. .	68	41	.....	.....	.....	60
	— 215	— 124	.....	.....	.....	— 58
Children—						
Boys .. .. .	115	54	.....	.....	.....	46
Girls .. .. .	74	35	.....	.....	.....	47
	— 189	— 89	.....	.....	.....	— 47

6. *Infection by Sex.*—In Table 3 we see that neither in the Gilberts nor in the Ellices is there much distinction in the infection by sex when all members of each sex are grouped together:—

TABLE 3.—INFECTION BY SEX.

<i>Gilbert Islands.</i>						
	<i>Examined.</i>	<i>Infected.</i>				<i>Per cent.</i>
Males .. .. .	541	54	.....	.....	.....	10
Females .. .. .	315	32	.....	.....	.....	9
<i>Ellice Islands.</i>						
Males .. .. .	262	137	.....	.....	.....	52
Females .. .. .	142	76	.....	.....	.....	53

7. *Severity of Infection as shown by Hemoglobin Index.*—From the nature of the survey it was impossible to get hemoglobin estimates from those examined. However, 357 persons in the Gilbert Islands showed an average of 86 per cent. hemoglobin and 249 persons in the Ellices showed an average of 78 per cent. hemoglobin. It would be unfair to attribute this whole difference to the difference in hookworm infection. It must be shared between greater degrees in the Ellices of hookworm infection, filariasis, tuberculosis, and yaws. Clinically it is patent to the most casual observer that the Gilberts are a more virile race than the Ellice islanders; they have brighter cleaner skins with more sparkling eyes and have greater energy.



8. *Degree of Infection as shown by Worm Count.*—The shortness of our stay in Funafuti prevented us from making full three days counts. Three persons were treated and stools were washed after twenty-four hours and the worms counted. The treatment given was 45 minims of carbon tetrachloride.

<i>Hookworms.</i>				
Individual one	..	..	..	18
Individual two	..	..	..	8
Individual three	..	..	..	25
Total				51 hookworms.

These were classified as 37 females and 14 males, and they are all necators. This does not indicate a heavy infection in worms per head. The series, however, is too small and the work had to be too hasty to afford a sure indication of the rate of infection in worms per head. In this case we have to look rather at the heavy infection rate of the population as found by ourselves and O'Connor and the clinical signs to form an idea of the effect of hookworm disease on the population.

It probably is fair to assume from this series that the infection in the Ellices is a pure infection with necators.

*Pig Hookworms.*—Minding O'Connor's suspicion that he had found human ancylostomes in pigs in Funafuti we washed three pigs' guts. One was negative, the washings from one were thrown out by a stupid assistant, and in the other we found 17 worms. Two of these worms we believe are pig ascarides, and none of the others is a human hookworm. These worms are being forwarded to S. T. Darling for further classification.

9. *Infection with Parasites other than Hookworm.*—No effort was made to find the ova of other intestinal parasites than hookworm, but these were noted when encountered. Only *Trichuris trichiura* ova were found, though the close search needed for the light infections in the Gilberts should have revealed any other common ova. We have noted in Fiji that the amount of rainfall has a marked effect on the incidence of *Trichuris trichiura*. Butaritari and Marakei are islands of closely related people in the northern Gilberts where there is a high average rainfall. The other Gilbert Islands shown have a smaller rainfall. This is a very common condition among Pacific islanders and is probably associated with their habit of eating with the hand. Our hemoglobin findings would indicate that there it has little effect in reducing the hemoglobin index.

TABLE 4.—OTHER INTESTINAL PARASITES.

<i>Gilbert Islands.</i>						
<i>Trichuris.</i>						
		<i>Examined.</i>		<i>Infected.</i>		<i>Per cent.</i>
Ocean Island	..	224	....	19	....	8
Butaributari	..	186	....	124	....	66
Marakei	..	61	....	26	....	42
Maiana	..	115	....	17	....	14
Tarawa	..	226	....	21	....	9
Bairiki School	..	60	....	1	....	1
Kuria	..	25	....	4	....	16
Tabateua	..	55	....	3	....	4
		— 952	....	— 215	....	— 21
<i>Ellice Islands.</i>						
Nanomea	..	101	....	56	....	55
Nui	..	100	....	44	....	44
Vaitupu	..	101	....	47	....	46
Funafuti	..	102	....	46	....	45
		— 404	....	— 193	....	— 47
Total for both Groups		1,356	....	408	....	30

## PART IV.—CONCLUSION AND DISCUSSION.

In general the Gilbertese and the Ellice islanders are people living under good physical conditions. They are afflicted with fewer natural or imported diseases than any race of the Pacific. The Gilbertese have in general only three public health problems: (1) the control of tuberculosis; (2) the control of yaws; and (3) quarantine against the filariasis of the Ellice group. Hookworm infection is not an economic problem in the Gilberts. The Ellices have the same problems of yaws and tuberculosis and in addition the burden of extreme filariasis, all three intensified by the drain on the blood caused by hookworm disease in this group.

The decay of the Pacific races and their regeneration is: (1) an important ethical problem, because their decay began with the entrance of white civilization, so far as can be determined, and it would be a callous crime of unparalleled selfishness to allow of their extinction, now for so many years rapidly going forward; (2) it is an economic problem, for the world can ill afford to lose their natural products of which they are the natural producers; it is above all (3) an important political problem for it is said that the Pacific will be the centre of the next great world struggle.



One of the prime causes of this racial decay is disease. Considerations of climate and expense make it physically and economically impossible to employ white doctors to care for native races except in an administrative capacity. The task must be left to trained native medical men. When these are good men they inspire more confidence in western medicine among the natives than do white doctors. Such a plan has been operating well in Fiji for the past forty years. The graduates of the Fiji Medical School employed in the Gilberts and Ellices have done excellent work. But these islands need at least ten in all instead of three. They could be directed by a white medical official from Tarawa, who should himself travel about the group and co-ordinate the service.

In the Ellices there should be placed a hookworm unit consisting of an especially trained native medical practitioner and assistant for the reduction of hookworm disease and the improvement of sanitary ideals. Hookworm disease is probably having important effects on the disease complex of the Ellices.

A campaign for the wholesale treatment of yaws should be undertaken in both groups. This would act also as a great demonstration of the value of western medicine and the value of western civilisation. A yaws unit consisting of a native medical practitioner with an assistant could work up through these groups and eliminate yaws as a cause of racial decay.

These two units might need a European layman to have charge and stabilize their work.

The control of filariasis will have to be undertaken as knowledge of mosquito habits are acquired or curative measures discovered.

The control of tuberculosis centres around the control of these anemia-producing diseases. Probably yaws and some filariasis in the Gilberts, and yaws, filariasis, and hookworm disease in the Ellices, are strong predisposing factors. Much can undoubtedly be done by proper treatment and operation of tubercular cases among the young natives. All of these matters are dependent also on better communication in the Colony.