

CHAPTER I

ORIGIN AND OBJECTS OF THE EXPEDITION

THE frequent occurrence during recent years of sprue amongst the planting community of Ceylon, together with the lack of trustworthy information on the subject, made it advisable, from an economic, as well as from a humanitarian point of view, that the subject should be investigated in the light of modern research.

Sir Patrick Manson had for some time past been in correspondence¹ on the subject with Sir Henry Macallum, G.C.M.G., the late Governor of the Colony, with the result that the Legislative Council voted £750 towards such an investigation and a further sum of £250 was provided for the same object by the executors of the late Mr E. S. Grigson, a former chairman of the Planters' Association, and himself a victim of the disease.

Accordingly the Committee of the London School of Tropical Medicine was requested to elect a representative to undertake this work and the author of the present paper was selected for the purpose.

I arrived in the Colony on March 16th 1912 and left on June 3rd 1913, having collected a considerable amount of information and pathological material bearing on sprue which I have since worked out, by kind permission of the authorities, at the London School of Tropical Medicine. For the seven months subsequent to my return from Ceylon I was continuously engaged in this work, in which I have been assisted throughout by my excellent assistant Mr W. J. Muggleton, who had accompanied me on a similar mission in 1910–11 to Fiji. In Ceylon a laboratory was installed on the back verandah of a private bungalow which I leased in Nuwara Eliya, a town situated at an elevation of 6200 ft. My reasons for selecting this town as the headquarters of the research were founded on the fact that it is the chief sanatorium of the Colony, to which invalids tend to gravitate, and whence all plantations and districts of the island can easily be reached by downhill road. Nuwara Eliya has the further advantage that the temperature is such (the thermometer rarely registering more than 75° F.) as to admit of prolonged physical and mental exertions.

¹ For correspondence on this subject, see *Year Book of the Planters' Association of Ceylon*, 1912, pp. 2, 8, 20, 35–36, 41, 100, 166–173.

CHAPTER II

ACKNOWLEDGMENTS

I NEED hardly say that the efforts of a private individual in a research of this kind, in Ceylon, would be of little avail, were he not actively supported by the Government authorities, and the Planters' Association, both of which took a great interest in the work, and assisted me in every way in their power.

I am therefore much indebted to Sir Allan Perry, the principal civil medical officer, and to Dr G. Rutherford, who acted while the former was on leave, for having given me every facility in the hospitals under their charge.

It would be invidious to single out any individual District Medical Officer to whom my thanks are due; without exception they unreservedly permitted me to examine their cases and to perform post-mortems in the district hospitals. I, however, especially wish to express my thanks to Dr F. Grenier, Physician to the Colombo General Hospital. I have also been greatly assisted by many private practitioners, especially Dr R. J. Drummond, late of Talawakelle, Ceylon, who has had a considerable experience of sprue in its early stages.

Mr E. Burgess, assistant at the Bacteriological Institute, Colombo, has assisted me in ways too numerous to mention.

Finally, I must acknowledge the unfailing advice and encouragement afforded me throughout this enquiry by Sir Patrick Manson, G.C.M.G., F.R.S., especially during the four months December 1912 to March 1913 when he visited the Colony, and also by Dr C. W. Daniels, of the London School of Tropical Medicine.

Every effort was made to visit all the planting districts of the island, especially those in which several cases of the disease had occurred and to interview past and present victims of the disease. Any success I may have attained in this way is entirely due to the unreserved manner in which many private individuals entrusted me with the history of their illnesses.

Such necessary laboratory apparatus as an incubator, autoclave, etc. with which I was unprovided were loaned to me by the Medical Department, while I was also permitted to buy drugs and reagents at cost price.

CHAPTER III

A DESCRIPTION OF CEYLON, ITS INHABITANTS, VEGETATION,
GEOLOGY AND PREVALENT DISEASES

ALTHOUGH it is difficult to compress into a reasonable space a description of Ceylon, I think it is essential in a report of this nature that I should describe briefly the physical features of the country inasmuch as they seem to bear upon the epidemiology of sprue. The island is situated between latitude 5·59' and 9·51' N. and longitude 79·41' and 81·54' E. and is separated from India by a channel 40 miles wide, a distance almost spanned by the island of Mannar and the series of coral reefs forming Adam's Bridge. It measures about 270 miles from north to south and about 140 miles in its greatest width, and occupies an area of about 25,481 square miles (equal to that of Holland and Belgium) and supports a population slightly over 4,000,000 (about equal to that of Ireland).

As to four-fifths, the island is an undulating plain, the coastal zone surrounds a central mountainous area of considerable elevation and of singular beauty. The central mountainous plateau, about 4000 square miles, is situated towards the south and is almost equidistant from the east and west coasts. Across this central mountainous region from north to south runs a dividing range. This range is composed of some 150 mountains of from 3700 ft. to 8296 ft. in height; Pidurutugalla and Adam's Peak are the best known and most prominent of these.

None of the rivers in Ceylon are navigable by ships, and only a few by boats. The largest river, the Mahaweliganga, rises in the heart of the mountains and flows into the sea at Trincomalee on the east coast after a course of 200 miles.

The mountainous country is provided with many beautiful rushing torrents, which in many instances have been successfully stocked with trout, indicating a comparatively low temperature.

The population represents a considerable number of races. This results from the fact that several European as well as Asiatic nations have in turn occupied the country. The Portuguese settled on the west and south coasts in 1507 and were dispossessed by the Dutch 150 years later. They in turn yielded to the English in 1796. As

a result of the several invasions by Asiatic tribes some seventy-eight races are to-day represented in the island. We need concern ourselves here only with the most prominent types.

The Sinhalese, a people peculiar to Ceylon, of Aryan race and originating from the north of India, form the bulk of the population and number over 2,700,000. They are divided into two classes, the low-country and the up-country or Kandyan. The former are twice as numerous as the latter. Although a considerable number are Christians the large majority are Buddhists. Their language is akin to Sanskrit.

The Veddas, a people also peculiar to Ceylon, and supposed to represent a pre-Aryan indigenous population, are but a small element in the population, numbering only about 5000. The remnant of this race still wanders in the jungles of the Eastern Province tracking and hunting their game with primitive bow and arrow.

The Tamils, who number over 1,000,000, are of Dravidian stock. They came to Ceylon in two ways: centuries ago as invaders and conquerors, and are still coming in at the rate of 100,000 annually imported as labourers from S. India. The descendants of the early Tamils, a fine manly race, are known as Ceylon Tamils, and live principally in the Northern and Eastern Provinces, where their language mostly prevails.

The Moors, who number some 260,000, are of Arab origin. On account of their religion—Mohammedanism—they live somewhat aloof from the other races. They are generally traders and for the most part speak the Tamil language.

The Burghers, about 26,000 in number, are of Portuguese, Dutch, and English descent. The higher classes fill the learned professions and many are engaged in mercantile pursuits or are members of the Civil Service.

The Malays, who are Mohammedans, are chiefly descended from soldiers imported from the Malay Peninsula. They fill the ranks of the police and find positions as prison warders, office messengers, etc.

Besides these races, there are numbers of tall savage-looking Afghans, familiar and picturesque figures in their flowing robes. They are usually usurers and horse dealers. Kaffirs of mixed blood, descended from soldiers imported by the Dutch in olden times, are occasionally met with.

For administrative purposes, Ceylon is divided into nine Provinces. Of these the Western is by far the most thickly populated, having 721 persons to the square mile. Next to it in density of population

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and in prosperity is the great tea-bearing mountainous area of the Central Province, with 172 persons to the square mile. The North-Eastern Province, by far the largest in extent, is the least densely populated; it has but 21 persons to the square mile. This arid deserted country, now known as the “Wanni,” was once, many hundred years before the Christian era, populated by thousands of the wonderful race who have left behind them as monuments to their skill and civilisation the ruined cities of Anuradhapura and Polonnurua besides hundreds of gigantic irrigation tanks.

The Europeans, who number about 7500, not including the military, naval and merchant marine services, are mostly confined to the plantations of the Central Province and to the Colombo district. There are but few Europeans in the Northern, North-Central, and Eastern Provinces.

The climate. It has been said that considering its size no country has such a variety of climate as Ceylon. The only feature common to all parts is the slight variation in the climatic elements in any given place.

Health in Ceylon depends in great measure on the elevation, rainfall, and cultivation. In the hilly districts, at an altitude of 1500 feet or over, the climate is healthy considering it is a tropical one. In the low-country, it is hot and unhealthy.

The mean annual rainfall varies from 30 to 40 inches in the north to 200 inches in the interior of the island. There are two seasons in Ceylon, the south-west and north-east monsoons. During the former, rainfall is confined mostly to the south-west part of the island, during the latter the rains are more evenly distributed throughout the entire island.

The south-west monsoon is said to commence at the beginning of April, reaching its height in the middle of May, and ending about the middle of August, when the north-east monsoon sets in accompanied by heavy rains which last till January.

The island may be divided into two dry and three wet zones. The dry zones—north and east—embracing about two-thirds of the island, receive less than 75 inches of rain per annum. As most of this rain falls within two months it is comparatively useless for agriculture, unless when artificially stored in tanks. The more fertile portions of the island are contained within the three wet zones—central, west and south. The first of these (rainfall 75–200 inches) comprises all the best tea and cocoa estates.

The temperature varies with the elevation and the seasons from an average mean of less than 60° F. in Nuwara Eliya to over 80° F. in the hot low-country districts and in Colombo.

Vegetation. The flora is as varied as the climate and comprises over three thousand species of flowering plants and ferns. The low-country is one of the most highly cultivated districts, the valley bottoms being occupied chiefly by rice fields. The more elevated ground being covered with the characteristic mixed cultivation of the Sinhalese, such as the jackfruit, the breadfruit, coconut, areca, mango, plantain, yam, custard apple, toddy palm, betel, pepper and other small plants. Large areas along the sea coast and along the Kandy railway are given up to coconut cultivation.

The low-country cultivation conducted by Europeans is mainly found in the Kelani Valley and the Kalutara districts. The principal products are tea of a poor quality, but of a large yield, and in the lower districts, rubber, which is gradually ousting tea from its premier position. Cocoa, cloves, nutmeg, vanilla and other crops are also grown as high up to Kandy (1700 ft.). Higher up among the hills the climate becomes colder and less sunny, and the more tropical forms of vegetation, as palms and the larger bamboos, gradually disappear. So much land has been taken up for tea cultivation that very little is now left of the vast forests of evergreen shrubs which clothed the mountain zone. Fearing a serious diminution in the rainfall, as a consequence of these extensive clearings, the Government no longer sells land above 5000 ft. so as to conserve the primitive jungle above that line and thus to assure an adequate rainfall.

Rice and other native cultivations cease above about 2000 ft. From this to 5000 ft. tea is the prominent feature, as was coffee in days gone by.

The lack of native timber is supplied by the planting on the tea estates of vast numbers of Australian trees, especially the silky oak (*Albizzia*), the *Grevillea* and many species of *Eucalyptus*.

At the highest levels and on the Horton Plains, and to eastward over the main watershed, the jungle is broken by patches of grass lands, known as "Patanas," covered with a turf of rank grass.

To the north-west, north, east, and south-west of the mountains there lies a vast plain, the dry zone. The climate of this zone is like that of Southern India, and the vegetation is similar. With the re-establishment of the ancient systems of irrigation in this area tobacco planting is becoming a large industry.

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Geology. The geological strata of the greater part of Ceylon consist of gneiss and metamorphic rocks, especially characterised by variability in their composition. They are to be regarded for the most part as of igneous origin, though it is possible that some metamorphic sedimentary rocks also exist; the former are known as granulites or gneisses, and belong to the Charnockite series of South India. The red soil of the tea and rubber plantations is formed mostly of weathered ferruginous and micaceous gneiss.

Prevalent diseases. Amongst the European population probably typhoid, amoebic dysentery, malaria and sprue are the most common diseases. The two former account for the most deaths, typhoid being specially prevalent in Colombo. Bacillary dysentery occurs sporadically, chiefly in young children (the Y bacillus of Hiss and Russell was the one most commonly isolated by me).

Amongst the native population malaria and ankylostomiasis are very prevalent. The latter claims a great number of victims especially among the plantation labourers, being found in an aggravated form in many low-lying estates, though its effects are often evident in the up-country coolies as well. Malaria, I have good reason to believe, rarely originates *de novo* above 2500 feet, but is a veritable scourge in the low-lying districts and of the rubber and coconut plantations in the Southern Province.

Diarrhoea figures largely in official reports as a cause of death among coolies. It is probably a symptom of a variety of different diseases, of which the ankylostome and the dysentery amoeba are among the commonest of the exciting causes.

Yaws is very prevalent among the Sinhalese in the dry Northern and Eastern districts, but is not found at all in the higher altitudes. Syphilis is very common among the Tamil labourers and is a great scourge. The death rate of the Colony is a high one and seems to be on the increase. In 1905 it was 35.1 per thousand; in 1912 it is said to have stood at a higher figure. The birth rate has increased of late years and in 1911 was at 39 per thousand.

CHAPTER IV

A DEFINITION OF SPRUE AND A DESCRIPTION OF ITS SYMPTOMS

SPRUE is a disease, essentially of the tropics. It is characterised by symptoms suggestive of a chronic affection of the alimentary tract and of the glandular organs subserving digestion.

The disease rarely runs an acute course, usually its progress is subject to periods of quiescence and exacerbation; it may remain latent even for a number of years.

In typical cases the tongue presents at first a peculiar raw appearance, most marked at the tip and edges, due to inflammation of the fungiform papillae. This process eventually leads to atrophy of all the papillae and to an eroded condition of the entire mucous surface of the mouth. Associated with these changes small yellow aphthous ulcers often appear periodically on the tongue and the buccal mucosa, especially on the inner surface of the lower lip, the cheeks, the fraenum or the soft palate.

Flatulent dyspepsia is generally a marked feature and is accompanied by distension of the entire intestinal canal, particularly of the small intestine. This distension is only relieved by the frequent passage, especially in the early morning, of large, pale, frothy acid stools and of much flatus.

In many instances the inflammatory disturbance spreads down the oesophagus, causing great pain and difficulty of swallowing; there may be, and usually is, extreme hyperaesthesia of the mouth parts, and the sense of taste is often in abeyance. In the later and profoundly anaemic stage there is a tendency to patchy pigmentation between the scapulae and on the interior aspect of the thighs.

Symptoms persisting, atrophy of all the organs of the body, particularly of the liver, and profound anaemia ensue. The disease unless promptly and properly treated ultimately proves fatal.

CHAPTER V

HILL DIARRHOEA

As in the sequel frequent reference will be made to hill diarrhoea, a disease which in some respects resembles sprue and which is frequently associated and confused with sprue, a word on the subject seems desirable.

Grant in 1854 first described the hill diarrhoea occurring at Simla at an elevation of 6500–8000 feet. He indicated it as a cause of serious inefficiency and loss to the English troops stationed there, and regarded the disease as a manifestation of scurvy. Crombie in 1880 described a very severe epidemic in Simla in which about 75 per cent. of the population were attacked. He regarded the disease as a functional disorder of the liver, brought about by the unaccustomed low temperature of the high altitudes, due to previous residence in the hot plains of India. Duncan advanced the hypothesis that this peculiar form of diarrhoea was due to the presence of mica in the drinking water derived from the laterite rocks. His hypothesis was revived and supported by Dyson, though Crombie in the Simla epidemic had excluded water as a factor.

Hill diarrhoea appears not to be limited to the hill stations of India; a similar affection is said to occur in the highlands of Europe, S. Africa and S. America. It is apt to occur in epidemics which observe a distinct seasonal character in their occurrence. Like sprue it is characterised by flatulent dyspepsia accompanied by nausea and sometimes vomiting, by the passage of large, liquid, pale and fermenting stools and by the marked tendency of this diarrhoea to occur in the early morning. In the early stages of the illness the stools are said to be dark coloured and bilious.

Its differentiation from sprue rests principally on clinical grounds. Amongst these may be mentioned the acuteness of the onset of hill diarrhoea, the absence of tongue symptoms, of toxæmia or of any appreciable shrinkage of the liver. In the majority of cases symptoms promptly subside on the patient leaving the endemic area for the plains; it is attended by little or no mortality. Sometimes diarrhoea persists for a considerable time and in a few instances may develop into, or predispose to, genuine sprue.

Though all classes and races are liable to attack, adult Europeans, especially visitors from the hot and low-lying districts, are most prone to contract the disorder. Children appear to be rarely attacked.

The facts, so far as they are known, rather suggest that hill diarrhoea is usually a functional disturbance of the digestive organs. Against this supposition, the experience of recent years has shown that there has been a decrease in the incidence of hill diarrhoea, apparently supervening on improvements in the sanitation and water supply of the Indian hill stations, a fact suggestive of some specific infection.

CHAPTER VI

THE TERM “SPRUE”

THE term “Sprue” has long been in use in the Netherland Indies as indicating forms of chronic diarrhoea, in the main that form which is the subject of this Report. It was first introduced into English medical literature by Manson in 1870 who anglicised the word into “Sprue¹.” About the same time the name was independently adopted in its Dutch form “Spruw” by Van der Burg. Previously to this, Bosch, in 1837, had applied it rather indefinitely to a variety of diarrhoeas.

To prevent confusion, it may be well to mention that this grave tropical disease has nothing to do with the aphthous stomatitis of badly-fed cachetic children, which was at one time known in Scotland and Holland as “Sprue” or “Spruw.” They appear to be totally different conditions.

¹ Many names have been bestowed on the disease now known throughout the world as sprue. The following is approximately a correct list:

Aphthoides chronica—*impetigo primarum viarum* (Hillary, 1766); *Indische spruw*, *aphthae tropicae* (Van der Burg, 1880); *sprue* (Manson, 1880); *psilosis linguae vel mucosae intestini* (Thin, 1897). Up to about the last quarter of the 19th century it was known to Indian physicians as white flux, white purging, white chronic diarrhoea, *diarrhoea alba*, scorbutic diarrhoea, endemic entero-colitis, chronic enteritis of Indo-China, endemic diarrhoea of warm countries.

Amongst its rarer designations are the following: Ceylon sore mouth, Singapore sore mouth, cachexia aphthosa, stomatitis intertropica, *aphthae orientalis*, *aphthaeo-gastro-enteritis tropicae*, *gastro-enteritis aphthae indica*—*phlegmasia membranae mucosae gastro-pulmonalis*. In German it is generally called *aphthae tropicae*, in French *athrepsie coloniale atrophique*, in Dutch *Indische spruw*, in Malay *seriawan* (Carnegie-Brown), and in Sinhalese *mandan* or *grahaney* (Wijesakere).