Report on health conditions at Panama / by H.B. Allen.

COMMONWEALTH OF AUSTRALIA.

2

REPORT

ON

HEALTH CONDITIONS AT PANAMA,

BY

Professor H. B. ALLEN, M.D., LL.D.

PUBLISHED UNDER THE AUTHORITY OF
THE MINISTER OF EXTERNAL AFFAIRS,
HONOURABLE JOSIAH THOMAS, M.P.,
MELBOURNE, AUSTRALIA, MARCH, 1913.

By Authority: McCARRON, BIRD & CO., Printers and Publishers, Collins Street, Melbourne

COMMONWEALTH OF AUSTRALIA.

With the compliments of

The Department of External Affairs

and

Prof. H. B. Allen, M.D., LL.D.

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[1913]

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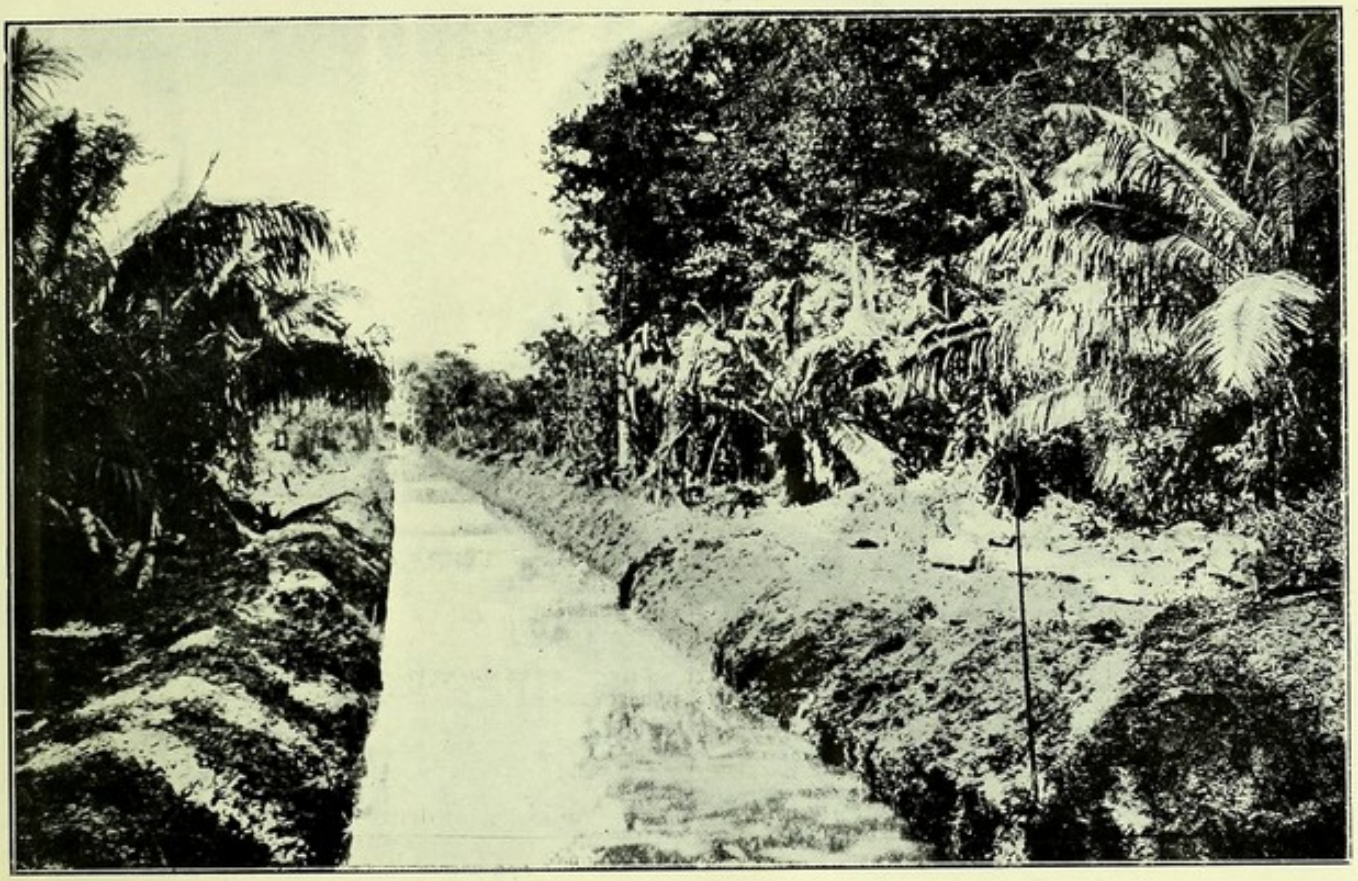

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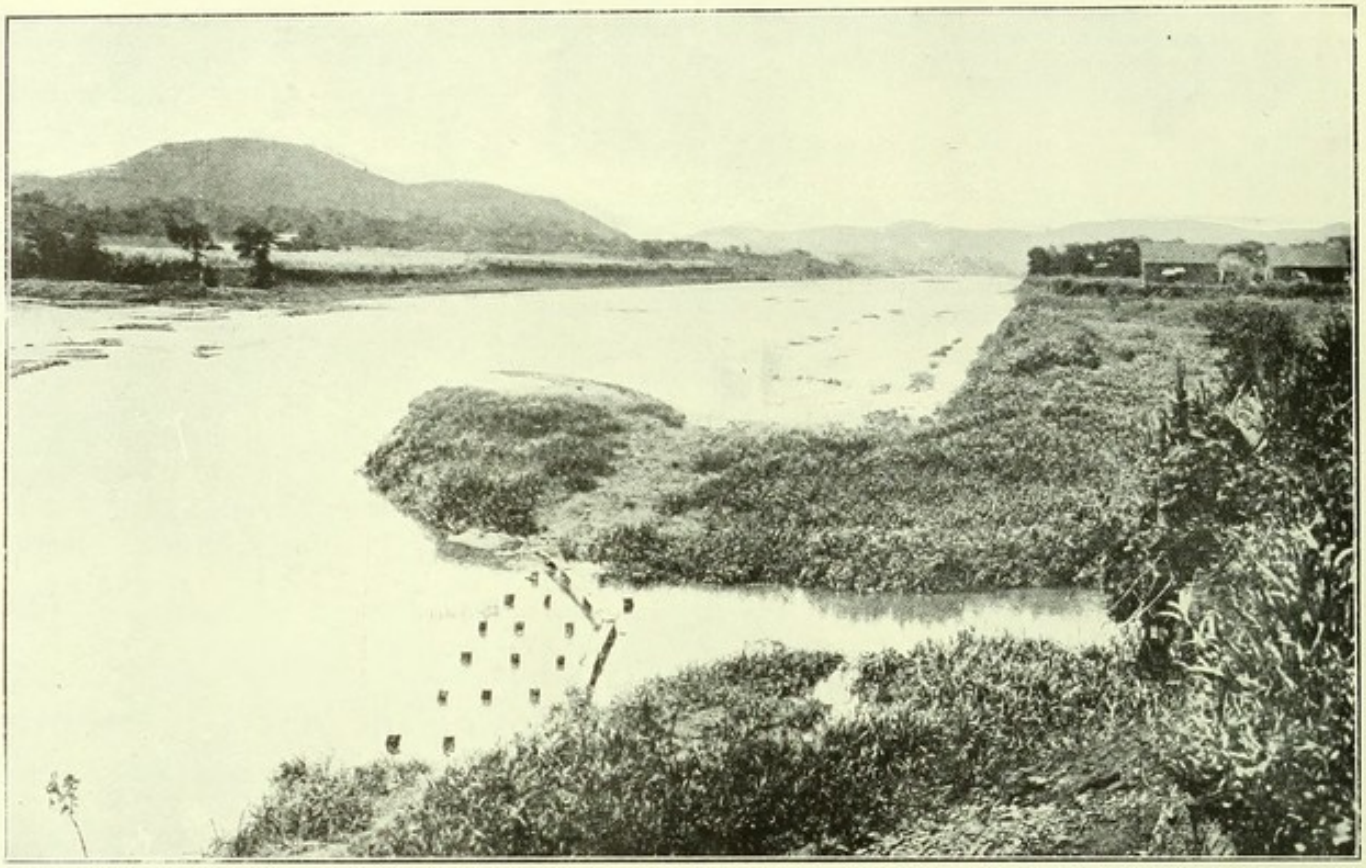

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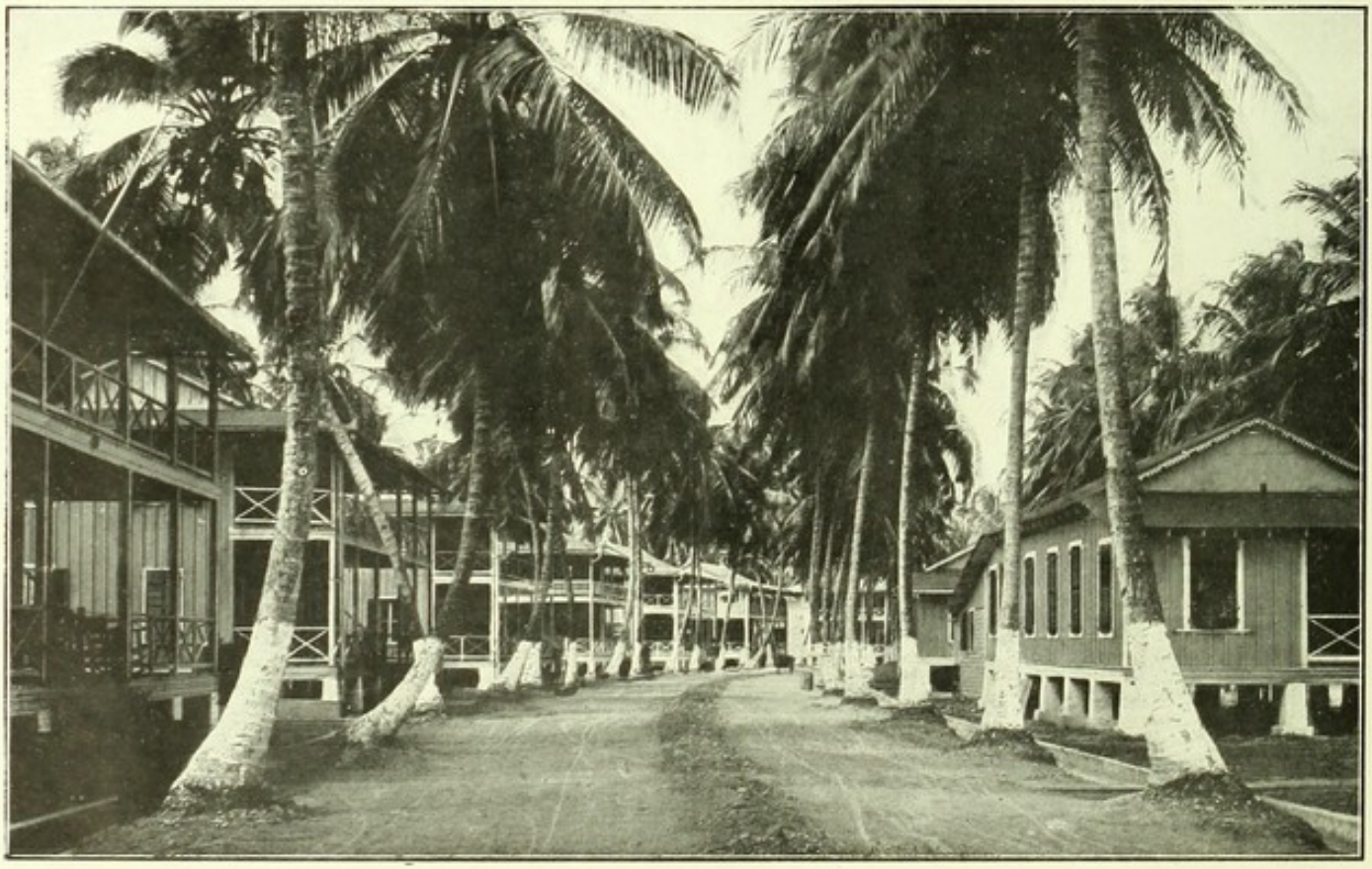

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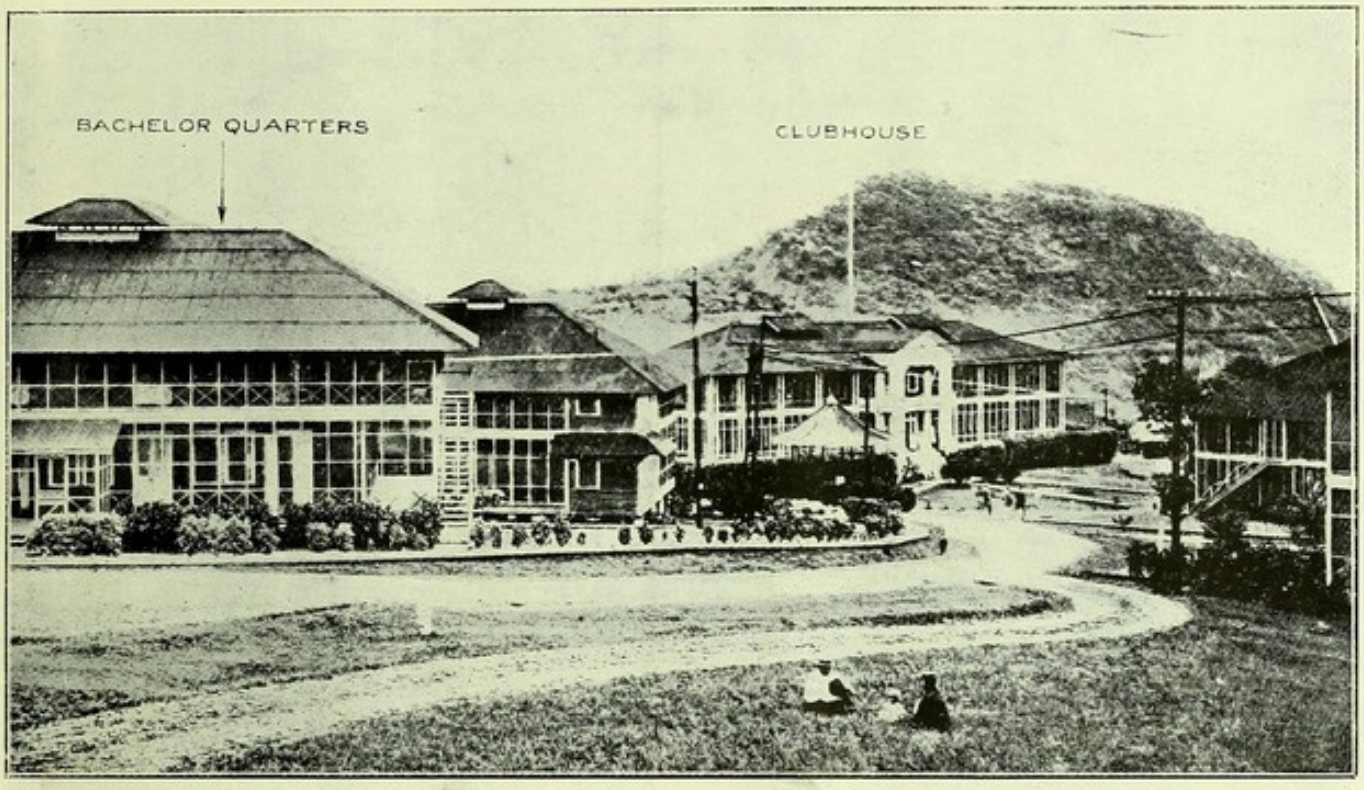

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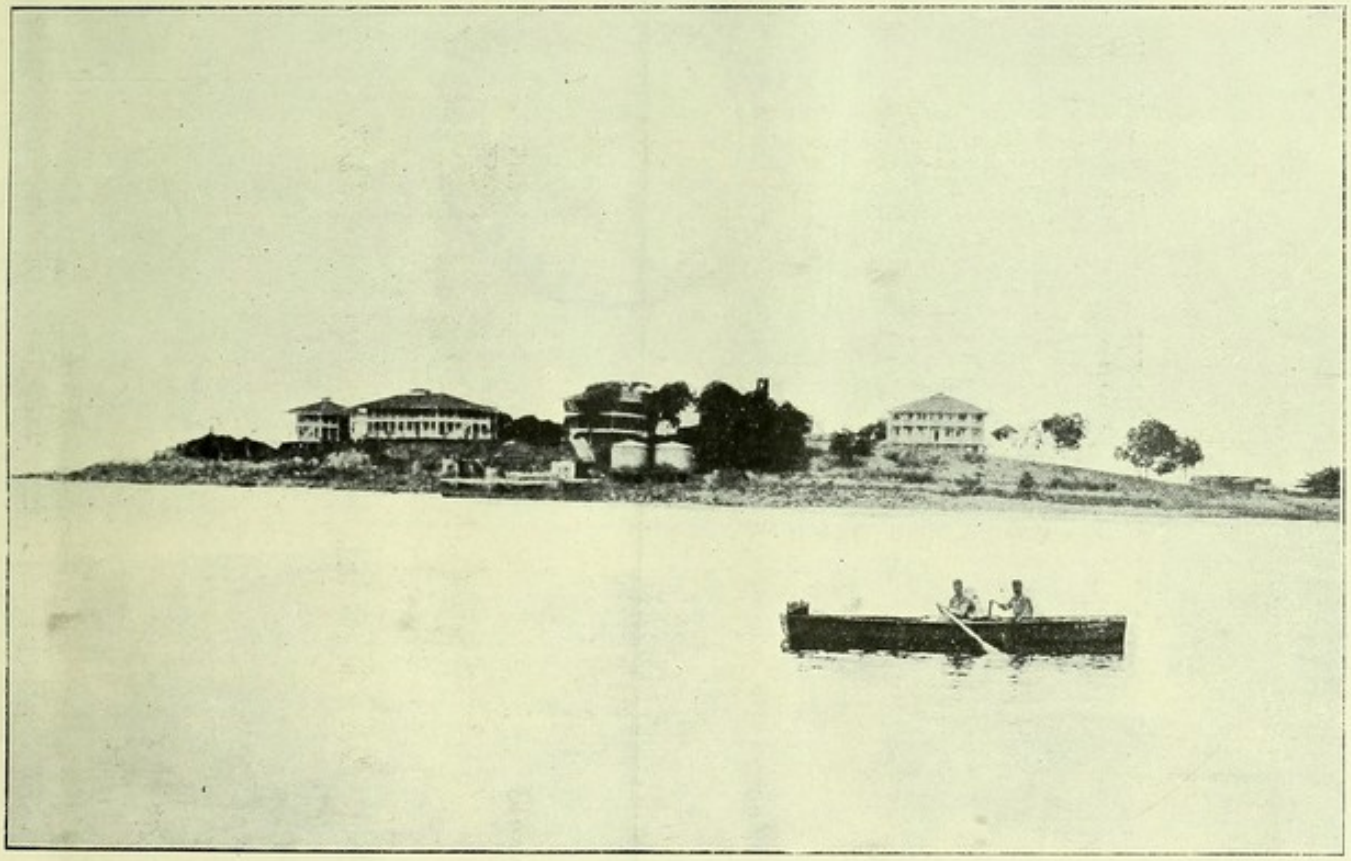

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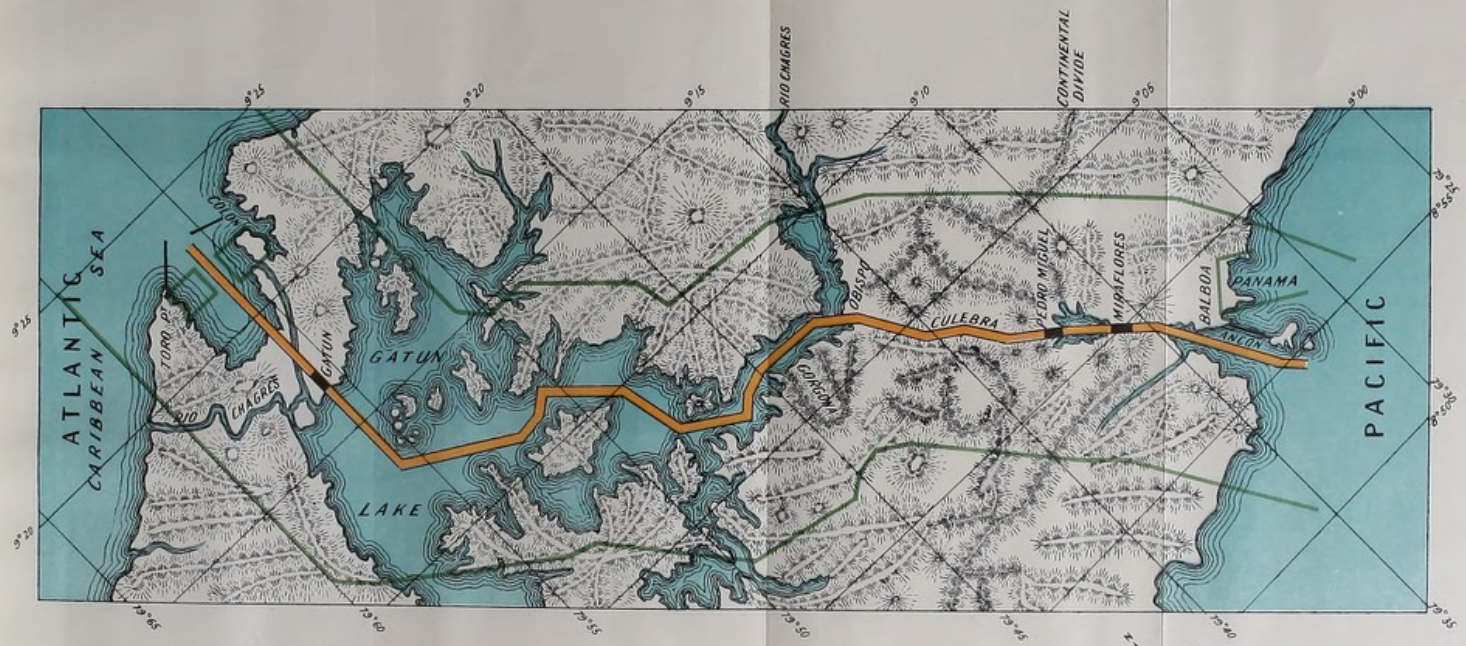

MAP OF THE CANAL ZONE

The Green Lines Outline the Canal Zone

REPORT

ON

HEALTH CONDITIONS AT PANAMA.

University of Melbourne, March, 1913.

The Honourable the Minister of External Affairs.

Sir,

I have the honour to submit the following Report on inquiries conducted under the letter of credit granted to me on the 26th February, 1912, with special reference to the subject of Tropical Medicine.

My attention had been drawn to certain statements published concerning health matters in Panama in connection with the Canal Administration under the Government of the United States of America.

In 1907, Colonel W. C. Gorgas, Chief Sanitary Officer of the Isthmian Canal Commission, in an address before the graduating class of the Cornell Medical College, was quoted (1) as saying, "That among the 6000 Americans connected with the Canal works, which number includes 1200 American women and children, the families of these employees, there is very little sickness of any kind, and their general appearance is fully as vigorous and robust as that of the same number of people in the United States." He concludes that if yellow fever and malaria are eliminated "life in the tropics for the Anglo-Saxon will be more healthful than in the temperate zones; and that gradually, within the next two or three centuries, tropical countries, which offer a much greater return for man's labour than do the temperate zones, will be peopled by the white races, and become the centres of wealth, population, and civilisation."

Further details were given in a paper by J. G. Leigh (2), headed "America's Triumph in Panama," and Dr. Gorgas, in 1909, amplified his statements in his Address (3) as President of the American Medical Association on "The Conquest of the Tropics for the White Race."

Professor Sir Wm. Osler, in a paper (4) on "The Nation and the Tropics," wrote as follows:—"Out of every 1000 engaged in 1908 only a third of the number died that died in 1906, and half the number that died in 1907. The death rate among the white males has fallen to 3.84 per thousand. The rate among the 2674 American women and children connected with the Commission was only 9.72 per 1000."

"The Lancet" of 21st May, 1910, reported that in 1906 the general death rate in the Isthmus was 41.73; in 1907 it was 28.74; in 1908 it was 13.01; and in 1909 it was 10.64.

Mr. Taft, at a meeting of the United States Senate Committee on Inter-Oceanic Canals on 16th January, 1908, is reported (5) to have spoken as follows:—"Dr. Gorgas has proved so uniformly successful that we have felt fully justified in taking his advice in such matters. . . . The Spanish war has taught us and all the world how to live in the Tropics."

The subject was dealt with in a Foreign Office Report (6) on Panama in 1908.

These statements seemed to me to have the utmost importance in their bearings on the settlement of the Northern Territory of Australia. There tropical diseases, though important, occupy only a secondary place, and the main problem is whether conditions of heat and light will permit the permanent establishment of a working white race. I accordingly brought these matters before the High Commissioner, the Rt. Hon. Sir George Reid, requesting him to take steps to procure the latest and most detailed information as to the results obtained up to the present time in the administration of the Panama Canal Zone. I suggested that such information might include—

1. The number of white persons, distinguishing adults, male and female, and children.
2. The morbidity and mortality rates in each class, with any available facts as to anaemia, childbirth and its results, &c.
3. The general nature of work of the men.
4. The general mode of life of the women and children.
5. Brief climatic data, including, if possible, mean monthly wet-bulb thermometric records.
6. Such general critique and suggestions as the American Authorities might kindly supply.
7. References to publications already available, supplementary to those quoted in my memorandum.

I expressed my conviction that a Report on these lines would be of the greatest service to the Government of the Commonwealth of Australia, and to all who are interested in the future of white races in the Tropics.

The High Commissioner kindly submitted my request to the Colonial Office, with the result that a suggestion was made that much information was already available, and that it would be well to communicate with Sir Ronald Ross at the Liverpool School of Tropical Medicine, and with Dr. A. G. Bagshawe, Director of the Tropical Diseases

(Sleeping Sickness) Bureau at Burlington House. Sir Ronald Ross offered the loan of the Monthly Health Reports from Panama, and referred to the articles by Dr. Gorgas (7) and Mr. J. A. Le Prince (8) in his work on "The Prevention of Malaria." Dr. Bagshawe gave me further references (9), but he agreed that further information would be of great value, both for the purposes indicated by me, and for use in the Tropical Diseases Bureau. The Secretary of State for the Colonies (the Rt. Hon. Lewis Harcourt) then requested the Foreign Office to ask the Government of the United States to supply a report on the questions contained in my memorandum.

In transmitting this invitation, the British Embassy in the United States, in order to avoid error, added a request for separate statistics concerning the white and coloured population in the Canal Zone, so that the following words appeared at the end of Question 2:—"If these rates or facts vary considerably between the white and the coloured population of the zone, it would be valuable, if possible, to give separate statistics for each race."

Under date 20th June, 1912, the United States Secretary of War supplied provisional answers to certain questions, with copies of several publications (10), and stated that further information was being sought from the authorities at the Isthmus.

On 30th July, 1912, the Secretary of War forwarded more detailed answers, together with various papers and publications (11), supplied by Colonel Gorgas, Chief Sanitary Officer of the Canal Commission.

In September, 1912, I received through the Colonial Office a recent paper (12) on the Sanitary Inspection of the Canal Zone, by Dr. A. J. Orenstein, Assistant Chief Sanitary Inspector, kindly forwarded by the British Legation at Panama.

On the 14th August, 1912, and again on the 19th October, 1912, I requested Captain Collins, Official Secretary to the Commonwealth of Australia in London, to convey my grateful thanks to the proper authorities, and to express to the High Commissioner, the Rt. Hon. Sir George Reid, my appreciation of his invaluable assistance.

THE CANAL ZONE.

The Isthmus of Panama lies between the parallels of 8.55 and 9.25 N., in about the same latitude as the Niger basin in Africa, or the neck of the Malayan Peninsula in the Northern Hemisphere, or the southern part of Papua in the Southern Hemisphere. The Isthmus runs mainly East and West, lying between the Caribbean Sea on the North, and the Bay of Panama, a prolongation of the Pacific Ocean, on the South. The great continental mountain range sinks to a chain of hills, and the lowest point was selected for the Canal. A considerable river, the Chagres, gathers from many branches on the northern side of the hills, and flows into the Caribbean Sea near the city of Colon (20,000 inhabitants). The little town of Cristobal (4000) immediately adjoins Colon, and marks the Atlantic entrance to the Canal. A smaller river, the Rio Grande, gathering from the Southern slopes, flows into the Bay of Panama at the little town of Balboa, which lies between two and three miles South-west of the city of

Panama (46,000), and forms the Pacific terminus of the Canal. The harbour at Balboa is called Ancon. Colon is built on artificial soil on a low-lying coral island, much of which remained swampy. For a distance of fifteen miles inland from Colon the land is low and swampy, traversed by the River Chagres and its branches. In the remaining thirty miles across the Isthmus the country is hilly. Panama, the capital of the Republic, lies on relatively high ground.

The Canal runs in a somewhat wavy course through the Isthmus, with a total length of forty-five miles, in such oblique fashion that the Pacific entrance is thirty miles East of the Atlantic entrance. The rivers on the Northern and Southern sides have been dammed into lakes. The dividing range is much nearer the Pacific than the Atlantic, so that the Northern river system was longer and larger. Hence, on the Atlantic side, there is the great artificial Gatun Lake, which replaces much of the ancient swamps, and now forms a large part of the waterway. The Southern lake is of small size, lying between Pedro Miguel and Miraflores. Elsewhere the rivers have been straightened, widened, and deepened, to aid in forming the Canal, a brief description of which may now be given.

From the Atlantic side, as shown in the accompanying map, an approach seven miles long leads to the three great locks at Gatun, where a vessel is raised 85 feet to the level of the Great Gatun Lake, which discharges the essential function of maintaining a proper depth of water throughout the Canal proper. After a course of 24 miles across this lake, the vessel enters the main cut through the hills. This is nine miles long, and at the end of it (Pedro Miguel) a single lock drops the vessel 30 feet into the small Miraflores Lake. This is only two miles across, and on the further side, at Miraflores, a pair of locks take the vessel down 55 feet to the level of the Pacific Ocean, which is reached by a waterway 8 miles long ending at Balboa. The narrowest part of the whole Canal (300 feet) is in the cutting through the hills, the waterways elsewhere varying from 500 to 1000 feet across. The clear depth is 45 feet. The passage of the Canal will occupy ten to twelve hours. Three hours will be spent in the locks in changes of level. The Canal Zone is a strip 10 miles wide, following the curves of the Canal, of which the use, occupation and control were granted in perpetuity to the United States by the Republic of Panama. The cities of Panama and Colon, which are within these boundaries, are not included in the grant, but are placed under the sanitary control of the United States Government. A monopoly is given to the United States for waterway and railroad across the Isthmus, with large rights of use of streams and lakes, and generally for the work and protection of the Canal. The Panama railroad has been re-located, and lies to the North of the Canal. The land generally is hilly, with steep slopes and narrow valleys. The highest hill in the Canal Zone is 660 feet above the sea. The hills and slopes are covered with tropical jungle. A fair idea of the vegetation may be gathered from illustration No. 1, showing one of the drains at Toro Point, next the great breakwater at the Northern entrance, and from illustration No. 2, which

is a waggon road near Bas Obispo, where the Canal enters the great cut through the hills. Illustration No. 3 (entitled Point 4, near Gorgona) shows a portion of the completed Canal traversing the upper part of the Chagres waterway, beyond the Gatun Lake, before entering the main cut through the hills.

The average daily range of temperature is from 72 deg. to 86. deg. Fahr. There is little variation between summer and winter, the winter season (such as it is) commencing with November. There is a short dry season extending through January, February, March and April, and a long wet season. The annual rainfall averages 128 inches at the Atlantic end, 92 inches in the interior, and 70 inches at the Pacific end. The number of days on which rain fell in 1910 varied at different stations in the zone from 211 to 344. The maximum fall in an hour was 3.82 inches, and in 24 hours 7.15 inches. During the rainy season, the rivers, especially the Chagres, may become angry torrents. The air is moist and muggy, especially in the wet season. In 1910, for the central section of the Canal, the mean relative humidity was 87 per cent. for the dry season, and 94 per cent. in the rainy season. Such moisture renders the heat far more trying than the limited range would at first indicate.

A few details concerning Culebra, the great Central Engineering Station in the cutting through the hills, may be of service. In 1910, the average daily maximum temperature in the sun was 91 deg. Fahr., and the average maximum shade temperature was only 6 deg. lower. The absolute maximum in the sun in 1910 was 98 deg. Fahr. During the years of record, the absolute maximum in the sun was 105 deg. Fahr. in 1909. The lowest record at Culebra in 1910 was 61 deg. Fahr. The lowest record on the Isthmus during the years of record was 59 deg. in 1907. The monthly mean at Culebra was 78.1 deg. Fahr. The rainfall at Culebra averages 7.01 inches for the four dry months, and 83.94 inches for the eight wet months.

The average temperature of the sea in 1910 was 81.3 deg. Fahr. at the Atlantic end, and 78.7 deg. Fahr. at the Pacific end.

Meteorological Summary for 1910.

Stations.	Mean Reduced Pressure.	Temperature.				Mean Relative Humidity.			Total Rainfall.		
		Maximum.	Minimum.	Annual Mean.	Mean Daily Range.	Dry Season	Rainy Season.	Annual.	Dry Season.	Rainy Season.	Annual.
	Ins.	° F.	° F.	° F.	° F.	%	%	%	Ins.	Ins.	Ins.
Pacific Section (Ancon)	29.853	94	63	79	15	86	91	89	7.19	68.59	75.7
Central Section (Culebra	29.863	92	61	78	14	87	94	91	8.95	94.42	103.37
Atlantic Section (Cristobal	29.869	89	67	78	8	84	90	88	15.28	134.66	1 9 94

SANITARY HISTORY.

Colonel Gorgas summarised the sanitary history in his address before the Los Angeles Chamber of Commerce in 1911 (11p). For hundreds of years, the Isthmus was deemed the most unhealthy place in the world. During the Spanish occupancy, from 1520 to 1820, a constant stream of Spaniards passed through Panama, high and low paying a heavy toll to yellow fever, malaria and dysentery. After the discovery of gold in California in 1849, thousands of Anglo-Saxons travelled by way of the Isthmus, and suffered in like manner. The railroad from sea to sea was constructed between 1850 and 1855, and several times construction was stopped because the labouring force was dead or incapacitated. A thousand negroes brought from Africa all died within six months. A thousand Chinamen were imported, and they also perished within six months. From 1881 to 1889, when the work of the French on canal construction was at its maximum, with an average force of not more than 10,200 men, Colonel Gorgas estimates the total loss of labourers by death at 22,189, which gives a rate of over 240 per thousand per year.

The United States assumed control of the property of the French Canal Company on 4th May, 1904. In the meantime, the researches of Manson and of Ronald Ross had established the fact that malaria was communicated to man by infected mosquitos (Anophelines), and at the end of 1900, two years after the American Army took possession of Cuba, Reed, Carrol, Lazear and Agramonte, in Havana, proved that yellow fever was carried to man by the Stegomyia. In 1901 a campaign against yellow fever was energetically pursued, and before the end of the year the disease was eradicated from Havana. In 1902, the plague of malaria at Ismailia was attacked under the direction of Ronald Ross, who was accompanied by Sir William Macgregor. Within a year the place was practically freed from Anophelines and ordinary Culicines, and the admissions for malaria fell from 2000 a year to 214, and finally endemic malaria disappeared (13).

This was practically the experience which was to guide the Canal Commission and its sanitary officers when they assumed their duties in 1904. Panama depended for water supply largely on rain water, conserved in tanks, barrels and other receptacles, in which the Stegomyia bred freely, and the only sewers were some old dilapidated drains of stone. Colon, though somewhat better supplied in these respects, had substantially the same defects, in addition to its unfavourable position amid swampy surroundings. Every little stream in the ravines among the hills along the line of the Canal, and every pool in the broad swampy flats, was a breeding place for Anophelines. Pernicious malaria was prevalent. Yellow fever was at all times present, though it seldom became epidemic. The introduction of a large non-immune population would give the Stegomyia the opportunity to do its former deadly work.

The engineers determined to replace the French plans for a sea-level canal by a high-level canal, converting the swamps largely into one great lake. Meantime the

sanitary officers introduced a proper system for the removal of refuse and street cleansing in the towns. Recognising that yellow fever was the great enemy, and that the Stegomyia which carried the infection was mainly a domestic mosquito, breeding in standing water adjacent to dwellings, they made proclamations and went regularly from house to house throughout the towns, insisting on the protection by wire netting of every receptacle for water, they oiled every access to the cesspools, they isolated those suffering from yellow fever so that mosquitos could not be infected from them, they fumigated infected dwellings and their surroundings, they watched all non-immunes as if they were contacts, they insisted for non-immunes on the netting of houses and protection of beds, they adopted measures for the killing of mosquitos and their larvae, and established a rigid quarantine at each approach to the Canal. The hope that, as in Havana, it would be enough to kill off infected Stegomyia proved unfounded. Success was only partial. In 1905 the working force was much demoralised by panic. The aim was extended to the destruction of all Stegomyia, and by the end of sixteen months, yellow fever was eradicated. The campaign against the Anophelines was more difficult. These are mosquitos of country districts, breeding in the stagnant pools and rank wet growth along the sluggish streams. The great object was to prevent their breeding. As their range of flight is small, operations were limited to breeding places within two hundred yards of the camps and villages. Surface drainage, subsoil drainage, cleansing and concreting the ditches, removing algae and grasses from the streams, oiling or treating with larvicide all breeding places that could not be abolished, protecting all houses with netting, urging the use of mosquito bars to beds, supplying quinine and advising a regular daily dose of three grains; these were among the special measures that accompanied the introduction of pure water supplies, proper disposal of refuse, &c. In three years such progress had been made that notwithstanding the introduction of thousands of non-immunes, the daily sick rate for 1907, among 39,000 employees, was only 25 per 1000, though malaria, with 16,753 cases, was still the chief cause of sickness. The improved water supply kept dysentery from being troublesome. It was a marvellous achievement when out of every 1000 workmen only twenty-five on the average would be in hospital or in sick camp each day from all causes.

EXPENSES OF SANITATION.

According to the statement of Colonel Gorgas, the yearly appropriation of the Sanitary Department, from 4th May, 1904, to 1st July, 1909, was at the rate of $1,352,712. Only one-fourth of the expenditure was for sanitation. The Sanitary Department was charged also with the care of the sick in hospitals and dispensaries, with quarantine, street-cleaning and garbage-collecting, draining, filling-in and reclaiming of waste lands, with the salaries of fifteen ministers of religion, care of all cemeteries, and with the undertaking and embalming business for 80,000 people. Colonel Gorgas estimates the sanitary expenditure proper at $3.38 per person per year, or 28 cents per month. The

daily expenditure on medical and hospital care of the employees and their families was 2.6 cents per person, while that for the prevention of disease was only one-third as much (9 mills). Colonel Gorgas claims that "these figures are well within the financial ability of any tropical community." In the same address he makes the following summary statement:—"These figures prove that in the case of the unacclimated foreigner, women and children as well as men, health conditions have been so changed in Panama that one can live about as well here as in the healthy parts of the United States. That in the case of the native and negro, who make up the bulk of the total population, his sanitary conditions have been so changed that he now enjoys at Panama about the same degree of health as the ordinary inhabitant of the United States. If this can be accomplished at Panama, the same may be accomplished anywhere else in the tropics." He also adds: "In this discussion I believe I have shown that the Caucasian native of the United States is at present living in large numbers in the most unhealthy locality in the tropics, doing the same out-of-door labour that he did at home" (11, o). Elsewhere he says that sanitary expenditures have been less than 1 per cent. of the total appropriation for all purposes; that when the Canal shall have been finished, it can be shown that sanitation cost about $365,000 per year, or for a population of 150,000 about one cent per head per day (11p).

DATA FOR THE CENTRAL PROBLEM.

The central problem, from the Australian standpoint, is whether the white man and the white woman, as a working race, can maintain good health from generation to generation in tropical climates, when tropical disease is brought under control. The recent history of Panama is too short to permit any final deductions, but the facts now available deserve the most careful consideration. We may now return to the questions submitted, and the replies that were returned, and supplementary information from various publications kindly forwarded.

1.—POPULATION OF THE CANAL ZONE (1911).

White American employees, male	6,025		
White American women	2,316		
White American children	2,148		
		10,489	
European employees, male	6,226		
European women	2,393		21,327
European children	2,219		
		10,838	
Coloured employees, male		36,625	
Coloured women		14,062	
Coloured children		13,057	
			63,744
Unclassified			5,363
Total ...			90,434

2.—MORBIDITY RATES.

(a) Average Number of Employees Constantly Sick per 1000.

Year.	White.	Coloured.	Total.	Year.	White.	Coloured.	Total.
1906	...	...	28.48	1909	42.35	15.23	21.93
1907	...	...	25.09	1910	47.24	16.50	24.37
1908	42.07	14.55	22.31	1911	45.88	17.30	24.46

NOTE.—Among the European Troops in India, the ratio per 1000 of those constantly sick was 89.61 from 1889-98; 43.07 from 1906-10; 28.81 in 1911. For the British Home Army the ratio was 59.85 from 1889-98; 30.90 from 1906-10; 24.28 in 1911.

(b) Deportations in 1910-11.

For Disease	104
For Injury	30
Total	134

(c) Malaria Statistics.

Year.	Hospital Cases of Malaria.					
	Admissions per 100 Employees.			Deaths per 1000 Employees.		
	White.	Coloured.	Total.	White.	Coloured.	Total.
1904	...	...	12.5	...	...	...
1905	...	...	51	...	...	...
1906	...	...	82	2	8	7.65
1907	75	30	42	3	4	3.82
1908	51	19	28	3	0.8	1.34
1909	37	16	22	2	0.5	0.85
1910	37	12	19	1	0.7	0.81
1911	34	13	18	2	0.5	0.84

NOTE.—1906 was the year of maximum prevalence.

MALARIA.

Total Hospital Admissions and Deaths in 1911:—

Admitted—White	4,175	
Coloured	4,812	
Total		8,987
Died—White	24	
Coloured	17	
Total		41

Number of Employees in 1911:—

White	12,251
Coloured	36,625
Total	48,876

(d) Anæmia.

Discharges and Deaths of Employees from Anaemia in Hospitals of the Isthmian Canal Commission:—

	Discharged.	Died.
1907	56	1
1908	86	2
1909	27	0
1910	85	1
1911	62	0

NOTE.—In this table "Anæmia" means ordinary anæmia from current disease; "Discharged" means "discharged from hospital cured."

Dr. Gorgas writes as follows, under date 12th July, 1912:—"Of Tropical Anaemia as generally understood we have practically none. Although some 30 per cent. of our negro employees when they enter the Hospital are affected with ankylostomiasis, it causes us practically no trouble."

3.—BIRTHS IN THE CANAL ZONE.

	Years.	
	1910.	1911.
Number of live births	706	809
Number of still births	118	133
Number of premature births	21	57
Number of abortions	78	107

4.—MORTALITY RATES.

It seems best to give in the first place the latest figures supplied by Colonel Gorgas, under date 12th July, 1912, and afterwards to supplement these as may be possible.

(a) Annual Average Death Rate per 1000 among White Employees of the Isthmian Canal Commission and Panama Railroad Company from 1906-1911 inclusive:—

Year.	No. of Employees.	Disease.	Violence.	Total.
1906	5,464	13.35	4.19	17.54
1907	10,701	10.92	5.69	16.61
1908	12,384	7.27	6.38	13.65
1909	11,662	6.43	3.43	9.86
1910	13,021	4.92	4.22	9.14
1911	12,251	5.88	4.16	10.04

NOTE.—The above figures are for all white employees including American employees and European labourers recruited from Spain, Italy and Greece. In comparing these figures with those of the American employees, shown below, it should be borne in mind that the European labourers are less reliable in taking care of themselves than the American employees, which would probably tend to raise the death rate.

(b) Death Rate per 1000 of White American Employees.

Year.	No. of Employees.	Disease.	Violence.	Total.
1906	5,000	3.80	3.20	7.00
1907	4,300	6.74	3.02	9.76
1908	5,459	3.84	3.84	7.68
1909	5,146	3.88	2.92	6.80
1910	6,079	2.63	3.13	5.76
1911	6,025	2.82	2.32	5.14

(c) Death Rate per 1000 of White American Women and Children.

Year.	Number	Disease.	Violence	Total.
1907	1,337	...	...	6.73
1908	2,674	7.85	1.87	9.72
1905	3,240	4.32	1.23	5.55
1910	4,097	5.13	.73	5.86
1911	4,464	6.72	.45	7.17

DETAILED CAUSES OF DEATH AMONG WHITE AMERICAN WOMEN AND CHILDREN (1907-11).

Year 1907.

Number of Women and Children, 1337; Number of Deaths, 9.

Causes of Death among Women (4)—

Haemoglobinuric Fever, 1; Vomiting of Pregnancy, 1; Septicaemia, 1; Chronic Nephritis, 1.

Causes of Death among Children under 15 (1)—

Railway Accident, 1.

Causes of Death among Infants under 1 (4)—

Marasmus, 1; Cerebral Paralysis (one day after birth), 1; Malaria, 1; Capillary Bronchitis, 1.

Year 1908.

Number of Women and Children, 2764; Number of Deaths, 26.

Causes of Death among Women (10)—

Amoebic Dysentery, 2; Vomiting of Pregnancy, 1; Heart Failure after Childbirth, 1; Puerperal Albuminuria and Convulsions, 1; Eclampsia, 1; Pelvic Abscess, 2; Uraemia, 1; Cancer, 1.

Causes of Death among Children under 15 (5)—

Accident, 2; Malaria, 2; Miliary Tuberculosis, 1.

Causes of Death among Infants under 1 (11)—

Premature Birth, 2; Congenital Heart Disease, 2; Congenital Marasmus, 2; Convulsions, 1; Cholera Infantum, 1; Endocarditis, 1; Capillary Bronchitis, 1; Meningitis, 1.

Year 1909.

Causes of Death among Women (2)—

Number of Women and Children, 3240; Number of Deaths, 18.

Senility, 1; Septic Endocarditis, 1.

Causes of Death among Children under 15 (7)—

Accident, 3; Malaria, 1; Enterocolitis, 1; Appendicitis, 1; Chronic Pachymeningitis, 1.

Causes of Death among Infants under 1 (9)—

Congenital Debility, 2; Suffocation by Overlying, 1; Malaria, 2; Intussusception, 1; Chronic Enteritis, 1; Basilar Meningitis, 1; Pemphigus, 1.

Year 1910.

Number of Women and Children, 4097; Number of Deaths, 24.

Causes of Death among Women (12)—

Accident, 3; Puerperal Septicaemia, 2; Septicaemia, 1; Convulsions, 1; General Peritonitis, 1; Acute Infectious Jaundice, 1; Acute Nephritis, 1; Chronic Nephritis, 1; Cancer, 1.

Causes of Death among Children under 15 (5)—

Malaria, 1; Diphtheria, 1; Tuberculous Meningitis, 1; Pneumonia, 1; Cerebral Paralysis, 1.

Causes of Death among Infants under 1 (7)—

Premature Birth, 1; Congenital Atelectasis, 1; Asthenia and Malnutrition, 2; Enterocolitis, 1; Dysentery, 1; Cerebral Haemorrhage, 1.

Year 1911.

Number of Women and Children, 4464; Number of Deaths, 32.

Causes of Death among Women (12)—

Malaria, 3; Vomiting of Pregnancy, 1; Abortion, 1; Eclampsia, 1; Pneumonia, 1; Organic Heart Disease, 2; Chronic Nephritis, 1; Cancer, 2.

Causes of Death among Children under 15 (9)—

Accident, 2; Malaria, 1; Dysentery, 1; Diphtheria, 1; Septicaemia, 1; Peritonitis, 1; Bronchopneumonia, 1; Disease of Lymphatic System, 1.

Causes of Death among Infants under 1 (11)—

Premature Birth, 4; Melaena Neonatorum, 1; Malnutrition, 1; Meningitis, 2; Meningeal Haemorrhage, 1; Bronchopneumonia, 1; Intestinal Obstruction, 1.

(d) Summary Concerning Death Rate from Disease among Americans in the Canal Zone (1911).

	Mortality per 1000.
White employees from U.S. (total death rate 5.14)	2.82
White employees from U.S., with American women and children	4.48
White employees from U.S., with American women and children, together with officers and men of the 10th Infantry and Marines and their families residing in the Canal Zone	2.36
Death rate from disease in the U.S. Army for 1910	2.44
Death rate from all causes in the British Army in the United Kingdom for 1911... ...	2.47
Death rate from all causes in the European Army in India, 1911	4.89

(e) Mortality from all Causes among Black Employees.

Year.	Number of Employees.	Deaths.	Per 1000.
1906-7	24,587	1,150*	45 94
1907-8	30,999	604*	19.48
1908-9	31,962	383	11.98
1909-10	38,581	440	11.40
1910-11	36,238	428	11.81

*NOTE.—In 1906 and 1907 epidemic pneumonia prevailed among the coloured labourers from the West Indies.

(f) Comparative Mortalities of White and Coloured Employees of Commission and Panama Railway Company for 1910-11.

	Number.	Disease.	Violence.	All Causes.	Per 1000.		
					Disease.	Violence.	All Causes.
White	12,891	70	59	129	5.43	4.58	10.01
Coloured ...	36,238	309	119	428	8.53	3.28	11.81
Total ...	49,129	379	178	557	7.72	3.62	11.34

(g) Mortalities from all causes among all Employees (Black and White).

Year.	Number of Employees.	Deaths.	Rate per 1000.
1904	6,213	82	13.26
1905	16,512	427	25.86
1906	26,547	1,105*	41.73*
1907	39,238	1,131*	28.74*
1908	43,891	571	13.01
1909	47,167	502	10.64
1910	50,802	558	10.98
1911	48,876	539	11.02

NOTE.—In 1906 and 1907 epidemic pneumonia prevailed among the negroes from the West Indies.

(h) Comparative Mortalities of Total Population in the Cities of Panama and Colon and in the Canal Zone.

	Population.	Deaths.	Rate per 1000.
Panama	46,214	1,523	32.96
Colon	19,801	539	27.22
Canal Zone	88,240	1,347	15.27
Total	154,255	3,409	22.10

NOTE.—In this table, the population of the Canal Zone includes, in addition to employees, the civil population. The following table gives the distribution of the deaths according to age and colour.

(i) Deaths among the Total Population in the Cities of Panama and Colon and in the Canal Zone in 1910-11, classified according to age and colour.

	White.	Black.	Yellow.	Total.
Under 1 year	139	900	3	1,042
1 to 4 years	46	272	4	322
5 to 10 ,, ...	5	47	0	52
11 to 20 ,, ...	18	162	2	182
21 to 30 ,, ...	93	578	12	683
31 to 40 ,, ...	90	362	12	464
41 to 50 ,, ...	68	242	10	320
51 to 60 ,, ...	31	131	3	165
61 to 70 ,, ...	9	58	2	69
71 to 80 ,, ...	8	24	1	33
81 to 90 ,, ...	5	8	...	13
91 to 100 ,, ...	2	1	..	3
Unknown	10	50	1	61
Total	524	2,835	50	3,409

5.—THE WORK OF MALE EMPLOYEES.

All persons employed under the Isthmian Canal Commission above the grade of unskilled labourer must be citizens of the United States. A foreign-born applicant must submit his final certificate of naturalisation. Clerks, stenographers, typewriters, physicians, surgeons, trained nurses, and draftsmen are selected in the United States through competitive Civil Service Examination. For other positions in the upper grades of service, persons are mainly selected by agents in the States. Appointments are, as a general rule, at the lowest entrance salary, mechanics and artisans coming in as journeymen, and rising in grade on approved merit. Specialists are sought for rather than all-round men. Previous experience of the particular work is insisted on. A record of

service must show all work since leaving school. The form of application includes particulars as to use of intoxicants, physical defects, chronic diseases. All appointees are subject to rigid physical examination by physicians in the employ of the Commission. There is a strict limit of age for employment, usually 20 to 45 years, but for some occupations the upper limit of service is fixed at 40, and for rodmen and hydrographers at 30.

All employees are provided with bachelor quarters immediately on arrival on the Isthmus, with bed, mattress, chairs, &c. Quarters for married employees are available to a large extent, but there is no absolute undertaking to provide such quarters. The houses are graded in quality according to the nature of service, and are protected by netting. The general type is fairly uniform in essentials, the great features being the provision for verandah life, the protection from mosquitos, and the provision for free passage of the lightest current of air through the dwellings. Illustration No. 4 shows a street in Cristobal at the Atlantic entrance, with an avenue of palms. Illustration No. 5 is a view in the town of Culebra in the main cut through the hills, showing a range of bachelor quarters and one of the club-houses close to the Canal. Illustration No. 6 shows the same constructional type in the quarantine station on the Island of Culebra, at the Pacific entrance.

Fuel, electric light, and water are supplied free. Government hotels and mess houses are provided along the Canal, with good table board at 30 cents a meal. Coupons are issued to employees, and deduction is made from salaries. Commissary stores have been established at convenient points, in which employees may purchase food, clothing, and all necessary supplies at the prices current in the United States. Refrigerating cars distribute perishable goods along the Canal route. Payment is by coupons. Sick employees are entitled to free medical, surgical and hospital attendance, with medicines and nursing. Their families receive hospital and dispensary treatment at nominal charges. Five large club-houses have been built, and many buildings devoted to religious sevices and the meetings of various societies, as well as schools for children. Athletic associations, fraternal clubs, band concerts, lectures, balls, and other social functions are encouraged. The influence of such provision on the morale of the employees must be very great. Employees paid on an annual or monthly basis, not accustomed to tropical climate, may receive six weeks' leave of absence in each year, and those paid by the hour may receive four weeks. Such leave must be spent out of the Zone, and many go to Porto Rico or to various places in Central or South America.

Unskilled labourers are not now engaged in the United States, but are recruited from the Isthmus, the West Indies, and in Southern Europe. Machinery replaces manual labour as much as possible. The actual work of digging is done largely by negroes from the West Indies. The coloured labourers have separate accommodation, separate waggons in the labour trains, and service kitchens, where they get good board for fifteen pence a day.

The general working day consists of eight hours. The usual hours of labour for out-door work are from 7 to 11 in the morning and from 1 to 5 in the afternoon.

The Dean of Hereford, in the Health Congress at York in 1912, and Mr. Saleeby, in the "Pall Mall Gazette" of 15th October, 1912, laid stress on the widespread abstention from alcohol. It is not a matter of absolute prohibition. In 1910-11 $2545 was received for distilling licenses and $97,200 for retail liquor licenses, and the Hospitals of the Commission treated 117 cases of alcoholism. But still the fact remains that the Canal is the work of water-drinkers.

It will be seen that the essence of the whole administration is a benevolent despotism, under a military dictator. There are no shops in the ordinary sense. Money is largely replaced by coupons. Everything is provided and regulated by agents of the Canal Commission.

6.—THE GENERAL MODE OF LIFE OF THE WOMEN AND CHILDREN.

The U.S. Secretary of War (Washington) reports as follows:—"The wives and children of employees of the Isthmian Canal Commission and Panama Railroad Company live under very favourable conditions, for the reason that they are provided with well-screened housekeeping quarters free, such quarters being of types suitable for the different grades of employees. So far as is known here, the mode of life of the wives and children of employees does not differ materially from that in this country. Schools are provided for the children; the women have organised various clubs. There are ample church facilities, and, in fact, it is belived that the communities formed on the Isthmus are much the same as similar communities would be in the United States. There are no particular data on hand here as to the mode of life of the women and children of the native population in the zone."

It would appear that at first the condition of the women was not satisfactory. They were listless and pale and lined. They were not getting enough exercise. Riding horses was introduced, and tennis courts followed, with excellent results. The institution of women's clubs was a brilliant suggestion by President Taft when visiting the Isthmus. Most women rise about five, so as to take advantage of the cool early hours. In the hot mid-day hours they take a siesta. About 4 or 5 in the afternoon is the usual time for a drive.

As to the children, Mr. A. Maurice Low reported as follows in the "Morning Post" of 8th October, 1912:—"The Government built schools and provided teachers; it furnishes children with railway or carriage transportation, so that there is less inconvenience in 'going to school' than there is at home; the children are given lunch, obviating the necessity of their going home at midday; the benevolent despot has even provided matrons, so that the children are properly looked after when they are not in their classes."

7.—CLIMATIC DATA.

These have been sufficiently indicated at an earlier stage of this Report.

SUMMARY OF RESULTS.

In a paper entitled "Sanitary Work on the Isthmus of Panama during the last three years," published in 1907, Colonel Gorgas submitted that the United States authorities could fairly make the following claim for their sanitary work:—"That when they got control of the Isthmus in May, 1904, the territory along the route of the Canal was in its normal condition as to health. It was overgrown by a dense tropical jungle; the natural conditions were everywhere ideal for breeding stegomyia and anopheles mosquitos. The region was inhabited by a considerable population, which was very poor, as the result of the failure of the French Canal Company and the recent bloody and destructive war, which had involved the whole country for some three years. Malaria, dysentery, and small-pox were prevailing among these people about as they would anywhere in the tropics under similar conditions. Yellow fever infection was present in both Panama and Colon. In fact, the conditions were more favourable for producing a high mortality upon the introduction of a large force than they had been at any time in the past. Into this region the Canal Commission has introduced the largest force ever before present on the Isthmus, some forty thousand persons, ten thousand of whom are white non-immunes. Yet the sanitary measures taken by the United States during the period of the introduction of this unprecedented force have been such that yellow fever has disappeared, malaria has been held in check, and the total sick rate in this force during the month of March, 1907, was only 23 per thousand."

Even the year before, in 1906, when the prevalence of malaria was at its height among the employees, Colonel Gorgas wrote (11 l):—"All these conditions ought to improve steadily as time goes on, and it seems to me a perfectly rational hope that malaria will decrease in the same ratio. Even if we cannot decrease malaria below what it is at present, we will have succeeded in building the Canal with no greater number of days lost from disease than if we were building it at home. I hope to do better than this."

The hope has been justified. The number of employees has risen from 26,547 in 1906 to 48,876 in 1911; but whereas in 1906 there were 82 admissions on account of malaria for every 100 employees, in 1911 there were only 18 admissions; and instead of a death rate per 1000 from malaria of 7.65, the death rate in 1911 was only 0.84. The general death rate from all causes among all employees, which was 41.73 per 1000 in 1906, fell to 11.02 in 1911. The average number of employees constantly sick, or in other words the daily average absent from work through illness in hospitals, sick camps and quar-

ters, has been kept under 25 per thousand. The construction work of the Canal has been pushed on with great rapidity. In the main cut through the hills, landslides have been frequent, and sometimes of large extent. At the present time there are twenty-five slides within a distance of nine miles. The slides will continue till the slopes have found a normal level in relation to the hill pressures and the treacherous clays. Even at the outer harbours and at the great locks, there have been reasons for anxiety. Yet every accident has been treated as an incident, and it is anticipated that the whole waterway will be open before the end of the present year, though the formal opening is not till 1st January, 1915.

THE MOSQUITO QUESTION.

The mosquito question has an importance to Australia that has not yet been appreciated. Besides the ordinary culicines, Australia harbours anophelines that may carry malaria and stegomyia that may carry yellow fever. With reasonable quarantine precautions, the infection of our stegomyia mosquitos may be prevented. The anophelines in the Northern Territory are already largely infected, and not only with the milder forms of malaria, but also with the parasites of the more severe forms such as occur in New Guinea. Much information is given in the Report on Health and Disease in the Northern Territory by Dr. Anton Breinl, Director of the Australian Institute of Tropical Medicine, in part 3 of the 1st Bulletin of the Northern Territory. Some progress has been made in the survey of mosquitos of Australia, but the work is incomplete. It must be remembered that the mosquito acts as carrier, not only in malaria and yellow fever, but also in the filarial disease so prevalent in Queensland, and probably for the widespread Dengue Fever, which is the cause of so much sickness and incapacity for work.

In the towns, the breeding of mosquitos is easily controlled. All useless pools should be drained. All sluggish streams should be kept clear of decaying weeds. All cisterns and other receptacles for water should be protected with wire gauze. Small vessels that can hold water should not be allowed to lie about. Sumps should be kerosened regularly, and a little crude carbolic acid may be added. For pools that cannot be drained, kerosene may be used, or a cheap larvicide of carbolic acid, resin and caustic soda, but precautions must be taken with pools that might be used for drinking purposes. For ornamental waters, the introduction of fish such as those called "millions" is found serviceable. It is especially within a radius of two or three hundred yards of dwellings that precautions should be taken, though experiments now in progress in Professor Nuttall's laboratory at Cambridge would indicate that the flight of ordinary mosquitos has been under-estimated.

The second line of defence is to prevent the infection of mosquitos, by giving them no access to infected patients. Segregation of patients can only be practised to a limited

extent. Something can be done by sleeping under mosquito netting. But where infection exists, infected mosquitos may be destroyed in large numbers by fumigation with pyrethrum or sulphur, or by other homely methods.

In malarial districts, a final defence consists in the daily dose of quinine. The gratuitous distribution of quinine for this purpose may be commended to the authorities concerned.

The survey of Australian mosquitos should not only be descriptive and geographical, but should include the study of life history, habits and relation to disease. A few illustrations will show how important such studies may become even from the economic standpoint. At a meeting of the Supreme Legislative Council of India last year, it was announced that, according to recent researches, the malaria prevalent in Bombay does not arise from the swamps around that city, but that infection is caused by a mosquito of very domestic habits, that breeds in the wells within the courtyards of private houses; and similarly that the malaria of the Andaman Islands is largely due to a mosquito that breeds in brackish pools on the seashore, while the mosquitos inhabiting the ricefields and jungle are harmless. A special officer has been sent from India to Panama to study measures for keeping yellow fever out of India, and the Council of India proposes to carry out a careful stegomyia survey (14). In Malaya, it is said that the larvae of mosquitos on the lowlands will not develop in running water, whereas in the hill streams they have this power. The newly-acquired technique for growing the parasites of malaria in laboratories on artificial media will probably soon lead to many important discoveries.

THE NORTHERN TERRITORY PROBLEM.

As already indicated, the main problem of the Northern Territory is not that of malaria, nor that of the mosquito, but purely climatic. Can the white man and the white woman, as a working race, maintain good health from generation to generation in Northern Australia, when tropical disease is brought under control?

Not having visited the Northern Territory, I must speak concerning it with great diffidence. But obviously it is not homogeneous. The low-lying coast, of which Port Darwin may serve as an example, differs greatly from the elevated plains of the hinterland. Darwin has a monthly mean temperature varying around 90 deg. Fahr., the usual limits being between 82 deg. and 94 deg. The monthly mean minimum is about 75 deg. in summer and 66 deg. in midwinter. There is practically no rain from May to October, though the annual rainfall amounts to 61 inches, the maximum fall being in January (15 inches). Only four-fifths of the Northern Territory lies within the Tropical

Zone, and the diverse climatic conditions may be gathered from the official table of annual rainfall:—

Annual Rainfall.	Area in square miles.
Under 10 inches	153,226
10 to 20 ,, ...	181,298
20 to 30 ,, ...	88,505
30 to 40 ,, ...	16,765
Over 40 ,, ...	83,826
Total area	523,620

With heavy rainfall, temperatures do not run very high, and the variations are small. With scanty rainfall, temperatures show much higher maxima and much lower minima. It may, however, be said with confidence that from the standpoint of health, the Northern Territory is far superior to the Panama Canal Zone, which corresponds more closely with Papua than with Northern Australia. Only the strip of coast running from West Australia up to Port Darwin approaches the conditions of Panama.

On this basis, the experience gained in the Canal Zone is of great value. Attention may be concentrated on facts concerning the white employees in 1911. The total number was 12,251. The gross mortality from all causes was 10.04 per 1000 (5.88 representing deaths from disease, and not from accident). The white employees from the United States took more care of themselves than those from the South of Europe and elsewhere. They numbered 6025, and the gross mortality among them was 5.14 per 1000 (2.82 representing deaths from disease). The American women and children numbered 4464, and the gross mortality among them was only 7.17 per 1000 (6.72 representing deaths from disease). If we add together the whole American Colony, including employees from the United States, American women and children, the officers and men of the 10th Infantry and Marines and their families, the mortality from disease was 2.436 per thousand.

The death rate from disease in the United States Army in 1910 was 2.44. The total death rate of the British Home Army in 1911 was 2.47. The total death rate in the European Army of Great Britain in India in 1911 was 4.89.

As to ill-health, of the complete force of white employees in the Canal Service in 1911, numbering 12,251, the average number absent from work daily in Hospital or Sick Camp or Sick Quarters was under 46 per 1000, and this, too, although there were during the year 4175 admissions of white employees into hospital on account of malaria alone. Colonel Gorgas reports that they have practically no Tropical Anæmia. He evidently regards his force of American men and their wives and children as being as healthy in appearance, with as good returns for mortality and morbidity, as corresponding folk in the United States. In this spirit he closed his Address (11, o) as

President of the American Society of Tropical Medicine at the St. Louis meeting on 11th June, 1910, with the words:—"We therefore believe sanitary work on the Isthmus will demonstrate to the world that the white man can live and work in any part of the tropics and maintain good health, and that the settling of the tropics by the Caucasian will date from the completion of the Panama Canal."

If we turn our attention to the coloured employees on the Isthmus, we find that the mortality from disease among them is higher (8.5) than that among the white employees (5.4), but the morbidity is much less among the blacks (17.30) than among the whites (45.88). Admissions to hospital on account of malaria were 341 per 1000 among the white employees, and 131 among the coloured employees. Probably a considerable proportion of the coloured employees were immune, or had passed into a quiescent chronic stage of malaria. Incidentally, it is gratifying to note that the coloured labourers shared fully in the benefits of the sanitary system, their general death rate falling from nearly 46 in 1906-7 to under 12 in 1910-11, the death rate from malaria among them falling from 8 per 1000 in 1906 to 0.5 per 1000 in 1911, the admissions into hospital for malaria decreasing from 30 per cent. in 1907 to 13 per cent. in 1911.

In the Philippine Islands, similar inquiries have been in progress, but the latest report takes a non-committal form:—"Whether the Philippines constitute a white man's land cannot be shown for a generation to come." In the large sense of the problem which has been stated for Tropical Australia, that is to say, whether the white man and white woman as a working race can maintain good health from generation to generation, a reserved opinion is doubtless necessary. The results that have been attained on the Isthmus of Panama are most encouraging, and give ample justification for the expenditure required to make railways and roads, to open up rivers, to make war on mosquitos, and generally to fit the Northern Territory to be the home of a working white race. That race should be predominantly British, but there is every reason why Italians, Maltese and other immigrants from the South of Europe should be encouraged to assist in the good work of settling the Northern Territory and making it a civilised land and a new source of wealth and security to Australia. In this undertaking, the example that the Panama Canal Commission has set in upholding the morale of its people, in teaching them how to find occupation for their leisure, should never be forgotten.

Incidental reference has been made to the fact that in latitude and climate Panama is more closely comparable with Papua than with Northern Australia. The lessons taught by the experience at Panama should be even more serviceable in the development of Papua than in the Northern Territory.

In closing this Report, the author desires to express his grateful thanks to those who have assisted in providing the material for it, especially to the High Commissioner

for Australia, the Right Hon. Sir George Reid; the Official Secretary, Captain Collins; the authorities in the Colonial Office and the Foreign Office; the Secretary of War of the United States; and more particularly to Colonel Goethals, the Chairman and Engineer-in-Chief of the Isthmian Canal Commission, and to Colonel Gorgas, the head of the Sanitary Administration.

In the British "Medical Journal" for 15th March. 1913, just received, it is announced that "Colonel Gorgas, of the Isthmian Canal Commission, Panama, has accepted the task of organising a sanitary system for the port of Guayaquil, Ecuador, which has been known hitherto as the pest-hole of the Pacific." There will be wide-spread wishes for the complete success of Colonel Gorgas in his new undertaking.

I have the honour to be, Sir,

Your most obedient servant,

H. B. ALLEN.

REFERENCES.

1. Lancet, 6th July, 1907, p. 57.
2. Lancet, 6th June, 1908, p. 1646.
3. Lancet, 10th July, 1909, p. 118.
4. Lancet, 13th November, 1909, p. 14 3.
5. Quoted by J. G. Leigh, Lancet, 6th June, 1908, p. 1649.
6. British Medical Journal, 28th November, 1908.
7. Malaria Prevention on the Isthmus of Panama, by Colonel Gorgas in "The Prevention of Malaria," by Ronald Ross, pp. 346-352.
8. Anti-malarial work on the Isthmus of Panama; Technics: ibid. pp. 353-368.
9. (a) Gorgas: Sanitation at Panama, Journal of the American Medical Association, 30th March, 1912, LVIII., No. 13, pp. 907-909, mainly on expense.
   (b) F. P. McCarthy: A Review of Sanitation in Panama, Boston Medical and Surgical Journal, 12th January, 1911.
   (c) J. E. Mears: The triumph of American Medicine in the construction of the Panama Canal, Trans. Amer. Surg. Assoc. 1911, XXIX., pp. 370-388, and in the Medical Record, N.Y., 26th August, 1911.
10. Publications forwarded by the U.S. Secretary of War on 20th June, 1912:—
   (a) Report of the Chief Sanitary Officer of the Canal Zone, 20th February, 1905.
   (b) Annual Reports of the Department of Sanitation for the years 1906-1911 inclusive.
   (c) Monthly Reports of the Department of Sanitation from January, 1911, to April, 1912.
   (d) Manual of Information concerning Employments for Service on the Isthmus of Panama, 1912.
   (e) Annual Report of the Isthmian Canal Commission for the fiscal year ending 30th June, 1911, with maps, plans, graphs, &c.
11. Papers and publications forwarded by the U.S. Secretary of War on 30th July, 1912:—
   (a) Letter from Colonel Gorgas dated 12th July, 1912.
   (b) Estimated number of white and coloured people in the Canal Zone for the year 1911.
   (c) Average number of employees constantly sick per thousand.
   (d) Discharges and deaths of employees from anaemia in the Hospitals of the Isthmian Canal Commission, 1907-1911.
   (e) Record of births in the Canal Zone.
   (f) Annual death rate per 1000 among white employees of the Isthmian Canal Commission and Panama Railroad Company, 1906-1911.
   (g) Death rate of American Women and Children.

(h) W. C. Gorgas:—The practical work done at Havana, Cuba, which resulted in the disappearance of yellow fever, 1903.

(i) ——— Work of the Sanitary Department of Havana, 1903.

(j) ——— Notes on the Treatment of Yellow Fever at Las Animas Hospital, 1903.

(k) ——— Report on the Isthmian Canal, 1904.

(l) ——— Malaria in the Tropics, Jl. Amer. Med. Assoc., 5th May, 1906.

(m) ——— Sanitation in the Canal Zone, Jl. Amer. Med. Assoc., 6th July, 1907, XLIX., pp. 6-8.

(n) ——— Sanitary Work on the Isthmus of Panama during the last three years, Medical Record (N.Y.), 18th May, 1907.

(o) ——— The Expenses necessary for Sanitation in the Tropics: Jl. Southern Med. Assoc., July, 1910.

(p) ——— Sanitation at Panama, Address before Los Angeles Chamber of Commerce, 26th June, 1911.

(q) J. A. Le Prince, C.E., A.M.: Mosquito Destruction in the Tropics, Jl. Amer. Med. Assoc., 26th December, 1908, LI., pp. 2203-2208.

(r) S. T. Darling, M.D.: Studies in relation to Malaria, from Laboratories of Board of Health, Canal Commission, 1910.

(s) W. E. Deeks, M.D., and W. M. James, M.D.: A Report on Haemoglobinuric Fever in the Canal Zone, 1911.

12. A. J. Orenstein, M.D.: Sanitary Inspection of the Canal Zone, Amer. Jl. Public Health, March, 1912.

13. Ronald Ross, The Prevention of Malaria, p. 41.

14. Times of India, Mail Edition, 16th March, 1912, p. 17.