Responses to yellow fever in British West Africa, 1900-1948

Thesis submitted in accordance with the requirements of the University of Liverpool for the degree of Doctor in Philosophy by Marisa Joanne Chambers

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ABSTRACT

This thesis examines perceptions of, and responses to yellow fever by the research groups and providers of medical care involved in its control in West Africa. Control efforts for the first three decades of the century were mainly the concern of the Colonial Medical Services. Only epidemics captured the Colonial Office's attention, when it would occasionally despatch a specialist to investigate. The CMS used methods based on insect vector models of disease control, targeting mosquitoes and humans in the preventive work. Contemporary western understandings of yellow fever were grounded in notions of endemicity, African immunity, Africans as a reservoir of infection and a mild form of the disease among the indigenous population. These concepts were influenced by racist beliefs in white superiority, and were mirrored in theories relating to other diseases. These notions affected the nature of anti-yellow fever measures. They ensured that whites enjoyed the greater protective efforts of the CMS, and that the indigenous population were regarded as potentially infectious agents: an element to be avoided. The CMS used measures that operated at the community and individual levels. These were ideally part of their routine sanitary work guarding against endemic yellow fever, but in reality, proved too difficult to sustain. During epidemics, this complacency was overcome, as colonial medical personnel intensified existing methods, and resorted to additional measures including quarantine, isolation and observation of the sick and their contacts and house fumigation.

The focus on epidemic yellow fever shifted during the 1930s as new immunological techniques, inoculation and mouse protection tests became available and proved essential against endemic yellow fever. Inoculation reduced the number of susceptible people, decreasing the potential for epidemics to erupt. The protection test detected endemic areas, highlighting regions in need of control measures. The Rockefeller Foundation was at the forefront of these new developments, but did not use them as part of a control campaign in West Africa, despite pledging an early commitment to such projects when it began its investigations in the region. Despite confusion within the medical communities in Britain and West Africa about safety and compulsory inoculation, the Colonial Office failed to provide coherent directions for its use. The limits of its haphazard approach to the disease were revealed during World War Two, when the specific conditions of war, and strategic necessity made yellow fever a more pressing problem. The Colonial Office acquired a new perception of the disease, and took an unprecedented role in its control in West Africa, and other parts of the continent. The problem of endemic yellow fever was prioritised.

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ABBREVIATIONS AND ACRONYMS

AMSC	Advisory Medical and Sanitary Committee for Tropical Africa
CAMC	Colonial Advisory Medical Committee
CBE	Command of the British Empire
CDA	Colonial Development Act
CDAC	Colonial Development Advisory Committee
CDF	Colonial Development Fund
CMAC	Contemporary Medical Archive Centre, Wellcome Library, London
CMRS	Colonial Medical Research Service
CMS	Colonial Medical Services
The Commission	The West Africa Yellow Fever Commission of the RF
DDMS	Deputy Director of the Medical Services
DMS	Director of the Medical Services
IDCYFC	Inter-Departmental Committee of Yellow Fever Control
IHB	International Health Board
IHD	International Health Division
IMS	Indian Medical Service
The Institute	The Yellow Fever Research Institute of the RF
LSHTM	London School of Hygiene and Tropical Medicine
LSTM	Liverpool School of Tropical Medicine
MO	Medical Officer
MOH	Medical Officer of Health
OIHP	Office International d'Hygiene Publique
PMO	Principal Medical Officer

PRO	Public Record Office, Kew, London
RAC	Rockefeller Archive Center, New York
RAF	Royal Air Force
RAMC	Royal Army Medical Corps
RF	Rockefeller Foundation
Rhodes House	Rhodes House Library, Oxford
Secretary of State	Secretary of State for the Colonies
SMO	Senior Medical Officer
SO	Sanitary Officer
SSO	Senior Sanitary Officer
Thomas Fisher	Thomas Fisher Rare Book Library, Toronto
WAMS	West African Medical Service
Wellcome Bureau	Wellcome Bureau for Scientific Research
WHO	World Health Organisation
YFWAC	Yellow Fever West Africa Commission

Journals

ATMP	*Annals of Tropical Medicine and Parasitology*
BMJ	*British Medical Journal*
SHM	*Social History of Medicine*
TRSTMH	*Transactions of the Royal Society of Tropical Medicine and Hygiene*

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INTRODUCTION

Aims

This thesis examines the reactions of western institutions to yellow fever in British West Africa from 1900 to 1948. These were changeable and sensitive to a variety of medical, social and political factors. Perceptions of the disease differed from group to group, reflecting their interests and preoccupations.[1] This study also explores the various understandings of epidemic and endemic yellow fever, and how these informed anti-yellow fever campaigns. Epidemic yellow fever attracted most attention for the majority of the period, and was capable of provoking a significant medical response. Yellow fever also existed in endemic form in the region, but induced less of a response until the 1930s. The intensity of anti-yellow fever measures waxed and waned in response to crisis situations, which were often, but not exclusively epidemics.

The period 1900 to 1948 was selected because it represents a distinct era in the discipline of tropical medicine. In Britain, government and imperial commerce demonstrated their commitment to addressing disease problems in their tropical colonies with the establishment of the Liverpool and London Schools of Tropical Medicine in 1898 and 1899 respectively. These institutions provided a dedicated forum for research and education into tropical diseases within Britain and established the status of tropical medicine as a distinct discipline. In 1948, the foundation of the World Health Organisation attempted to organise health care, and later research, on

[1] When I refer to the medical community in West Africa in this thesis, I mean only those groups involved in yellow fever research and control, rather than the diverse range of practitioners (and researchers) which included private practitioners, missionaries, indigenous health care providers etc.

an unprecedented global scale. Thus, this period illustrates how the medical and colonial communities approached tropical diseases, prior to the emergence of the new international community in the 1950s and 1960s.

The thesis has an institutional focus, concentrating on the various national and international research bodies and providers of health care involved in yellow fever efforts in West Africa. It provides an analysis of the activities of some of the major actors in tropical medicine during this period. This approach ensures that colonial medicine is not treated as a monolithic activity, but rather as one consisting of several interacting groups operating within the colonial system. These included the Colonial Medical Services, the Colonial Office, the International Health Division of the Rockefeller Foundation, the Liverpool School of Tropical Medicine, the Wellcome Bureau of Scientific Research, and the Office International d'Hygiene Publique. These institutions were exclusively western. An examination of the African perspective is not intended. This would require a different approach and research methodology incorporating oral history, ethnography and anthropology. There is another story which analyses the various roles of the indigenous population in the history of yellow fever, as patients and practitioners, merchants and producers. Such topics have been a growing area of research and a future study, examining African reactions to yellow fever would be a valuable contribution to this area.[2]

[2] For examples of this genre see L. White, " 'They Could Make Their Victims Dull': Genders and Genres, Fantasies and Cures in Colonial Southern Uganda", *American Historical Review* **100** (1995), pp.1379-1402; A. Cunningham and B. Andrews (eds.), *Western Medicine as Contested Knowledge* (Manchester: Manchester University Press, 1997); P. Stanley Yoder (ed.), *African Health and African Healing Systems* (Los Angeles: Crossroads Press, 1982); A. Kleinman, *Patients and Healers in the Context of Culture* (Berkeley: University of California Press, 1980); S. Feierman, "Struggles for Control: The Social Roots of Health and Healing in Modern Africa", *African Studies Review* **28** (1985), pp.73-147.

The introduction begins with a brief history of the disease, from 1850 to 1948, in the medical and scientific context. I then explore British West Africa giving an overview of the colonial regime, and topographical details as well as discussing the population and commercial structure of the four colonies. An examination of the themes of the thesis then follows, incorporating an analysis of the historiography and an explanation of my sources and methods. The themes reflect current preoccupations in the history of tropical medicine. The focus on institutions raises questions about western approaches to disease control and how each represents different facets of colonialism. The prioritisation of white over indigenous health is a common feature of colonial medicine and an important issue in this study. As yellow fever is an epidemic disease, often provoking extreme reactions, this study engages with notions of epidemics as social and medical forces. These themes address the practical response to yellow fever, in terms of control measures implemented, in addition to a research context for the disease. The impact of epidemiological understanding and the various technical developments which arose from research efforts, for example inoculation, are addressed within the issues outlined. These themes are combined to explore how perceptions of, and responses to yellow fever were fluid; differing from group to group and changing in response to altered circumstances.

Yellow fever, 1850-1948

Medical understanding of yellow fever underwent significant revision during the period studied in this thesis. Many of these developments were related to wider changes in medical and scientific knowledge which began during the nineteenth century. It is therefore necessary to place yellow fever in this broader context. Current understanding of yellow fever holds that the disease is caused by a virus transmitted from person to person by the bite of an infected mosquito, mainly the *Aedes aegypti* (see figure i.1 on page five), although other *Aedes* vectors have been identified.[3] There are two forms of the disease which are identical except for the means of transmission. Urban yellow fever is transmitted to humans by the bite of the *Aedes aegypti* mosquitoes and mainly occurs in cities although it has been detected in rural areas. Jungle (or sylvan) yellow fever occurs in the absence of *Aedes aegypti* mosquitoes. Unlike urban yellow fever, infection is maintained in an animal reservoir consisting of various breeds of monkeys in Africa and probably rodents in South America. Mosquitoes other than *Aedes aegypti* are the vectors of transmission. Humans are infected mainly as a result of ecological changes, particularly forest clearance.[4] Symptoms depend on the severity of infection but typically include fever, chills, jaundice, vomiting, constipation, pain in the back and limbs, and decreased urine output. An attack either results in death within a matter of days or recovery, conferring a life long immunity. There is no cure but effective vaccines have been available since the 1930s.

Yellow fever has been recorded since the seventeenth century as a particular scourge of the Americas, the West Indies and Africa. It does not have the long history of other infectious diseases such as plague or malaria. There is tentative evidence to suggest that yellow fever existed in West Africa before European exploration of the region began in the fifteenth and sixteenth centuries, but there is no "reliable

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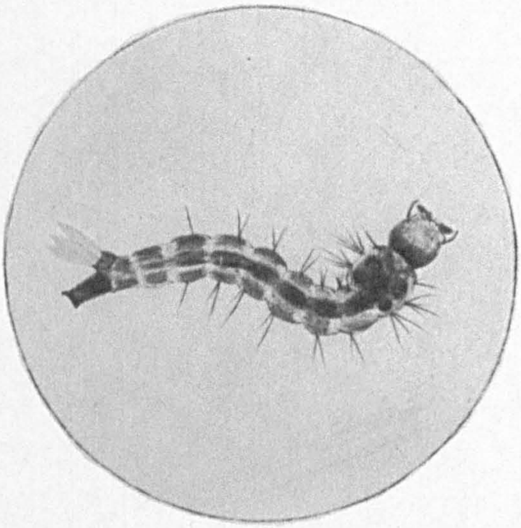
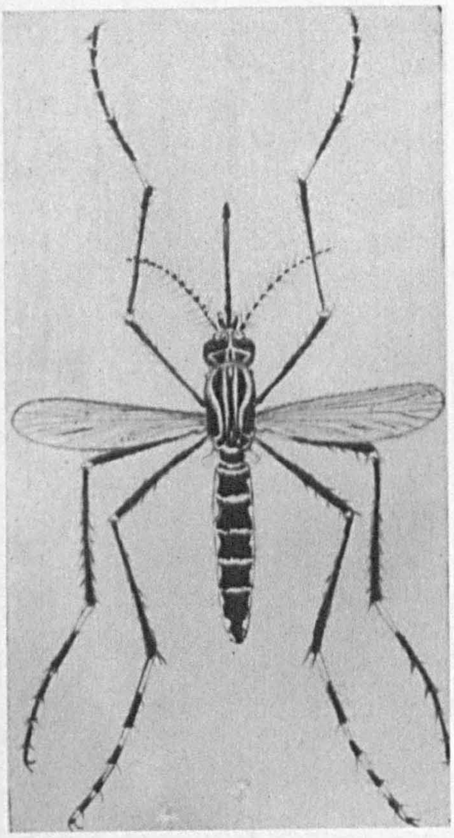
[3] The *Aedes aegypti* mosquito was also known as *Stegomyia fasciata* earlier in the period.

[4] G.C. Cook (ed.), *Manson's Tropical Diseases* (London: Saunders, 1996), pp.641-642.

Figure i.1: The *Aedes aegypti* larva and mosquito.





Source: R. Boyce, *Yellow Fever and its Prevention* (London: John Murray, 1911), p.274

recording" of the disease in West Africa until the late eighteenth century.[5] The disease made its appearance in Yucatan, Mexico in the mid seventeenth century, and by the nineteenth century, yellow fever had a strong grip in the Americas, occurring in South and North America, even as far north as New York. The West Indies were also hit by severe epidemics during the 1800s, and yellow fever was responsible for twenty five per cent of deaths from disease of British troops stationed in the West Indies from 1870 to 1890.[6] It also made sporadic appearances in Europe, travelling in ships along trade routes, but it was relatively rare, and never became a common affliction.[7]

Yellow fever was therefore well established in the Americas and West Africa by the nineteenth century when it became subject to medical attention. There was little consensus about its cause and prevention; some believed it was spread by some form of "germ", while others blamed local conditions.[8] This reflects the division in nineteenth century medical understandings of disease between contagionists and anti-contagionists or sanitarians. The former believed that some agency spread the disease from person to person. The latter argued instead that diseases arose from filth and rotting matter which produced "miasmas" in which diseases arose. In particular, swamps and low lying marsh land were associated with these unhealthy miasmas.[9] As such, sanitarians advocated avoiding such environments, or draining where practicable. Consequently, the century was marked by conflicting health measures

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[5] W. Coleman, *Yellow Fever in the North: The Methods of Early Epidemiology* (Wisconsin and London: University of Wisconsin Press, 1987), p.14.
[6] P. Curtin, *Death by Migration: Europe's Encounter with the Tropical World in the Nineteenth Century* (Cambridge: Cambridge University Press, 1989), p.130.
[7] Coleman, *Yellow Fever in the North* (1987) provides an account of three yellow fever epidemics in Europe.
[8] See M. Humphreys, *Yellow Fever and the South* (Baltimore: John Hopkins University Press, 1999), pp.17-44, for an overview of the differing theories in the United States of America.
[9] M. Worboys, "Germs, Malaria and the Invention of Mansonian Tropical Medicine: From 'Diseases in the Tropics' to 'Tropical diseases' ", in D. Arnold (ed.), *Warm Climates and Western Medicine, 1500-1900* (Amsterdam: Editions Rodopi B.V., 1996), p.186.

based on one or other theory and designed to prevent the spread of disease.[10] Doctors used a cocktail of measures to counter yellow fever, including quarantine, isolation of the sick, and evacuation of the healthy to uninfected areas. Disinfection of victims' property was also a popular method of preventing further infection as were general sanitary improvements such as rubbish removal.

Developments in the late nineteenth and early twentieth century provided new models of understanding for yellow fever. Germ theories emerged from the work of scientists such as Louis Pasteur and Robert Koch and became acceptable frameworks for disease causation.[11] Proponents of the germ theory isolated the causal agents of numerous diseases such as typhoid, pneumonia, syphilis, meningitis and leprosy. This raised the status of the laboratory and bacteriologists, giving them centrality in the process of diagnosis. Medicine switched its gaze from miasmas to micro-organisms in efforts to prevent diseases. Developments in microscopy and parasitology enabled the discovery of numerous causative disease agents during the latter decades of the nineteenth century.[12] By this time, germ theories were being brought to bear on theories of yellow fever causation; medical opinion largely agreeing that some form of germ caused yellow fever, but its nature remained elusive.[13]

The identification of insect-vector models of transmission during this period was significant for yellow fever control. For example, in 1897, Ronald Ross

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[10] M. Pelling, "Contagion/ Germ Theory/ Specificity", in W.F. Bynum and R. Porter (eds.), *Companion Encyclopedia of the History of Medicine* (London: Routledge, 1993), pp.309-334.
[11] For analyses of the emergence and impact of the germ theories see *ibid.*; W.F. Bynum, *Science and the Practice of Medicine in the Nineteenth Century* (Cambridge: Cambridge University Press, 1993), pp.129-130; M. Worboys, *Spreading Germs: Disease Theories and Medical Practice in Britain, 1865-1900* (Cambridge: Cambridge University Press, 2000).
[12] See A. Cunningham and P. Williams (eds.), *The Laboratory Revolution in Medicine* (Cambridge: Cambridge University Press, 1992), for relevant discussion.
[13] See M. Warner "Hunting the Yellow Fever Germ: The Principle and Practice of Etiological Proof in Late Nineteenth Century America", *Bulletin of the History of Medicine* 59 (1985), pp.361-382, for an examination of the differing theories put forward about the variety of germs that caused yellow fever.

demonstrated transmission of the malaria parasite from mosquitoes to birds, and a year later G.B. Grassi showed mosquito to human transmission.[14] The idea of insect-vector models was particularly relevant to yellow fever. In Cuba in 1900, Walter Reed, head of the Yellow Fever Commission of the United States Army, conclusively demonstrated the mosquito's role in yellow fever transmission. His findings resulted from experiments in which mosquitoes which had previously fed on yellow fever patients, were then allowed to bite healthy volunteers, who subsequently developed the disease.[15]

This changed the nature of yellow fever control efforts, leading to vertical campaigns which revolved around the mosquito. Measures based on this new knowledge aimed to destroy mosquitoes and their breeding sites, and prevent contact between humans and insects. Control efforts against other diseases reflected this vertical approach. [16] Sanitary reforms popular in the nineteenth century, particularly against malaria, had resulted in general improvements in health. However, these diminished in importance within this new framework. They became secondary to campaigns which concentrated on controlling one disease by destroying the vector.

The Americans lost no time in applying the new knowledge of the yellow fever vector during their military occupation of Cuba where two years of serious sanitary activity had been ineffective in reducing cases of yellow fever. The consequent change in methods provided a dramatic demonstration of the value of the mosquito's identification. In 1901, General William C. Gorgas, of the United States Army and

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[14] M. Worboys, "Tropical Diseases", in Bynum and Porter, *Companion Encyclopedia* (1993), pp.519-520.

[15] His work was not without controversy as many credit Carlos Finlay for the original theory of mosquito transmission of yellow fever. See F. Delaporte, *The History of Yellow Fever: An Essay on the Birth of Tropical Medicine*, trans. by A. Goldhammer (Cambridge, Mass.: MIT Press, 1991) for a full analysis.

[16] See Worboys, "Tropical Diseases", (1993), pp.512-536 for an overview of these changes.

Chief Sanitary Officer of Havana, began a campaign based on Reed's research. Quarantine was enforced; victims were isolated in rooms protected with mosquito screens to prevent infection spreading to uninfected mosquitoes; victim's houses and their neighbours were fumigated to kill adult mosquitoes; and mosquito breeding sites were attacked. This was an immense task. *Aedes aegypti* mosquitoes breed in collections of water in domestic environments: discarded tin cans, tanks, wells, roof guttering, even tree hollows. Teams of inspectors searched houses for possible breeding sites, collected rubbish, oiled ponds and covered water tanks and wells. Gorgas's efforts were successful. Within nine months of the implementation of these measures, yellow fever had disappeared from Havana. It returned briefly in 1905, but in 1909 Cuba was declared free of the disease.[17] Similar control campaigns were implemented in Brazil and Mexico and during the 1905 epidemic in New Orleans.[18]

These methods were then transferred to the West Indies and yellow fever was subsequently eliminated. As the recognised endemic regions, West Africa and South America were subject to further control campaigns. Following their interest in hookworm, the RF began work in South America in 1918 to eradicate yellow fever from the region. Its methods epitomised the vertical control approach, relying solely on the destruction of mosquito breeding sites. In West Africa, the British also favoured vertical strategies. Against yellow fever specifically, the CMS imposed quarantine, fumigated houses, isolated the sick, destroyed mosquitoes and breeding places and encouraged the residential segregation of Europeans from Africans. Such measures had limited success and the region suffered at least one epidemic every decade in the period studied. The area to be controlled proved too vast and resources

[17] H.H. Smith, "Controlling Yellow Fever", in G. Strode (ed.), *Yellow Fever* (New York: McGraw Hill, 1951), pp.549-550.
[18] *Ibid.*, pp.550-555.

too scarce. The colonial authorities' commitment to yellow fever control was rarely consistent, hampering efforts.

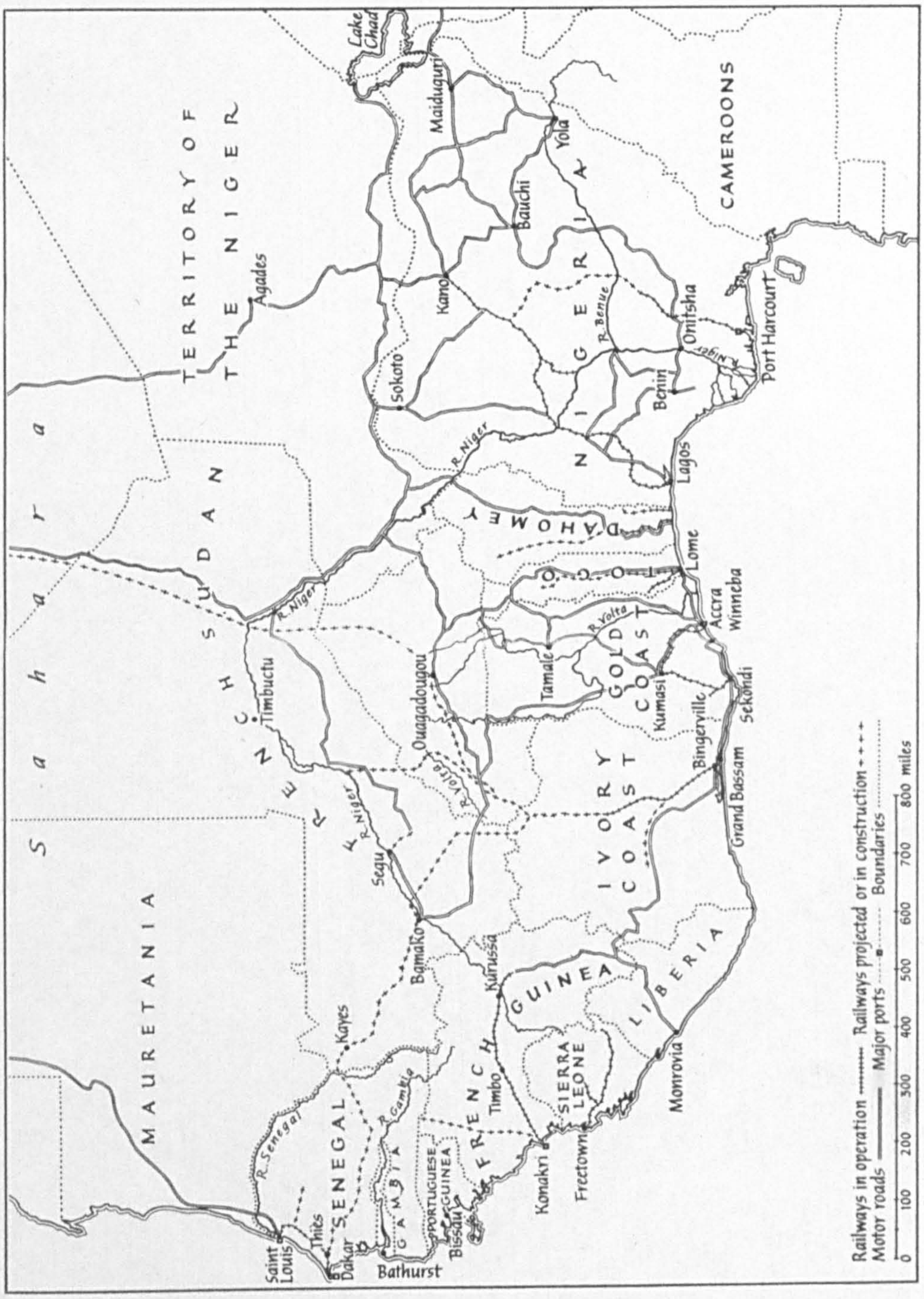
The causative organism of yellow fever proved elusive, and was not conclusively demonstrated until 1927, when RF researchers identified it as a virus. This was followed by important etiological and immunological developments. The RF's immunity test, known as the mouse protection test, could identify previous yellow fever sufferers. From 1931, the RF and others used this technique and conducted large scale immunity surveys, locating regions where yellow fever had existed, and mapping endemic areas around the globe. These surveys suggested that the endemic area in Africa was not restricted to the west but extended in a vast belt across Central and East Africa. Various research groups including the RF, began to develop effective vaccines providing a new means of control. These were gradually improved becoming increasingly safe and more effective. The epidemiological picture became more complex at this time. During the 1930s, yellow fever researchers recognised the jungle form, confirming the long held suspicion of the existence of an animal reservoir. They also acknowledged that although mainly a disease of large urban centres, epidemics could occur in rural areas.[19]

British West Africa: Sierra Leone, the Gambia, the Gold Coast and Nigeria

The geographical location and political climate had implications for the disease and its control. Therefore, I will briefly examine the history of the four colonies; their climate, topography, agriculture and commercial activities, in addition to the nature of

[19] F.L. Soper, "Yellow Fever: The Present Situation (October, 1938) with Special Reference to South America", *TRSTMH* **32** (1938), p.300.

Figure i.2: West Africa, c. 1918.



Source: J.F.A. Ajayi and M. Crowder (eds.), *History of West Africa. Vol.II* (London: Longman, 1974), pp.426-427.

colonial rule. As this study concentrates on anti-yellow fever measures undertaken in urban centres, I will outline certain aspects of urban West Africa. I will provide some details of the commercial activities of the colonies, as yellow fever affected the commercial sectors of the four British West African colonies with the imposition of quarantine, and the practice of segregation which attempted to influence residential patterns in urban centres. I will also provide population details of the larger cities, rather than for the entire colony, though these figures are not consistently available. Other details are also pertinent. For example, the duration of the rainy season was an important consideration for yellow fever control, as mosquitoes proliferated during the rains when breeding sites became more abundant.

The colonies and their capitals are illustrated on page eleven, as figure i.2. The rapid expansion of British possessions occurred in the 1880s during the "scramble for Africa" when the European colonial powers carved up the continent but there was a British presence in West Africa prior to this period. Beginning in 1808, territory in Sierra Leone gradually evolved into a British colony. The port of Freetown was established as its capital, and the remaining hinterland became part of the protectorate in 1896.

Sierra Leone was the third most populous of the four colonies, but population statistics for all four colonies are highly unreliable, particularly for the indigenous population. During the period studied, the colonial authorities took censuses every decade, (except during World War Two) but these were acknowledged as being inaccurate. They usually distinguished between population groups but there was little consistency between the colonies as to how they classified the non-indigenous population. Some categorised "whites" as a population group; others European; while some applied a wider definition of non-indigenous, to include Asians, and Africans non-indigenous to West Africa.

The *Annual Medical Reports* of the four colonies provided estimates of the African and European population for the colony and occasionally for the main urban centres. Kuczynski's survey of West Africa is the best guide to population statistics as he analysed the accuracy of the available data and detailed the differing definitions used in the censuses. He reported the population of Freetown, Sierra Leone "excluding aliens and resident strangers" as 33,247 in 1911; 43,409 in 1921; and 55,250 in 1931.[20] As anti-yellow fever efforts prioritised white urban health, details regarding their numbers are useful. However, there are few statistics relating to numbers of whites in cities. The only figures provided by Kuczynski were of Europeans in Freetown in 1931 for which he recorded a figure of 285.[21] He detailed the non-African, non-Asiatic population of the Sierra Leone Colony and Protectorate, which was recorded as 820 in 1911. It increased to 1,042 by 1921, and significantly decreased to 651 ten years later.[22]

The size of the colony and protectorate of Sierra Leone remained static throughout the twentieth century at 27,925 square miles.[23] The topography was varied, with a forest belt beginning a few miles from the coast line, with several ranges of hills. After the capital Freetown, the colony's principal port, the second town of importance was Bonthe, situated on the Island of Sherbro.[24] The rainy season

[20] R.R. Kuczynski, *Demographic Survey of the British Colonial Empire. Vol.I: West Africa* (London: Oxford University Press, 1948), p.159.
[21] *Ibid.*, p.191.
[22] *Ibid.*, p.193.
[23] M. Havinden and D. Meredith, *Colonialism and Development: Britain and its Tropical Colonies 1850-1960* (London: Routledge, 1993), p.9.
[24] A. MacMillan (ed.), *The Red Book of West Africa* (London: Frank Cass & Co., 1968, reprint of the 1920 edition), pp.229-230.

commonly began in May and ended in October. Agriculture was the main activity of the Protectorate with rice, maize, cassava and yams the most important crops for domestic consumption. The most lucrative export commodities were palm kernels, kola, rubber (which diminished after 1910), palm oil, and diamonds after 1934, when mining began in earnest.[25] Freetown was the commercial centre of the colony, and dominated by an import-export economy. General merchants traded in any commodity for which there was demand. More specialist firms supplied fine clothing, books and stationary, photographic equipment, musical instruments and fireworks. Coal, imported from South Wales, served the shipping lines.[26]

As with the other three West African colonies, Sierra Leone was administered by the principle of "indirect rule".[27] This system was based on Nigeria's prominent Governor, Sir Frederick D. Lugard's notion of the "dual mandate", which stressed the importance of balancing the interests of the rulers and the ruled in the colonial regime.[28] Under indirect rule, colonial control was administered using indigenous authorities.[29] Along a system similar to the other West African colonies, Executive and Legislative Councils assisted the Governor of Sierra Leone. The Legislative Council provided representation for the non-official population of the colony, with four members from the European commercial sector and the indigenous community. It saw all proposed legislation but operated only in an advisory capacity.[30]

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[25] Havinden and Meredith, *Colonialism and Development* (1993), p.184.
[26] MacMillan, *The Red Book of West Africa* (1968), pp.251-270.
[27] For a nuanced account of indirect rule see A.E. Afigbo, "The Establishment of Colonial Rule, 1900 to 1918", pp.424-483; and M. Crowder and J.F.A. Ajayi, "West Africa 1919-1939: The Colonial Situation", pp.514-541, both in J.F.A. Ajayi and M. Crowder (eds.), *History of West Africa. Vol.II* (London: Longman, 1974).
[28] F.D. Lugard, *The Dual Mandate in British Tropical Africa* (London: William Blackwood and Sons, 1923, 2nd edition).
[29] P.J. Cain and A.G. Hopkins, *British Imperialism: Crisis and Deconstruction, 1914-1990* (London: Longman, 1993), p.217.
[30] MacMillan, *The Red Book of West Africa* (1968), p.246.

A British colony was founded in Bathurst, the Gambia in 1815 to provide a base for British naval patrols. The Protectorate was established in 1889, creating a boundary around the River Gambia. This acted as a barrier to prevent the French gaining access to the river. As with Sierra Leone, population details are incomplete. Kuczynski recorded the European and white population in Bathurst in 1901 as 193, in 1911 as 243; in 1921 as 238; decreasing to 185 by 1931, but rising again to 261 in 1939. He stated that the African population for these years was 8,614; 7,470; 8,967; 14,096; and 21,051 respectively.[31] It was the smallest colony in British West Africa with an area of 4,003 square miles.[32] The capital was the port of Bathurst situated on the Island of St. Mary. Mangrove swamps lined the River Gambia from its mouth to 150 miles up river. Beyond this area was a sandstone plateau which provided the best soil for groundnuts, the Gambia's principal export crop.[33] Ground nut oil was used in soaps, lubricants, and cattle cake, with the best forming the ingredients of luxury confectionery in Britain. Although initially grown for domestic purposes it became an important export commodity during the nineteenth century, and in 1918 accounted for up to ninety per cent of exports, followed by hides and rubber.[34] As in Freetown, general import-export merchants dominated the commercial sector, although these were less numerous. The rainy season was quite short, from June to October.

The Gold Coast, (see figure i.3 on page sixteen) was made up of a handful of trading stations and forts left over from the slave trading era. British control of the hinterland of the Gold Coast increased between 1872 and 1902.[35] It expanded after World War One with the attachment of the mandated territory of Togo, previously a

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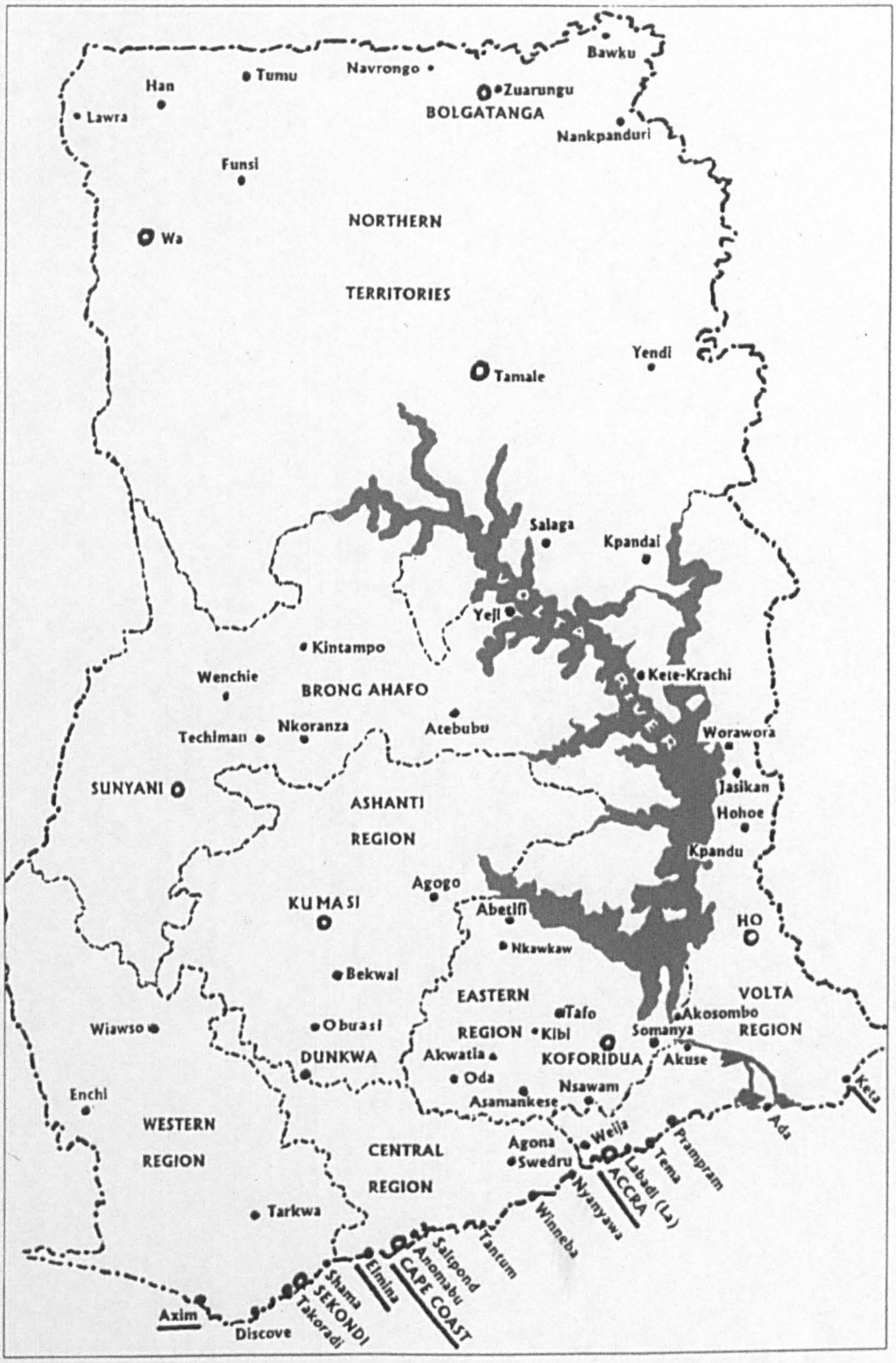
[31] Kuczynski, *Demographic Survey* (1948), p.318.
[32] Havinden and Meredith, *Colonialism and Development* (1993), p.9.
[33] H.A. Gailey, *A History of the Gambia* (London: Routledge & Kegan Paul, 1964), pp.3-4.
[34] MacMillan, *The Red Book of West Africa* (1968), pp.280-282.
[35] Havinden and Meredith, *Colonialism and Development* (1993), pp.55-56.

Figure i.3: The Gold Coast, showing the principal towns of the colony together with sites of yellow fever epidemics



Source: S. Addae, *Evolution of Modern Medicine in a Developing Country: Ghana, 1880-1960* (Durham: Durham Academic Press, 1996).

German colony. Kuczynski recorded the African population in Accra, the capital, as 99,603 in 1921; and 136,696 in 1931.[36] Unfortunately, he did not provide statistics for the European population of the city but gave details of the European population in the Gold Coast (including Togoland) as 2,245 in 1911; 2,939 in 1921; 3,508 in 1931; and 3,147 in 1944.[37] It was the second largest colony in British West Africa with an area of 91,843 square miles just prior to decolonisation.[38]

The topography was varied, with gentle hills in between the lagoons east and west of the coast line, and a hilly interior with a large forest belt. Its rainy season lasted from March to July, with later rains in September and October.[39] The majority of the population worked in agriculture. Domestic food crops were mixed, and included yams, cassava, millet, guinea corn, groundnuts, assorted vegetables and sugar cane. At the turn of the century, the Gold Coast's most important exports were rubber, palm oil and palm kernels. However, the growth of cocoa production, introduced to the colony in the late nineteenth century, altered this trend. Cocoa became the primary export commodity by 1911, followed closely by gold. At this time the Gold Coast was the largest cocoa producing country in the world.[40] A decade later, this crop accounted for 77.4 per cent of exports and gold 11.6 per cent.[41] Cocoa continued to dominate exports, with gold second in value during the 1930s. The Gold Coast's mining industry was dominated by gold, but there were also productive deposits of manganese ore, diamonds and bauxite.[42] Accra was the commercial centre

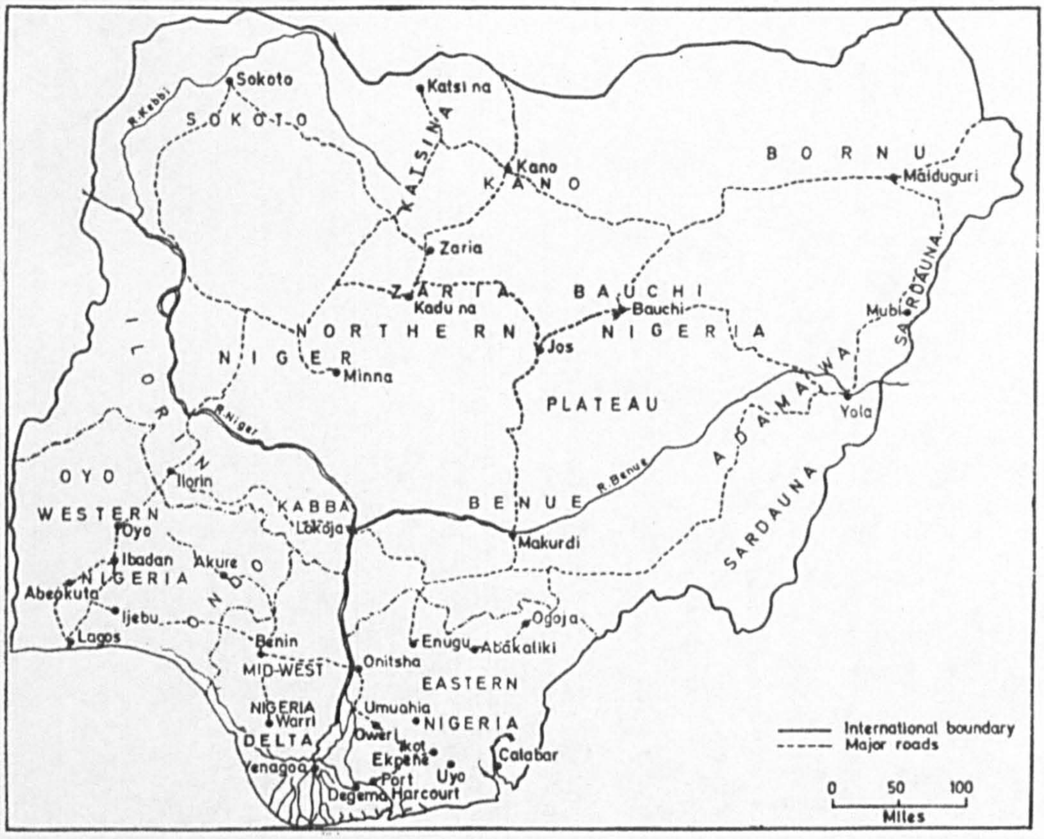
[36] Kuczynski, *Demographic Survey* (1948), p.430.
[37] *Ibid.*, p.445.
[38] Havinden and Meredith, *Colonialism and Development* (1993), p.9.
[39] MacMillan, *The Red Book of West Africa* (1968), pp.139-140.
[40] *Ibid.*, p.158.
[41] Havinden and Meredith, *Colonialism and Development* (1993), p.184.
[42] MacMillan, *The Red Book of West Africa* (1968), p.161.

of the colony, but Seccondee and Kumasi also served as trading bases.[43] Like Freetown and Bathurst, general import-export companies made up the majority of Accra's merchant community but some commercial diversity, with department stores, printers, motor engineers, architects and builders, and businesses dedicated to the cocoa trade made it more varied.[44]

Nigeria (see figure i.4 on page nineteen) did not become an official British colony until later in the nineteenth century, although there were British missionaries and traders present in earlier decades. The British claimed Lagos in 1861 and made the rest official as Nigeria in 1914.[45] As a result of World War One, it absorbed part of the mandated German colony of Cameroon. As with the other three colonies, Nigeria's population statistics are unreliable. The census recorded the total population of the Municipal Area of Lagos without distinguishing between racial groups: 73,766 in 1911; 99,690 in 1921; and 126,108 in 1931.[46] The figures for the "non-native" population of Nigeria, including the Cameroons, were as follows: 3,618 in 1911; 4,115 in 1921; and 5,442 in 1931.[47] It was the largest colony of West Africa, consisting of 373,250 square miles.[48] The coastline ran for 500 miles, lined with mangrove forest and swamp. Beyond the coast lay a strip of dense forest from fifty to one hundred miles wide. The interior was more open with hilly ground followed by a large plateau.[49] The rainy season extended from April until October.

[43] Kumasi was alternatively spelt Coomassie during this period, I shall use the former throughout the thesis. There were also different spelling variations of Seccondee, including Sekondi. I shall use the former.
[44] MacMillan, *The Red Book of West Africa* (1968), pp.172-212.
[45] Havinden and Meredith, *Colonialism and Development* (1993), pp.74-75.
[46] Kuczynski, *Demographic Survey* (1948), p.577.
[47] *Ibid.*, pp.612-613. See also for precise definitions of the "non-native" population in relation to these statistics.
[48] Havinden and Meredith, *Colonialism and Development* (1993), p.9.
[49] MacMillan, *The Red Book of West Africa* (1968), pp.19-20.

Figure i.4: Nigeria, showing the principal towns of the colony, together with sites of yellow fever epidemics



Source: R. Schram, *A History of the Nigerian Health Service* (Ibadan: University Press 1971), p.2.

Again, agriculture dominated with cassava, groundnuts, maize, sweet potatoes and yams grown for domestic use. Nigeria also had productive tin mines on the Bauchi Plateau, which Europeans began exploiting at the turn of the twentieth century employing 21,568 workers by 1920. Tin was also mined in Ilorin, Yola and Calabar. The government mined coal at Enugu.[50] Palm kernels dominated exports throughout the period studied, although declined in significance in later decades. They accounted for 51.8 per cent of exports in the period 1899-1901, and only 21.9 per cent by 1934-1938. Other chief exports included kola, palm oil, joined by iron ore in the late 1930s.[51] Lagos was the capital and the primary port of the colony. Its municipal area included the Island of Lagos, Iddo Island, Ebute-Metta, Apapa and Victoria. Other ports of importance included Forcados and Burutu on the mouth of the Niger, and Port Harcourt and Calabar. The cities of Ibadan, Ilorin, Kaduna, Kano, Lokoja and Yola were significant for commerce.[52] Commercial activities in Lagos represented the needs of the European population and the industries of the colony. General merchants abounded. Specialists included book suppliers and makers of cold storage facilities. The Elder Dempster Shipping Company had premises in the city which boasted the only interior marble walls in West Africa. Motor car and motor part importers, auctioneers, pawnbrokers, suppliers to the tin mines, builders and hide exporters all traded in the city.[53] As in the other three British West African colonies, the racial make-up of the commercial community was diverse, consisting of Europeans, Syrians, and indigenous Africans.

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[50] *Ibid.*, p.47.
[51] Havinden and Meredith, *Colonialism and Development* (1993), p.184.
[52] MacMillan, *The Red Book of West Africa* (1968), p.52.
[53] *Ibid.*, pp.63-118.

The scourge: yellow fever in West Africa

Yellow fever had been feared as a particular scourge since Europeans began to explore West Africa. Assessing incidence is difficult because of unreliable or absent statistics, and difficulties with diagnosis. P. Curtin claims that yellow fever and malaria were the main killers in West Africa in the late eighteenth to the mid-nineteenth centuries: malaria possibly the most significant.[54] Yellow fever maintained its grip on the region in the nineteenth century and mortality in the small European communities remained high. There were five recorded epidemics of the disease in the Gambia, four in Sierra Leone and at least one serious epidemic in the Gold Coast.[55] The devastating effect of the disease was undeniable; an epidemic in Sierra Leone from 1822 to 1823 prompted one resident to write:

> What a scene of woe does this Colony present just now! Widows lamenting the deaths of their husbands, families mourning for the loss of parents. Everything seems to conspire against this unfortunate colony, which is now visited by one of the most baneful fevers that was ever seen in this or any other place. Trade is depressed beyond all former precedent and nothing but misery and despair seems to be depicted in the countenance of the few Europeans who yet remain. Nearly eighty gentlemen have died within six weeks.[56]

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[54] P. Curtin, " 'The White Man's Grave': Image and Reality, 1780-1850", *Journal of British Studies* **1** (1961), p.95.
[55] R. Boyce, "Recent Outbreak of Yellow Fever in West Africa", in *Correspondence Relating to the Recent Outbreak of Yellow Fever in West Africa.* p.4. Cd. 558, 1911; Kuczynski, *Demographic Survey* (1948), pp.384-385.
[56] Kuczynski, *Demographic Survey* (1948), p.294.

The disease maintained this image into the twentieth century. When confronted with the possibility that a recent spate of illness in her locality in Kukuruku in 1928, may have been yellow fever, Mrs W.E. Evans commented: "We were very shaken by this. It had not occurred to us that the sickness could be yellow fever, the dreaded killer of the West Coast, the Panama Canal and other tropical places".[57] However, statistics suggested that the disease was in decline from the start of the twentieth century (problems with these statistics will be discussed later). Sierra Leone, which suffered several epidemics in the nineteenth century, enjoyed a relative freedom from recorded cases in the first half of the twentieth century. Except for the epidemic of 1910 which saw ten occurrences of the disease, reported cases in Sierra Leone were rare until 1935 when the CMS only diagnosed two cases, but suspected a further sixteen among the indigenous population.[58] The Gambia also tended to suffer from sporadic epidemics; there were eleven cases from three separate epidemics in 1911, yet unlike Sierra Leone, cases were recorded in the Gambia during the 1920s: five in 1922, and four in 1928. The last time yellow fever struck the colony was during the epidemic in 1934 which resulted in five cases, and an additional victim early in 1935.[59]

The situation was somewhat different in the other two colonies. Figure i.5 on page twenty three shows that yellow fever was recorded regularly in the Gold Coast and Nigeria during the period.

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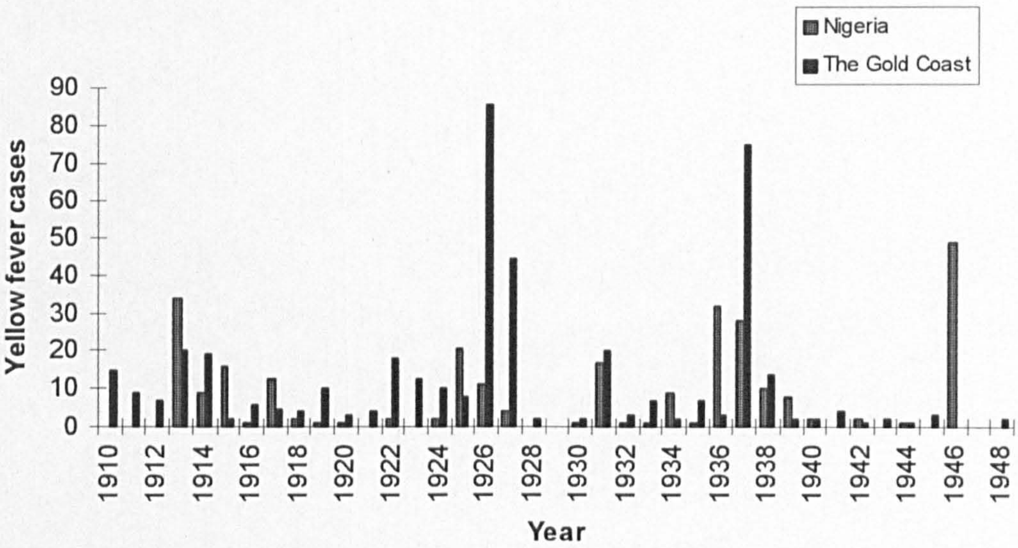
[57] Rhodes House Library, Oxford. MSS Afr.s.1165. W.E. Evans, "Rockefeller Foundation Yellow Fever Commission Expedition to Kukuruku, Nigeria, 1928". A team of researchers from the IHD investigated the epidemic. Mrs Evans was convinced that they had diagnosed yellow fever, but the reports of the RF suggest that they had ruled out the disease.
[58] *Sierra Leone Annual Medical Reports, 1910-1948.*
[59] *Gambia Annual Medical Reports, 1910-1948.*

Figure i.5: Yellow fever cases by year in Nigeria and the Gold Coast, 1919-1948



Source: *Annual Reports of the Medical Departments of Nigeria and the Gold Coast, 1910-1948.*

As the graph reveals, only small numbers were involved; in both colonies yellow fever cases only exceeded twenty on five separate occasions. These figures contrast with the sheer scale of epidemics of other diseases during this period. For example, medical authorities in the Gold Coast estimated that over 10,000 people died during an epidemic of cerebrospinal meningitis in 1907.[60] Despite yellow fever's statistical insignificance in comparison to other epidemic diseases, the colonial medical community in Britain and West Africa considered that only a handful of cases in one locality constituted an epidemic, and responded accordingly: a pattern repeated throughout this period. It also contrasts with endemic diseases such as malaria which

[60] Kuczynski, *Demographic Survey* (1948), p.491.

created consistently high levels of morbidity and mortality. For example, in the Gold Coast, cases of malaria for the same period (1910 to 1948) occurred by the thousand, and constantly increased: 2,817 in 1910, 4,696 in 1920, 24,972 a decade later and reaching 78,831 in 1948.[61] However, yellow fever was capable of attracting significant medical and colonial attention. The thesis examines the reasons for this situation. They include a belief throughout the medical community that yellow fever statistics belied the true picture of incidence with many cases being unreported or undiagnosed. The notion that whites were particularly susceptible to the disease is also significant in explaining medical reactions. Its assumed epidemiology thus corresponded with and reinforced the principal purpose of the CMS: the protection of white health.

Historiography and themes

The major themes of this thesis engage with other historical accounts. The supporting historiography for an analysis of yellow fever in West Africa includes general histories of medicine and tropical medicine, in addition to those which focus on disease and health care in specific localities, particular diseases, and the concepts of infectious and epidemic diseases. Histories of twentieth century colonialism, and West Africa are also important. All these historiographies have undergone considerable revision since the 1950s. The shift from a whiggish approach to a more analytical focus has been well documented. G. Brieger provides a useful overview of

[61] S. Addae, *Evolution of Modern Medicine in a Developing Country: Ghana, 1880-1960* (Durham: Durham Academic Press, 1996), p.485.

historiography of medical history,[62] and R. Macleod offers a brief account of historical studies of tropical medicine prior to the 1980s in the introduction to his edited collection of essays on tropical medicine.[63] Historical studies of empire and the colonies themselves have moved from celebratory, anglo-centric political histories through apologistic accounts, to what J. MacKenzie claimed in 1990 to be a more mature approach.[64]

A new agenda in the history of tropical medicine emerged with the publication of two edited volumes by Macleod and M. Lewis, and D. Arnold.[65] They both demonstrate a deeper level of social, cultural, political, racial and economic analysis than most earlier accounts. Macleod and Lewis cover a vast amount of geographical territory and address "imperial" rather than "tropical" medicine with the inclusion of accounts of medicine in the white settler colonies such as Australia. They claimed that there was little coherence among studies of imperial medicine but identified three themes in the relationship between medicine and empire: medicine as a "tool of empire"; the CMS upholding the sanitary order as part of the established colonial order; and the nature of the practice of medicine in the colonies in temperate zones.[66]

[62] G. Brieger, "The Historiography of Medicine", in Bynum and Porter, *Companion Encyclopedia* (1993), pp.24-44.
[63] R. Macleod "Introduction", in *idem* and M. Lewis (eds.) *Disease, Medicine and Empire: Perspectives on Western Medicine and the Experience of European Expansion* (London: Routledge, 1988), pp.4-6.
[64] J.M. MacKenzie, "Introduction" in *idem* (ed.), *Imperialism and the Natural World* (Manchester: Manchester University Press, 1990), p.2. See essays in R. Winks (ed.), *Oxford History of the British Empire. Vol. V: Historiography* (Oxford: Oxford University Press, 1999) for historiographical trends in colonial and African studies, in particular, A.D. Roberts, "The British Empire in Tropical Africa: A Review of the Literature to the 1960s", pp.463-485; and A.G. Hopkins, "Development and the Utopian Ideal", pp.635-652.
[65] Macleod and Lewis, *Disease, Medicine and Empire* (1988); D. Arnold (ed.), *Imperial Medicine and Indigenous Societies* (Manchester: Manchester University Press, 1988).
[66] Macleod, "Introduction", in *idem* and Lewis, *Disease, Medicine and* Empire (1988), pp.2-3. D. Headrick first examined the notion of tropical medicine as a tool of empire in his examination of the impact of science and technology on the colonising process, D. Headrick, *The Tools of Empire: Technology and European Imperialism in the Nineteenth Century* (Oxford: Oxford University Press,

Certainly, efforts against yellow fever can be regarded in the context of the first theme, as they attempted to safeguard the health of whites, particularly colonial officials.

My thesis engages with many of the themes explored in Arnold's edited volume, which was restricted to medicine in the tropical colonies and India. He asserts that the discipline's value lies not in what the research reveals about medicine and disease, but how they inform about the imperial rulers, their methods, priorities, preoccupations and limitations.[67] The yellow fever case study explores many of these factors. I will demonstrate that the "imperial rulers" as they relate to yellow fever were not a monolithic group, but one embodying a variety of colonial attributes. They prioritised the maintenance of white health in urban centres, and were limited by money and other resources including specialist personnel.

However, my thesis is not intended to be a study of colonialism in West Africa. It is an examination of the interaction of medicine, professions and populations in a given region, using medicine as a case study, rather than a study of the colonising process itself. This approach is best illustrated by comparing two separate accounts of medicine in nineteenth century India by Arnold and M. Harrison.[68] I intend to present a study along the lines of Harrison's analysis, which focuses on the development of public health in India. He addresses the more recent themes which emerged in the Arnold and Macleod and Lewis volumes, including the notion of colonial medicine as

1981). In a later study he went on to assess how these technologies were transferred from the mother country to the colonies, *idem*, *The Tentacles of Progress: Technology Transfer in the Age of Imperialism* (Oxford: Oxford University Press, 1988).
[67] D. Arnold, "Introduction", in *idem*, *Imperial Medicine* (1988), p.2. He returns to this theme in later studies, for example, *idem*, *Colonizing The Body: State Medicine and Epidemic Disease in Nineteenth Century India* (Berkeley: University of California Press, 1993).
[68] M. Harrison, *Public Health in British India: Anglo-Indian Preventive Medicine* (Cambridge: Cambridge University Press, 1994); Arnold, *Colonizing The Body* (1993).

a tool of empire, medicine as an instrument of social control and the interaction of colonial medicine and the indigenous population. He assesses the provision for, and providers of medical services in India to create a history of public health, set within its wider social and political context.[69]

Arnold emphasises the indigenous response to western medicine. He implicitly denies that his book is a history of medicine in India, rather it: "is a study of the colonizing process" of which medicine is only one example.[70] He contends that western medicine in India was a highly influential force in the management and direction of colonial power. Arnold bases this argument more on the power and influence of medical discourse in shaping the way the British perceived Indians, rather than on direct medical intervention in the lives of the indigenous people.

Arnold and Harrison provide differing interpretations of colonial medicine in India. Arnold stresses the power and influence of Western medicine and medical discourse and portrays the British medical profession in India as an authoritative, powerful force in colonial rule. Harrison offers a less aggressive account. He describes a medical service undermined by professional strife and dispute, a political regime unable to fully commit itself to medical reform fearing political unrest, and health measures that did little to consolidate colonial rule. However, both agree that medical discourse was a powerful factor in shaping Western perceptions of, and reactions to, Indians. For Arnold, this is the central focus of the argument. For Harrison, medical discourse represents only part of his analysis of western medicine in India, hence the different interpretations. I intend to present an account following

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[69] Harrison, *Public Health in British India* (1994), p.1.
[70] Arnold, *Colonizing the Body* (1993), pp.7-8.

Harrison's approach, focusing on medical providers and practice, rather than on the colonising process.

West Africa is the location for my study. Looking specifically at medicine and disease in the region, the role of the Colonial Office, colonial governments, and the CMS has received sporadic historical attention. There are, for instance, some convincing accounts of the practice of segregation in West Africa (to be discussed later) and other attempts at sanitary reform in the early twentieth century.[71] However, there are few major works relating to the practices and policies in West Africa of formal colonial institutions and independent groups; nothing comparable to Arnold's and Harrison's studies of India. R. Schram has outlined the history of the CMS in Nigeria.[72] K.D. Patterson examined disease in Ghana, concentrating on morbidity and mortality, although there is a limited level of economic and social analysis.[73] Useful details are provided by Stephen Addae's account of the development of western medicine in Ghana.[74] He attempts to provide a systematic study of the development of medical services in the colony. As such, he examines many aspects of colonial medicine and provides useful statistical data, although he does not engage with the recent historiographical agenda. Useful unpublished sources include T.S. Gale's

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[71] For example see, R.E. Dumett, "The Campaign Against Malaria and the Expansion of Scientific Medical and Sanitary Services in British West Africa, 1898-1910", *African Historical Studies* **1** (1968), pp.153-195; T.S. Gale, "The Struggle Against Disease in the Gold Coast: Early Attempts at Urban Sanitary Reform", *Transactions of the Historical Society of Ghana* **16** (1995), pp.185-203. See also R. Dumett, "Disease and Mortality Among Gold Miners of Ghana: Colonial Government and Mining Company Attitudes and Policies, 1900-1910", *Social Science and Medicine* **37** (1993), pp.213-232.

[72] R. Schram, *A History of the Nigerian Health Services* (Ibadan: University Press, 1971).

[73] K.D. Patterson, *Health in Colonial Ghana: Disease, Medicine and Socio-Economic Change, 1900-1955* (Massachusetts: Crossroads Press, 1981).

[74] Addae, *The Evolution of Modern Medicine* (1996).

thesis, and to a lesser extent, that of F.E. Nkwam.[75] Such patchy cover leaves considerable scope for further investigations.

This thesis examines the action taken against a single disease. Such disease centred approaches feature in the secondary literature and can be used to address a range of issues. Recent examples include M. Lyons's examination of sleeping sickness epidemics; and J. Farley's study of Bilharzia.[76] A disease centred focus is particularly useful for studying yellow fever because it tends to be lost in general accounts due to its relative statistical insignificance when compared with, for example, malaria and smallpox.

The disease in West Africa has been neglected in the historiography. Many historians focus on the RF's anti-yellow fever efforts in South America, examining in particular, control measures and their impact on local communities.[77] Others have assessed the disease in other locations. Looking at nineteenth century control efforts in the Southern States of America, M. Humphreys also analyses yellow fever within an institutional framework, suggesting the value of examining medical institutions. She links the incidence of the disease in the region with the growth of federal public

[75] T.S. Gale, "Colonial Medical Policy in British West Africa 1870-1930", (D.Phil.: University of London, 1973); F.E. Nkwam, "British Medical and Health Policies in West Africa, 1920-1960", (PhD: University of London, 1988).
[76] M. Lyons, *The Colonial Disease: A Social History of Sleeping Sickness in Northern Zaire, 1900-1940* (Cambridge: Cambridge University Press, 1992); J. Farley, *Bilharzia: A History of Imperial Tropical Medicine* (Cambridge: Cambridge University Press, 1991).
[77] M. Cueto, "Sanitation From Above: Yellow Fever and Foreign Intervention in Peru, 1919-1922", *Hispanic American History Review* 72 (1992), pp.1-22; and *idem*, "The Cycles of Eradication: The Rockefeller Foundation and Latin American Public Health, 1918-1940", in P. Weindling (ed.), *International Health Organisations and Movements, 1918-1939* (Cambridge: Cambridge University Press, 1995), pp.223-243; S.C. Williams, "Nationalism and Public Health: The Convergence of Rockefeller Foundation Technique and Brazilian Federal Authority During the Time of Yellow Fever, 1925-1930", pp.23-51; A. Solorzano, "The Rockefeller Foundation in Revolutionary Mexico: Yellow Fever in Yucatan and Veracruz", pp.52-71. Both in M. Cueto (ed.), *Missionaries of Science: The Rockefeller Foundation and Latin America* (Bloomington: Indiana University Press, 1994).

health facilities, arguing that epidemics of yellow fever stimulated their creation and expansion. [78] H. Bell's analysis of yellow fever in the Anglo-Egyptian Sudan reveals a similar pattern, and she contends that it prompted an extension of sanitary services to urban areas in Southern Sudan.[79] These create an interesting contrast with my findings in West Africa. I argue that yellow fever had only a temporary effect on medical and sanitary provision and assess the reasons for this disparity.

Bell also engages with the growth of knowledge and research as she focuses on immunological developments relating to yellow fever during 1930s and their application in the Anglo-Egyptian Sudan. This permits useful parallels with my study which explores their relevance in the West African context, revealing varying experiences and perceptions between the two regions. F. Delaporte concentrates on an earlier episode in the development of understanding of the disease.[80] He examines the events surrounding the discovery of the mosquito vector, in particular the role played by elements of the disciplines of tropical medicine, parasitology, entomology and epidemiology. W. Coleman also focuses on epidemiology in his examination of three separate epidemics in Europe: in Gibraltar, Swansea, and Saint-Nazaire in France.[81] He provides a comparative analysis of the epidemiological methods used in three different epidemics, outlining the development of epidemiological knowledge and the numerous factors that effected methodology. He clearly states that his intention is not to provide a history of the disease, nor to examine aspects of disease control or the consequences of disease but to use these epidemics to offer insights

[78] Humphreys, *Yellow Fever and the South* (1999).
[79] H. Bell, *Frontiers of Medicine in the Anglo-Egyptian Sudan, 1899-1940* (Oxford: Oxford University Press, 1999), p.178.
[80] Delaporte, *The History of Yellow Fever* (1991).
[81] Coleman, *Yellow Fever in the North* (1987), p.14; see also L.A. Sawchuk and S.D.A. Burke, "Gibraltar's 1804 Yellow Fever Scourge: The Search For Victims", *Journal of the History of Medicine and Allied Sciences* **53** (1998), pp.3-42, for a European experience of the disease.

into the development of the discipline of epidemiology. As I will demonstrate in subsequent chapters, yellow fever research during the 1930s and 1940s reflected changing epidemiological methods. I. Löwy assesses the impact of such changes on the RF's differing methodology in Brazil during the 1920s and 1930s.[82] This allows a comparison of the RF's research and control techniques in South America and West Africa. Two preoccupations of my thesis are common to much of the literature: the practice of control efforts; and the development of knowledge and medical technologies. The concentration on the latter attempts to address the scientific aspects of yellow fever control: an approach that M. Malowany has recently advocated when asking: "what is medical about the history of medicine in sub-Saharan Africa?".[83] She calls for a recognition that: "the role and nature of science and research are significant", and for histories of health and disease in Africa that address science, medicine and epidemiology. This thesis agrees with the directions highlighted by Malowany.

Yellow fever was widely acknowledged to exist in endemic and epidemic form in West Africa. With its immunological approach, the RF had a persistent interest in endemic yellow fever which the British did not share. For the majority of the period studied, it was the more dramatic epidemics of yellow fever that prompted action by the British medical community and colonial authorities. I therefore engage with the

[82] I. Löwy, "Epidemiology; Immunology and Yellow Fever: The Rockefeller Foundation in Brazil, 1923-1939", *Journal of the History of Biology* 30 (1997), pp.397-417. Löwy has written extensively about the disease in South America, see *idem*, "What/Who Should be Controlled? Opposition to Yellow Fever Campaigns in Brazil, 1900-1939", in Cunningham and Andrews, *Western Medicine as Contested Knowledge* (1997), pp.124-146; *idem*, "Yellow Fever in Rio de Janeiro and the Pasteur Institute Mission, (1901-1905): The Transfer of Science From the Metropole to the Periphery", *Medical History* 34 (1990), pp.144-163.

[83] M. Malowany, "Unfinished Agendas: Writing the History of Medicine of Sub-Saharan Africa", *African Affairs* 99 (2000), pp.325-349. I would like to thank Dmitri van den Bersselaar for drawing my attention to this reference.

considerable secondary literature on epidemic diseases. Historians have analysed epidemic diseases in tropical and temperate settings, with the focus on more dramatic diseases such as cholera, smallpox, yellow fever and plague.[84] Many of these, including yellow fever, existed in endemic form in the tropics, occasionally erupting into epidemics, yet only manifested in epidemic form in the west.

Epidemics tend to be well documented and represent a dramatic crisis point within a society. Rosenberg argues the history of epidemics is profound: "an epidemic, if sufficiently severe, necessarily evokes responses in every sector of society. ... Values and attitudes, especially in the areas of science, religion, and traditionalism and innovation, for example, are inevitably displayed during an epidemic".[85] Epidemics offer windows on a society in crisis. Therefore, studying epidemic diseases such as yellow fever is a fruitful means of exploring aspects of a given society. In this study, I use yellow fever epidemics to illustrate the nature of medicine and health care in West Africa. I will apply Rosenberg's framework for examining a community's response to an epidemic in chapter two, establishing that yellow fever mirrored and diverged from his model.[86]

The medical and colonial response to epidemic yellow fever reveals much about their notions of disease, Africa and the indigenous population. It also

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[84] T. Ranger and P. Slack (eds.), *Epidemics and Ideas: Essays on the Historical Perspective of Pestilence* (Cambridge: Cambridge University Press, 1992); A. Hardy, *The Epidemic Streets: Infectious Disease and the Rise of Preventive Medicine, 1856-1900* (Oxford: Clarendon Press, 1993) provides an analysis of several epidemic diseases. Cholera has also generated several excellent studies: M. Pelling, *Cholera, Fever and English Medicine, 1825-1865* (Oxford: Oxford University Press, 1978); R.J. Evans, *Death in Hamburg: Society and Politics in the Cholera Years, 1830-1910* (Oxford: Clarendon Press, 1987); and F. Delaporte, *Disease and Civilisation: The Cholera in Paris, 1832* (London: MIT Press, 1986). More recently, the contemporary problem of AIDS has come under historical investigation. The collection of essays in the volume by E. Fee and D. Fox (eds.), *AIDS: The Burdens of History* (Berkeley: University of California Press, 1988) are a good example of this genre.

[85] C.E. Rosenberg, *Explaining Epidemics and Other Studies in the History of Medicine* (Cambridge: Cambridge University Press, 1992), p.110.

[86] *Ibid.*, pp.280-287.

demonstrates the prioritisation of white health. This was profound in anti-yellow fever efforts, as whites were considered to be particularly susceptible to the disease. This is a common theme in the literature. In an interesting departure from studies of dramatic epidemic diseases, S. Hewa examines epidemic hookworm in colonial Sri Lanka.[87] Hewa demonstrates that despite high mortality, the colonial authorities in Sri Lanka were reluctant to deal with a hookworm epidemic as it did not threaten Europeans. As a reverse example, this illustrates a prevailing hypothesis of my analysis of yellow fever: that European mortality was often a prerequisite for colonial medical action.

In the context of epidemic and endemic yellow fever, the prioritisation of European health was reinforced by the belief that Africans were a reservoir of the disease, and as such were a potential threat to European health. This led to a level of social control under the remit of protecting Europeans from this source of risk. This is a popular topic. M. Swanson has revealed how the colonial authorities in South Africa were able to manipulate the preoccupation with white health, which in his study, was associated with a fear of plague. They employed medical rhetoric to associate Africans with epidemic disease, thereby presenting Africans as a major threat to the well-being of whites. This created what Swanson termed a "sanitation syndrome", with Africans being perceived as a reservoir of disease, mirroring beliefs relating to the indigenous population and yellow fever. The colonial authorities used this to legitimise the implementation of the political and racial goal of black and white urban segregation.[88] J. Cell and P. Curtin have explored the segregation of the indigenous

[87] S. Hewa, "The Hookworm Epidemic on the Plantations in Colonial Sri Lanka", Medical History **38** (1994), pp.73-90. See also *idem*, *Colonialism, Tropical Disease and Imperial Medicine: Rockefeller Philanthropy in Sri Lanka* (Lanham: University Press of America, 1995).
[88] M. Swanson, "Sanitation Syndrome: Bubonic Plague and Urban Native Policy in the Cape Colony, 1900-1909", *Journal of South African Studies* **18** (1977), pp. 387-410; see also S. Parnell, "Creating Racial Privilege: The Origins of South African Public Health and Town Planning Legislation", *Journal of Southern African Studies* **19** (1993), pp.471-488.

population and whites in West Africa.[89] Their work examines how the colonial authorities used medical theory and research as a powerful tool to promote and defend racial segregation in West Africa as a preventive measure against malaria. These articles provide useful parallels to my analysis as they assess action against a mosquito borne disease in West Africa. As I will demonstrate, the medical community frequently advocated segregation as an anti-yellow fever measure, rationalised by notions of Africans as reservoirs of yellow fever infection.

Rosenberg, and many other historians of epidemic disease such as R. Evans have highlighted the importance of notions of susceptibility, another theme occurring in my analysis of yellow fever. Frequently, wider society has accused victims of causing their misfortune by certain behaviours and/or attributes which have made them more vulnerable to disease. This usually had moral implications. For example, in nineteenth century Europe, too much alcohol, rich food or sex was believed to leave a person susceptible to cholera.[90] Over 100 years later, AIDS patients in the 1980s have been vilified for their sexual habits or drug addition which are implicated in HIV transmission. An analysis of yellow fever does not fit this model, as vulnerability was assessed predominantly in an immunological rather than a behavioural context.

My account is presented within an institutional framework. Yellow fever control in West Africa involved the interaction of several research groups and medical care providers at international, national and local levels. This approach will provide an

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[89] P. Curtin, "Medical Knowledge and Urban Planning in Tropical Africa", *American Historical Review* 90 (1985), pp.594-613; J.W. Cell, "Anglo-Indian Medical Theory and the Origins of Segregation in West Africa", *American Historical Review* 91 (1986), pp.307-335. See also O. Goerg, "From Hill Station (Freetown) to Downtown Conakry (First Ward): Comparing French and British Approaches to Segregation in Colonial Cities in the Beginning of the Twentieth Century", *Canadian Journal of African Studies* 32 (1998), pp.1-31.
[90] Rosenberg, *Explaining Epidemics* (1992), p.114.

account of the different medical responses to, and perceptions of yellow fever and appraise the actions of the various colonial and medical agencies. The formal institutions of the colonial regime involved in medicine and disease control in West Africa were the CMS, the colonial governments and the Colonial Office. These are assessed using official material found in the Public Record Office at Kew and official parliamentary publications and command papers.

The annual reports of the CMS give much valuable information. Obviously, using *Annual Medical Reports* involves a methodological bias, as they are written to inform a selected audience. The data included will necessarily depend on the author and the intended readership. Information will have been edited and presented to show events in a certain desired light. Empirical data from West Africa as found in the *Annual Medical Reports* tends to be unreliable owing to the limited collection of vital statistics. Recordings of births, deaths and marriages were scanty and varied in quality during this period. Data for the white population, particularly colonial officials and the military, can be regarded as more accurate. The *Annual Medical Reports* of the colonies presented medical statistics derived from hospital and occasionally dispensary records. These usually recorded disease incidence, details of surgery performed and wounds treated. Sometimes, patients were categorised by race and gender. Only diseases that came under the gaze of western medical practitioners were noted. Contemporaries and historians have documented the reluctance of Africans to seek treatment for their illnesses during this period: a tendency which left an indeterminate amount of illness unseen and unreported. The statistics also varied in quality; for example, *Annual Medical Reports* lost much detail during World War Two.

The potential for misdiagnosis of yellow fever also affects the reliability of extant statistics. The disease was notoriously difficult to diagnose clinically and many experts claimed that mistakes were common. Post-mortem pathological diagnosis was possible. Laboratory diagnosis for surviving patients only became available in the 1930s. Contemporaries were aware of these problems and authors of *Annual Medical Reports* did not hesitate to state if they thought statistics were providing an inaccurate picture of morbidity and mortality. Based on their qualitative impressions they often claimed that statistics underrepresented levels of yellow fever. However, not all misdiagnoses of yellow fever were accidental. In the earlier part of this period, medical practitioners were often reluctant to diagnose the disease as the consequent measures were usually highly disruptive and unpopular.

Statistics were at their best in urban areas with a colonial presence. They represent a limited and discrete disease environment. This is also true of the non-statistical evidence. Large areas of Africa did not come under the colonial medical gaze and thus the experience of disease in such regions cannot be reconstructed using colonial sources.[91] Therefore, this study of yellow fever in West Africa is mainly a study of yellow fever as it occurred in colonial centres, rather than in the hinterland. It was also here that the commercial pressures of yellow fever, via quarantine, were most noticeable.

Official and non-official sources are very much products of their time, and were written by men who existed and operated within the racist regime of colonialism. Belief in the innate moral and intellectual superiority of whites and the ignorance and

[91] This was the case for other diseases in West Africa. J.W.S. Macfie of the Colonial Medical Research Laboratory in Accra commented that many diseases of the Gold Coast go unrecorded, except perhaps in coastal towns where there was a concentration of western medical practitioners. J.W.S. Macfie, "The Prevalent Diseases of the Gold Coast", *TRSTMH* 16 (1922), p.156.

primitive nature of Africans permeated all levels of society.[92] This is inevitably reflected in the sources. A.L. Stoler and F. Cooper reflect that: "We are confronted with the obvious fact that every document in a colonial archive is - no matter how ignorant its author was of indigenous society or how unimportant his ideas were to future policy - layered with the received account of earlier events and the cultural semantics of a political moment".[93] Cooper and Stoler claim that these sources are too limiting if a fuller understanding of colonialism is to be achieved and that: "we cannot just *do* colonial history based on our given sources".[94] They call for the creation of "new archives of our own".[95] Such an approach using new sources would indeed create rich varieties of colonial history. However, we cannot reject the intrinsic value of official archival sources, for all their faults they constitute fruitful sources of data which serve to illuminate many, but not all, aspects of colonialism and tropical medicine.

As the varied and extensive historiography illustrates, official and non-official sources have been used effectively in studies of many aspects of colonialism. These are too diverse to detail but those particularly pertinent to this thesis have been histories which provide an overview of the political, social and economic context of colonialism. General studies, such as B. Porter's *The Lion's Share*, which analyses the wider aspects of British imperialism, outline the colonial process.[96] Histories of

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[92] For analyses of racism in British society see N. Stepan, *The Idea of Race in Science: Great Britain, 1800-1960* (Basingstoke: Macmillan Press, 1982); and K. Malik, *The Meaning of Race: Race, History and Culture in Western Society* (Basingstoke: MacMillan Press, 1996).
[93] A.L. Stoler and F. Cooper, "Between Metropole and Colony: Rethinking a Research Agenda", in F. Cooper and A.L. Stoler (eds.), *Tensions of Empire: Colonial Cultures in a Bourgeois World* (Berkeley: University of California Press, 1997), p.17.
[94] *Ibid.*, p.18.
[95] *Ibid.*, p.16.
[96] B. Porter, *The Lion's Share: A History of British Imperialism, 1850 to 1995* (London: Longman, 1996). *The Oxford History of the British Empire. Vols. I-V* (Oxford: Oxford University Press, 1999) has a large collection of essays on colonialism. J.M. MacKenzie has edited the *Studies in Imperialism* series: a collection of volumes about various aspects of colonialism, including medicine (Arnold's

twentieth century colonial West Africa are somewhat dated. The Cambridge History of Africa has bibliographic essays,[97] and M. Crowder has written extensively on the region, particularly Nigeria, and edited several collections.[98] J. Fage has also provided an overview of West African history.[99] Histories of individual colonies are quite numerous and discuss issues such as tribal identity, agriculture, economics, and legislation.[100]

Economic histories have also been useful. M. Havinden and P. Meredith examine the impact of colonialism on the development of Britain's tropical colonies from 1850 to 1960.[101] A.G. Hopkins looks at the economics of British West Africa, providing specific information on the financial position of the four colonies and has extended his economic analysis to the British empire.[102]

Imperial Medicine and Indigenous Societies (1998) was part of this series), propaganda, the natural sciences, hunting and conservation, sexuality and language. See also D. Engels and S. Marks (eds.), *Contesting Colonial Hegemony: State and Society in Africa and India* (London: British Academic Press, 1994).

[97] J.D. Fage and R. Oliver (eds.), *The Cambridge History of Africa*, 8 vols, (Cambridge: Cambridge University Press, 1975-1986).

[98] See for instance, M. Crowder, *Colonial West Africa: Collected Essays* (London: Frank Cass, 1978); *idem, West Africa under Colonial Rule* (London: Hutchinson, 1981); Ajayi and *idem* (eds.), *History of West Africa* (1974); Crowder, *The Story of Nigeria* (London: Faber, 1962).

[99] J.D. Fage, *A History of West Africa: An Introductory Survey* (Cambridge: Cambridge University Press, 1969). J.M. Gray provides a history of the Gambia, J.M. Gray, *The Gambia* (London: Frank Cass, 1966).

Overviews of the Gold Coast history can be found in D. Kimble, A Political History of Ghana: The Rise of Gold Coast Nationalism, 1850-1928 (Oxford: Clarendon Press, 1965); and W.F. Ward, A History of Ghana (London: Allen and Unwin, 1967). For general accounts of the history of Sierra Leone see .R. West, *A History of Sierra Leone and Liberia* (London: Cape, 1970); and C. Fyfe, *A History of Sierra Leone* (London: Oxford University Press, 1968).E. Isichei, *A History of Nigeria* (London: Longman, 1983); and A. Burns, *A History of Nigeria* (London: Allen and Unwin, 1972) provide histories of Nigeria.

[100] See for example, D. van den Bersselaar, *In Search of Igbo Identity: Language, Culture and Politics in Nigeria, 1900-1966* (Leiden: Leiden University, 1998).

[101] Havinden and Meredith, *Colonialism and Development* (1993). See S. Constantine, *The Making of British Colonial Development Policies, 1914-1940* (London: Frank Cass, 1984) for a detailed examination of colonial development policies.

[102] A.G. Hopkins, *An Economic History of West Africa* (London: Longman, 1973); P.J. Cain and A.G. Hopkins, *British Imperialism. Vol. I: Innovation and Expansion, 1688-1914; Vol.II: Crisis and Deconstruction, 1914-1990* (London: Longman, 1993).

The practice of tropical medicine in West Africa involved institutions other than these formal representatives of empire. These non-official groups had diverse interests, reflecting educative, philanthropic or commercial aims. The LSTM, the Wellcome Bureau, the IHD of the RF, and the OIHP were all involved in yellow fever control in West Africa in some way. Sources about these institutions inevitably share some of the problems already discussed in relation to official material such as popular notions of racism, data selection and the difficulties associated with yellow fever diagnosis. Medicine and science have been assumed to be somehow "rational" and "pure", untainted by political, cultural or socio-economic forces in its pursuit of knowledge. However, they are as vulnerable to outside influences as much as any other social endeavour. Tropical medicine did not escape the prejudices of its time, and often reinforced and justified racial stereotypes and racist behaviour, as will be demonstrated throughout this thesis. Thus, all the sources used, be they colonial or medical in origin, will inevitably bear the hallmarks of the racial bias of the era. However, the sources consulted provide fascinating diversity for the study of yellow fever in West Africa.

The archive of the LSTM contains limited but valuable material. The annual reports of its laboratory in Sierra Leone and correspondence have been useful because of the involvement of its staff in yellow fever control. The RF archives at New York are a unique record of its research in West Africa. I referred to the annual reports of both the RF's research groups in West Africa, as well as extensive personal correspondence between its personnel in West Africa and New York. The series of special reports were also of use, particularly those of the RF expedition to the region. The annual reports of both institutions suffer the same biases of those of the CMS.

They were written to inform a specific audience and the material was selected and presented with this in mind. Non-official material held in the African collections at Rhodes House library at Oxford give individual rather than institutional perspectives. The Contemporary Medical Archives Centre at the Wellcome Library, London holds the records relating to the Yellow Fever West Africa Commission in the 1910s. These contain a variety of material, including minutes of the meetings of the YFWAC, correspondence between the colonial governments, the CMS, and the YFWAC, and reports relating to yellow fever from members of the CMS.

Recent historiography reflects the value of examining national and international non-official institutions and my thesis creates links between these various studies. There has been some useful work looking at international systems for disease prevention.[103] The Sanitary Conferences and the work of the OIHP are of particular relevance to yellow fever. Useful overviews of the two can be found in accounts by N. Howard Jones, in addition to earlier chapters in the WHO's official early history.[104] Historians have examined the motives behind the RF's philanthropy and direction of work.[105] E.R. Brown's assessment of the RF as a colonial institution and J. Farley's appraisal of the impact of the Director, Frederick Russell, have been pertinent to my analysis of the RF's work in West Africa.[106] The RF's numerous campaigns in South

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[103] Weindling, *International Health Organisations and Movements* (1995).
[104] N. Howard-Jones, *The Scientific Background of the International Sanitary Conferences, 1851-1938* (Geneva: WHO, 1975); *idem*, *International Public Health Between the Two World Wars: The Organisational Problems* (Geneva: WHO, 1978); The World Health Organisation, *The First Ten Years of the World Health Organisation* (Geneva: WHO, 1958).
[105] For a general history of the RF and the IHD see, J. Ettling, *The Germ of Laziness: Rockefeller Philanthropy and Public Health in the New South* (Cambridge, Mass.: Harvard University Press, 1981); R.B. Fosdick, *The Story of the Rockefeller Foundation* (London: Odhams Press, 1952); and G. Williams, *The Plague Killers* (New York: Charles Scribners Sons, 1969).
[106] E.R. Brown, "Public Health Programmes in Imperialism: Early Rockefeller Foundation Programmes at Home and Abroad", in J. Ehrenreich (ed.), *The Cultural Crisis of Modern Medicine* (New York: Monthly Review Press, 1978); J. Farley, "The International Health Division of the Rockefeller Foundation: The Russell Years, 1920-1934", in Weindling, *International Health Organisations* (1995), pp.203-221.

America have been the subject of a recent collection edited by M. Cueto which explores its efforts in medicine, agriculture, science and genetics in that region.[107] As the RF's work on yellow fever in West Africa constitute a central element in this thesis, accounts examining the RF's anti-yellow fever activities in South America are of particular value. They have permitted a comparative analysis of the RF's campaigns in South America and West Africa, incorporated in chapter three. *Yellow Fever* edited by G. Strode gives a thorough, if somewhat biased, account of the RF's work on the disease, with a series of essays written by Foundation personnel.[108] Focusing on the key moments in yellow fever control, it provides a narrative of events and activities and obviously celebrates the RF's efforts. There is no criticism of the wider social and economic implications. It goes beyond the laboratory and details control measures in the Americas and West Africa, but does not analyse the social and economic cost of the measures. The only mention of economics refers to the cost to the Foundation in terms of dollars, time and manpower.[109] Despite its obvious flaws, it provides painstaking details of many of the central developments in yellow fever epidemiology and control including vaccination and immunity tests. As already discussed, the work of Cueto and Löwy have contributed significantly to this area of historical research.

Historians have also focused on British institutions of tropical medicine. The Liverpool and London Schools of Medicine have been of particular interest: the former most applicable to my study. M. Worboys explores their effect on the foundation of the discipline, and its early agenda.[110] Most recently, the schools have

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[107] Cueto, *Missionaries of Science* (1994). See *Parassitologia* 40 (1998) for essays on the RF campaigns against malaria.
[108] Strode, *Yellow Fever* (1951).
[109] G. Strode, "Costs and Manpower", in *ibid.*, pp.631-639.
[110] M. Worboys, "Manson, Ross and Colonial Medical Policy: Tropical Medicine in London and Liverpool, 1899-1914", in Macleod and Lewis, *Disease, Medicine and Empire* (1988), pp.21-37.

been the subject of two monographs by H. Power and L. Wilkinson.[111] In Power's examination of the Liverpool experience, she places the history of the School within its wider context, providing an analysis of the development of the discipline of tropical medicine.[112]

Thesis outline

The institutional framework of the thesis is introduced in chapter one which explores the aims and motives of the principal research groups and health care providers involved in yellow fever control in West Africa. It demonstrates that tropical medicine was not a monolithic process but comprised of several local, national, and international groups, who interacted to some degree in their anti-yellow fever efforts. The groups had common and unique characteristics, including aspects of colonialism.

Chapter two focuses on local anti-yellow fever measures conducted by the CMS in West Africa who were charged with the task of controlling the disease, but limited their activities to concentrate on white health. This chapter focuses on the period from 1900 to 1930 before immunological developments changed the nature of yellow fever control methods. It explores the theoretical basis for the CMS's methods and understanding of the disease through their understanding of contemporary views

[111] H. Power, *Tropical Medicine in the Twentieth Century: A History of the Liverpool School of Tropical Medicine, 1898-1990* (London: Kegan Paul International, 1999); L. Wilkinson, *Prevention and Cure: The London School of Hygiene and Tropical Medicine. A Twentieth Century Quest for Global Public Health* (forthcoming).
[112] The Medical Research Council's role in tropical research has been assessed by J. Beinart, "The Inner World of Imperial Sickness: The MRC and Research in Tropical Medicine", in J. Austoker and L. Bryder (eds.), *Historical Perspectives on the Role of the MRC* (Oxford: Oxford University Press, 1989), pp.109-135.

on immunity and endemicity. In particular, it discusses the significance of western notions of African experiences of the disease in shaping control methods and the consequent implications for the indigenous population of West Africa. The chapter then examines measures commonly implemented, which illustrate the tendency of colonial medicine to prioritise white health and use medicine as a form of social control. I distinguish between efforts against its endemic and epidemic form and demonstrate that epidemics, despite the small numbers involved prompted the greater medical and colonial response. I contend that the CMS rarely sustained their actions against yellow fever without a visible presence of the disease.

Research efforts are the focus of chapter three, which appraises the work of the IHD of the RF, operational in Nigeria from 1925 to 1934. I argue that its aims were fluid, changing from the initial goal of eradication to research which was of little immediate use to West Africa, although there were valuable contributions to yellow fever epidemiology. Its work in West Africa was sensitive to several factors including developments in the RF's anti-yellow fever campaigns in South America and changes in the IHD's ethos and methods. There was a move away from practical control work to a concentration on basic scientific research and epidemiological studies. This analysis compares the goals and agendas of the RF's work in South America and West Africa; the concepts of yellow fever held by the RF and the CMS; and their approaches to disease control.

Chapter four investigates the immunological developments of the 1930s, protection tests and effective vaccines. These techniques represented a new dimension in yellow fever control; contrasting with measures discussed in chapter two which focused on controlling the mosquito vector. Protection tests enabled researchers to detect past infection and thus map endemic areas. Together with inoculation, they provided effective means to deal with endemic yellow fever. Protection tests located the endemic area, and inoculation helped to prevent endemic yellow fever sparking into an epidemic by reducing the number of susceptible people. Concentrating mainly on inoculation, I contend that the Colonial Office failed to devise a coherent strategy for its application, and the period was marked by uncertainty about its use, with conflict among the medical and colonial communities who were particularly concerned about safety and the question of compulsory inoculation.

The colonial and medical authorities confronted the limits of this haphazard approach during World War Two: the focus of chapter five. The war saw a transformation of the Colonial Office's role in yellow fever control, forcing metropolitan led campaigns and initiatives against the disease. Wartime necessities meant that yellow fever was too important to be left in the hands of colonial governments and medical services as had previously been the case. There was an expansion in understanding of yellow fever, as the colonial and medical communities recognised the threat presented by the endemic disease and extended their efforts to deal with this problem. A stark contrast to the confused attempts at using the new immunological techniques during the 1930s.

CHAPTER ONE

CONDUCTING RESEARCH AND PROVIDING MEDICAL CARE: PLAYERS IN THE YELLOW FEVER STORY AND THEIR INTERRELATIONSHIP

A historical study of colonial medicine is complex because it involves numerous institutions, which utilised a variety of expertise. It also incorporated a range of activities from filling puddles to prevent mosquito breeding, to overseeing vaccination campaigns and providing epidemiological surveillance.[1] Broadly speaking, there were two main thrusts to the endeavours of the discipline: first, medical research and second, medical practice embodying preventive and curative methods. The two did not always exist as separate and distinct categories, often the lines between researcher and practitioner became blurred. Medical personnel were required to be professionally versatile, particularly if financial and staffing resources were scarce. National and international efforts directed at medical research and practice in the tropics formed a largely uncoordinated venture. Throughout the tropical colonies, colonial authorities found they were only one of several bodies conducting research and practising medicine. Each operation reflected different agendas and methods and provided insights into national distinctions.

Behind these efforts lay various motives dictated by the institutions and individuals involved. As this thesis will demonstrate, tropical medicine was not a monolithic process, but rather a complex interaction of several groups and institutions. All worked within the colonial framework, some exhibiting varying

[1] H. Bell, *Frontiers of Medicine in the Anglo-Egyptian Sudan, 1899-1940* (Oxford: Clarendon Press, 1999), p.2.

aspects of colonialism; others, on occasion, facilitating colonial rule. The Colonial Office represented the formal machinery of the empire while others had subtler links to colonialism. For example, the RF demonstrated certain colonial characteristics: seeking to use medicine as a vehicle to consolidate its financial and political presence in a region. Others, such as the LSTM, occasionally served the interests and needs of the larger colonial administration, although existing outside its official mechanisms. However, J. Farley has noted a factor common to the various groups before World War Two: "As stated constantly at that time, the basic goal of tropical medicine was to render the tropical world fit for white habitation and white investment. Its practitioners were members of colonial services, armies of occupations, mining and fruit companies".[2] Certainly, concern for Europeans living or working in the tropics was a fundamental driving force behind tropical medicine. As the period advanced, there was an increased recognition of the need to protect the health of the indigenous population for both humanitarian and economic reasons. Standards of health had to be maintained if they were to continue to work productively. There were also less commercially driven activities which reflected an increasing humanitarianism in colonial medicine. For example, the CMS strove to provide child and maternal welfare facilities, albeit with an eye on the birth rate and infant mortality statistics.[3]

However, it is too simplistic to analyse tropical medicine as an agent of colonial forces alone. The reality was more complex, and tropical medicine operated

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[2] J. Farley, *Bilharzia: A History of Imperial Tropical Medicine* (Cambridge: Cambridge University Press, 1991), p.4.

[3] See M. Vaughan, *Curing Their Ills: Colonial Power and African Illness* (Cambridge: Polity Press, 1991), for an analysis of the interaction between the missionary and increasing colonial provision of maternal health care provisions; and N.R. Hunt, " 'Le bébé en brousse': European Women, African Birth Spacing and Colonial Intervention in Breast Feeding in the Belgian Congo", in F. Cooper and A.L. Stoler (eds.), *Tensions of Empire: Colonial Cultures in a Bourgeois World* (Berkeley: University of California Press, 1997), pp.287-331.

on several interacting layers. For example, it provided a fruitful source for professional advancement.[4] As H. Bell notes: "empire was also a tool of medicine, a vehicle through which doctors could promote their professional interests".[5] On the research front, the advent of germ theories and vector transmission models created opportunities for researchers as they provided the means to discover more about the exotic diseases found overseas.[6] These developments coincided with the expansion of the British empire at the end of the nineteenth century, and thus presented a means to facilitate colonial rule and promote scientific enterprise. Reputations could be made or enhanced by success in the race to identify the guilty germ and its means of transmission, and the tropics had a plethora of diseases awaiting study. The advancement of several disciplines was involved in this process. Aspects of pathology, medical entomology, parasitology, and later immunology and virology were boosted by their involvement in tropical medicine during this period. Scientists and doctors could gain prestige with their ability to dazzle the academic and commercial world with their contributions to making the tropics healthier. For example, Ronald Ross was awarded a Nobel Prize for his efforts against malaria, and George Marshall Findlay received a C.B.E. for his work on the yellow fever vaccine.

Away from the laboratory, others were driven by more altruistic impulses and put their energy into genuine efforts to ease the suffering of people in, and of, the

[4] M. Harrison examines the possibilities for professional advancement for members of the IMS, M. Harrison, *Public Health in British India: Anglo-Indian Preventive Medicine, 1859-1914* (Cambridge: Cambridge University Press, 1994), pp.6-35; E.B. van Heyningen does the same for medical practitioners in the Cape Colony in South Africa, E.B. van Heyningen, "Agents of Empire: The Medical Profession in the Cape Colony, 1880-1910", *Medical History* **33** (1989), pp.450-471. For an analysis of how professional tensions shaped the development of the discipline see D.M. Haynes, "Social Status and Imperial Service: Tropical Medicine and the British Medical Profession in the Nineteenth Century", in D. Arnold (ed.), *Warm Climates and Western Medicine* (Amsterdam: Editions Rodopi B.V., 1996), pp.208-226.
[5] Bell, *Frontiers of Medicine* (1999), p.7.
[6] M. Worboys, "Tropical Diseases", in W.F. Bynum and R. Porter (eds.), *Companion Encyclopedia of the History of Medicine* (London: Routledge, 1993), pp.520-521.

tropics. Missionaries, for instance, provide examples of those offering medical care beyond the formal empire and were active in both Africa and India.[7] Their endeavours were not entirely without self interest as the provision of missionary medical care went hand in hand with the desire to convert the indigenous population to Christianity. Missionaries, as M. Vaughan claims, did not miss any opportunity to preach the joys of Christianity to those in their care.[8] She argues that this was the primary role of missionaries, for whom: "the healing of the body had always to take second place to the winning of the soul and the fight against the 'evils' of African society".[9] Because of the acute nature of yellow fever, its control did not benefit from missionary activity which tended to concentrate on more chronic diseases such as leprosy.

In deconstructing tropical medicine as it relates to yellow fever, this thesis addresses the activities of a number of research organisations and providers of medical care. In this chapter, these groups are introduced and their role in yellow fever activities in West Africa appraised. They are also located within a wider framework, assessing how they each interacted with, or represented the various forms of colonialism and colonial medicine. As a result, a spectrum of definitions of colonial activity, and of tropical medical research and practice is created. This analysis also demonstrates that although the study is limited to a discrete geographical location; the prevention of yellow fever was a global affair. This chapter depicts this broad

[7] D. Arnold has written that Christian missionaries in India were involved in medical work, yet their impact cannot be accurately assessed as it has not been the subject of much scholarly interest, D. Arnold, *Colonizing the Body: State Medicine and Epidemic Disease in Nineteenth Century India* (Berkeley: University of California Press, 1993), p.244. S. Karkar has attempted to redress this neglect in an examination of the interaction between missionary and colonial activity against leprosy, S. Karkar, "Leprosy in British India, 1860-1940: Colonial Politics and Missionary Medicine", *Medical History* 40 (1996), pp.215-230.
[8] Vaughan, *Curing Their Ills* (1991), p.62.
[9] *Ibid.*, p.65.

involvement and begins with an exploration of international efforts against the disease as undertaken by the OIHP. It then examines the formal institutions of British colonialism: the Colonial Office and the CMS in West Africa. The analysis then turns to groups that arguably demonstrated colonial characteristics or occasionally served its interests, but were not part of the official mechanisms of the empire, such as the RF, and the LSTM.

International frameworks for disease prevention

In this period, medical and health care in the tropics was provided by an uncoordinated patchwork of agencies including, but not restricted to, those described in this chapter. Prior to the creation of the WHO in 1948, there were some limited global networks established in the hope of achieving some co-ordination of effort in the field of transmissible diseases with the potential to become epidemic. Yellow fever was at once a local, national and international issue. In respect to yellow fever, the OIHP was a key international organisation, concerned with epidemiological and practical measures to manage the disease and prevent transmission across international boundaries, particularly in setting and regulating standardised forms of quarantine and disease notification and surveillance. It did not undertake any direct form of research. In this context quarantine does not refer to the isolation of specific communities or infected individuals, but a sanitary barrier enforced by non-infected countries to prevent the importation of disease carried by people, goods or vectors travelling from a disease stricken nation.

Nations had long recognised the dangers yellow fever posed to their citizens and imposed quarantine regulations and restrictions to protect their borders. At the level of individual countries, some forms of quarantine had existed in Europe since the fourteenth century. However, these were inward looking and aimed to protect national health. It was not until the nineteenth century that these concerns were manifested at international level, when countries began to co-ordinate their disease prevention efforts to provide some consistency in the varying systems of quarantine.

Attempts at a systematic co-operative effort against general epidemic diseases began in 1851 with the First International Sanitary Conference in Paris, where national representatives gathered to discuss quarantine. There were nine further meetings that century mainly dealing with cholera and plague; yellow fever meriting only a brief mention. The adoption of four conventions resulted; to be merged into one at the 1903 Conference.[10] This convention provided up to date quarantine regulations that took into account new epidemiological knowledge. Thus, a pattern of international co-operation against disease became established and continued into the twentieth century. International participation improved steadily during the following forty years. For example, at the Eleventh International Sanitary Conference in 1903, twenty three countries were represented. Nine years later, at the Twelfth Conference, there were delegates from forty one countries. By the final Conference in 1938, fifty nations participated. Some colonies, such as Egypt and the Sudan often had their own representatives, and signed the resulting conventions individually. The delegate's signature did not bind their government's participation, who could choose whether to ratify the convention or not, regardless of its delegate's decision. A government could

[10] N. Howard-Jones, *International Public Health Between Two World Wars: The Organizational Problems* (Geneva: WHO, 1978), p.7.

specify whether its accession also bound its colonies. If it not, then the convention did not apply to individual colonial governments who were then free to notify its inclusion at a later date. Allowing individual colonies to opt out created a potential weakness in the system, which operated more effectively with fuller participation. It also suggests that colonial pressures affected its operation. For example, a colony may decide not to abide with a convention if it could not afford to uphold its regulations.

Participants recognised that there was potential for a permanent international health movement. Consequently, they convened a special meeting in Rome in 1907. There they resolved to create an organisation to deal with international issues relating to epidemic disease. The establishment of the OIHP resulted. It was controlled by a committee with a technical representative from each member country. Its function was to collect and disseminate information on diseases, to revise conventions and mediate in disputes. It dealt predominantly with epidemic diseases subject to quarantine laws, in particular cholera, plague and yellow fever.[11]

The Health Organisation of the League of Nations also addressed international aspects of disease control. Created in 1923, it had a wider remit than the OIHP, dealing with a variety of infectious diseases from yellow fever, plague, and smallpox to non-infectious heart disease and rheumatism. It was responsible for various international conferences in the 1930s, including two specifically on African health problems: in Capetown (1932) and Johannesburg (1935).[12] These conferences had several important functions: they gave many countries the opportunity to make known their disease problems and to search for international solutions; they also provided a

[11] C.F. Fraser, *World Health* (London: J.&A. Churchill Ltd, 1967), p.173.
[12] *Ibid.*, p.174.

forum for debate involving a wide field of expertise and interests; and finally, information dissemination.

The OIHP, the League of Nations and the conventions together provided an international system of disease prevention dealing with quarantine regulations, surveillance, and notification. What problems did the international control of yellow fever present within the context of their particular disease prevention activities? The twentieth century saw an intensification of the potential risks yellow fever posed to the international community: in particular from transmission within the African continent, and to Asia from the endemic areas in Africa and South America. The British were particularly concerned about the possible infection of India. Colonial authorities and medical personnel in India were well acquainted with quarantine against both the exportation and importation of diseases into the continent; outbreaks of cholera and plague frequently proved the necessity of imposing restrictions. As M. Harrison describes, maritime quarantine was a major medical preoccupation in the last half of the nineteenth century. Many factors, including politics, religious rights, commerce, relations with the indigenous population and medical developments such as inoculation affected this issue.[13] India abounded with *Aedes aegypti* mosquitoes, and the Indian authorities did not wish a return to the quarantine difficulties experienced in the previous century, this time against yellow fever rather than plague or cholera.

The Panama Canal, opened in 1903, created the potential to transmit yellow fever from the Americas to Asia, as it provided a direct shipping route between Asia and the endemic regions in South America.[14] Its spread overland was also an

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[13] Harrison, *Public Health in British India* (1994), pp.117-138.
[14] In 1903, Patrick Manson stressed the danger the Panama Canal presented for yellow fever's transmission from South America to Asia, P. Manson, "The Relation of the Panama Canal to the

increasing problem. Earlier in the century, yellow fever's incubation period of approximately six days in humans, limited the potential for its transmission across international boundaries by the slow speeds of available forms of transport.[15] However, the advent of swifter forms of transport as the century progressed significantly reduced the incubation period safety buffer. Fears grew about the transportation and spread of the yellow fever virus in infected mosquitoes and humans overland from West Africa to other areas of Africa believed to be non-endemic, and from there, on to India. For example, in 1927, rumours of the possible construction of an African transcontinental railway concerned the Indian government, fearing that yellow fever could be spread along the railway to East Africa, where it could then be transmitted to India.[16] The advent of air transportation intensified this problem. Journeys that would have taken weeks by sea or train could possibly be completed in days when travelling by air.

How did these international systems of disease prevention deal with these problems? Despite fears of importation, the conference attendees and the OIHP did little about yellow fever until the 1930s. Quite simply, as far as the international community was aware, and indeed was being informed, yellow fever was in decline

Introduction of Yellow Fever into Asia", *Transactions of the Epidemiological Society of London* **22** (1902-1903), pp.60-91. However, in 1911, the Government of India despatched S.P. James to the endemic area in Central America to assess the risk posed to India by the opening of the Panama Canal. He concluded that there was no direct threat to India, but there were more risks to ports in Japan, China, Australia, the East Indies, from which the disease could then spread to India, S.P. James, "The Protection of India from Yellow Fever", *Indian Journal of Medical Research* **1** (1913), pp.213-257.

[15] However, the duration of the incubation period was disputed during the period. Synthesising the current literature, in 1934, R.M. Gordon, Director of the Alfred Jones Laboratory, advised that a European was infective for up to seven days after the onset of fever, an African possibly longer; and a mosquito could transmit the virus between nine to twelve days after biting an infected human, R.M. Gordon, "Notes on Yellow Fever, with Special Reference to the Possibility of its Recurrence in Sierra Leone", December 1934, pp.2-3, in Collected Papers of Sir Alfred Jones Laboratory, Sierra Leone. Vol. III.

[16] Public Record Office, Kew, London. CO 554/75/11. E.W. Flood, Assistant Secretary of State for West Africa, to E.G. Turner at the India Office, 16.06.1927.

for the first thirty years of the century. The United States Army, under the direction of General Gorgas, had wiped out the disease in Panama, eliminating the potential threat of that new shipping route. At the 1912 conference in Paris, yellow fever was low on the agenda. The conference president, Camille Barrere, was dismissive about its role in yellow fever prevention putting the onus on North America to provide solutions to its problems.[17] However, it was still included in the resulting convention on quarantine regulations, along with plague and cholera.[18]

The next International Sanitary Conference was not held until 1926, again in Paris. This reviewed and updated the convention of 1912. By this time, there was a well established notion that yellow fever was in decline. The RF had performed several large scale anti-yellow fever campaigns elsewhere in the Americas which had apparently wiped out the disease on that continent except in one small area and was being congratulated on its success. As the RF moved its attention to West Africa, the perception that yellow fever was on the verge of extinction grew. N. Howard-Jones comments that nineteenth century perceptions of the three epidemic diseases of yellow fever, cholera and plague had been transformed by the progress of the new century, claiming: "they had been robbed of the superstitious terror that they inspired ... it could be said that yellow fever was almost an extinct disease".[19] It must be noted that this was prior to the large epidemics in the Gold Coast in 1926 and 1927 when the indigenous population clearly suffered heavily, and before the disease made its undeniable reappearance in South America. Despite the relaxed attitude to yellow fever, it still appeared in the 1926 International Sanitary Convention, which provided

[17] N. Howard-Jones, *The Scientific Background to the International Sanitary Conferences, 1851-1938* (Geneva: WHO, 1975), p.89.
[18] This convention was not put into force until 1920 because of the interruption to international sanitary work caused by World War One.
[19] Howard-Jones, *The Scientific Background* (1975), p.95.

regulations for the notification of the first case of yellow fever. It was also subject to quarantine regulations laid down in the convention along with cholera, plague typhus and smallpox.[20] The inclusion of yellow fever suggests that the international community was still wary of the disease, even when various scientific experts were reporting its demise.

The OIHP responded to the emerging threat presented by air transport. At the end of 1930, it engaged the expertise of the IHD of the RF to survey Africa using mouse protection tests to determine past infections of yellow fever. The RF and other experts believed this was a reliable indicator of endemicity and would highlight areas where anti-yellow fever measures were necessary. The OIHP used this information to devise new air transport regulations, taking yellow fever endemicity into account.[21]

By 1933 it had drafted the International Sanitary Convention for Aerial Navigation. This dealt with the spread of epidemic diseases, including yellow fever, by air. Twelve countries signed, and it came into force in 1935. It provided a set of standards for designated airports and aerodromes, defining three types of aerodrome. Authorised aerodromes were the first and most basic, and were places suitable for aircraft as designated by the relevant authorities. The next category, sanitary aerodromes, had more demanding criteria. The airport or aerodrome had to have access to a medical officer and sanitary inspector, have facilities for medical inspection, isolation, care of, or transport of the sick, and equipment for disinfection, disinsectisation and deratisation (rat destruction), as well as safe drinking water and effective sewerage removal.

[20] *International Sanitary Convention, 1926.* Cd. 3207, 1928-9.
[21] "Annual Report of the Commission, 1931", p.35. Box 215, Subseries 495, Series 3, Record Group 5. Rockefeller Foundation Archives, Rockefeller Archive Center.

The most rigorous regulations applied to the third type: anti-amaryl airports and aerodromes. This specifically referred to yellow fever and applied to aerodromes in the endemic area. An anti-amaryl aerodrome was defined in article thirty eight of the convention to be a sanitary aerodrome with additional criteria including being situated a suitable distance from the nearest inhabited centre, possessing a mosquito free water supply, with mosquito proof buildings for crew and staff, and for passengers needing to be detained.[22] The convention also included additional provisions on travel to, and from, infected areas. Great Britain signed but specified that the signature did not bind her tropical colonies. Their participation was their choice alone. No reason was provided; to speculate, the omission may have been for purely economic reasons, creating sanitary and anti-amaryl airports and aerodromes necessitated a large financial outlay. By 1935, the British West African colonies except for the Gambia, had signed the convention, thus agreeing to abide by its regulations. The convention soon became outdated by the manufacture of effective vaccines, and developments in epidemiology. The latter suggested that the endemic area of Africa was more extensive than implied by the RF's initial protection test surveys.

How did the Colonial Office interact with this international framework of disease prevention? The conferences of the League of Nations' Health Organisation provided a forum for British representatives to discuss their ideas and concerns. For example, at the Pan African Health Conference of 1935, a representative of the government of India, Major-General C.A. Sprawson complained at the insufficient number of protection test surveys. He demanded more extensive testing along air

[22] *International Sanitary Convention for Aerial Navigation, 1933*. Cd. 4650, 1933-4.

routes in the Anglo-Egyptian Sudan, Uganda and Kenya. He also called for areas that gave a "fair percentage" of positive results in protection tests and viscerotomy (a technique of post-mortem diagnosis) to be designated and treated as endemic.[23] He had presented his argument earlier in the year to the Quarantine Commission for Aerial Navigation of the OIHP. This committee was established to discuss the implications of air transport for epidemic diseases. It reacted by advocating an intensification of viscerotomy and protection test survey efforts, although did stress that it considered current preventive measures adequate.[24] This episode demonstrates that the OIHP was responsive to the concerns of its member nations.

The British government could maintain its independence from the convention system and could choose whether to accept its regulations. As explained earlier, the signature of the delegate did not bind its government, nor did a government's approval ensure its colonies' participation. This permitted a level of autonomy across the British empire, allowing governments to express their disapproval or otherwise in a fundamental manner. The OIHP consulted with governments ensuring that they could also influence the OIHP's decision making process in a limited way. For example, in 1935, the OIHP's Quarantine Commission for Aerial Navigation proposed a new system of disease notification. Previously, colonial governments in Africa had informed the OIHP of epidemics of notifiable diseases via their home country. Under the system proposed, the colonies would directly inform the OIHP of the first case of yellow fever by telegram.[25] Initially, Thomas S. Stanton, the Chief Medical Advisor to the Colonial Office, was enthusiastic about this change in

[23] PRO. CO 847/4/7. Pan African Health Conference, Johannesburg, 1935. "Brief statement of the position of India in regard to the yellow fever question". Presented by Major General C.A. Sprawson.
[24] PRO. CO 323/1331/5. OIHP. Session of October, 1935. Report of the Quarantine Commission for Aerial Navigation.
[25] *Ibid.*

procedure, even suggesting that colonies should report all cases directly to the OIHP, not merely the first.[26] Others in the Colonial Office disagreed, insisting that the current system was adequate. Stanton acquiesced and informed the Director of the OIHP, Dr Abt, that the Colonial Office did not wish to comply with the request, believing it would fail to improve the current procedure of notification.[27] This incident demonstrates that governments could influence OIHP policy. Its role in disease prevention was by no means absolute, and was dependent on the co-operation and participation of the nations concerned.

The Colonial Office

The Colonial Office was the administrative body for the British empire. As such, it played a role in health care delivery and research efforts relevant to the medical problems in its colonies. The India Office and Indian Medical Service managed India's medical problems. The Colonial Office was established as a separate government department in 1854 to administer government policy in colonies and territories acquired over several centuries of British imperial growth.

The Secretary of State for the Colonies (hereafter the Secretary of State) headed the Colonial Office. The Parliamentary Under-Secretary of State assisted him, serving as his deputy and advisor. The Permanent Under-Secretary of State was the main advisor to the Secretary of State and was head of the office staff, supported by deputy permanent under-secretaries. The Colonial Office's administrative functions developed and expanded, but underwent a major change in 1925 when control of the

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[26] PRO. CO 323/1331/5. Memo by T.S. Stanton, Chief Medical Advisor to the Colonial Office, 27.11.1935.
[27] PRO. CO 323/1331/5. Stanton to Abt, Director of the OIHP, 01.01.1936.

Dominions was transferred to the newly created Dominions Office. Charles Jeffries described the role of the Office to be:

> concerned with the Secretary of State's responsibility for the good government of oversea territories each of which possess a complete and self-contained administrative organisation, simple or complex as the case may be. Even in the most primitive territory the administration has to carry out all the activities which current political thought regards as proper to the government of a modern State.[28]

In this sympathetic review of the role of the Colonial Office, Jeffries stated that the Colonial Office provided "direction and advice" to colonies and "organises the help that the colonies need".[29] It was responsible for the external and internal defence of the colonies, their financial security, and their international representation. Thus, the Office had two major functions. Firstly, to represent the interests of British colonies ensuring that their best interests were served and justifying the nature of their rule. Secondly, to secure the transfer of British government policies to the colonies providing rationalization and explanation of policies to the governed.[30]

The Colonial Office and colonial governments together provided a two tier system of rule. The Colonial Office did not directly rule the colonies from London as the British colonial system was based on local government, in contrast to French colonialism. The British government appointed a governor as its representative to rule in each of the four British West African colonies. His role was to convey and implement the wishes and policies of the British government. The governor's power

[28] C. Jeffries, *The Colonial Office* (London: George Allen and Unwin Ltd, 1956), p.21.
[29] *Ibid.*, p.40.
[30] *Ibid.*, pp.34-35.

was not absolute, if deemed necessary an act of Parliament could overrule him. However, he had some level of autonomy as the Secretary of State heeded his advice, unless there was good reason to ignore or overrule it.

The provision of tropical medicine reflected the system of colonial rule, with the colonial governments controlling the day to day running of their medical departments and the Colonial Office overseeing the larger picture. While not a central guiding force of tropical medical research, the Colonial Office did have a role to play in this area, albeit haphazardly. It also had some influence in determining the nature of education in tropical medicine. Its formation and implementation of colonial development policy also affected medicine and research, as it came to include health care and medical provision in the tropics. An analysis of the Colonial Office's role in yellow fever is essential to in order to appreciate the numerous factors contributing to the yellow fever story in West Africa.

The Colonial Office became actively concerned with the medical problems of its tropical colonies in the last decades of the nineteenth century during the expansion of British Africa. It was responding to the alarming rates of mortality and morbidity among colonial officials suffering from tropical diseases. The motives were twofold: to ensure its officers stayed healthy and therefore capable of performing their colonial duties, and to make the tropics more attractive to foreign investment. Patrick Manson, the medical advisor to the Secretary of State, was vocal in his condemnation of the existing system for education in tropical medicine and proved influential in persuading the Colonial Office to consider a specialist school. The tentative first moves occurred in 1898, when circulars highlighting the need for specialist education of colonial medical officers and research into tropical diseases, were issued to the General

Medical Council, leading medical schools, and colonial governments. This culminated in the creation of two schools of tropical medicine in Liverpool in 1898, and London in 1899. The Treasury financed the establishment of the London School at the request of the Colonial Office.[31] The School benefited considerably from the patronage of the Colonial Office; its head, Manson, as the medical advisor to the Secretary of State, naturally enjoying its favour. It had a larger staff and was the recipient of far more government grants than its Liverpool counterpart. In contrast, a grant donated by a local business man, Sir Alfred Jones, initially funded the Liverpool School. H. Power argues that the creation of the Liverpool School was an unforeseen result of the Colonial Office's invocations.[32] She contends that although the two Schools had contrasting means of finance: one funded by the Colonial Office, the other by commercial interests, they were not so different in aims and outlook.[33] However, the Liverpool School never enjoyed the patronage of the Colonial Office to the same extent as its colleagues in London. Not surprisingly, London was more representative of, and influential in determining the Colonial Office's medical policies. The foundation of the two Schools was significant for yellow fever control as they provided specialist training in disease control and research methods. This was important given the difficulty in diagnosing yellow fever, and the need to identify and destroy *Aedes aegypti* mosquitoes. The Schools also provided dedicated forums for research into tropical diseases, from which yellow fever control benefited sporadically.

The early function of British colonial medicine was to protect the health of British colonial officials, the military and the mercantile sector. This safeguarded the

[31] For a history of the London School see L. Wilkinson, *Prevention and Cure: The London School of Hygiene and Tropical Medicine. A Twentieth Century Quest for Global Public Health* (forthcoming).
[32] H. Power, *Tropical Medicine in the Twentieth Century: A History of the Liverpool School of Tropical Medicine, 1898-1990* (London: Kegan Paul International, 1999), p.16.
[33] *Ibid.*, p.15.

three vital components of British twentieth century colonialism: the administrative system; military effectiveness and commercial interests. The interwar years saw a further expansion in the role of the Colonial Office in tropical medicine. It established a number of expert panels and posts such as the Colonial Advisory Medical Committee and the Chief Medical Advisor to provide specific expertise.[34] The various Chief Medical Advisors are key figures in this analysis. Stanton, who held the position from 1926 until his death in 1938, played a major role in vaccination efforts during the 1930s and acted as the Colonial Office's liaison with the RF.[35] He was succeeded by his assistant Arthur John Rushton O'Brien, who retained the post for two years.[36] Archibald Guelph Holdsworth Smart was appointed during World War Two, and was chairman of the specially convened Commission to deal with yellow fever problems arising from the war.[37] In the 1930s, the Colonial Office also attempted to extend colonial medical care to the indigenous population. It provided funds for systematic development initiatives that targeted welfare and development programmes including medical care and sanitary provisions. This did not materialise from purely altruistic

[34] There had been medical advisors to the Colonial Office prior to 1926, most famously Manson. However, their duties appear to have been mainly clinical, to examine colonial officers (see E. Chernin, "Sir Patrick Manson: Physician to the Colonial Office, 1897-1912", *Medical History* **36** (1992), pp.320-331). After 1926 the post was more related to policy development.

[35] T.S. Stanton was born in Canada in 1875, and was educated at Trinity Medical College, Toronto and University College, London. He was the Senior House Surgeon at the Hospital for Tropical diseases and a demonstrator at the London School of Tropical Medicine, before working as an assistant in the Institute of Medical Research in the Federated Malay States in 1907. He became a bacteriologist there by 1908, and was made Director of the Government Laboratories of the Federated Malay States by 1920. He died in January 1938, while holding the position of Chief Medical Advisor to the Colonial Office.

[36] Born in Shropshire in 1883, A.J.R. O'Brien was educated at Edinburgh and Durham Universities. He was a House Surgeon at Monkwearmouth Hospital, in Sunderland, and at the Infectious Diseases Hospital in Newcastle Upon Tyne. He joined the WAMS in 1911, and was appointed to the Gold Coast, where he became a surgical specialist from 1921, and was in charge of the Accra Hospital from 1923. He retired from the WAMS in 1929, and became the Assistant Medical Advisor the following year. He succeeded Stanton in 1938, and held the position of Chief Medical Advisor until his death in 1940.

[37] A.G.H. Smart was born in 1882. He was educated at Edinburgh University. After a period as a House Surgeon at Edinburgh's Royal Infirmary, he served in the CMS: in Malaya, 1912-1934, and the West Indies, 1935-1938. He became Assistant Medical Advisor in 1938 after O'Brien's

concerns for the well-being of indigenous populations, but was designed to benefit the metropolitan economy. It anticipated that developing the colonies would stimulate British employment, create markets for British goods in the colonies, and help exploit the colonies as sources of raw materials.[38]

There is no specific account detailing the mechanisms of the Colonial Office's decision making process for medical issues. Indeed, available evidence suggests that it was a haphazard affair: a feature perhaps of the Colonial Office's broader administrative system and the low status of medicine. It consulted widely, using the expertise of its in-house committees and advisors. It also used outside experts and commissioned temporary specialist groups. For example, after a number of epidemics of yellow fever in West Africa in 1910, it despatched Rubert Boyce, Dean of the LSTM to the region to investigate and make recommendations.[39] Boyce had experience of the disease and had studied it in the West Indies, British Honduras, and British Guiana. The Secretary of State sent Boyce's report to the four West African governors together with a request that Principal Medical Officers compile a detailed memorandum on yellow fever cases for the Colonial Office. He also enclosed general advice on anti-mosquito measures.[40] The Advisory Medical and Sanitary Committee for Tropical Africa, a Colonial Office specialist committee, debated Boyce's findings, and provided an additional dimension to colonial decision making. After two years

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promotion, replacing him in 1940. He remained Chief Medical Advisor for four years. He died in 1964.

[38] See M. Havinden and D. Meredith, *Colonialism and Development: Britain and its Tropical Colonies 1850-1960* (London: Routledge, 1993), chapter seven, pp.140-159; and S. Constantine, *The Making of British Colonial Development Policies, 1914-1940* (London: Frank Cass, 1984) for an analysis of the motivation behind British colonial development policies.

[39] R. Boyce was born in 1863, and obtained his medical degree in London in 1889. He worked as Assistant Professor of Pathology from 1892, before he moved to Liverpool in 1884 where he became Professor of Pathology of the University College of Liverpool. He became Dean of the LSTM when it was created, and remained there until his death in 1911.

[40] *Correspondence Relating to the Recent Outbreak of Yellow Fever in West Africa*. Cd. 558, 1911.

deliberating the yellow fever problem, it decided that a special investigatory committee be established. Within two months, the Secretary of State appointed William John Richie Simpson head of the Yellow Fever West Africa Commission; its function and purpose shaped by a sub committee of the AMSC.[41] The YFWAC was funded by the Yellow Fever Commission Fund; its contributors were the four West African colonies, rather than the Colonial Office, signifying its distance from yellow fever control. After the YFWAC was disbanded, colonial agents allowed the funds to accumulate, and permitted its release for various purposes. Some of these were connected to yellow fever control measures, but others were unrelated to the disease, for example a portion was given to the Alfred Jones Laboratory of the LSTM to ease its precarious financial position. This suggests the Colonial Office lacked commitment to yellow fever control. Another example, the 1934-35 epidemic in Bathurst, the Gambia, sheds further light on the decision making process. As with many yellow fever epidemics, the CMS and colonial governor decided which anti-yellow fever measures to use. However, in this instance, Stanton in London objected to their use of a French vaccine, known as the Laigret method, arguing it was unsafe. In response, the Secretary of State contacted the Governor of the Gambia, Sir Arthur Richards, and instructed him to discontinue use of the vaccine. As in 1910, the Colonial Office turned to an external expert for assistance demonstrating its continued interaction with non-official research groups. Stanton consulted with Findlay at the Wellcome Bureau of Scientific Research, an acknowledged yellow fever expert and developer of a British vaccine. Between them, they decided that his vaccine should be used in

41 *First Report of the Yellow Fever West Africa Commission*, 1914 (Yellow Fever Bureau, LSTM).

during the epidemic. Interestingly, the CAMC discussed the issue, but only after the decision had been made: they were not instrumental in this process.[42]

In both examples, official notification and appointments were made by the Secretary of State, not the medical personnel involved. This gave their decisions or recommendations the official weight of the Colonial Office, even if the Secretary of State was not involved personally in decision making. These episodes demonstrate that there were many subtleties in the workings of the Colonial Office concerning medical policies. A variety of people who operated officially outside the Colonial Office were called into play, giving an additional dimension to this form of colonial activity. Definitions of colonialism, even at the official level, are complex.

The Colonial Office was the official face of tropical medicine. Safe in London, far away from the physical proximity of tropical diseases, its members had a substantially different experience and perspective of diseases such as yellow fever than those overseas. The use of medical advisors and specialist committees occasionally helped to make the Colonial Office privy to the gritty realities of tropical diseases. Medicine was only one facet of colonialism that the Colonial Office regulated, and was therefore subject to trends in general colonial policy and designated priorities. This thesis will demonstrate, using yellow fever as a case study, that the Colonial Office's interest in tropical medicine fluctuated in response to numerous factors. Obviously, the disease environment was a critical consideration, but the interplay of other elements: social, political and economic, proved vital in constituting Colonial Office medical policy. This provided a specific approach to disease control, framed by the institution's interests and priorities.

[42] PRO. CO 885/37. Minutes of the 355th Meeting of the CAMC, 18.12.1934.

The Colonial Medical Services

The members of the medical services that operated in British colonies represent the other end of the spectrum from the home based administrators. They faced the practical realities of grappling with the health conditions pertaining to their particular colony on a daily basis. In Africa, each colony had its own medical and sanitary department, funded from an individual colony's budget.

Because of the method of funding, the quality and composition of the medical services varied considerably from colony to colony. The larger, more prosperous colonies could afford to have superior medical provision and a greater number of specialist staff. At the end of the nineteenth century, the West African medical services were reputed to be mediocre at best. Medical departments in West Africa experienced considerable difficulties in attracting recruits, and for applicants, it was often a last ditch attempt to gain employment, after numerous failures elsewhere.[43] The inferior quality of some of his staff provoked Dr Henderson, the Gold Coast's PMO, to condemn them as "the dregs of the profession; men who cannot get anything in England and take whatever offers".[44] In 1902, colonial medical personnel were amalgamated into the unified West African Medical Service, in an attempt to provide a boost to the much maligned medical services. The establishment of the WAMS did help increase staff levels, from seventy three European MOs in 1901, to 210 in 1914.[45] However, African doctors were not permitted to serve in the WAMS because

[43] T.S. Gale, "Colonial Medical Policy in British West Africa, 1870-1930", (D.Phil: University of London, 1973), p.277.
[44] R.R. Kuczynski, *Demographic Survey of the British Colonial Empire. Vol. I: West Africa* (London: Oxford University Press, 1948), p.479.
[45] Gale, "Colonial Medical Policy", (1973), p.277.

of racial prejudice among the colonial authorities in West Africa (some were allowed to practice in African hospitals albeit with poorer salaries and promotion prospects). This was in contrast to the IMS which employed Indian practitioners as part of a deliberate process of Indianisation within the administrative system.[46] This had implications for detecting yellow fever among the indigenous population and gathering epidemiological data. Researchers found that local people were more receptive to African medical personnel and more likely to discuss past and ongoing cases of infection with them than they would with Europeans.[47] The WAMS race bar was gradually relaxed during the 1920s with the appointment of some African doctors to the service, although fierce hostility to such moves continued.

The WAMS functioned as a unified service with one promotion list and pay scale for all officers, although each colony retained autonomy over its own medical departments in which officers served. A PMO headed each medical department, assisted by Senior Medical Officers, Senior Sanitary Officers, Sanitary Officers, Medical Officers, and Medical Officers of Health.[48] MOs provided medical care to colonial officials in their assigned region and were also permitted to engage in private practice that could prove lucrative. Salaries of WAMS officers were generous, in the hope of attracting greater numbers of doctors, but placed a large financial strain on West African colonial budgets. The minimum salary was set at £400 per annum in 1902, in contrast, the same year, MOs in Jamaica received annual salaries ranging

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[46] Harrison, *Public Health in British India* (1994), p.32.
[47] "Annual Report of the Commission, 1928", p.13. B215, SS495, S3, RG5. RFA, RAC.
[48] The titles of the head of the medical department and other senior posts varied over the period. In 1921, the title of Principle Medical Officer changed to Director of Medical (and Sanitary) Services, and the Senior Sanitary Officer became the Deputy Director of Sanitary Services, (which changed to the Health Service in 1930). The Gambia functioned without a PMO or DMS until 1948, the medical department being headed by the Senior Medical Officer until then.

from £75 to £200. By way of further comparison in 1914, the starting salary in the Royal Army Medicine Corps was only £225.[49]

The duties of officers varied throughout the period, and were responsive to a range of factors including the general ethos and function of colonial medicine, the size of the colonial budget, the whims of the appointed governor, and the energy and personal direction of the PMO. For the first two to three decades of the twentieth century, colonial medical departments concerned themselves mainly with the protection of European health. Resources were allocated accordingly, with the main bulk of colonial medical provision being limited to areas with a substantial colonial presence in towns and ports. The health of African colonial officials came next, followed by other areas of colonial influence: the police, the military and inmates of local jails and lunatic asylums.[50] In very general terms, medical and sanitary departments strove to improve conditions in those areas with a colonial presence, commonly the larger urban centres. In this guise, they inspected living conditions, initiated anti-mosquito measures, improved sewage works, and gradually provided piped water, etc. Many of these routine measures helped to prevent yellow fever epidemics. MOs toured their designated territory practising primary care medicine and some limited surgery. They also conducted vertical campaigns targeting diseases considered to be of particular threat, or in response to epidemics. These usually incorporated measures against mosquitoes or other disease vectors, and curative

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[49] Gale, "Colonial Medical Policy", (1973), p.278. The WAMS was superseded by the creation of the Unified Colonial Medical Services, in 1934. S. Addae argues that, in the Gold Coast at least, this led to a deterioration in the conditions of service for colonial medical staff. S. Addae, *Evolution of Modern Medicine in a Developing Country: Ghana, 1880-1960* (Durham: Durham University Press, 1996), p.73.

[50] Addae, *Evolution of Modern Medicine* (1996), p.57.

efforts and later vaccination campaigns. Their tours provided one of the few means of detecting yellow fever outside the large colonial urban centres.

Medical provisions emulated western models, assumed to be the most appropriate form of medical care. Scant attention was paid to the vast differences in environment, resources and disease profiles between the tropics and the west, which might have suggested an alternative approach. The popularity of colonial hospital building epitomises this tendency. Gale has pointed to the large numbers of hospitals prior to World War One. Except for the Gambia, the British West African colonies had also established a number of small medical outposts at colonial stations. Southern Nigeria had thirty four hospitals in twenty five towns, Northern Nigeria had hospitals in twenty seven towns, the Gold Coast had twenty nine in various parts of the country, and Sierra Leone had ten, one was a maternity hospital in Freetown.[51] These all provided medical care, in varying degrees, mainly for Europeans and colonial officials although there were facilities for the indigenous population. Many hospitals were in a shocking state of disrepair; the European ones tended to be of a superior type, although in many cases, they were not a suitable benchmark. Hospitals naturally proliferated in the larger urban centres, but more isolated regions had smaller hospitals, or dispensaries, often called "bush hospitals". These were run by the MO designated to that particular region, and operated by subordinate African staff in his absence. These facilities were often of dubious quality and poorly equipped and supplied. This reduced the likelihood of accurate yellow fever diagnosis, a notoriously difficult task even in more ideal conditions.

[51] Gale, "Colonial Medical Policy", (1973), pp.317-318.

In the 1930s, medical departments began to address the health needs of the West African population; a move that corresponded with general Colonial Office development policy directed at indigenous welfare. They had considerable ground to make up, facilities for Africans were primitive and woefully inadequate. Observers vilified existing hospitals for their terrible conditions and limited number of beds. For example, in 1925 in the Northern Provinces of Nigeria, there were only four "proper" hospitals, providing a total of 187 beds for a population of 10.4 million.[52] That same year in the Gold Coast, there were approximately thirty seven African hospitals with 700 beds for African patients.[53] The ethos of the WAMS and the ethnic and cultural backgrounds of its members also hampered efforts to provide medical services to local peoples. Gale argues that as the primary function of the WAMS was to protect the health of Europeans, MOs did not believe their duties should extend across the colour line. In addition, he claims that many remained oblivious of local customs and peoples, even the wider environment. As an example, he cited an acting PMO who was ignorant of the habits of local *Anopheline* mosquitoes: facts vital and basic to anti-mosquito campaigns.[54] Africans were also reluctant to make use of western medicine, a feature that Addae claims ran so deep, that it was "to die a very slow death".[55]

The CMS made slow progress in extending facilities to local people, providing maternity and infant welfare services. The squeeze on colonial budgets during the economy drive in the depression of the 1930s affected the provision of health and medical care and consequently hampered these efforts. In particular, staffing problems became acute. For example, in Sierra Leone, numbers of Medical and Sanitary

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[52] *Ibid.*, p.367.
[53] Addae, *Evolution of Modern Medicine* (1996), p.33, p.67.
[54] Gale, "Colonial Medical Policy", (1973), p.371.
[55] Addae, *Evolution of Modern Medicine* (1996), p.65.

Officers decreased from thirty in 1930, to twenty six by 1932, to just twenty one in 1936.[56] Events throughout the other three British colonies echoed this trend. The situation failed to ease during the 1940s, as many MOs were transferred to military duties. Financial constraints also led to the reduction and even cancellation of vital sanitary work. The 1932 *Annual Medical Report* of the CMS in Sierra Leone wrote: "In the absence of adequate funds, directly due to the financial depression through which the whole world is passing, it is impossible to envisage the carrying out of any important sanitary works".[57] The Gold Coast Medical Department was also feeling the pinch: there was a complete freeze in hospital building, work in this area was restricted to maintenance and repairs only.[58] This led to overcrowding in hospitals and at dispensaries. The colony also suffered a decrease in the standard of rural hygiene with harmful repercussions on local health. However, although attempts to address the health needs of the indigenous population were variable, the recognition of the need to take action signified a shift in the creed of the CMS in West Africa.

Research came rather low in the list of duties conducted by the colonial medical departments. With the exception of the Gambia, the colonies looked, on paper, to be amply equipped to undertake medical research. After all, where better to conduct research than the actual site of the diseases? In 1909, Nigeria established a medical research institute at Lagos, and by 1923 it had a clinical laboratory and a Tsetse Investigation Team. The Gold Coast also had some facilities. By 1930, it had established the Medical Research Institute and a clinical laboratory at Accra, and two further laboratories at Seccondee and Yeji. Sierra Leone had a clinical laboratory at Freetown, and the services, on varying terms, of the Alfred Jones Laboratory of the

[56] Kuczynski, *Demographic Survey* (1948), p.251.
[57] Quoted in *ibid.*, p.251.
[58] Addae, *Evolution of Modern Medicine* (1996), p.74.

LSTM, which will be discussed in greater detail later. The Gambia did not possess its own laboratory and relied upon assistance from other colonies.[59] There were opportunities for the appointment of specialists such as bacteriologists and entomologists to conduct research within these facilities.

However, the reality was somewhat different, with important ramifications for anti-yellow fever work. The financial stringency of the depression of the 1930s ensured that few specialist staff were actually employed in medical departments. For example, in 1930, the Gold Coast employed seven pathologists. This number declined to three in 1933 and remained as such for the following five years. During the same period, it lost its sole entomologist.[60] This had implications for routine anti-yellow fever work, which revolved around anti-mosquito measures. A lack of entomologists meant that the identification of *Aedes aegypti* mosquitoes was left in the hands of non-specialist staff. It also hampered effective training of subordinate staff in anti-mosquito methods. The laboratories failed to conduct any serious research, instead they performed routine tasks for local hospitals. The necessary finance, and possibly commitment, were lacking. Colonial governments failed to initiate research agendas within their colonies, and thus they under utilised laboratories as research institutions. There were rarely any internally generated attempts at systematic, co-ordinated research programmes. The yellow fever case study will amply demonstrate this pattern. Occasionally, opportunities for new research possibilities materialised, yet colonial governments in West Africa failed to seize them. For example, in the 1920s and 1930s, the RF operated a yellow fever laboratory in Lagos, Nigeria, which it reopened in the 1940s. In 1934, and later in 1946, as the RF prepared to wind down

[59] See F.E. Nkwam, "British Medical and Health Policies in West Africa, 1920-1960", (PhD: University of London, 1988), pp.87-107 for more details on these laboratories.
[60] Addae, *Evolution of Modern Medicine* (1996), p.74.

its activities, staff envisaged their former laboratory as part of the colonial medical enterprise. They entered negotiations with the Colonial Office and the CMS in Nigeria to this end. However, on both occasions, the Colonial Office and colonial government squandered their good fortune. The RF left the laboratory in the hands of the colonial government in 1934 after its departure. Despite the energy and enthusiasm of the DMS, W.B. Johnson, and limited financial assistance from the RF, the laboratory failed to flourish as a site of yellow fever research. In the closing stages of the RF's second operation of the laboratory in Lagos, there were discussions of transforming it into a centralised virus centre serving the four British West African colonies. Owing to a lack of colonial commitment, this venture never materialised. Once again, the Nigerian government took-over the use of the laboratory but it ceased to function as a centre for research, instead conducting routine pathological and diagnostic work.

Some MOs were able to conduct research on an individual basis on areas of special interest. They were sometimes seconded to research projects, or undertook certain projects as part of a larger research programme. The colonial governments rarely initiated such programmes by themselves, instead external agencies were involved. This lack of initiative was a critical factor in yellow fever research. It forced colonial governments to rely on the investigations of outside sources. This tendency often deprived research of the input of members of the CMS, who had direct knowledge of the practical realities of life and disease in West Africa, and occasionally had personal experience of yellow fever.

The CMS operated in a somewhat ad hoc fashion, as the yellow fever case study will illustrate. Its ethos followed that of the Colonial Office: its function during the initial decades of the twentieth century was to provide health care to Europeans and colonial officials, addressing indigenous health only when it posed a threat. As the period progressed, it sought to ameliorate the disease problems of local people, where and when resources allowed. Fluctuating finances and a lack of a consistent policy encumbered colonial medical departments. There were only sporadic opportunities for the formulation and maintenance of a coherent policy by a single DMS. Heads of departments came and went, bringing their own styles of leadership and notions of the role of a colonial medical department. Nigeria was fortunate to have the services of Johnson, its longest running DMS for seven years from 1929 to 1935. During the same period, the Gold Coast had three heads of the medical department. Sierra Leone's fortunes fluctuated: P.D. Oakley was its DMS for the greatest length of time, serving five years. Yet between 1912 to 1922, the colony had seven different directors. Less senior members of staff repeated this pattern, reinforcing disorderly tendencies. Kuczynski commented on this phenomenon in Sierra Leone:

> In the greater part of Sierra Leone sanitary work is necessarily unorganised, without continuity and with little regular plan. Things are often done by one man, undone by the next; some are keen on sanitation, others not, but usually, with the best of wills and energy, sanitation shows signs of amateurism. ... The financial position of the Colony is so bad that it is useless recommending anything that will cost money unless it is absolutely necessary.[61]

The colonial governor could also restrict and frustrate the efforts of a medical department, as well as enhance them. The DMS may have been the head of the medical department, but it was the governor who had control, as one disgruntled

[61] Kuczynski, *Demographic Survey* (1948), p.251.

anonymous letter to the *BMJ* in 1907 reveals: "the average Governor is not the best man to deal with the problems of health and sanitation and the Principal Medical Officer, who ought to be the expert advisor in such matters, is in most cases merely a medical secretary who registers the decrees of the Governor".[62]

Therefore, the CMS faced several elements which hindered and shaped their work; lack of financial resources being arguably the most significant. Their actions against yellow fever demonstrate the influence of other factors. The colonial governments' and their medical departments' perceptions of, and reactions to yellow fever were fluid, shifting in response to changing circumstances. Contemporary medical knowledge, and medical and scientific innovations were also compelling influences. At critical periods, not exclusively epidemics, the CMS regarded yellow fever as a severe threat to European health, and reacted accordingly. When the status quo returned, yellow fever lost its potent mystique in the colonial mind, and had to once more compete with a long list of risks to European health. Quite simply, colonial medical departments in West Africa were too under-resourced to maintain long term campaigns against the disease. Outside an epidemic, yellow fever was unable to inspire and sustain an enduring fear necessary to guarantee perpetual anti-yellow fever campaigns.

The International Health Division of the Rockefeller Foundation

The IHD of the RF was the largest independent research group involved in anti-yellow fever efforts in West Africa.[63] With its vast resources and expert staff, it

[62] PRO. CO 879/99/918.
[63] The International Health Division experienced several name changes. It was created in 1913, known as the International Sanitary Commission. It became the International Health Board the

provides a fascinating contrast to the understaffed and poorly financed CMS, although its form reflected a rather different function. It displayed a fervour for the disease never matched by even the most zealous of the various British participants. It also demonstrates that definitions of colonial medicine extended beyond the services provided by the official institutions of the British empire.

By the time of its entrance into the yellow fever arena, the IHB had made an acknowledged contribution to disease control. The RF began work into disease prevention in 1909, with the creation of the Rockefeller Sanitary Commission for the Eradication of Hookworm Disease, established to eliminate hookworm in the southern states of America. The RF hoped this would bolster its poor popular image. It also anticipated that its campaigns would foster interest in health care provision, provoking action to improve local medical and sanitary facilities. The RF chose the disease as part of a deliberate strategy devised for less than humanitarian motives. It wanted to make a dramatic impact on the medical world, and thus targeted a disease that it had been assured was eradicable. There were strong economic motives for the choice of hookworm. It was a debilitating disease causing anaemia and lethargy in sufferers, prompting its nickname as the "germ of laziness". The RF and other commentators considered its effects to place a considerable burden on worker productivity: its eradication was a means to boost labour output. With its vast and diverse business empire, the RF stood to gain indirectly by its own programme, as did the United States' economy generally. The Sanitary Commission's program was extensive: it examined nearly 1.3 million people for hookworm in five years.[64]

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following year, and was renamed the International Health Division in 1927. I will refer to the organisation as the IHB or IHD as appropriate, and as the latter when discussing it in general terms.

[64] E.R. Brown, "Public Health in Imperialism: Early Rockefeller Programs at Home and Abroad", in J. Ehrenreich (ed.), *The Cultural Crisis of Modern Medicine* (New York: Monthly Review Press, 1978), p.254. See also J. Ettling, *The Germ of Laziness: Rockefeller Philanthropy and Public Health*

Encouraged by its efforts in the Southern States, the RF saw further potential for hookworm and set out to expand its health activities beyond the domestic sphere. In June 1913, the Sanitary Commission's work was extended to other countries world wide under the new name of the International Health Commission. These developments marked an unprecedented move into global health care, promoting and consolidating the RF's financial and commercial interests throughout the world. Its international activities on hookworm began in the British empire spreading to South America and Asia.

The immediate aim of IHB programs was to improve the health of labour forces; raise awareness of disease and health among local authorities; and establish local health care units. A.E. Birn has recently argued that these goals were more central in IHB policy than reducing disease.[65] Although outwardly philanthropic, RF health work around the world was in fact a means of fostering and promoting RF and North American economic interests. E.R. Brown has offered an additional rationale for the RF's health campaigns, arguing that they represented a form of colonialism when official control of territory was frowned upon. The United States was becoming of increasing importance economically and financially. Foreign countries presented commercial opportunities for North America, providing cheap imports of raw materials and new markets for American exports. IHB programmes abroad were a means of establishing American economic interests in a particular region, giving the RF the opportunity to develop and control local resources. Brown also claims that campaigns had a deeper effect, helping to establish American capitalism:

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in the New South (Cambridge Mass.: Harvard University Press, 1981) for a comprehensive analysis of the hookworm campaigns.

[65] A.E. Birn, "Eradication, Control or Neither? Hookworm vs Malaria Strategies and Rockefeller Public Health in Mexico", *Parassitologia* 40 (1998), p.139.

the foundation strategists believed that the biomedical sciences and their application through public health programs would increase the health and working capacity of these peoples *and* help induce them to accept Western industrial culture and U.S. economic and political domination.[66]

Farley does not wholly support Brown's position arguing that to see the RF's activities as a "blatant form of economic and cultural imperialism", is too simplistic.[67] It is an inadequate model to explain the RF's work on yellow fever in West Africa.

The RF developed campaigns for the eradication of yellow fever as part of its globally expanding health work. Gorgas, famed for his pioneering anti-yellow fever efforts in the Panama Canal, told the RF in 1914 that the disease: "could be eradicated from the face of the earth within reasonable time and at reasonable cost".[68] Such assurances prompted the RF to embrace yellow fever eradication as part of the IHB's remit, beginning in South America. Brown's analysis of the RF's activities as a form of capitalism can be effectively applied in this context as the Foundation had strong commercial interests in the region. Success against yellow fever would help strengthen its economic position. Both the RF and the North American economy stood to gain. The RF would gain positive publicity and kudos from freeing South America of a feared disease; the imposition of quarantine against yellow fever would no longer disrupt its commercial activities in the region.

With great optimism, in 1916, the IHB created a yellow fever commission, headed by Gorgas. This aimed to eliminate yellow fever from the cities in South

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[66] Brown, "Public Health in Imperialism", (1978), p.253.
[67] Farley, *Bilharzia* (1991), p.317.
[68] R.B. Fosdick, *The Story of the Rockefeller Foundation* (London: Odhams Press, 1952), p.76.

America thought to be endemic, providing RF staff and partial funding. Beginning in Guayaquil, Ecuador in 1918, then extending its scope of operations throughout the Americas: to Peru, Colombia, Central America, Brazil and Mexico, the IHB had apparently almost eradicated yellow fever from the continent.[69]

It based its campaigns on Henry Rose Carter's key centre theory.[70] Carter advocated that yellow fever was a human disease transmitted only by *Aedes aegypti* mosquitoes. Urban areas - the key centres - were the only places with sufficient numbers of non-immune people to sustain the disease. The theory held that epidemics in rural areas originated from the key centres. It assumed that these cases would burn out without medical intervention, as the local population gained immunity. Carter contended that further epidemics in such rural places were unlikely as the local population were now immune and that the influx of susceptible people was insufficient to sustain an epidemic. He argued that there was little immigration of adults to these small commercially insignificant towns and villages. Should susceptible infants succumb to infection, they would fall sick and be nursed in one place, surrounded by a shield of immunity held by their carers, and thus the disease would not be spread to any other non-immunes.[71] Therefore, according to the theory, anti-yellow fever measures were only required in the larger urban centres. Thus, the IHB restricted its eradication efforts to such places. The key centre theory offered a relatively simple

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[69] M. Cueto, "The Cycles of Eradication: The Rockefeller Foundation and Latin American Public Health, 1918-1940", in P. Weindling (ed.), *International Health Organisations and Movements, 1918-1939* (Cambridge: Cambridge University Press, 1995), p.231.

[70] H.R. Carter was born in Virginia in 1852. He acquired his medical degree from the University of Maryland in 1879. He had a long career in the United States Public Health Service where he was particularly active in yellow fever and malaria control. He periodically worked for the RF: for six months in 1914 in Costa Rica; as a clinician for the Yellow Fever Commission, 1916-17; and was a member of the Yellow Fever Advisory Council, 1920-25. He retired from the Public Health Service in 1919, and died six years later in 1925. His book on yellow fever was published posthumously.

[71] H.R. Carter, "Spontaneous Disappearance of Yellow Fever From Failure of the Human Host", *TRSTMH* 10 (1917), pp.119-139.

means of removing a deadly disease. The IHB believed that it could achieve all this by eliminating mosquito larvae: there was no need to become involved with the health and medical infrastructure of selected countries.

However, a series of epidemics beginning in 1928 in several areas in South America forced the IHD and the RF to re-evaluate the efficacy of campaigns. This, together with the discovery of jungle yellow fever, a strain with an animal reservoir, spelt disaster for the simplistic basis of earlier campaigns. Hopes for eradication faded as a recognition of the need for further research emerged.

The IHB did not restrict its yellow fever work to the Americas, and in 1920 turned its attention to West Africa. It announced that this move was part of its global eradication campaign declared three years previously.[72] It did not intend to begin control work immediately, but conduct essential preliminary research into the nature of the disease in the region. That year, an investigative commission visited West Africa. It returned after several weeks without seeing one single case of the disease, but nonetheless, recommended that a more permanent research base in the region would be rewarding. Five years later, this came into fruition with the establishment of the West Africa Yellow Fever Commission, in Lagos, Nigeria. The Director was Henry Beeuwkes, a relative newcomer to yellow fever research and the RF, having only joined the RF the previous year, which he spent gaining experience of yellow fever control in Brazil and Salvador. Members of the IHD had faith in his diplomatic and administrative skills. He did not operate in isolation, and enjoyed the input of more experienced members of the IHD. In particular, its Director, Frederick Russell

[72] *Annual Report of the RF, 1917* (New York: Rockefeller Foundation, 1917), p.41. The report wrote: "It is hoped wholly to eradicate yellow fever from the world".

was instrumental in guiding the aims of the Commission.[73] It never fulfilled its originally stated goal of implementing control campaigns to eradicate the disease. However, it proved a productive research group, elucidating many aspects of yellow fever epidemiology and aetiology. It closed in 1934, but the IHD returned to the same site nine years later with the West Africa Yellow Fever Institute, to spend a further six years in the field and the laboratory. John C. Bugher was the Director, with Wilbur A. Sawyer, Russell's successor, providing support from IHD headquarters in New York.[74] Both men had experience in yellow fever research and control. Sawyer had a distinguished career in the IHD and been a member of several IHD yellow fever research teams. He had contributed to the conclusive demonstration that yellow fever in West Africa and South America were the same, the development of immunity tests, and an early vaccine.[75] Both Sawyer and Bugher had been involved in the IHD's immunity surveys in South America of the 1930s and 1940s.

Despite being an independent North American institute, the IHD could not detach itself from the wider colonial community. It had to forge relations with various colonial representatives throughout the existence of both research groups in West Africa. Obviously, the IHD had to negotiate with the Colonial Office, particularly in

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[73] Russell was born in 1870. He was Director of the Laboratory Service of the IHB, 1920-24, and Director of the IHD from 1924 to 1935. He died in 1960.

[74] J.C. Bugher (1901-1970) had originally taught pathology at the University of Michigan for eight years before joining the IHD in 1937, where he worked on yellow fever control until 1948. He then joined the IHD's laboratories in New York. He left the organisation in 1951 to work for the Atomic Energy Commission.

[75] W.A. Sawyer had a distinguished career in the IHD. Born in 1879, he obtained his medical degree at Harvard University, and then worked at the University of California earning several promotions, becoming Clinical Professor in 1916. During the war he joined the U.S. Army Medical Corps, where his work was dominated by the prevention of venereal disease. In 1919, he joined the IHB, and spent five years in Australia working on hookworm campaigns. In 1924, he returned to New York to become the Director of the IHB's Laboratory Service. In 1928, he was put in charge of the IHD's yellow fever laboratory in New York, and worked on the development of the yellow fever vaccine. In 1935, he replaced Russell as Director of the IHD, retiring in 1944 to join the United Nations Relief and Rehabilitation Administration. He retired from this position in 1947, and died in 1951.

the early stages of the Commission's and Institute's establishment. This led to triangular associations, operating over a decade apart, between Stanton and Smart at the Colonial Office; the IHD in New York: namely Russell and Sawyer, and Beeuwkes and Bugher in West Africa. However, the IHD also had to secure the good will of the West African CMS. The co-operation of local MOs proved essential in obtaining clinical and pathological data. This relationship involved colonial and IHD staff purely at a local level and was initiated for the convenience of IHD researchers, rather than to benefit the CMS. Personnel in London and New York did not engage directly in this interaction. The IHD and the Commission also operated in an international health framework when it conducted widescale global immunity surveys for the OIHP, beginning in West Africa.

The IHD's work in West Africa demonstrated a different focus from that in South America. In the latter, it concentrated on practical measures to eradicate yellow fever making exclusive use of anti -larval measures. It was a campaign of systematic disease control, not a programme of scientific, laboratory based investigation, although it did conduct some work of this nature. In West Africa, the opposite held true. Although the RF had initially proudly declared its intentions to commence control work in the region aimed at eradicating the disease, after a period of investigation, such campaigns failed to materialise. The activities of the Commission were research orientated; as such, the IHD did not instigate any practical control measures in the region. The Commission's findings provided vital developmental information for anti-yellow fever work in the Americas, and led to crucial immunological and epidemiological knowledge. Its activities in West Africa do not fit neatly into Brown's framework of colonialism and the RF. The RF had no direct economic interests in West Africa, and did not establish any long term links. It is possible it may have used the Commission as an opportunity to consolidate relations with British colonial authorities, or foster a tenuous presence in Africa hoping it would present similar economic opportunities to South America. It is difficult to see the same colonial drive behind its efforts in West Africa compared to those in South America, concurring with Farley's argument that such an analysis needs greater subtlety than given by Brown. It also demonstrates the limits of analysing tropical medicine solely as an agent of colonialism. As this thesis will contend, the reality was more subtle, involving wider medical issues such as the development of scientific techniques, and social elements.

Despite the differences between the IHD's projects in West Africa and South America, they both demonstrated the overriding doctrine of the RF's health programmes: the focus on the disease entity alone. The RF ignored the wider context of health and medical care provision, and concentrated instead on the elimination of a single disease. The RF's many disease campaigns, including yellow fever, epitomised the vertical approach to disease control. It concentrated on diseases that it assumed would be easy to eradicate: yellow fever, hookworm, malaria; even if in practice, these goals proved unattainable. With its single focus on the disease itself, the RF neglected the multiple determinants of health conditions. It used methods that it believed would provide the speediest results, avoiding investment in long term projects that would improve general health standards. As M. Cueto notes, the major cause of yellow fever was an inadequate piped water supply, yet the RF was not prepared to provide extensive piped water networks.[76] Problems relating to

[76] Cueto, "Cycles of Eradication", (1995), p.237.

malnutrition, maternal and infant welfare, poverty, housing, sanitary provision and work conditions had no place in the RF's maxim for disease campaigns. Farley elegantly encapsulates this tenet:

> They [the IHB] viewed health simply as the absence of disease, which to the Western mind is often equated simply by the absence of pathogens. Thus health could be achieved only by the cure and elimination of each disease, one at a time, as it were. ... They assumed that diseases had only biological causes, which could be fixed; they ignored poverty, malnutrition, and other social causes which could not.[77]

The Liverpool School of Tropical Medicine and the Alfred Jones Laboratory

The LSTM had an intermittent role to play in yellow fever control in West Africa. Liverpool had a tradition of strong commercial interests in the region and the LSTM, founded to serve these mercantile concerns, continued this link to the four colonies. The expeditions the School undertook in its first fifteen years reflect this: fifteen out of thirty two were to West Africa to study a variety of tropical diseases and health problems. As Power asserts, the LSTM's expeditions were a unique and important method of research, shaping the direction of work conducted in Liverpool.[78] Although the two institutions were officially unconnected, the LSTM's yellow fever activities often colluded with the interests of the Colonial Office. The

[77] Farley, *Bilharzia* (1991), p.81.
[78] Power, *The Liverpool School* (1999), p.25.

LSTM operated mainly as an independent organisation, yet some of its activities helped to consolidate colonial rule in the tropics by improving health and reducing disease. On occasion, it worked directly for the Colonial Office and the CMS. Indeed, much of the LSTM's work on yellow fever resulted from these associations.

The LSTM demonstrated an interest in the disease in its early years. Between 1899 and 1914, its researchers studied yellow fever on six expeditions: four to the Americas, and two to West Africa. The School established the Yellow Fever Bureau in 1911, directed by Harald Seidelin. The Bureau was responsible for the publication of the *Yellow Fever Bureau Bulletin*, used to disseminate the latest research and findings among the scientific community. The School was able to provide other institutions with expert personnel to investigate and advise on the disease. As discussed earlier, at the request of the Colonial Office, Boyce visited several locations to look into yellow fever. His visit to West Africa in response to epidemics during 1910 is particularly pertinent to this study, and will be discussed in greater detail in subsequent chapters. The School furnished the Colonial Office with further expertise with the appointment of Seidelin as an investigator to the YFWAC in 1913. The Commission's third report, published in 1915, discredited Seidelin's claims to have discovered the cause of yellow fever, He named the organism *Paraplasma flavigenum*, others nicknamed it "Seidelin's Bodies". However, the LSTM did not sustain its initial commitment to yellow fever after World War One.

The School's overseas laboratories embody its attempts to put the aims, practices and rationale of expeditions on a more permanent basis. The Alfred Jones Laboratory was funded by a bequest of £10,000 from Sir Alfred Jones. It was situated in Freetown, Sierra Leone, opened in 1922 and closed in September 1941. It suffered from fluctuating fortunes throughout its existence; the constant fight for financial survival restricted research and sapped the energy of its personnel. The laboratory customarily functioned with insufficient staff. As Power demonstrates, the laboratory never developed a coherent policy of research. Individual interests, chance occurrences and specially commissioned projects and surveys shaped its agenda.[79] The pressing financial situation forced staff to undertake more routine paid pathological work for the Sierra Leone government than desirable, diverting valuable time and expertise away from scientific research.

Yellow fever was not a significant research interest of the laboratory, although it became involved on several occasions, typically by coincidence than by an informed and deliberate strategy. Greater detail of the laboratory's work on the disease will be given throughout the thesis, although it may be useful here to indicate how the laboratory functioned in relation to colonial authorities. It conducted two major mosquito surveys in Sierra Leone: mainly to assess the risk posed by *Anopheline* mosquitoes: the vector of malaria. One resulted from a direct request from the DMS of Sierra Leone, illustrating direct colonial interaction with this independent research laboratory. In both surveys, researchers also collated information on yellow fever vectors, although little use was made of the data. The Colonial Office also called upon the laboratory to investigate epidemics of the disease, collect pathological material, and conduct local research. The first attempt to do so in 1923 proved unsuccessful as the epidemic had abated by the time the researcher, Philip A. Maplestone, had arrived. Unable to collect any pathological samples himself, his only recourse was to visit sites of cases and examine what pathological material was available. Thomas Herbert

[79] See *ibid.* chapter 2, pp.47-77 for a thorough analysis of the laboratory's activities.

Davey met with greater success when the Colonial Office asked him to investigate the disease at the start of 1935 in Bathurst, the Gambia.[80] Collaborating with Findlay, he assisted in a pioneering inoculation campaign, and an immunity survey. Both episodes demonstrate the Colonial Office's use of independent research groups to assist in the disease problems of the empire. The laboratory played a minor role in yellow fever inoculation later that decade when its facilities were used for vaccination storage and distribution.

The 1934-35 epidemic in the Gambia prompted Rupert Montgomery Gordon, the laboratory's Director to initiate a minor education campaign.[81] He produced a booklet detailing the latest epidemiological knowledge on yellow fever and an appraisal of methods of control.[82] This booklet was intended for distribution throughout the four British West African colonies, particularly to assist MOs. Unusually, this did not result from a request for help from the CMS, but rather came from Gordon's own initiative.

The laboratory therefore made an intermittent contribution to anti-yellow fever efforts in West Africa, utilising several epidemiological and immunological techniques. However, it was rarely the initiator, but rather acted as an accidental participant or a subsidiary actor in another's campaign. Frequently, its efforts resulted from requests from the Colonial Office or the CMS. In this context, the LSTM can be

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[80] T.H. Davey was born in Belfast in 1899. He was educated at Queen's University, Belfast. He joined the LSTM in 1929, and was made Director of the Alfred Jones Laboratory in 1938 until its closure in 1941. He remained at the LSTM for the rest of his career, becoming Professor of Tropical Hygiene in 1945. He died in 1978.

[81] R.M. Gordon was born in Dublin in 1893, and was educated in Dublin. He spent a considerable part of his career abroad, beginning with period in the RAMC, in Salonica, 1916-1919. He joined the LSTM, and became a research assistant in its first overseas laboratory in Manaos, Brazil, 1920-21. He then returned to Liverpool where he became Professor of Tropical Diseases of Africa. In 1930, he left England for Sierra Leone, in his new position of Director of the Alfred Jones Laboratory, which he held until 1937. He then became the Walter Myers Professor of Entomology and Parasitology at Liverpool until his retirement in 1958. He died in 1961.

[82] Gordon, "Notes on Yellow Fever".

seen to operate within the colonial framework, albeit with a limited role. Although the School cannot be regarded as critical in the yellow fever story, its activities demonstrate the interplay between formal colonial institutions and independent research groups. Anti-yellow fever work cannot simply be regarded as an activity of the formal machinery of empire, but instead involved a variety of groups and individuals with their own aims and agendas. Given the resources and priorities of the CMS, buying in expertise for limited resources is not surprising. However, unlike the relationship with the RF, who had the upper hand, in the case of the small LSTM programme in West Africa, it was the CMS who invited its participation.

George Marshall Findlay

Findlay was a key figure in British yellow fever activities throughout the 1930s and 1940s.[83] Originally a pathologist, he lectured at the University of Edinburgh, becoming Assistant Pathologist at the Edinburgh Royal Infirmary, from 1920 to 1923. He then spent five years at the laboratories of the Imperial Cancer Research Fund. His research on yellow fever began in 1928 when he started work at the Wellcome Bureau of Scientific Research in London: a research branch of the Burroughs Wellcome pharmaceutical company, dedicated to the study of tropical diseases. The Bureau sprang from Henry Wellcome's interest in Africa, which had already led to the establishment of tropical research laboratories in Khartoum, financed by Wellcome.[84]

[83] G.M. Findlay was born in 1893, the son of a GP. He obtained his medical degree at Edinburgh University. After his work on yellow fever during World War Two, he continued his research into rift valley fever, the coxackie virus and polio. He died in March 1952.
[84] For an analysis of this laboratory's work see A.A. Abdel-Hameed, "The Wellcome Tropical Research Laboratories in Khartoum (1903-1934): An Experiment in Development", *Medical History* 41 (1997), pp.30-58.

The Bureau, founded in 1913, became the Wellcome's metropolitan site for tropical research. Its early Directors, Andrew Balfour (1913-1923) and Charles Morley Wenyon (1923-1939) were both experienced in conducting scientific studies in the tropics.[85] Working in this specialised environment from 1928 to 1946, Findlay made major contributions to vaccine development and epidemiological knowledge and published extensively on yellow fever. His work on the yellow fever vaccine was of particular importance, earning him the C.B.E. in official recognition of his contributions.

His informal association with the Colonial Office partly determined the nature of his yellow fever research. He straddled the boundaries between commercial and colonial medical research, and can be seen to illustrate the interaction between the two spheres. He was the Colonial Office's choice to visit the RF's yellow fever laboratory in New York to learn inoculation techniques. His consequent work on the vaccine, including its manufacture and administration was conducted at the Wellcome Bureau, with some financial assistance coming from the Yellow Fever Commission Fund.[86]

This was not the end of Findlay's association with the Colonial Office. By the mid 1930s, his efforts with the vaccine had established him as the British expert on the disease. As such, he acted as occasional advisor to the Colonial Office, writing reports and giving evidence before several colonial medical advisory committees. The Colonial Office also despatched him to the Gambia early in 1935 in response to the epidemic occurring in the capital, Bathurst. His expenses for the trip were paid out of the Yellow Fever Commission Fund. This again places him in the colonial realm.

[85] H. Turner, *Henry Wellcome: The Man, his Collection and his Legacy* (London: Heinemann, 1980), pp.22-23.
[86] PRO. CO 554/108/11.

However, he was never on the staff of the Colonial Office, alongside men such as Stanton, rather he acted as their occasional external consultant. The government called on his expertise again during World War Two, bringing him into the RAMC to investigate yellow fever in the Sudan and trench fever in Tunis. He was made Brigadier in the West African Command and continued his interest in yellow fever in West Africa. His favour within the Colonial Office was well known, although not all shared a high opinion of Findlay. Members of the IHD found him somewhat antagonistic and territorial. There is no evidence of any adversity against him among the British medical and colonial communities. Indeed, his repeated role as advisor on the disease to the Colonial Office suggests its members held him in some regard, or at least, respected his ability and knowledge.

Conclusion

As this chapter demonstrates, the control of yellow fever in West Africa is made up of several overlapping narratives, each formed by the organisations involved and reflecting their differing creeds, methods and motivations. All worked within the framework of colonial West Africa, but their commitment to a policy of colonialism was not uniform. Thus, the participation in tropical medicine was a more subtle process than the location might suggest. Some displayed obvious colonial characteristics, while others occasionally served colonial interests. The RF's health activities were colonial in an informal sense: in that it used medicine to enhance its economic and political influence in a region, although this is not wholly applicable to its activities in West Africa. The LSTM and the Wellcome Bureau were educational and/or commercial research bodies, operating within a colonial system, and the Colonial Office and CMS often called upon their expertise. In this sense, they can be regarded as being a part of the colonial enterprise.

These groups all played a limited role in anti-yellow fever efforts, operating at different levels: internationally, nationally and locally. International frameworks of disease prevention provided standardised systems for disease notification, surveillance and quarantine regulations which related to yellow fever and other diseases. The Colonial Office and the CMS were the official institutions dealing with colonial medicine. The Colonial Office's role in tropical medicine increased as the century progressed, with the establishment of the London School of Tropical Medicine, and the creation of specialist advisory committees and investigations, some of which it convened to deal with yellow fever. The CMS played a more direct role in yellow fever control. They faced considerable obstacles such as limited finance, a lack of specialist staff, constant changes in leadership, and occasionally, an indifferent colonial administration. These problems ensured that the CMS were restricted to the immediate problems of disease control, able to initiate only small scale research efforts. In contrast, the RF, the LSTM and the Wellcome Bureau were dedicated research groups. The RF was extremely well funded, with expert personnel, and an outwardly philanthropic outlook. The LSTM's and the Wellcome Bureau's involvement in yellow fever was less extensive than the RF's. The latter's occurred as a result of Findlay's specific interest in the disease. The LSTM's was more opportunistic, and did not signify a dedicated research concern.

These groups did not act in isolation, but interacted to provide an amalgamation of yellow fever control and research efforts. The British Government could selectively choose its level of participation in international systems of disease control, and discuss its particular concerns. The RF was particularly proactive in its dealings with other health care providers and research groups. For example, it carefully fostered its association with the British government, and commonly took the initiative in these relationships, approaching the relevant authorities when it wished for their co-operation in its campaigns. The RF determined its own agenda when interacting with colonial institutions. The LSTM and the Wellcome rarely followed this approach in their dealings with the Colonial Office and the CMS in their work on yellow fever. In these instances, the colonial authorities usually called upon them to deal with their particular concerns about the disease. This demonstrates that the RF had some distance from the colonial regime, doubtless facilitated by the other groups' inability to replicate the RF's extensive work on the disease.

CHAPTER TWO

CONTROLLING YELLOW FEVER: 1900 TO 1934

The efforts of the CMS against yellow fever were characterised by uniform methodologies during this period. MOs promoted and employed measures including anti-larval campaigns, segregation, and quarantine as part of day to day sanitary activities and during epidemics. I will contend that the complex ideas of yellow fever held by the CMS were central to their efforts against the disease. This chapter will explore the various contributions to their understanding of the disease and seek to explain their roles in determining anti-yellow fever action. This analysis will engage with notions of yellow fever endemicity, African immunity, Africans as reservoirs of infection, and mild yellow fever among Africans. Non-medical factors will also come into play, including commercial considerations. I will argue that the CMS's perceptions of yellow fever fluctuated during this period in response to the changing disease environment. An appearance of epidemic yellow fever created considerable alarm among western medical personnel in West Africa, resulting in action that was repressive and arguably extreme given the numbers of reported cases. However, during periods free from visible infection, the CMS's zeal lapsed into complacency, despite the widely held belief that the disease was endemic in the region, with many cases going unnoticed and undiagnosed, particularly among the African population. This analysis attempts to explain this trend. There were significant epidemiological and immunological developments during the 1930s and 1940s which affected understanding of, and campaigns against yellow fever. Therefore, they will be dealt with in subsequent chapters.

As the primary providers of medical care in the colonies, the CMS were the main actors in anti-yellow fever campaigns. The initiation of practical control measures in the community, rather than laboratory research, was at the centre of their response to the disease. To what extent can this analysis treat the CMS as a homogenous group? The four British colonies had varying experiences of yellow fever. The disease was considerably more prevalent in the Gold Coast and Nigeria than in the Gambia and Sierra Leone. As a consequence, staff who had served in the Gold Coast and Nigerian Medical Services were more likely to have encountered, and gained a practical understanding of the disease, than their colleagues in the other two colonies. Other differences existed. Although the WAMS offered its staff standardised conditions of service, medical departments operated independently as separate units. Inevitably, variations in personnel, facilities, budgets, ethos, and disease environment ensured their operation varied from colony to colony. However, there was sufficient common ground between them, in terms of their response to yellow fever, to make a combined analysis viable. As the period progressed, most members of the medical services of the four colonies shared a common education in tropical medicine, having attended either the London or Liverpool Schools of Tropical Medicine as a condition of their service.[1] Thus, they would have been taught similar methodologies and theoretical understanding of diseases in the tropics. Members who joined before the Schools' creation in 1899 would not have the benefit of this experience. Some MOs experienced quite dynamic career trajectories, serving in more than one West African colony. W.D. Innes served as DMS in Sierra Leone from 1924 to 1926, followed by two years in the Gold Coast when anti-yellow fever measures were at a height. D.

[1] R.E. Dumett, "The Campaign Against Malaria and the Expansion of Scientific Medical and Sanitary Services in British West Africa, 1898-1910", *African Historical Studies* 1 (1968), p.163.

Alexander spent five years as the SSO, and two as DMS in the Gold Coast before transferring to Nigeria in 1923.[2] Therefore, as administrative units the medical departments were relatively static, but the personnel within were not, and had opportunities to broaden their experiences and perceptions.

To a more limited extent, this chapter seeks to examine, where possible, non-medical responses to yellow fever, concentrating on Europeans. The non-medical European population in West Africa was a diverse community, whose disparate interests shaped its members' responses to yellow fever. Far from being restricted to colonial officials, the colonial enterprise included members of the military, merchants, and missionaries who acted as individuals as well as interest groups. It must be remembered too, that colonial officials were also individuals as well as components of a colonial administrative bureaucracy. The non-official community was predominantly British in origin but most European countries were represented, in addition to some Americans, and a thriving Syrian community.[3] Many expatriates were accompanied by their wives, but rarely their children. How did they react to the disease, both as an abstract possibility, and in the face of an epidemic? How did they respond to measures against yellow fever in both epidemic and non-epidemic circumstances, and what factors informed this response?

Answers to these questions interact with the historiography on epidemics which has enjoyed considerable popularity in the last twenty years. Historians have found that epidemics exhibit many shared features of human behaviour, revealing a

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[2] *Annual Reports of the Medical Departments of Nigeria, Sierra Leone and the Gold Coast, 1910-1930.*

[3] For ease, I shall refer to this non-immune community as either "non-immunes" or "Europeans", although their makeup was probably more diverse. Syrians are not included among this category and are referred to separately, as they were sometimes treated by the CMS as distinct from Europeans albeit with the same non-immune status.

society's prejudices and preoccupations, C.E. Rosenberg argues: "the behavior of society during an epidemic and of medicine as a social function provides an organic context in which the structural configuration of attitudinal and institutional factors may be discerned".[4] Historians have tended to concentrate on the more exotic and sensational diseases as they occurred in Europe and North America, such as cholera, small pox, and plague which elicited powerful reactions from fearful populations and beleaguered medical services.

Recently there has been considerable attention paid to epidemics in the tropics. M. Lyons has examined sleeping sickness in the Belgian Congo, and M. Vaughan has written on syphilis in Central and East Africa.[5] Yellow fever in the twentieth century has been relatively ignored in the research on African epidemics. As it affected the white colonisers this disease fits well within the framework of "exotic" epidemics; its symptoms, like those of cholera, were distressing and painful, capable of killing with breathtaking speed. High mortality rates among European victims intensified the fears of the CMS who were tasked with the control of epidemic diseases, and provoked a strong reaction amongst them. D. Arnold analyses colonial reactions to epidemics of smallpox, plague and cholera in British India and revealed that these were subtle and disease specific.[6] Therefore, this examination of yellow fever can be interwoven with other studies of tropical epidemics, demonstrating a wide variety of medical and

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[4] C.E. Rosenberg, *Explaining Epidemics and Other Studies in the History of Medicine* (Cambridge: Cambridge University Press, 1992), p.110.

[5] M. Lyons, *The Colonial Disease: A Social History of Sleeping Sickness in Northern Zaire, 1900-1940* (Cambridge: Cambridge University Press, 1992); M. Vaughan, "Syphilis in Colonial East and Central Africa: The Social Construction of an Epidemic", in T. Ranger and P. Slack (eds.), *Epidemics and Ideas: Essays on the Historical Perception of Pestilence* (Cambridge: Cambridge University Press, 1992), pp.269-302.

[6] D. Arnold, *Colonizing the Body: State Medicine and Epidemic Disease in Nineteenth Century India* (Berkeley: University of California Press, 1993).

colonial reactions; some shared with other epidemics, others unique and specific to yellow fever.

This chapter addresses a number of themes in the thesis. It first engages with scientific theories of yellow fever constructed by various research groups. These displayed several subtle differences in understanding. I attempt to place a framework on these theories, offering possible explanations for their divergence. I have included the CMS within this model. They did not construct theory, but rather blended elements of the various notions to create a workable basis for campaigns that corresponded with their own understanding and experiences of the disease.

How did theories translate into practice? For the remainder of the chapter, I demonstrate that these theories led to widely held notions of Africans as dangerous to European health with regard to yellow fever. As a consequence, anti-yellow fever campaigns aimed to protect Europeans from what the CMS considered the two principal sources of infection: mosquitoes and the indigenous population. An examination of practices divides the CMS's anti-yellow fever efforts into two spheres: routine activities, and responses to epidemics. The former combined anti-mosquito measures with residential segregation of Europeans from Africans. This chapter examines the foundations of these measures and assesses their application by the CMS, and the barriers to their implementation. These include a lack of co-operation by the non-medical community as well as apathy among some medical personnel. It concludes that these obstacles were considerable in some cases. As a result, the CMS did not administer routine anti-yellow fever measures to the extent that they themselves, and other tropical medicine experts commonly deemed desirable.

Epidemic measures were more varied. They consisted of an intensification of routine measures, together with measures designed to control the population using medical isolation, surveillance, and quarantine. I locate these factors within a framework constructed by Rosenberg. This permits an extension of Rosenberg's analysis of epidemic diseases using yellow fever as a case study. Rosenberg restricts his analysis to epidemics in Europe and North America: mainly looking at the importation of exotic diseases such as plague and cholera. Lyons and Vaughan have focused upon these diseases among the indigenous population in the tropics. This study offers a further dimension by extending Rosenberg's model to examine western experiences of epidemics of a tropical disease among an expatriate European population.

Understanding what you are trying to control: two spectrums of understanding

An overall understanding of yellow fever in this period centred on four interrelated elements in epidemiological theory: endemicity; Africans as reservoirs of disease; immunity and a mild type of yellow fever among the indigenous population. Their relationship was a critical factor in constructing perceptions of, and responses to the disease by the various groups outlined in the previous chapter. However, their association was complex as different institutions held a slightly modified appreciation of each element. In order to establish a framework, this chapter places them within two spectrums of understanding; the first relating to endemicity and reservoirs of disease; the second to immunity and mild yellow fever. The latter factor was relatively uncontested. It had implications for notions of endemicity and immunity and is central to theories on both spectrums. Research groups and individuals such as Boyce, the YFWAC, 1913-1916, Carter and members of the RF were the principal manufacturers of these theories, and are included. I also locate CMS's understanding of the disease. Although they did not generate theoretical knowledge, they selected, modified and applied what was on offer to their anti-yellow fever efforts in West Africa. Their understanding of the epidemiology was central to the shape of their campaigns, and occupy an important place on the spectrums.

Endemicity and reservoirs of disease

There was little dispute that yellow fever was endemic in West Africa. However, the degree of endemicity proved controversial. Standard sources were equivocal, a contemporary dictionary definition of the term referred to location and/or ethnicity: "endemic is a term applied to the diseases which exist in particular localities or amongst certain races".[7] *Manson's Tropical Diseases* merely commented that yellow fever was "apparently" endemic in West Africa.[8] Specialist opinion was obviously warranted. Endemicity was significant because it was used to create perceptions of Africans as reservoirs of the disease. If the disease was endemic, it had to be maintained by some source of infection. Some researchers made vague references to the possibility of an animal reservoir, but discussions remained speculative.[9] Although RF researchers went on to discover an animal reservoir in the

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[7] J.D. Comrie (ed.), *Black's Medical Dictionary* (London: The Waverley Book Co., 1928).
[8] P.H. Manson-Bahr (ed.), *Manson's Tropical Diseases: A Manual of the Diseases of Warm Climates* (London: Cassell and Co., 1921), p.190; *ibid.*, (1929), p.191.
[9] Henry Carter of the RF argued that the available evidence strongly indicated that there was no animal reservoir, H. Carter, "Spontaneous Disappearance of Yellow Fever From Failure of the Human Host", *TRSTMH* 10 (1917), p.120.

1930s, during this earlier period, experts considered humans, namely the indigenous population, to be the likeliest source. The spectrum established below uses expert opinion of yellow fever endemicity. It seeks to unravel the competing theories and present a nuanced interpretation of the term.

Boyce's notions of endemicity are located at the extreme end of this spectrum. In 1910, at the behest of the Colonial Office, he travelled to West Africa to investigate recent epidemics in the region. His qualifications for the task were undeniable; his impressive activity as Dean of the LSTM quickly remedied an initial lack of tropical expertise before his involvement with the School.[10] He had several publications on tropical medicine and health: two on mosquito borne diseases and two specifically relating to yellow fever.[11] His mission in West Africa was to investigate the nature of yellow fever in the region and analyse the potential threat it represented. Boyce examined case books of colonial hospitals in the four colonies, analysing reported yellow fever cases and making retrospective diagnoses where he believed misdiagnosis had occurred.

In conclusion, he offered a highly controversial theory of endemicity. He suggested the indigenous population in West Africa was "saturated" with the disease, which was as common as malaria. This was a dramatic statement given the widespread levels of epidemic and endemic malaria in the region. He unequivocally labelled the indigenous population, particularly children, as a disease reservoir: "It is then to the black races that we must look for the source of supply of the yellow fever

[10] H. Power, *Tropical Medicine in the Twentieth Century: A History of the Liverpool School of Tropical Medicine* (London: Kegan Paul International, 1999), pp.19-20.

[11] R. Boyce, "The Yellow Fever Epidemic in New Orleans in 1905", *Transactions of the Epidemiological Society of London* 25 (1905-6), pp.270-294; *idem*, *Report to the Government of British Honduras Upon the Outbreak of Yellow Fever in that Colony in 1905, Together with an Account of the Distribution of the Stegomyia Fasciata in Belize and the Measures Necessary to Stamp Out or Prevent the Recurrence of Yellow Fever* (London: Waterlow, 1906).

virus: it is they who, in childhood and adolescence, have the disease in a mild form: but mild though it be, sufficient to infect the *Stegomyia*".[12] He argued that much yellow fever went undiagnosed by western medical personnel explaining why they had previously underestimated its incidence. He claimed it occurred frequently among the European population, but medical personnel mistook it for bilious remittent fever or deliberately failed to diagnose cases fearing the inevitable resulting panic and commercial disruption: a phenomenon Boyce called "notification fear". The CMS also misdiagnosed cases among the African population or failed to recognise it among them because the mild type of infection resulted in almost undetectable symptoms. Thus, reported levels of the disease among the indigenous and non-indigenous population were considerably lower than actual incidence.[13]

Few other members of the medical community were willing to concur with such an extreme version of endemicity, immediately after he made his findings public, or during the following twenty years. Some of his colleagues in Liverpool supported the fundamental tenet of his theory: that yellow fever was endemic in West Africa, but offered a slightly diluted version. John William Watson Stephens, famed for his role in the Royal Society Malaria Commission's investigations of malaria in West Africa at the start of the century, was closest to Boyce's end of the spectrum.[14] He accepted that Boyce's evidence demonstrated that yellow fever was endemic in West Africa in the sense that: "cases of yellow fever smoulder ... perhaps widely scattered".[15] He

[12] *Idem*, *Yellow Fever and its Prevention* (London: John Murray, 1911), p.258.
[13] *Idem*, "Recent Outbreak of Yellow Fever in West Africa", p.7. *Correspondence Relating to the Recent Outbreak of Yellow Fever in West Africa*. Cd. 558, 1911. See also *idem*, "The Distribution and Prevalence of Yellow Fever in West Africa" *TRSTMH* 4 (1910), pp.33-58.
[14] J.W.W. Stephens was born in 1865, and was educated at Cambridge University. He had an impressive career in tropical medicine, including membership of the Royal Society's Malaria Commission, 1898-1902. He then held the Walter Myers Lectureship at the LSTM until 1913, when he became the Alfred Jones Professor of Tropical Medicine, also at Liverpool until 1928. He died in 1946.
[15] Boyce, "Yellow Fever in West Africa", "Discussion", (1910), p.115.

contended that it was impossible to determine the extent of endemicity given contemporary levels of knowledge. Following Boyce's death, within a year of the publication of his theory, Stephens argued that the medical community had misunderstood Boyce's findings claiming: "people quite unjustifiably interpreted that yellow fever was raging along the whole coast".[16] He reiterated his opinion that the extent of endemicity was greater than previously suspected, but that an "unknown regional factor" limited its diffusion.[17]

Drawing on his experiences of the disease in Yucatan, Mexico, Harald Seidelin of the LSTM agreed with Boyce that many cases among the non-indigenous population went unnoticed. He contended that nearly all new comers to the region contracted the disease, but only the severe cases captured medical attention. He was convinced a mild febrile disorder suffered by his entire family shortly after their arrival in Yucatan was yellow fever. From this he inferred that a similar situation could occur in West Africa, supporting Boyce's notion of high endemicity.[18]

The majority of the British medical community occupied a middle ground until the 1930s. What Stephens had suggested to be a misinterpretation of Boyce's theory, was actually the general understanding. In the immediate aftermath of Boyce's contentions, some tropical experts expressed dismay at its possible implications. These included medical, social, and economic factors, demonstrating that theories of disease were sensitive to non-medical considerations. The construction and acceptance of such theories were guided by more than epidemiological understanding. Some experts, including Patrick Manson, spoke of their concern of the effect on quarantine. They argued that it may dissuade some officials in the region from

[16] J.W.W. Stephens, "Discussion of Yellow Fever on the West Coast of Africa", *BMJ* (1911), p.1264.
[17] *Ibid.*, p.1264.
[18] *Ibid.*, "Discussion", p.1265.

declaring quarantine on a neighbouring colony or town if they considered the disease to be ever present among their own local population.[19] Dr J.P. Tullock, who had served as an MO in the West Indies, an area which suffered from bilious remittent fever, argued: "the acceptance of [Boyce's theory] ... will most certainly lead to inconvenience and financial loss".[20] The reputation of West Africa as "the white man's grave" still dogged the region; admitting that yellow fever may be as common as malaria would hardly have improved its image. It could have potentially deterred commercial investment, discouraged recruitment of officials, and perhaps necessitated costly intensification of anti-yellow fever work.

The view of the YFWAC epitomised main stream opinion. The Commission was established by the Colonial Office's AMSC. It appointed the YFWAC in 1913, to investigate yellow fever in West Africa and advise the Colonial Office. The Colonial Office took no financial responsibility for the operation of the YFWAC, instead contributions from the four West African colonies which totalled £5,000 per annum, provided funding.[21] The medical members included Sir James Kingston Fowler, Ronald Ross, William Leishman and William John Richie Simpson. Fowler had little direct tropical experience but his role as chairman of the Colonial Medical Appointments Board gave him insight into the workings of the colonial medical system. Ross and Simpson contributed a wealth of tropical expertise between them. Ross, a professor at the LSTM, was famed for his groundbreaking research on malaria and had vital knowledge of conditions in West Africa and of insect borne

[19] See for example, the arguments of C.W. Daniels and P. Manson, in Boyce, "Yellow Fever in West Africa", "Discussion", (1910), p.91, and p.114 respectively.
[20] *Ibid.*, p.72.
[21] Contemporary Medical Archive Centre, the Wellcome Library, London. GC/59/A3. Secretary of State to the Governors of the Gambia, the Gold Coast, Northern and Southern Nigeria, 02.09.1913.

diseases in particular.[22] Simpson's qualifications were as impressive. Like Ross, he had worked in India, then moved on to investigate dysentery and enteric fever among troops in South Africa. He gained hands-on knowledge of West Africa in 1908 while studying plague and public health in the Gold Coast, Sierra Leone and Southern Nigeria.[23] Leishman had no direct experience of West Africa but was a highly skilled laboratory researcher. He was a member of the RAMC and spent several years in India. He then returned to the Army Medical School at Netley, where he conducted research in tropical diseases and was made Professor of Pathology until 1913. This prestigious group of men represented a high profile pool of expertise, with proven talents in research both in the laboratory and the field, specifically West Africa.

The Colonial Office instructed the YFWAC to produce interim and final reports for the AMSC to present to the Secretary of State. Its stated objective was to: "study the nature and relative frequency of the fevers occurring among Europeans, natives and others in West Africa, especially with regard to yellow fever and other non-malarial fevers in that country".[24] It adopted a dual approach of field investigations with an expedition to West Africa; and information gathering in London by interviewing MOs of the WAMS and numerous yellow fever experts. The expedition established three bases at locations in the Gold Coast and Sierra Leone: D.

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[22] Ross is famed for his prestigious career in tropical medicine. Born in 1857, he joined the IMS in 1881, and from 1892 specialised in research into malaria, winning the Nobel Prize for Medicine for his work in 1902. He became the Director of the LSTM when it was established and remained there until 1912. He then moved to London where he continued his work. He died in 1929. Biographies of Ross include: R.L. Megroz, *Ronald Ross: Discoverer and Creator* (London: Allen & Unwin, 1931); and J. Rowland, *The Mosquito Man: The Story of Sir Ronald Ross* (London: Lutterworth Press, 1958).

[23] See R.A. Baker and R.A. Bayliss, "William John Richie Simpson (1855-1931): Public Health and Tropical Medicine", *Medical History* **31** (1987), pp.450-465, for a thorough examination of his career.

[24] CMAC. GC/59/A1. "Report of the sub committee appointed by the Advisory Medical and Sanitary Committee for Tropical Africa to formulate proposals for the investigation of the question of yellow fever in West Africa", undated.

Thompson and G.E.H. Le Fanu went to Accra, H.M. Hanschell and H.S. Coghill to Seccondee, and J.C.B. Statham and G.G. Butler to Freetown. Their instructions were to study as many fever cases as possible, to visit hospitals and dispensaries to search for African and European victims, and extend their enquiries, where practical, beyond these institutions. Investigators petitioned all medical personnel in the region for their assistance including private practitioners, missionaries, and obviously the CMS, requesting they keep detailed notes of all fever cases suggestive of yellow fever using the standard 'fever cards' they distributed.[25]

The YFWAC was disbanded in 1916; disruptions caused by the war preventing effective investigation. Its final report offered a more moderate definition of endemicity: the opposition to Boyce's hypothesis was clear. It stated that there were areas in West Africa in which the disease temporarily occurred, and areas in which yellow fever was a permanent presence, and it was in this sense that yellow fever was endemic, rather than occurring universally among the indigenous population.[26] The latter statement suggests that the YFWAC did not consider the African population to be vast reservoirs of infection. It refused to commit itself further on the issue. It stated, quite obviously, that either Africans, mosquitoes, or animals must be the source of infection, yet claimed additional research was necessary to elucidate this problem. It contended that the endemic area extended from "Senegal in the north to the French Congo in the south".[27] Economic or political factors possibly swayed the authors of the report, prompting them to present a much gentler scenario to counter Boyce's rather terrifying version. Indeed, the Colonial Office and the AMSC may have convened the YFWAC with this result in mind. Ross and Simpson

[25] CMAC. GC/59/A1.
[26] *Final Report of the YFWAC* (London: J.&A. Churchill, 1916), p.239, p.255.
[27] *Ibid.*, p.126.

had previously stated their doubts about Boyce's findings: Simpson, by coincidence, calling for a special investigative commission. By including these men, the Colonial Office ensured that the YFWAC held some bias against Boyce before investigations began.

The RF's West Africa Yellow Fever Commission of 1920 also contributed to the debate; its view occupied the opposite end of the spectrum to Boyce's. It agreed that the disease had been endemic in West Africa, but considered that Boyce and even the YFWAC overestimated its present status and intensity. Its own investigations in the region in 1920 failed to find one ongoing case of the disease. Its report speculated that if yellow fever had existed in the region that year it was likely to have been "in small foci, fenced in and isolated by living screens of immune people".[28] One member, Juan Guiteras, an acknowledged yellow fever expert from South America, claimed that yellow fever's presence in the region was "extremely precarious". He stated that the "extinction" of the disease was not only possible, but even probable.[29] This view accommodated the RF's grand plans for yellow fever eradication, providing an optimistic outlook for its success.

Although this position clashed with that held by the majority of the British medical community, the RF Commission was not entirely alone at this end of the spectrum. There is anecdotal evidence to suggest that Ross was sympathetic to such a view. Before departing for West Africa to begin the study, Robert E. Noble, the head of the Commission debated the issue with Ross in London. Ross, he claimed, believed that the YFWAC's findings were flawed. The investigators in West Africa were young

[28] J. Guiteras, "The General Situation on the West Coast of Africa with Respect to Yellow Fever, with Suggestions as to Subsequent Investigations", in *Report of the Yellow Fever Commission to the West Coast of Africa, July 19 to October 1920*, p.47. F331, B52, SS495, S2, RG5. RFA, RAC.
[29] *Ibid.*, pp.46-47.

and inexperienced, unable make effective diagnosis, and thus mistook other febrile conditions such as Weil's disease or malaria for yellow fever. Although he would not commit himself to refute the disease's existence in the region, he told Noble that he believed that there were very few cases.[30]

As the CMS did not conduct any cohesive studies, they did not formulate medical theory in contrast to the groups mentioned so far. They did apply theories to anti-yellow fever practices in West Africa and thus, their understanding of endemicity is crucial. From the available evidence, which includes opinions expressed in the *Annual Medical Reports*, occasional publications and their actions against the disease, it can be surmised that they generally concurred that yellow fever was endemic in their region. When the YFWAC asked his understanding of yellow fever endemicity in West Africa, T. Hood, the PMO of Southern Nigeria replied that it was harboured by a large proportion of the indigenous population almost constantly.[31] R.O. White, a member of WAMS clearly expressed his belief that the disease was endemic in the region. He dismissed the contrary arguments of Guiteras and the RF's Commission. Instead he contended that the recent spate of cases in the Gold Coast in 1923 signified the disease was endemic and maintained by an indigenous reservoir.[32] However, his colleagues were not always as explicit and did not always specifically use the term "endemicity" or "endemic". They expressed concern at yellow fever's occurrence among the indigenous population as well as the danger of importation from other colonies. This suggests they were aware of the endemic threat in West Africa believing in a reservoir of infection among Africans. Even in Sierra Leone, which

[30] R.E. Noble, "The Visit of the Yellow Fever Commission of the International Health Board to the West Coast of Africa", in *ibid*, p.2. F331, B52, SS495, S2, RG5. RFA, RAC.
[31] CMAC. GC/59/A4. Minutes of the YFWAC, 07.01.1914.
[32] R.O. White, "Yellow Fever in the Gold Coast: Its Endemic and Epidemic Nature", *ATMP* **17** (1923), pp.431-437.

enjoyed a marked freedom from the disease for most of the period, the CMS were reluctant to claim the colony was non-endemic.[33] Their experiences of practising medicine in the tropics led them to believe that yellow fever was greater than recorded levels suggested and that many African cases went unnoticed. This view was reminiscent of Boyce's statements regarding underreporting. Members of the CMS blamed several factors for this; contending that the difficulty of accurate diagnosis was a crucial factor. In the absence of a specific diagnostic test, clinical diagnosis and possibly a post-mortem confirmation by histopathological examination of the liver were the only means available. The clinical picture of yellow fever was notoriously complex, and easily confused with other febrile conditions. Even the classic textbook symptoms of black vomit and jaundice were not apparent in all cases and thus practitioners in the tropics could not rely on them for diagnosis. The existence of mild and atypical yellow fever, in both Europeans and Africans, (with mild yellow fever believed to be far more prevalent in the latter) further complicated this problem. Working conditions also affected accuracy, as highlighted by A.J.R. O'Brien, MOH in the Gold Coast in 1913, when trying to confirm an epidemic in an African village. He complained:

> The facilities for demonstrating mild and atypical Yellow Fever on a hurried visit to the bush are limited. It seems to me that we will not meet with much success in that direction until we are able to prove the presence of a parasite. Careful clinical observations made in hospitals, where the patient is under control, are at present essential.[34]

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[33] *Sierra Leone Annual Medical Report, 1912, 1917*, p.38 and p.52 respectively.

[34] *Gold Coast Annual Medical Report, 1913*, p.72.

MOs frequently complained that Africans failed to seek medical treatment when sick, thus exacerbating under reporting. They contended that many cases went unnoticed in more isolated rural areas, simply because there was no colonial presence to note their incidence. They did agree with Boyce on the existence of "notification fear", but were adamant that this was a feature limited to the first decade of the century.[35]

As I argue throughout this chapter, the CMS regarded the indigenous population as a reservoir of yellow fever infection, an indication of their acceptance of yellow fever's endemicity maintained by infection among Africans. Medical personnel conceptualised West Africans as reservoirs of the yellow fever pathogen, presenting a danger to white health that was accentuated by the difficulty in detecting mild yellow fever. Only when the disease appeared amongst the non-indigenous population, believed to experience more severe bouts of the disease, could the menace be recognised. Therefore, they treated the indigenous population as a possible threat to European health. The CMS's promotion of residential segregation as an anti-yellow fever measure was based on this belief. For example, in 1911, in the Gambia, a report written about an epidemic that year stated: "so long as Europeans live in quarters close to natives an outbreak of yellow fever is always likely to occur": a belief that persisted throughout the period.[36]

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[35] *Ibid., 1932-33*, p.89.
[36] *Gambia Annual Medical Report, 1911*, p.34.

Immunity and mild yellow fever

The medical and research communities agreed that Africans enjoyed some form of immunity to yellow fever. They based this stance on reports and anecdotal evidence from West Africa which suggested several key features about the disease among Africans. First, they noted the apparent absence of epidemic yellow fever among the indigenous population: they observed that the disease occurred sporadically and failed to spread to the remainder of the African community. Second, that the disease frequently took a milder course among African victims, and European mortality and morbidity were most unfavourable by comparison. This led to widespread conclusions that Africans, as a population group enjoyed immunity, and Europeans were non-immune. This permitted the transformation of racial groups into medical categories, based on their immune status. Tropical experts dismissed notions of an inherent, racial immunity early in the period; instead they assumed it to be acquired by a previous attack of the disease. Therefore, these theories were not limited to Africans born in West Africa, rather applied to Africans residing in the region for a sufficient length of time to be exposed to infection. However, opinions differed on the nature and extent of immunity, and focused on whether mild attacks conferred partial or life long immunity. Most agreed that mild yellow fever was not a consequence of immunity, but a cause.

Boyce, again is located at the extreme end of the spectrum. He contended that immunity was partial; acquired in childhood and adolescence after a mild attack of the disease, and maintained through repeated infections of the mild type. [37] This

[37] Boyce, *Yellow Fever* (1911), p.254.

hypothesis was unpopular among many of his British peers as it suggested intense endemicity in the region with all the associated economic and social implications. He was not entirely alone in this view. Again Stephens offered tentative support. He argued that immunity was probably acquired by "mild and frequent attacks in childhood".[38] E. Marchoux and P.L. Simond of the Pasteur Institute, argued that immunity following an attack of yellow fever was maintained for approximately four years. Manson commented in 1910 that this position was "very generally adopted", but he was reluctant to support an unproved hypothesis.[39]

As with endemicity, the YFWAC occupied the middle ground in 1916. It reported that Africans suffered a milder form of the disease which conferred immunity. Reluctant to commit to claiming this immunity was life long, it nevertheless contended that second attacks were rare. This distanced it effectively from Boyce's theory of repeated attacks. It speculated on the reasons for the milder course among Africans, suggesting that the mild cases supported a theory that "the virulence of the infection in Yellow Fever increased with its passage through *non-immunes* and diminished in its passage through natives".[40]

However, there were others who believed that one attack conferred permanent immunity. Carter maintained this position. In addition, he attempted to explain the mild symptoms in Africans using arguments suggestive of a racial immunity: "Negroes" were "as susceptible to *infection* as other races, but less susceptible to the toxins; and that is what we should expect in the evolution of a race long subject to

[38] Stephens, "Discussion on Yellow Fever", (1911), p.1265.
[39] Boyce, "Yellow Fever in West Africa", "Discussion", (1910), p.113.
[40] *Final Report of the YFWAC* (1916), p.128.

yellow fever".[41] Members of the RF's Commission to West Africa in 1920 refused to comment on African immunity, merely claiming that more research was required.[42]

Manson's Tropical Diseases repeated the notion that one attack conferred permanent immunity. This publication surely represented the mainstream British medical and scientific community. As early as 1904, it contended that "one attack establishes a permanent immunity": a claim it maintained unwavering throughout this period.[43]

How did these various slants on immunity translate to West Africa? The CMS concurred that Africans enjoyed some form of immunity and suffered a milder form of the disease than Europeans. The *Annual Medical Reports* of all four colonies commonly distinguished between indigenous and non-indigenous people using the terms "immune" and "non-immune" respectively in reference to yellow fever. However, as with theories of endemicity it is difficult to ascertain the subtleties of their understandings. The available evidence suggests that some were swayed by individual arguments. For example, the report of the Gold Coast's medical department in 1912 reflects Boyce's influence. It described West Africans as being rendered "comparatively immune" by "repeated inoculation by infected mosquitoes".[44] As the period progressed, staff at the colony's medical department still continued to define the indigenous population by their assumed immune status, yet there was less certainty about the nature of immunity. In 1924, the *Annual Medical Report* debated its origin: "The immunity or partial immunity of the adult may be explained by

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[41] H. Carter, *Yellow Fever: An Epidemiological and Historical Study of its Place of Origin* (Baltimore: Williams and Wilkins, 1931), p.81.
[42] Guiteras, "The General Situation on the West Coast of Africa", in *Report of the Yellow Fever Commission*, p.48. F331, B52, SS495, S2, RG5. RFA, RAC. Discussions of immunity to yellow fever in South America were just as controversial and undecided.
[43] P. Manson, *Manson's Tropical Diseases* (London: Cassell, 1904), p.187.
[44] *Gold Coast Annual Medical Report, 1912*, p.97.

assuming an attack in childhood, but Yellow Fever has not yet been recognised in African children".[45] Regardless of the differences between the theories they held, they certainly treated the African population as immune, as needing less protection against the disease than Europeans, who received the greater intensity of colonial prophylactic efforts.

All the varying adaptations of immunity on the spectrum were based on notions that African communities did not experience epidemics as levels of immunity prevented the spread of infection. However, a serious epidemic at Asamangkese in the Gold Coast in 1926 shook the certainty of these theories. This presented an alternative scenario: that epidemics could occur among the indigenous population, making their vulnerability to the disease obvious. The town was an important cocoa centre approximately forty miles north west of Accra, with an African population of 4,800. Expert observers believed that the epidemic began among the indigenous population in May, went unnoticed by colonial personnel until July, and finally receded in September. They recorded fifty cases with eight deaths.[46] However, colonial medical personnel and staff at the RF's West Africa Yellow Fever Commission acknowledged that these cases were merely the tip of the iceberg, the latter concluding that there had actually been over 1,000 cases with 100 deaths.[47]

This unfortunate example challenged the theory of African immunity. Oskar Klotz eloquently summarised the contradiction Asamangkese presented:

> Such an epidemic would suggest that this group of people at least were not immune and had never had the disease in childhood or later. As this community was situated along the highway of native travel, it is

[45] *Ibid., 1924*, p.74.
[46] *Ibid., 1926*, p.20.
[47] *Ibid., 1927*, p.122.

difficult to conceive how it had escaped previous infection if the neighbouring villages and towns were constantly endemic centers.[48]

The *Annual Medical Report* speculated on the epidemiological implications of the epidemic. It suggested that a recent freedom from epidemics had created a "relatively non-immune" race, or that African epidemics had long occurred unseen but were now coming under the medical and colonial gaze due to improvements in the transport and communications infrastructure.[49] It did not reach any definite conclusions. Consequent to this and other epidemics among the indigenous population the following year, medical personnel in the Gold Coast altered their use of the words "immune" and "non-immune". Their terminology became more subtle and their uses of the terms "immune" and "non-immune" were less definitive. In 1927, the *Annual Medical Report* labelled the white population as "so-called 'non-immunes' ", stating it was a "misnomer" to refer to Africans as immune.[50] In the early 1930s *Annual Medical Reports* described whites as "susceptibles" and "the highly susceptible non-indigenous community".[51]

The language of the CMS changed after Asamangkese, and there was certainly a recognition among researchers and practitioners in West Africa that it was a fallacy to regard the indigenous population of the region as enjoying widespread immunity. Asamangkese and consequent epidemics among the African population refuted the notion that there were insufficient numbers of non-immune Africans to sustain an epidemic among them. However, this had limited implications for anti-yellow fever

[48] O. Klotz, "Yellow Fever in West Africa", *De Lamar Lectures, 1927-1928* (Baltimore: The Williams and Wilkins Company, 1928), p.17.
[49] *Gold Coast Annual Medical Report, 1926*, p.19.
[50] *Ibid., 1927*, p.128.
[51] *Ibid., 1932-33*, p.17, and *ibid., 1934*, p.15.

activities. The CMS failed to translate this knowledge into practice. They still treated Africans and Europeans as two separate and distinct groups in relation to their experiences of the disease. The legacy of Asamangkese was short-lived. From 1929, the RF used diagnostic immunity tests to survey levels of past incidence of yellow fever in West Africa. Its discoveries cancelled out the implications of the epidemic as results demonstrated higher levels of African immunity than expected and consolidated the tendency of the CMS to treat Africans as an immune group.

Together, the theories of endemicity, reservoirs of disease, immunity and mild yellow fever formed a confusing epidemiological profile that could be both paradoxical and rational, depending on the theories selected. For example, how could West Africa be endemic to the extreme Boyce claimed, if the indigenous population gained permanent immunity after just one attack? If the theories are taken individually, a conflict does not emerge. Boyce contended that Africans only gained a partial immunity which was maintained by repeated attacks. This concurs with his notion that the indigenous population was "saturated" with the disease, and the endemicity in the region was more intense than previously believed. At the other end of the spectrum, the views of Carter and the RF's 1920 Commission also combined to make sense. If immunity was permanent, then there would be many immune people, reducing the possibility for infection to be maintained. Thus endemicity would be less intense, even precarious. This was a fundamental tenet of Carter's key centre theory: the basis for the RF's campaigns in South America.

However, researchers and practitioners in West Africa and Britain failed to consolidate these differing views. No single theory emerged as dominant, and there were no obvious attempts to make sense of their variations. The medical community was faced instead with a complex amalgamation which, at some levels, made little sense. To create a theoretical basis for anti-yellow fever measures, the CMS managed to construct a vague symbiosis. This resulted with anti-yellow fever practices that reflected an assumption of mass African immunity, and endemicity in West Africa. Theories of endemicity fostered a pervasive view among the CMS that Africans were a reservoir of yellow fever. A view unaffected by the more cautious views of the YFWAC, who refused to regard the disease as universal throughout the population.

The commonplace labelling of West Africans as "immune" created a perception of an entire racial group enjoying immunity, disregarding that infection, and immunity, were acquired at an individual, rather than a community level. Medical personnel in West Africa apparently forgot that immunity was not ubiquitous throughout the indigenous population: many were as vulnerable to infection as the so-called non-immunes. The epidemic at Asamangkese in 1926 did lead to a redefinition of African immunity by some members of the CMS, but they did not translate this change into anti-yellow fever practices, demonstrating the strength of the belief in the immune African.

Defining the indigenous and non-indigenous population in medical terms helped to strengthen colonial racial prejudice and practices. The CMS and the wider medical community justified the neglect of indigenous health in terms of their alleged lower susceptibility to disease. It also permitted racial discrimination that may not have been politically acceptable in other circumstances. Residential segregation is a classic example of this. Advocated by the CMS, with varying degrees of vigour, as an effective anti-yellow fever measure, it aimed to prevent contact between the highly vulnerable non-immune population with the indigenous reservoirs of the yellow fever pathogen.

The wider theoretical context

These theories were not developed in isolation. Parallels can be found in earlier and contemporaneous epidemiological theories. Concepts of African immunity were not exclusive to yellow fever; many also believed that Africans enjoyed partial or full immunity to a range of diseases, including, of course, malaria.[52] The image of the immune African was an enduring one. This may partly explain the potency of medical theories of African immunity to yellow fever even in the face of contradictory evidence such as Asamangkese. Theories of racial immunity were common in the nineteenth century based on notions of racial difference affecting susceptibility and resistance to disease. M. Harrison analyses the effects of beliefs in inherent immunity to tropical disease and argues that these beliefs grew in strength in the nineteenth century. This factor contributed to increasing pessimism in the ability of Europeans to adapt to tropical climates. It was contrary to notions that Europeans could acclimatise to tropical climates, and would consequently suffer less from disease.[53] The social and scientific climate contributed to these ideas. As W. Anderson argues, colonialism provided a fertile framework for such ideas to proliferate: "... in colonial

[52] J.T. Culbertson, *Immunity Against Animal Parasites* (New York: Columbia University Press, 1941), p.22.
[53] M. Harrison, " 'The Tender Frame of Man': Disease, Climate and Racial Difference in India and the West Indies, 1760-1860", *Bulletin of the History of Medicine* 70 (1996), pp.68-93.

circumstances, racial difference was undoubtedly the most prominent of all the possible influences on a population's immunity or liability to disease".[54] These ideas persisted into the twentieth century, although modified by germ theories. Anderson notes that tropical medicine experts began to regard immunity as something acquired rather than inherited, offering partial not absolute protection. Yellow fever can be located within this framework of acquired immunity with some features shared with other diseases, such as mild types of infection, and children as reservoirs.[55]

Ideas of the indigenous population as reservoirs of infection were common in the period and widely applied to other diseases in the colonial setting. This perception of Africans became particularly entrenched in contemporary medical theories of malaria which held that African children were a major source of malarial infection: a theory which led to the endorsement of racial segregation for much of the period. Anderson describes these linked concepts of mild symptoms and immunity: "A local population, then, possessed at best only a limited clinical resistance to local disease: just enough to render a large number of them carriers - not victims - of the biological pathogens to which alien white colonists were still uniquely vulnerable".[56] The notion of Africans as reservoirs of disease parallels the recognition of healthy disease carriers, epitomised by the public health scare in North America presented by "Typhoid Mary": a young Irish immigrant. In the 1900s she unwittingly infected several people in New York with typhoid because she was a healthy carrier of the typhoid bacillus. She was consequently demonised by the medical authorities and the media. The former incarcerated her because of the potential threat she presented to

[54] W. Anderson, "Immunities of Empire: Race, Disease and Tropical Medicine 1900-1920", *Bulletin of the History of Medicine* 70 (1996), p.96.
[55] See Culbertson, *Immunity Against Animal Parasites* (1941), pp.22-23, for his explanation of milder forms of malarial infection among Africans.
[56] Anderson, "Immunities of Empire", (1996), p.110.

public health.[57] The term "Typhoid Mary" became synonymous with other healthy carriers of the disease, who suffered varying degrees of repression at the hands of the public health authorities in their attempts to prevent the spread of infection. However, theories of African immunity to yellow fever deviated from this model, because the medical community did not consider them to be healthy carriers, rather that they suffered from an infection, albeit mild enough to be undetectable.

C.A. Gill offered a working epidemiological framework for epidemic diseases in 1928 with the "quantum theory" of disease. He explained epidemics in terms of an imbalance between immunity, infection, the parasite and the "transmission factor".[58] Although he did not use yellow fever as an example, his model incorporated many of the attributes of yellow fever in West Africa as outlined in the previous sections. He demonstrated how the different theories might result in conflicting pictures of yellow fever in the region. For example, his "hyper-endemic" model paralleled Boyce's theory of endemicity and immunity. It presented a community where immunity and endemicity were intense but the high immunity decreased the likelihood of epidemics. If applied to Boyce's vision of yellow fever in West Africa, it would explain the absence of frequent epidemics. Gill's "inter epidemic" example reflected the RF's version. This depicted a situation where infection was absent for some time, and immunity was initially high, but in gradual decline due to the lack of infection. An epidemic could only occur if infection was reintroduced.[59] None of the research groups referred to the quantum theory in their hypotheses, and indeed Gill's book was published in the final years of this period, after many of the theories had been

[57] See J. Leavitt, *Typhoid Mary: Captive to the Public's Health* (Boston: Beacon Press, 1996) for an analysis of medical and media reactions to Mary.
[58] C.A. Gill, *The Genesis of Epidemics and the Natural History of Disease* (London: Bailliere, Tindall and Cox, 1928).
[59] *Ibid.*, pp.36-37.

formulated. However, it is useful as it illustrates that each theory of yellow fever in West Africa was theoretically possible. Their distinctions arose because of the different perceptions of yellow fever in West Africa. These perceptions were created partly from epidemiological understandings, but were also shaped by self interest and social and economic considerations. It is possible that a desire to counter Boyce's controversial picture may have affected the YFWAC's views. The wider plans of the RF for yellow fever eradication came into play in its Commission's assessment of endemicity in 1920.

These theories formed the epidemiological understanding of yellow fever for the CMS. Together they permitted the CMS and the wider medical community to conceive of an entire area and its peoples in medical and scientific terms. The theories helped to shape control by determining which people were to be protected, and who could be ignored. The interaction of notions of African immunity, yellow fever endemicity, mild yellow fever and Africans as reservoirs of disease is a crucial factor in explaining the CMS's response to yellow fever in this period. Racism and colonial self interest were also important influences in the formulation of control measures. As outlined in the Introduction, the available statistics may have been suggesting that yellow fever was far from a serious or widespread problem in the region. However, although aware of these statistics, the CMS and the wider medical community acknowledged the limits of this data. They based their notions on alternative criteria which revolved around the various theoretical understandings of the disease. The medical image of Europeans as "non-immune" and particularly susceptible corresponded with, and reinforced the principle function of the CMS: to protect the white population. The construction of Africans as both immune and a reservoir of disease, a seeming paradox rendered logical by the combination of the varying theories, also had implications for anti-yellow fever practices. It ensured that the CMS discounted any indigenous need for yellow fever prophylaxis, and treated them as potential health risks.

Controlling what you understand: anti-yellow fever measures

Anti-yellow fever measures throughout this period epitomised what we now term vertical disease campaigns, that is focusing on a single disease rather than aiming to improve health generally. Colonial medical personnel commonly implemented them in a military fashion. Action against yellow fever was firmly grounded in vector transmission models. Although researchers did not conclusively confirm yellow fever's causative agent as a filterable virus until 1927, knowledge of the mode of transmission by mosquitoes provided a workable basis for campaigns. Carlos Finlay first speculated on the role of mosquitoes in 1881, but the medical and scientific community largely ignored this until Reed confirmed his theory in Cuba in 1900. The *Aedes aegypti* mosquito is the principal vector of the disease although other members of the genre such as *Aedes vittatus* and *Aedes simpsoni* have also been identified as minor vectors.

During the period from 1900 to the mid 1930s, action against yellow fever mainly revolved around the *A. aegypti* mosquito and its larvae. For the first decade, there was little action against the disease, which was rarely mentioned in the *Annual Medical Reports*. The Colonial Office's efforts were limited to a pamphlet published in 1906 which outlined preventive measures against the disease but did not refer to

West Africa specifically.[60] However, a series of epidemics between 1910 and 1912 put yellow fever on the colonial medical agenda. The CMS in British West Africa spearheaded their efforts in two directions: preventing contact between infected mosquitoes and healthy humans; and denying mosquitoes access to infected humans. Numerous other vertical disease campaigns in the tropics employed the insect-vector model of disease transmission, aiming to break the cycle of transmission by targeting either the parasite, or, as in the case of yellow fever, the vector. Arguably, the most famous example is action against malaria. Ross advocated anti-mosquito measures as the most effective defence against the disease and urged large scale action directed at preventing mosquito breeding. In practical terms, this incorporated work reminiscent of nineteenth century sanitary improvements such as effective drainage, piped water supplies and refuse removal, although the aim was not to remove the filth responsible for miasma. Such measures could improve health generally as well as decreasing mosquito levels. However, Ross's schemes' style was based on the new specificity of germ theories and his own specific research into malaria transmission. However, as with yellow fever, such grand schemes proved impractical in West Africa and other parts of the tropics, and a more moderate approach, still based on mosquito transmission was adopted which included the use of quinine, mosquito screening and nets, and mosquito destruction. As M. Worboys argues: "From Europe and elsewhere, these 'vertical', single-disease control programmes were attractive and seemed feasible, though with hindsight, clearly few medical planners grasped the scale of the problem or the cultural diversity of the tropics".[61]

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[60] The Colonial Office, *The Prevention of Yellow Fever* (London: HMSO, 1906).
[61] M. Worboys, "Tropical Diseases", in W.F. Bynum and R. Porter (eds.), *Companion Encyclopedia of the History of Medicine* (London: Routledge, 1993), p.522.

Anti-yellow fever measures will be analysed within two contexts: as part of the general routine activities of the CMS; or as acute measures initiated in response to epidemics. There was considerable methodological overlap between the two as routine measures would be intensified in response to an epidemic, by dealing with its endemic form. The CMS implemented some measures at the levels of communities. I will assess how these affected entire sections of the population, and how they were centred on specific social or racial groups. I will also examine endeavours that they levelled at individuals. Routine measures aimed to remove or reduce the conditions necessary for an epidemic. For an epidemic to occur there had to be a source of infection, a means of transmission, and a non-immune population. Therefore, the CMS implemented measures that prevented the spread of infection from the reservoirs of disease - the indigenous population, to non-immune people - Europeans and occasionally Syrians. They were aware that infection could be imported from elsewhere in addition to arising from the local population. They also attempted to reduce the *Aedes aegypti* population to diminish the possibility of transmission. Obviously, campaigns implemented during an epidemic aimed to prevent its escalation. Measures remained largely unchanged throughout this thirty year period, with very few developments in methodology, or technique and no changes as a result of subtle developments in scientific theories. There was also little social, political or economic impetus for transformation.

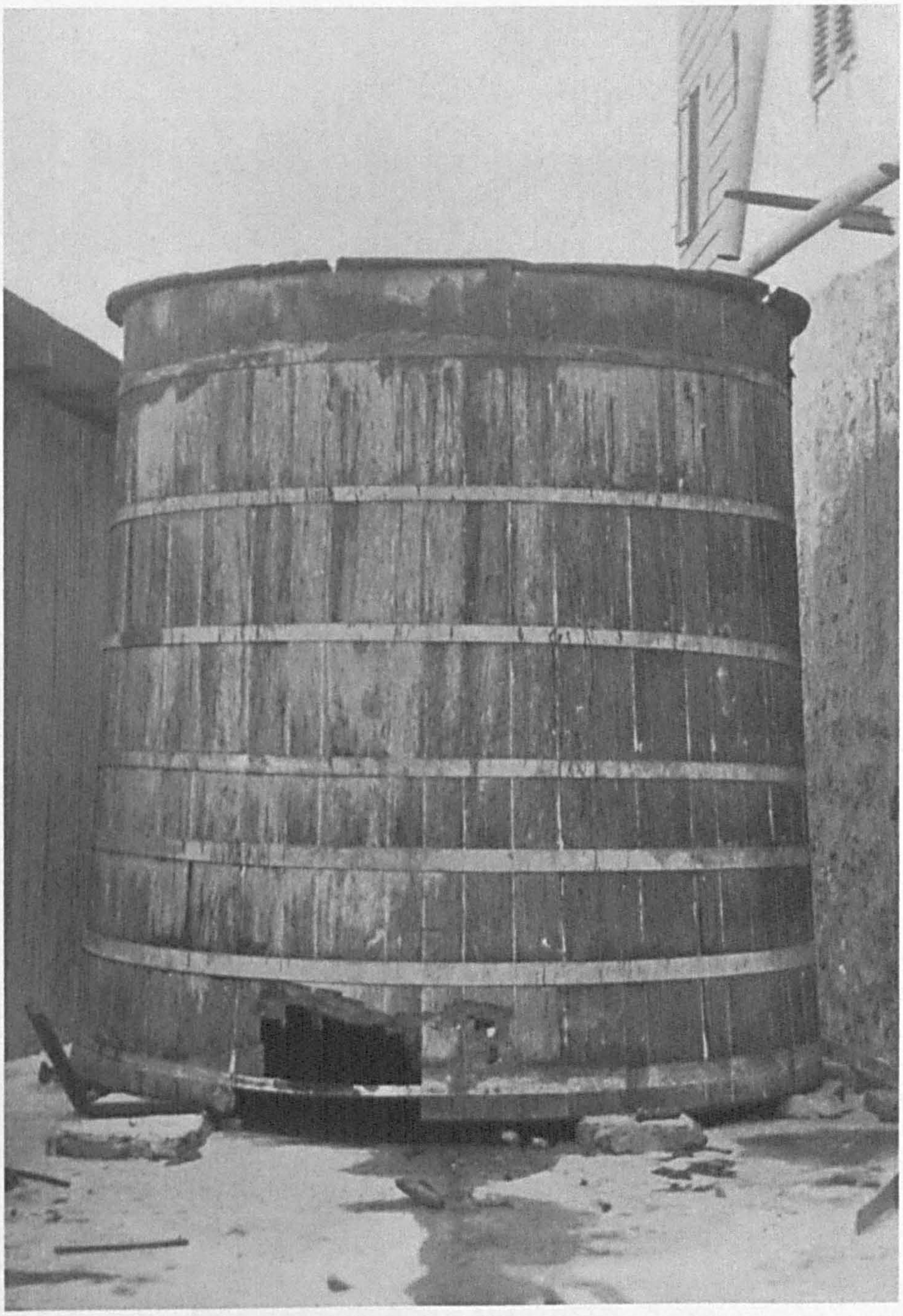
Routine activities:

I. Anti-mosquito measures

The CMS favoured anti-mosquito measures against yellow fever incorporating these as part of their general routine sanitary activities. *Aedes aegypti* breed in the smallest collection of water. Larvae can be found in discarded tins and bottles, water containers, wells, tanks, ponds and even in tree hollows, although it is more common in domestic environments. West Africa mainly lacked piped water supplies, although these were introduced very slowly in the larger urban centres. Containers filled with water for household use and rainwater collected in rubbish and in puddles, were persistent problems.

Ideally, the CMS employed a variety of personnel and means to find and destroy breeding sites. They limited their efforts to urban areas in which there was a large European presence; resources would not permit their extension to smaller towns and villages. Scavenger gangs collected discarded rubbish able to hold water. Colonial authorities provided householders with bins and a refuse removal service for domestic waste. Other measures were more intrusive. Sanitary inspectors searched African and European compounds and houses for water receptacles containing larvae. These searches served two purposes. Sanitary inspectors tabulated levels of larvae in a percentile index, theoretically providing a warning system for potential epidemics: more mosquito larvae indicated a greater potential for yellow fever epidemics. Secondly, it enabled inspectors to destroy larvae, remove breeding sites and punish householders for allowing mosquitoes to breed using a system of warnings and fines. See figure 2.1 on page 125 for an example of this action.

Figure 2.1: Water vat forcibly broken to prevent mosquito breeding, Seccondee, 1910.



Source: R. Boyce, *Yellow Fever and its Prevention* (London: John Murray, 1911), p.344.

Colonial medical personnel destroyed as many breeding places as was practicable. This was labour intensive. For example, in 1914, in Bathurst, a year free from yellow fever, there were five sanitary inspectors. Throughout the year they made 45,487 house inspections, 1,036 of which revealed larvae on premises. As a consequence, they served 665 people with notices to remove breeding places and fined 198 for the presence of larvae. The CMS stocked all drains in the town with larvae eating fish, excavated 100 pools, and oiled thirty three tanks and barrels.[62] Eleven years later, the number of drains, pools, excavations, tanks and barrels oiled totalled 1,134, there were six inspectors who conducted 49,960 house inspections finding 240 collections of larvae. They served notices on 268 people to remove breeding places and fined 238 for larvae.[63] In addition, medical and sanitary staff trimmed long grass and bush by compounds to prevent the concealment of refuse, and felled trees where they had found *Aedes aegypti* breeding in hollows. Obviously, these measures were more extensive in larger, more prosperous colonies such as Nigeria and the Gold Coast and in towns with a significant European presence. In the Gold Coast in 1913, for instance, there were forty four sanitary inspectors working at nineteen colonial stations and inspecting just under 400,000 houses.[64]

The CMS and other experts in tropical medicine considered the provision of piped water a vital element in the fight against mosquitoes as it would obviate the need to store water. This was obviously an expensive long term venture. In 1917, the PMO in Bathurst declared that the introduction of piped water to the town the previous year reduced the levels of water stored in houses, limiting the number of

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[62] *Gambia Annual Medical Report, 1914*, p.37.
[63] *Ibid., 1925*, p.31.
[64] *Gold Coast Annual Medical Report, 1913*, p.65.

breeding places.[65] However, this was a luxury for large urban centres only, the colonial government and medical services did not make resources available for rural areas, presumably as those considered non-immune mainly resided in the cities.

These were general and non-specific measures, affecting and benefiting entire urban communities, regardless of considerations of their immune status. Africans and Europeans alike profited from decreased levels of mosquitoes. Unfortunately, the details regarding anti-mosquito actions give no indication of racial equality in the imposition of measures. For example, the statistics regarding prosecutions for larvae offences did not detail the race, or social status of offenders. Therefore, it is difficult to know if the indigenous population were over-represented in these figures. This would have suggested that they suffered a greater burden from anti-yellow fever efforts, perhaps resulting from notions of the African as reservoir of disease or inherently insanitary. From the evidence available, it would seem that Europeans suffered similar invasions of privacy by house inspections. For example, the rules for residents of Hill Station, the exclusively European residential area in Freetown, clearly instructed them to remove all possible water bearing containers amenable to mosquito breeding. Sanitary regulations subjected even the resident colonial elite to inspections, albeit conducted by more senior medical staff.[66]

However, other anti-mosquito measures aimed at more individual protection, and focused on the European population in particular. This was a consequence of their status as non-immunes and the ethos of the CMS which prioritised European health. Measures commonly aimed to prevent contact between humans and mosquitoes, and included mosquito screening of houses and hospitals, and promotion

[65] *Gambia Annual Medical Report, 1917,* p.12.
[66] *Sierra Leone Annual Medical Report, 1920,* pp.51-52.

of the use of mosquito nets and mosquito boots. These provisions had the added benefit of safeguarding against malaria. The colonial governments were keen to protect their own as they provided many of these measures to European colonial officials. Frequently, non-official Europeans received only the advice and encouragement of the CMS on these methods of prophylaxis. Clearly, the resources of the colonial government to preserve the health of Europeans only went so far. This suggests the existence of a subtle hierarchy in the implementation of anti-yellow fever measures, even within the European community.

The CMS believed in the intrinsic value of anti-mosquito campaigns against yellow fever. Unlike malaria, there were few other recourses against the disease. However, their efficacy varied considerably throughout the thirty year period, and beyond. They required unrelenting vigilance, conducted by sufficient numbers of well trained and diligent staff. A certain level of co-operation from the public was also necessary to allow sanitary inspectors access to their properties; to continuously guard against mosquito breeding in their water receptacles and to tolerate the many inconveniences such as oiling wells and tanks. Most importantly, as with many colonial improvement schemes, money was an essential ingredient. Maplestone of the Alfred Jones Laboratory made this explicit when investigating an epidemic of yellow fever in the Gold Coast in 1923. Commenting on the persistent presence of the disease in the colony he reasoned:

> the only means of lessening the incidence of Yellow Fever on the Gold Coast that suggests itself at the present is still further reduction of mosquitoes, and as the index is already so low it would mean the

annual expenditure of a large sum of money to make any material improvement in this direction.[67]

The financial records of the medical departments as outlined in the *Annual Medical Reports* are highly inconsistent. Subject to numerous variables, they cannot be used to analyse financial commitment to a single measure. For example, between 1914 and 1924, the Gambia's spending on anti-mosquito measures and disinfectants rose from 5.6 per cent of the Public Health Department's budget to 9.6 per cent. However, this increase may have resulted from price increases or an extension of measures into other urban centres.

The ability of the CMS to conduct thorough anti-*Aedes aegypti* campaigns varied considerably. A mixture of criticism and praise appear in the *Annual Medical Reports* of the colonies, providing a confusing and inconsistent record. Senior MOs deemed the effectiveness of sanitary inspectors crucial for the success of anti-*Aedes* efforts. Many inspectors were Africans working under European supervision. European medical staff frequently invoked racist notions of Africans as lazy and stupid during discussions about their effectiveness. They often accused these inspectors of complacency, inefficiency and of underreporting larval levels, assuming the "true" index was revealed only when white medical personnel conducted inspections.[68] For example, in 1912, the PMO of the Gambia argued that a massive drop in the mosquito index was the result of "inefficient inspection by 'native' inspectors", rather than any reduction in mosquitoes.[69] Criticism continued into the

[67] Archives of the Liverpool School of Tropical Medicine, University of Liverpool, Liverpool. TM 13/56/10/1. P.A. Maplestone, "Report on Investigations into Yellow Fever in the Gold Coast Colony", 1923, p.5.
[68] On his visit to the Gold Coast in 1923, Maplestone was told by MOHs that: "They always find a considerably higher number of mosquito larvae than the native inspectors do", *ibid.*, p.4.
[69] *Gambia Annual Medical Report, 1912*, p.22.

1920s, yet there is an indication of a more understanding attitude, with calls for better training, pay, prospects and promotion as European colonial medical personnel admitted that "there is little inducement at present for the native inspectors to thoroughly qualify themselves for their work".[70] There was no similar criticism of European members of the CMS in the *Annual Medical Reports.*

The African population also faced accusations of complacency as the colonial mentality considered them ignorant and superstitious in the face of anti-mosquito measures. In Southern Nigeria in 1913, the PMO wrote: "... the majority of natives are absolutely apathetic, and content to believe that, apart from the inconvenience caused by mosquito bites, the pests can do no harm".[71] This racist attitude was evident throughout the period in all four colonies. As a result, the CMS used various means to force or persuade Africans to adhere to anti-mosquito efforts. A common legal recourse was the imposition of fines on householders found to have larvae on their properties. One MO recalled the effect of fines, giving an insight into European perceptions of African reactions to anti-mosquito measures:

> I can remember too, after the Police Courts at Accra had been blocked for weeks by accumulations of prosecutions for larval offences some hundreds of women forming in procession and marching to Government House, defying the Guard and invading the Governor in his drawing room, to complain that they were being taken to Court and fined because larvae was found in their pots and everyone knew that these larvae came down in the rain from Heaven, and so how could they help having larvae in their pots.[72]

[70] *Ibid., 1923,* p.9.
[71] *Southern Nigeria Annual Medical Report, 1913,* p.28.
[72] *Nigeria Annual Medical Report, 1919-21,* pp.8-9.

He argued that although legislation had its role, education and sanitation were more effective. Education would combat African "ignorance". Techniques included lectures, radio broadcasts, visits to schools and "dry pot days" when water receptacles were emptied and inspected. A member of the CMS in the Gold Coast noticed by 1933 what he perceived as good progress with "intelligent Africans", and claimed that: "The African has now great confidence in, and respect for, European medicine and medical men, and the progress we have made, as evidenced by a steadily lessened opposition to anti-larval measures, is due in a large measure to this confidence and respect".[73] This account suggests the MO imposed a social hierarchy on the local population by distinguishing different groups, i.e. "intelligent Africans". This may have been a common feature of other aspects of colonial life, but other than this instance, there is little evidence that this was widespread in anti-yellow fever practices. The sources indicate as far as yellow fever was concerned, the CMS mainly regarded Africans as an aggregate group.

The attitude of Europeans to community anti-mosquito measures received little comment. Prosecution figures did not reveal the extent of European adherence. Occasionally there were individual comments on Europeans' effectiveness in controlling mosquitoes and larvae on their property. For example, in 1916 in Sierra Leone, a case of yellow fever in the town of Blama instigated a mosquito search. The MO noted the propensity for greater numbers of mosquitoes in European quarters compared to Syrian and African, although he was quick to suggest that the infection may have come from a Syrian child living nearby, thus shifting the onus of responsibility away from Europeans.[74]

[73] *Gold Coast Annual Medical Report, 1932-33*, p.91.
[74] *Sierra Leone Annual Medical Report, 1916*, p.46.

There is more evidence available about how Europeans reacted to individual methods of prophylaxis, such as mosquito nets and screens. Quite early in the period, the CMS and other commentators were confident that Europeans needed little encouragement to use a mosquito net. In 1911, Boyce claimed their use was universal and declared that anyone who did not use one was "rightly regarded as a crank".[75] The PMO for Nigeria commented in 1916: "It is now practically impossible to find a European of any class who does not either inhabit a mosquito-proof room at night, or sleep habitually under a mosquito net".[76] If this is an accurate picture, it is clear there were occasional lapses. In 1923, Maplestone noted in a recent yellow fever epidemic that one European victim did not use a net, and in another case it was in such a state of disrepair as to render it useless. He commented: "This is a factor which will never be overcome, and will always to some extent nullify whatever efforts the Government may make to keep down the disease".[77] Eleven years later, Gordon, also of the Alfred Jones Laboratory, echoed such sentiments by suggesting that more European women than men contracted the disease in an epidemic because they failed to wear the necessary protective clothing.[78]

Mosquito screening of houses proved more problematic. In the Gold Coast, the tendency of the gauze to corrode when houses were by the sea impaired the complete screening of European houses. However, medical personnel noted that portable mosquito cages were quite popular.[79] Yet, some four years earlier, the AMSC dismissed them as inadequate, arguing that only mosquito proofing of the

[75] Boyce, *Yellow Fever* (1911), p.305.
[76] *Nigeria Annual Medical Report, 1916*, p.15.
[77] LSTM. TM 13/56/10/1. Maplestone, "Yellow Fever in the Gold Coast" (1923), p.5.
[78] R.M. Gordon, "Notes on Yellow Fever, with Special Reference to the Possibility of its Recurrence in Sierra Leone", December 1934, p.17, in Collected Papers of Sir Alfred Jones Laboratory, Sierra Leone. Vol. III.
[79] *Gold Coast Annual Medical Report, 1915*, p.13.

entire house would give full protection.[80] However, this presented a potential conflict between the medical and non-medical communities. Quite simply, regardless of medical recommendations, lay people were reluctant to use screens because they compromised their comfort. When asked about what they considered to be important in staff housing in the tropics, three of the British West African governors argued against screens as they restricted ventilation.[81] In 1910, Sir George Denton, Governor of the Gambia, argued that he personally objected to the screening of verandas, windows and doors because it prevented the breeze. His staff reportedly agreed because their houses "would be rendered so close and stuffy" by total screening. Denton submitted that "officers are expected to protect themselves from mosquito bites as far as they possibly can, and I do not believe that any further admonition on the subject would help much".[82] Lugard, Governor of Northern Nigeria, demonstrated that not all governors were as unyielding. His assessment of ideal housing for Europeans in the tropics was an amalgamation of features designed to provide both comfort and protection from mosquitoes.[83] D.B. Blacklock of the LSTM argued that by 1935, the introduction of electricity in many places had removed objections to screens on the grounds of poor ventilation as it permitted the installation of effective fans.[84]

Thus, Europeans and Africans shared some of the inconveniences of anti-mosquito campaigns, although the evidence suggests that Africans bore the brunt of

[80] PRO. CO 879/107/966. Minutes of the 23rd Meeting of the AMSC, 02.05.1911.
[81] P. Curtin, "Medical Knowledge and Urban Planning in Tropical Africa", *American Historical Review* 90 (1985), p.604.
[82] PRO. CO 879/102/940. G.C. Denton, Governor of the Gambia, to the Secretary of State, 05.02.1910.
[83] F.D. Lugard, *The Dual Mandate In British Tropical Africa* (London: William Blackwood and Sons, 1923), pp.145-147.
[84] D.B. Blacklock, "Screen Cloth for Houses in the Tropics", *ATMP* 29 (1935), p.261.

criticism for any inadequacies. Perhaps the view of the author of the Gambia's 1928 *Annual Medical Report* amply reflects medical frustration with the layman's attitude to the "notorious" *A. aegypti*: "As long as its presence here continues to be accepted with comparative nonchalance by magistrate and citizen so long will the town and colony suffer the pains and expenses of outbreaks and quarantines".[85]

II. Segregation

Like anti-mosquito measures, segregation was a non-disease specific measure used against yellow fever. The former represents the CMS's efforts to prevent epidemics by reducing the possibility for transmission. By promoting segregation, the CMS aimed to reduce the possibility of infection spreading to the non-immune population by restricting their contact with sources of infection: in this case, the African population. As such, it reflects their belief in the interlinked theories of endemicity and Africans as a reservoir of disease. Historians have particularly associated segregation with anti-malarial campaigns. To see it in terms of malaria prevention alone fails to fully appreciate the role segregation played in British West Africa. What may have been started with malaria in mind was perpetuated by fears of yellow fever. Segregation based on medical grounds began in British West Africa around the start of the twentieth century following the discovery of the mosquito vector by Ross and the existence of malarial parasites in African children. Ross championed mosquito destruction, Robert Koch the prophylactic use of quinine. S.R. Christophers and Stephens of the Royal Society Malaria Commission advocated

[85] *Gambia Annual Medical Report, 1928*, p.11.

residential segregation of Europeans from Africans, the supposed reservoirs of malaria, anticipating the rationale behind its use against yellow fever.

Being able to employ a medical justification for this policy enabled colonial authorities to downplay its inherent racial nature. M. Swanson demonstrates how a "sanitation syndrome" was created in South Africa at the turn of the century, utilising medical concepts of the indigenous population and plague to rationalise racial prejudice. He suggests that the urban indigenous population in South Africa became intrinsically associated with disease and insanitary conditions. This notion ran deep in the white colonial mentality, and thus permitted the removal of the African population from major urban centres to hastily constructed housing located beyond the city. Colonial authorities achieved this under the guise of public health yet it actually served a racist regime that had long desired the mass expulsion of the African population.[86]

Less dramatic in that it created an enclave rather than expel a population group, segregation in West Africa used medical theory to secure racial barriers. As L. Spitzer argued, medical segregation corresponded well with racist notions based on social Darwinism popular from the mid nineteenth century onwards. In Sierra Leone, this ended a period of racial tolerance during which Europeans freely mixed and socialised with upper class Africans.[87] Both J. Cell and P. Curtin argue that segregation enjoyed a short period of popularity in West Africa and in reality was never practised to the extent recommended by the CMS.[88] They mainly restrict their

[86] M. Swanson, "Sanitation Syndrome: Bubonic Plague and Urban Native Policy in the Cape Colony", *Journal of African History* **18** (1977), pp.387-410.
[87] L. Spitzer, "The Mosquito and Segregation in Sierra Leone", *Canadian Journal of African Studies* **2** (1968), pp.49-61.
[88] Curtin, "Medical Knowledge", (1985), pp.594-613; J. Cell, "Anglo-Indian Medical Theory and the Origins of Segregation in West Africa", *American Historical Review* **91** (1986), pp.307-335.

analyses to the context of malaria prevention. However, experts in tropical medicine and the CMS saw it as playing a central role in controlling yellow fever, justifying this racist practice in terms of European lives saved. Boyce's stance strongly echoed this as he claimed: "It would be barbaric and uncivilised not to adopt this fundamental method of self protection".[89] Evidence suggests that it did not garner the same support among the non-medical colonial community.

Typically, the policy created residential areas for Europeans which were physically separated from Africans' housing by a corridor of land: a "neutral zone" of variable width. This zone was supposed to be sufficiently wide to protect against infected mosquitoes flying from the African to the European sector. For example, in some regions in Nigeria in 1913, a strip of land a quarter of a mile wide separated the two populations. Regulations permitted African servants access only by day, ensuring the comforts of the European population were met. Early scientific notions that *Anopheline* and *Aedes* mosquitoes fed mainly after dark compelled their exclusion at night. Commonly, other Africans were completely banned.

The medical services of the four British West African colonies were unanimous in their written support for this measure, advocating its value into the late 1930s. However, the colonies had differing experiences of the reality of residential segregation. Sierra Leone, which suffered the fewest reported cases of yellow fever, practised segregation at its most extreme, constructing Hill Station in 1902, a completely separate residential area six miles from Freetown. This monument to the ideal of segregation provided numerous bungalows for European residents, connected to Freetown by a specially constructed railway. Africans were only permitted access

[89] Boyce, *Yellow Fever* (1911), p.304.

during the daytime. The powerful influence of racism cannot be underestimated as a motivating force behind Hill Station. However, O. Goerg offers a multicausal explanation for Hill Station's construction. In particular, he highlights concepts of racial superiority, a need to prevent fires, and medical theory as dominant factors.[90] It is evident that medical and scientific reasoning also guided the CMS rather than merely ideas of race hierarchy when rationalising Hill Station and segregation generally. P.A. Clearkin, an MO in Sierra Leone from 1914 to 1915 reflected this attitude when discussing Hill Station:

> This development (Hill Station) arose from a concern of the Government in Whitehall at the steady drain of manpower in Freetown resulting from disability and illness particularly among senior officers. No sooner had a young man begun to know the people among whom he had to work than he died or was invalided.[91]

Segregation occurred, in less regimented forms, in the other three colonies with varying degrees of intensity. In Bathurst, a combination of factors hampered the enthusiasm of the CMS. European residences were scattered and the colonial and medical authorities considered that nothing short of rebuilding the town would permit acceptable segregation. Indeed, they proposed several schemes to segregate European residents of Bathurst, with the provision of European areas both within and outside the capital.[92] None were realised during this period. There was limited segregation in

[90] O. Goerg, "From Hill Station (Freetown) to Downtown Conakry (First Ward): Comparing French and British Approaches to Segregation in Colonial Cities at the Beginning of the Twentieth Century", *Canadian Journal of African Studies* **32** (1998), pp.5-7.
[91] Rhodes House. MSS Brit. Emp. R4. P.A. Clearkin, "Ramblings and Recollections of a Colonial Doctor, 1913-1956", p.34.
[92] Curtin, "Medical Knowledge", (1985), p.601. See also the *Annual Medical Reports* of the colony and LSTM. TM 13/133 for details.

Northern and Southern Nigeria, with residential areas for Europeans created in towns by World War One.[93] It is clear from the *Annual Medical Reports* of Nigeria that the CMS maintained a predilection for segregation well into the 1930s, yet the problem appeared to be one of ensuring compliance among the general European population. Towns in the Gold Coast were also segregated.

Non-official Europeans were a constant thorn in the side of the CMS in their efforts to promote segregation. Many refused to live in separate enclaves, pleading financial stringency and a need to live near their business premises which were generally located in African sections of towns. Throughout the 1910s and 1920s the CMS despaired at their unwillingness. During this period, the Gold Coast saw fatalities among Europeans residing in African townships. In response, the CMS strongly advised "vigorous propaganda and possible legislative measures" to persuade firms to provide facilities for employees in European areas. They were clearly frustrated at the situation in which some firms had long owned land in residential areas, yet failed to construct housing. They even considered the necessity of introducing compulsory permanent segregation in the worst areas should propaganda measures fail, although this was never initiated.[94] In Sierra Leone, Hill Station never gained popularity with European traders. As early as 1905, the PMO bemoaned the lack of interest from commercial firms: not one had purchased bungalows for their employees on the site. By 1907, only one firm had taken advantage of the facilities Hill Station offered, much to the disgust of the CMS: "... one cannot help being struck with the apathy and indifference shown in this particular instance. But, when a large firm does not supply even quinine for the use of its European staff, it would be too

[93] Curtin, "Medical Knowledge", (1985), pp.602-606.
[94] *Gold Coast Annual Medical Report, 1927*, p.138.

much to expect them to go to the expense of building residential bungalows on Hill Station".[95] Interestingly, Spitzer argues that Hill Station proved only slightly more popular among European colonial officials, and claims that nine years after construction only twenty five per cent of their "contingent" resided there.[96] This notwithstanding, evidence suggests that colonial officials were more willing to segregate than other Europeans but that the practice was not universal amongst them.

Other barriers to segregation existed. The response of colonial governments varied enormously: some governors supported the measures, while others expressed their abhorrence. T.S. Gale points to a conflict in West Africa between enthusiastic medical officers and reluctant colonial governors and administrators. Their different roles in the colonial machine accounts for this. The former had to safeguard the health of Europeans, the latter to govern a colony, thus having concerns reaching far beyond the immediate medical sphere.[97] This conflict goes far in explaining the obvious divergence in calls to segregate in the *Annual Medical Reports* and what was occurring in reality in the four colonies. In the Gold Coast, between 1910 and 1914, a number of governors hampered segregation, including Sir Hugh Clifford, an ardent opponent of the practice. Despite his and the best efforts of his predecessors, by 1914, residential areas were created for Europeans in several parts of the colony including Accra, Seccondee, Kumasi, Dunkwa, Tarkwa, Axim, Salt Pond, Winneba and Cape Coast. In the latter, a European reservation was constructed one and a half miles away from the town, and even Clifford admitted its worth.[98] However, not all governors were against the policy. Lugard supported the measure, writing of a "moral

[95] *Sierra Leone Annual Medical Report, 1907*, p.11.
[96] Spitzer, "Segregation in Sierra Leone", (1968), p.60.
[97] T.S. Gale, "Colonial Medical Policy in British West Africa 1870-1930", (D.Phil.: University of London, 1973), p.263.
[98] *Ibid.*, pp.265-268.

responsibility" of government and commercial firms to promote segregation where practical. In his colony, new townships were built along segregated lines. He denied there were racist implications to the policy, arguing that it imposed equal restrictions on both races.[99]

The European population in West Africa never practised segregation to its fullest extent. The commercial sector proved the most intransigent. However, many residents of segregated areas did not abide by the full spirit of the policy, allowing Africans on the premises; making a mockery of the supporting medical rationale behind the measure. In 1921, the *Annual Medical Report* of the Gold Coast noted that despite efforts of the MOH, residents allowed African children into the restricted area: in August that year, medical staff found twelve in Accra's segregated zone.[100] In Nigeria, MOs complained about lax segregation practices in 1933: "It is unfortunate, however, that in spite of repeated warnings householders in too many instances allow the families and friends of servants to reside in their compounds".[101]

The routine methods of controlling yellow fever: anti-larval measures, personal anti-mosquito protection and segregation were part of general attempts to protect against general disease and maintain health. They can be seen as the CMS's efforts to prevent the predisposing conditions of an epidemic arising, by reducing the threat presented by endemic yellow fever.

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[99] Lugard, *The Dual Mandate* (1923), pp.148-149.
[100] *Gold Coast Annual Medical Report, 1921*, p.11.
[101] *Nigeria Annual Medical Report, 1933*, p.16.

Responses to epidemics

Epidemics of yellow fever in West Africa occurred sporadically: the Gold Coast and Nigeria suffering more than the other two colonies. At least once a decade, one colony experienced an epidemic of the disease. They provoked an acute and intense reaction from the CMS that was arguably out of proportion to reported levels of morbidity and mortality. Reported cases in any one epidemic in this period did not exceed eighty six, and it was rare for them to total more than twenty. In the bid to protect the vulnerable European populations, the CMS enacted measures that the wider society were unlikely to tolerate under other circumstances. Rosenberg argues that epidemics mobilise "communities to act out propitiatory rituals that incorporate and reaffirm fundamental social values and modes of understanding".[102] This can be applied particularly effectively to yellow fever in West Africa as the response of the colonial community laid bear its preoccupations and guiding interests. These included the prioritisation of white health, the medically justified control of the indigenous population and commerce.

Definitions of what constitute an epidemic are fluid, and change according to the disease, society and medical perceptions. The CMS usually used the terms outbreak and epidemic to describe the occurrence of several related cases, the latter used more commonly when larger numbers of cases were involved. For example, the CMS labelled five cases in Bathurst in 1928 as an outbreak. The previous year, medical personnel in the Gold Coast determined that sixteen cases in the colony constituted an epidemic. This indicates that, on occasion, the CMS differentiated

[102] Rosenberg, *Explaining Epidemics* (1992), p.279.

between the severity of yellow fever occurrences. However, it is possible to overestimate the significance of this use of language as they often used the terms interchangeably. For example, the CMS in the Gold Coast referred to the fifty recorded cases at Asamangkese as both an outbreak and an epidemic, even though the RF West Africa Yellow Fever Commission estimated that nearly 1,000 cases could have occurred.[103] Given CMS's ambiguity, I shall not differentiate, but use the term epidemic throughout.

Inevitably, the intensity of response from the CMS and colonial governments corresponded with the scale of the epidemic. However, even epidemics consisting of two or three cases were sufficient to elicit a strong colonial medical response, albeit on a smaller scale than more severe occurrences. This suggests that the threat from a yellow fever epidemic was quite potent; a handful of cases was sufficient to galvanise colonial medical action. This may have been accentuated by a common belief among the CMS that actual reported cases were the tip of the iceberg, with many more going unnoticed and undiagnosed. However, as demonstrated in the previous section, a visible presence of infection was often essential to overcome complacency and generate medical activity.

Rosenberg argues that a "classic epidemic" goes through a series of recognisable and predictable stages. The first is "progressive revelation": the slow and reluctant recognition of an epidemic. This is followed by attempts at "managing randomness": the framework contemporaries employ in which to understand and explain the misfortune facing them. The third phase is "negotiating public response": how communities react. The epidemic is concluded with the final stage: "subsidence

[103] *Gold Coast Annual Medical Report, 1926*, p.20.

and retrospection": the examination of the lasting effect of the epidemic.[104] This provides a useful model to analyse yellow fever epidemics in West Africa.

As observed in the Gold Coast's *Annual Medical Reports*: "Yellow Fever has a ritual of its own, which comprises of notification, fumigation of infected house or district, evacuation of non-immunes where thought desirable, house to house inspection, quarantine, screening of patient, and inspection of non-immunes".[105] As this list of measures suggests, responses to epidemic yellow fever had considerable ramifications. These measures represent a substantial medical trespass into peoples' lives; involving a large element of social control. As will be demonstrated, the indigenous population endured the greater burden, suffering more indignities and intrusions than their European counterparts. Numerous factors came into play during epidemics, reflecting the priorities and preoccupations of various social groups, in particular the CMS. The effect of medical theories, economic interests, racism and the intensification of apprehension can all be clearly demonstrated in their reaction, and to a lesser extent, other colonial communities to yellow fever.

Stage one: progressive revelation

The first stage of the epidemic, true to Rosenberg's model, was the recognition of a problem. As mentioned earlier, the first decade of the century was marked by what Boyce labelled "notification fear": a reluctance of the medical or colonial authorities to recognise yellow fever cases as such:

[104] Rosenberg, *Explaining Epidemics* (1992), pp.281-287.
[105] *Gold Coast Annual Medical Report, 1915*, p.14.

> It arises primarily from the press and mercantile community; and these agencies, in their turn, slowly but surely influence those in authority as well as the younger members of the medical profession. There is absolute notification fear. I have known personally medical men who have been persecuted because they dared to notify yellow fever. I have examined the correspondence in other cases where the medical officer making the diagnosis has been promptly sat upon, and where in consequence the opinion, he secretly held, has been abandoned in deference to the view that it was better not to diagnose yellow fever.[106]

Rosenberg contends such reluctance was a common feature of epidemics, resulting from fear of social and economic disruption. The public disclosure of an epidemic usually only occurred when authorities could no longer deny its existence. The CMS did not deny the phenomena of notification fear but from 1910 were keen to assert it as a thing of the past. This implied that their response had matured beyond Rosenberg's framework which asserted only a slow admission of epidemics. However there is doubt whether they had ever banished the practice. As late as 1932, W.H. Hoffmann of the Instituto Finlay, Havana, discussing the disease in South America and West Africa, claimed the tendency to conceal cases remained in both regions.[107]

[106] Boyce, "Yellow Fever in West Africa", (1910), p.56.
[107] W.H. Hoffmann, "Epidemic and Endemic Yellow Fever", *Journal of Tropical Medicine and Hygiene* **35** (1932), p.361.

Stage two: managing randomness

Here, Rosenberg refers to the explanatory framework that a society applied to epidemics. This is the central factor in understanding the CMS's responses to yellow fever: a major theme of this thesis. As this chapter contends, they used scientific theories of disease causation, vector transmission models, and ideas of immunity, disease reservoirs and endemicity. In the past, as Rosenberg comments, other communities turned to religion to explain their epidemic misfortune, in West Africa, during this period, science provided rationalisation. Rosenberg notes that societies sought explanations of susceptibility, often citing immoral behaviour as a predisposing factor. He argues that this meant that "epidemics could serve as vehicles for social criticism as well as a rationale for social control".[108] Yellow fever diverges from this model, as vulnerability was expressed in biological terms, i.e. immunity, rather than moral and social. However, biological immunity had overlain racial immunity. In Rosenberg's model those most vulnerable to infection were castigated for their role in perpetuating disease. In the yellow fever case study, western medical communities blamed the group they considered least susceptible - Africans - for epidemics based on notions of Africans as disease reservoirs. If this was not due to their race per se, it was assisted by racial characteristics of laziness, ignorance and insanitary behaviour.

[108] Rosenberg, *Explaining Epidemics* (1992), p.284.

Stage three: negotiating public response

I. Isolation and surveillance

In Rosenberg's model, this is the collected response of the community: as providers of anti-epidemic action, and recipients. The experience would have had different implications for each social group. R. Chandavarkar, discussing plague epidemics in India at the turn of the century, asserts that diseases do not possess a set of unifying characteristics. Rather they take on traits which vary according to the social group or individual concerned: "...epidemics do not represent a single, integrated phenomenon but signify different things to different people".[109] This can be applied effectively to medical and non-medical responses to epidemic yellow fever. Epidemiological understandings of the disease shaped CMS's action, as outlined earlier in the chapter. In addition, they were affected by financial concerns and their wider public health functions. However, the CMS represented only one section of the community. What was the response of the colonial government? How did the wider European and African communities react to the disease and the imposition of these procedures?

It is unlikely that they were as bound to the medical theories which informed much of the CMS's actions and attitudes. There is no doubt that the appearance of the disease among them alarmed the European community. For example, the CMS wrote of "a great deal of panicking" after two European deaths from yellow fever in the Gambia.[110] The non-medical perspective is difficult to assess as evidence is patchy. The *Annual Medical Reports* were unlikely to report unfavourable reactions to their

[109] R. Chandavarkar, "Plague Panic and Epidemic Politics in India, 1896-1914", in Ranger and Slack, *Epidemics and Ideas* (1992), p.205.
[110] *Gambia Annual Medical Report, 1928*, p.66.

campaigns. Here I want to explore this outlook where possible. I will demonstrate that commercial factors and implications of social restrictions shaped Europeans' experiences of yellow fever and affected their response to the CMS's campaigns.

Once the colonial and medical authorities acknowledged the epidemic, the primary concern of the CMS was to control contacts of the victim and the nearby population to limit the spread of infection. This targeted the human element of the yellow fever transmission cycle. The medical and colonial authorities acted together to provide a formidable array of measures against yellow fever. They achieved control using a number of legislative measures that increased the power of the medical authorities, thereby effecting social control based on a medical rationale. The governor commonly declared the site of the epidemic to be infected within days of notification. This permitted the CMS to employ techniques of evacuation, isolation, surveillance and inspection. The police frequently established cordons around the infected area regulating or preventing movement. The time taken to declare an area infected, relative to the occurrence of cases, varied considerably, as did the size of the infected area. For example, in the 1913 epidemic in Lagos, the Governor notified the area as infected on the same day the first patient was diagnosed, although he limited the area to the patient's house. Later that year in a separate epidemic, Lagos was declared an infected area immediately after the recognition of a second case of the disease, five days after the first, which occurred in a separate area of the town.[111] However, the proclamation was not always as prompt. In the 1934-35 epidemic in Bathurst, the colonial authorities did not announce the area as infected until a month after the first case, but some four days after the diagnosis of a third.[112] Unlike the

[111] *Southern Nigeria Annual Medical Report, 1913*, pp.29-30.
[112] *Gambia Annual Medical Report, 1934*, p.55.

Lagos epidemic, the cases did not occur closely together which may explain the long delay in declaring Bathurst an infected area. It is more likely that commercial factors played a determining role. Bathurst was in the middle of the groundnut season on which the colony's economic fortunes depended. Declaring an area infected, with all the associated social disruptions, would have had a deleterious effect on this trade. This demonstrates that some elements of anti-yellow fever campaigns were sensitive to economic and social factors. It also indicates that flexibility was possible in the operation of campaigns. There were no rigid rules. International regulations related to the notification of cases of yellow fever, not the declaration of infected areas.[113]

Events during the 1913 epidemic in Lagos were quite typical of medical measures during yellow fever epidemics in this period. The CMS only diagnosed twenty five local cases, with a further ten imported, but they subjected several thousand people to forced medical regulation. They placed a total of eight hundred people - contacts of victims, and those displaying suspicious symptoms - under "observation". This process involved their compulsory removal to the infectious diseases hospital at Ikoyi Plains, two miles out of Lagos, where medical personnel examined them twice daily. A further six thousand people: all those remaining in the infected area, were put under surveillance and required to present themselves for examination twice a day. Failure to comply resulted in an enforced transfer to Ikoyi Plains. These measures mainly affected the indigenous population, who made their objections known to the colonial government. They accused the medical authorities of inadequately explaining the rationale for isolation and for setting the inmates at Ikoyi to work. As one newspaper reported: "It is certainly a strange and novel idea this of

[113] *International Sanitary Convention, 1926*. Cd. 3207, 1928-9.

curing a man of a deadly fever by setting him to work weeding grass in the sun".[114] Other newspaper reports gave further indication of the indigenous response. Critical of what it termed European "scare-crow making" at yellow fever in other colonies, the paper commented that medical action during an earlier epidemic in the Gold Coast was unpopular: "The constant hue and cry at the Gold Coast on yellow fever is creating strong suspicion against Government medical men on the Gold Coast and the belief is general that their yellow fever is a false alarm".[115] Some three weeks later, it congratulated the Nigerian government on its calm manner in dealing with an epidemic in the colony. This attitude changed after several weeks when measures became more repressive as the epidemic intensified:

> We think that if the medical authorities charged with stamping out the scourge of yellow fever could link more tact and discretion with their novel methods of extirpation they would enlist more from the public their unqualified support but the present plan of breaking in unceremoniously into private apartments, seizing people in a harem scarem [sic.] manner, in the street, pressing thermometers into their unwilling mouths and then deporting them to the quarantine station as suspect of infection is calculated to inspire no degree of confidence and satisfaction, but rather a strong feeling of resentment.[116]

Popular protest forced the government to relax isolation measures and allow detainees back to their communities where medical personnel monitored their health.[117]

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[114] *Lagos Standard*, 06.08.1913.
[115] *Lagos Weekly Record*, 03.05.1913.
[116] *Ibid.*, 09.08.1913.
[117] *Southern Nigeria Annual Medical Report, 1913*, pp.31-32.

The use of isolation in West Africa for suspicious yellow fever cases was part of a tradition of medical response to epidemics and can be seen as a feature of colonial measures against other diseases elsewhere. Enforced isolation was institutionalised in the Belgian Congo during the 1900s against sleeping sickness, although with some crucial differences. The isolation camps, or lazarets, were a central element of a long term campaign against epidemic sleeping sickness, rather than the temporary recourse against yellow fever that they represented in West Africa. By 1912, there were fourteen lazarets established in the Belgian Congo. The regime could hold internees for up to several months, rather than several days, as was the case in West Africa. With the introduction of the drug atoxyl, sleeping sickness victims were subjected to compulsory treatment.[118] This campaign was a response to vast levels of the disease, rather than the few cases of yellow fever seen in West Africa.

The pattern was slightly different for people not considered immune to yellow fever. If medical personnel treated Africans as a threat to be contained, Europeans were in need of medical protection. Like Africans, the CMS isolated or observed European contacts or suspicious cases. They were held in more salubrious surroundings and, more crucially, segregated from Africans. As medical opinion considered Europeans non-immune, and more vulnerable to the disease, MOs scrutinised them regularly during epidemics. In response to an epidemic in Accra in 1911, the Gold Coast CMS observed all Europeans in the general locality of cases and took their temperature twice daily to check for fever.[119] This represents a major intrusion into the lives of the European population, undoubtedly causing considerable inconvenience. In this context, both Europeans and Africans suffered from medical

[118] See Lyons, *The Colonial Disease* (1992), for a thorough analysis of colonial campaigns against sleeping sickness in the Belgian Congo this century.
[119] *Gold Coast Annual Medical Report, 1911*, p.50.

intervention. However, the medical services implemented these measures with the benefit of the former community in mind. It is difficult to ascertain the European community's response to these measures. The *Annual Medical Reports* recorded mainly positive responses. In a smaller epidemic in Nigeria, in 1915, the *Annual Medical Report* contended that Europeans "cooperated cheerfully and energetically with the medical officers concerned", despite the entire area being quarantined and railway stations closed to all travellers.[120] Syrians also enjoyed non-immune status. They represented a double risk to Europeans, they were vulnerable to infection, and preferred to live in African sections of towns, close to their business premises, thus placing them in proximity of possible infection. As such, the CMS occasionally targeted them for special consideration. For example, during the 1913 epidemic in Lagos, colonial medical authorities listed Syrians and kept them under "careful surveillance". Syrians were apparently "pleased to have such a keen interest taken in their welfare"![121]

The CMS isolated victims in screened rooms immediately after they diagnosed or suspected yellow fever. They fumigated patients' houses, and usually surrounding buildings with sulphur to kill any *Aedes aegypti* mosquitoes (see figures 2.2 and 2.3 on page 153). There is some evidence about African responses to fumigation of their homes, but unsurprisingly, the *Annual Medical Reports* only recorded favourable reactions. However, a description of the process in the Gambia in 1922, after medical personnel reported a number of yellow fever cases, gives fascinating insight into the procedure and the indigenous reaction, despite what we may regard as the writer's lack of objectivity:

[120] *Nigeria Annual Medical Report, 1915*, p.13.
[121] *Southern Nigeria Annual Medical Report, 1913*, p.31.

Infected houses (and their immediate neighbours) were enveloped in large tarpaulins well laced and overlapped, and fumigation of them by Sulphur (both open pots and Clayton methods) was so successful that mosquitoes, beetles, bugs, ants, rats and bats all fell victims to the fumes. The people at first chary of the performance, rejoiced over the wholesale destruction of their insect tormentors. No damage to property was reported.[122]

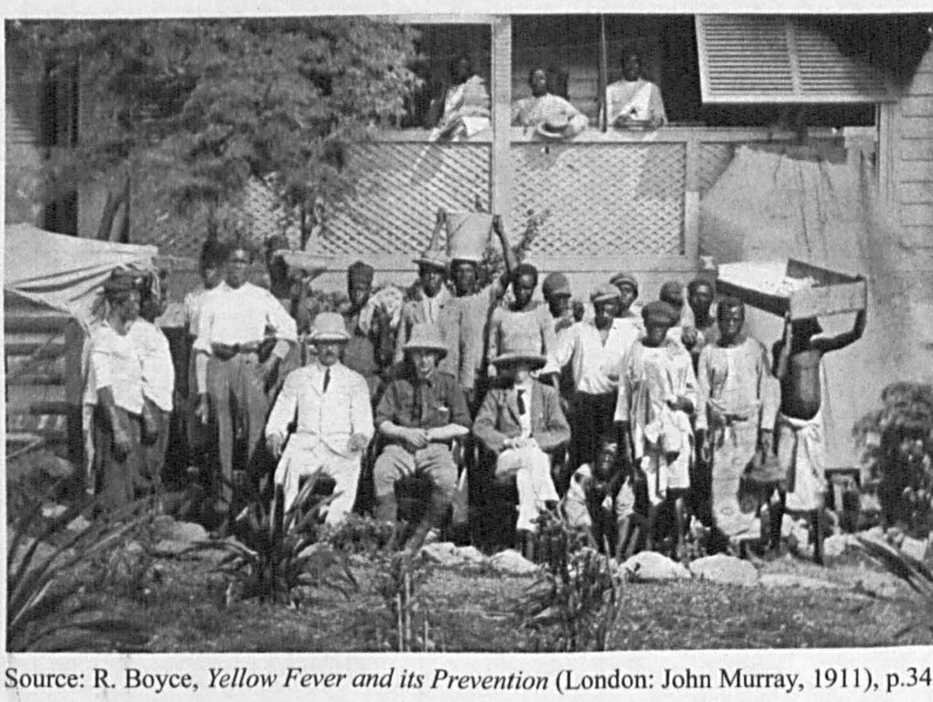
As European communities were rarely fully segregated, epidemics prompted temporary segregation: removing Europeans away from immediate sources of danger: Africans and mosquitoes. The CMS initially achieved this with persuasion, although adopted a more direct approach if necessary. For example, in the epidemic in Accra in 1927, an evacuation order, obtained at the behest of the medical department, forced the reluctant few to move out of the African town into a designated area. Yet as with other epidemics, non-medical factors, particularly commercial concerns modified medical policy. The medical authorities allowed Europeans to return to the infected area during business hours, albeit under orders to wear mosquito boots.[123] This was probably partially based on the erroneous idea that *Aedes aegypti* mosquitoes tended to bite more at night. However, it is more likely a concession to the economic reality dictating that European merchants be allowed to conduct business on their own premises, and the recognition that many commercial and official colonial duties could not be conducted from afar. However, there is evidence suggesting that Europeans lost some of their hostility to general segregation during and after an epidemic. The

[122] *Gambia Annual Medical Report, 1922,* p.10.
[123] *Gold Coast Annual Medical Report, 1927*, p.133.

Figure 2.2: Fumigating a house in Seccondee, 1910, using Clayton Sulphur Apparatus

Source: R. Boyce, *Yellow Fever and its Prevention* (London: John Murray, 1911) p.314.

Figure 2.3. Yellow Fever Epidemic, Seccondee, 1910. The Medical Officers and their Fumigating Gang.



Source: R. Boyce, *Yellow Fever and its Prevention* (London: John Murray, 1911), p.342.

appearance of epidemic yellow fever perhaps sharpened fears of the disease among the non-medical European community, inducing its members to act on medical advice commonly ignored under normal circumstances. On several occasions, Gold Coast medical personnel noted the positive effect of epidemics on encouraging segregation in the colony particularly in persuading the stubborn mercantile sector. In 1915, the PMO commented: "Yellow fever is proving a powerful ally on the side of the advocates of segregation, and two firms in Accra have been converted directly as the result of recent deaths from yellow fever".[124]

II. Anti-mosquito measures

The medical services waged a serious campaign against mosquitoes; an activity marked by laxity in long non-epidemic periods. They intensified routine anti-mosquito work, moving from complacency to serious activity. The format was the same, but there was an unmistakable zealous urgency, even panic, in these anti-mosquito campaigns. The DMS of Nigeria recalled his role as an SO in suppressing the 1910 epidemic in Accra. He described himself as being then: "a believer in the adoption of repressive and punitive measures" to destroy mosquitoes. As part of this regime:

> ... after due warning had been given that all vessels used for the storage of water must be made mosquito proof, I used to go out with an axe in the early morning (sometimes accompanied by the provincial

[124] *Ibid., 1915*, p.20.

Commissioner and Sir Rubert Boyce) and up-end and smash in every cask or barrel I saw that was not mosquito proof.[125]

The Medical Services and Public Works department enhanced the protection of individual Europeans from mosquitoes, ensuring they were safe from mosquitoes. The response in Southern Nigeria in 1912 to an epidemic in neighbouring Dahomey was quite typical. Fearing infection could spread to his colony the acting Governor used his personal influence to make funds available to protect the European population. Medical personnel inspected and replaced where necessary the nets of all government officials. They visited mercantile firms making recommendations, rather than providing anti-mosquito equipment. European and African wards in the hospital were made mosquito proof. A number of mosquito proof portable rooms were constructed and used in the epidemic the following year.[126]

III. International quarantine

Quarantine was frequently imposed against port towns suffering a yellow fever epidemic. Like many of the non-disease specific measures discussed so far, the use of quarantine in British West Africa derived from sanitary measures used widely in the history of epidemic control. It elicited a wide range of responses from the medical and commercial sectors of the population. Many among the European non-medical community in West Africa considered that the consequent commercial disruption offset the possible medical benefits. Western medical experts believed it a very

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[125] *Nigeria Annual Medical Report, 1919-1921*, p.8.
[126] *Southern Nigeria Annual Medical Report, 1913*, pp.27-28.

necessary evil to protect neighbouring West African colonies in addition to a wider international community: Europe, the Americas and India. However, this view was not shared by all members of the CMS.

Quarantine in West Africa aimed to prevent importation of yellow fever by stopping the transportation of infected people or mosquitoes to non-infected areas. West African colonies frequently declared quarantine against each other, despite theories claiming that the disease was endemic in the entire region. MOs or port health officers commonly examined travellers about to depart from a quarantined port or isolated them for a period before departure and on arrival. International regulations stated that all passengers on ships infected with yellow fever or suspected as such should be subjected to medical inspection on arrival at a healthy port with the sick isolated and all others kept under observation or surveillance for six days.[127] On occasion, MOs provided certificates indicating freedom from infection. Cargo was often disinfected or fumigated on arrival at non-infected ports. These measures were costly as well as disruptive, a further reason for their unpopularity. On arrival at, or indeed from, quarantined ports, ships had to anchor several hundred feet from the harbour, at a distance considered beyond the flight capabilities of any *Aedes aegypti* mosquitoes on board. There was little consensus on the necessary distance, with opinion and policy varying from 400 to 1,000 yards (366 to 915 metres).[128] The 1926 International Sanitary Convention stipulated that a distance of 200 metres from the shoreline was sufficient, and that ships should be fumigated on departure from the infected port.[129]

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[127] *International Sanitary Convention, 1926*. Cd. 3207, 1928-9. Articles 35-37.
[128] See for example the *Gold Coast Annual Medical Report, 1927*, p.133, and Gordon, "Notes on Yellow Fever", p.18.
[129] *International Sanitary Convention, 1926*. Cd. 3207, 1928-9. Article 36.

The *Annual Medical Reports* noted the hostility of the European commercial sector to the imposition of quarantine. Certainly, the policy was notorious for its deleterious effect on commerce. This is unsurprising given the additional costs, delays and limits on travel and trade caused by the various medical quarantine regulations imposed at the quarantined port and destination. The private sector duplicated some of these restrictive measures, causing greater inconvenience. Ship owners and captains were reluctant to deal with the health hazards and practical difficulties encountered in a quarantined port, in addition to restrictions imposed in subsequent ports. However, sometimes their response was excessive and unjust. During the 1913 epidemic in Lagos, all travellers free from infection received a medical certificate affording them unfettered movement. The shipping companies operated their own variation of quarantine, with the Elder Dempster Shipping Company and its rival the Woermann line refusing passage to all third class customers, the latter initially refusing to call at Lagos but later doing so accepting only first class passengers.[130] Lower class passengers were more likely to be African and thus the shipping companies' refusal to permit them on board can be seen as racial, as well as class discrimination. This indicates that the fear of epidemic yellow fever was not restricted to the medical services or European residents of West Africa.

Businessmen in West Africa were not alone in their objections to quarantine. Colonial governments also voiced dissent. For example, in 1913, Lugard made his anti-quarantine stance known to the Secretary of State. Clifford stated the common objections to the measure:

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[130] *Southern Nigeria Annual Medical Report, 1913*, p.30.

> These frequent declarations of quarantine cause a great deal of inconvenience to the general public, they discourage and dislocate trade; they quicken the excessive apprehension with which far too many Europeans regard the known risks of life in West Africa; and they inevitably advertise the less satisfactory features of our health conditions in a way which cannot fail to be detrimental to the material prosperity of a Colony.[131]

In particular, he argued of the futility of West African colonies imposing quarantine on each other when yellow fever was possibly endemic throughout the four colonies. (This argument echoed Manson's fears in 1911 of the implications of Boyce's theory of endemicity on quarantine.) However, colonial governors were not alone in their objections. In their protests to the Secretary of State, both men cited supporting statements by their senior MOs.[132] This indicates that some members of the CMS did not wholeheartedly support quarantine. Lugard, Clifford and their medical staff were in an ideal position to judge the negative effects of quarantine. It had been declared on Lagos and Accra that year. As this example demonstrates, the imposition of quarantine invoked a number of economic and social issues. In this case, it brought mainly commercial considerations to the fore. This tendency can be seen elsewhere. M. Harrison's analysis of quarantine restrictions in British India in the latter nineteenth century demonstrates that quarantine in India also involved non-medical issues. He reveals that numerous factors, more varied than in West Africa, informed the policy in India, including social, economic, political and religious considerations. The control of Muslim pilgrims from India proved central in the quarantine debate in

[131] CMAC. GC/59/A2. Hugh Clifford, Governor of the Gold Coast, to the Secretary of State, 23.07.1913.
[132] *Ibid.*

India.[133] These two examples demonstrate that medical campaigns did not operate in medical and social isolation. Policies such as quarantine had a considerable effect on wider non-medical aspects of life. In India, these elements also shaped quarantine. In West Africa, the policy was less susceptible to their influence and hence less modified, as demonstrated by continued declarations of quarantine despite the arguments of Lugard and Clifford.

Stage four: subsidence and retrospection

Epidemic yellow fever had a galvanising effect on both the medical and non-medical European population alike. As demonstrated, epidemic yellow fever created considerable alarm among the CMS prompting quite zealous action, assisted by powers conveyed by the colonial government. In many ways, the medical response could be interpreted as an overreaction, if the degree of repression, and the small number of cases involved are considered. To a certain extent, epidemics also eased the hostility of the European community to anti-yellow fever measures as they became more accommodating of their imposition.

The legacy of yellow fever epidemics, Rosenberg's final phase, would seem to be temporary. Providing a stimulus for action from the medical and European non-medical population, it required fresh and constant outbursts to maintain momentum. The DMS of the Gold Coast noted this tendency in 1933:

> Occasional cases which appear from time to time do not keep the menace steadily before the public eye. Anti-mosquito activities on the

[133] M. Harrison, *Public Health in British India: Anglo-Indian Preventive Medicine, 1859-1914*, (Cambridge: Cambridge University Press, 1994), pp.117-138.

> part of the Health Branch gradually become more and more irksome to the public, less assistance is forthcoming, until another outbreak with its attendant dislocation of trade and limitation of movement brings the problem to the forefront.[134]

Yellow fever in West Africa was a disease characterised by panic, easily forgotten in its absence but capable of creating alarm and extreme reactions when it reappeared, particularly on the part of the medical community. The notion of Europeans as being particularly susceptible to the disease, and statistics which demonstrated higher mortality among European victims than African sufferers, created considerable fear of the disease. This fear forced and enabled the CMS to respond. The colonial government put greater legal powers and resources at their disposal to facilitate the instigation of vigorous anti-yellow fever campaigns. The non-medical, non-indigenous community exhibited a mixed response to epidemics. Its members' anxieties were manifested in an increased willingness to abide by some medical measures. Yet there was also a parallel dread, felt most acutely by the non-medical European community, of the severe inconveniences imposed by a yellow fever epidemic: quarantine, isolation, segregation and intensive anti-mosquito measures.

Conclusion

The perceptions and preoccupations of the CMS can be seen clearly in their reactions to yellow fever. Various medical theories of the disease informed their response. These led to the focus on both mosquitoes and the indigenous population as

[134] *Gold Coast Annual Medical Report, 1932-33*, p.17.

dangerous elements of the environment. Notions of Africans as being both immune and reservoirs of disease were particularly central and manifested in other doctrines of disease control such as anti-malarial schemes. Indigenous populations as a reservoir of disease was a common concept in tropical medicine, and applied to smallpox, plague and malaria. The construction of the European population as non-immune corresponded well with the primary role of the CMS in West Africa: to protect the health of the white population. Labelling Africans as "immune" together with the wide recognition of mild cases among them enabled the CMS to justify this policy for yellow fever. Within their own framework, the CMS could claim that their measures targeted the most vulnerable section of the population. Presenting Africans as harbouring invisible infectious agents and requiring control, helped to rationalise repressive measures such as mass isolation and segregation. West Africa's persistent reputation as the "white man's grave" and epidemics of yellow fever, which apparently hit the white population the hardest, fed into and reinforced these concepts.

The key to understanding the invasive and draconian measures enacted when yellow fever appeared as an epidemic, was the danger it represented to the European population specifically in terms of health and trade. Epidemics permitted measures such as compulsory isolation, and vigorous anti-mosquito techniques. These were not unusual or more repressive then other campaigns against different diseases in the tropical colonies. Indeed, they may compare relatively favourably against some, such as measures against sleeping sickness in the Belgian Congo. What is striking is that the CMS enacted them in response to merely a handful of yellow fever cases rather than the quarter of a million deaths that sparked off the campaigns against sleeping sickness.[135] However, the failure of the members of the non-medical European community to alter their behaviour acted as a constraint on colonial action, particularly in non-epidemic periods. Many measures, such as segregation or house inspections, required co-operation at a community level, and as this chapter demonstrates, the response was poor.

However, this sense of urgency was limited to epidemics. A different sense overtook the CMS in West Africa when yellow fever was no longer a visible threat, resulting in more relaxed attitudes and practices that were somewhat at odds with behaviour during epidemics. This occurred despite the acknowledgement that the disease was endemic in West Africa, with many cases going unrecognised. They did not entirely forget the menace of the disease during non-epidemic periods, yet they certainly allowed measures to slacken. The CMS often paid lip service to the need to maintain or enhance anti-yellow fever measures but they took little action until they faced yellow fever epidemics. They were quick to blame external factors for these lapses, such as poor quality African sanitary inspectors, lack of financial and administrative support from the colonial authorities, and an unco-operative spirit shown by the non-medical community. The CMS's inaction can be interpreted as their response to their understanding of endemic yellow fever, indicating that they did not subscribe to Boyce's extreme view of endemicity. In spite of their laxity, they insisted that Africans formed a reservoir of the disease and promoted measures that aimed to protect Europeans from this alleged source of infection. This suggests that the CMS took this element of endemic theory quite seriously, even if it was at odds with their somewhat complacent anti-mosquito measures. They may have subscribed to the idea

[135] Lyons, *The Colonial Disease* (1992), p.70.

of Africans as disease reservoirs because it was common to other theories of tropical diseases, and accorded well with contemporary racial attitudes of Africans as something different; as intrinsically part of a dangerous and diseased environment. Discussing mass campaigns in colonial Africa M. Vaughan makes a similar point: "Africans were represented as an integral part of a hazardous environment, they were as a group, potential hosts for dangerous pathogens".[136]

Non-medical Europeans seemed to be more consistent in their perception and reaction to yellow fever. They protected themselves as far as convenience permitted, and were selective in the medical advice they heeded. They undoubtedly feared contracting the disease. However, as far as evidence reveals, many were bound by other, possibly more overriding concerns. For example, the effect of the disease on trade and commerce, the cost of preventive measures such as segregation, and mosquito screens, or the inconvenience of frequent house inspections. Epidemics may have persuaded some of the benefits of medical campaigns. The CMS had noted this tendency during, and in the wake of epidemics, yet they also observed the short term nature of this trend. Certainly, the CMS could themselves also be accused of this temporising. A policy of laissez faire could perhaps be best justified economically by extreme measures in the isolated instances of epidemic yellow fever.

[136] M. Vaughan, *Curing Their Ills: Colonial Power and African Illness* (Cambridge: Polity Press, 1991), p.52.

CHAPTER THREE

THE ROCKEFELLER FOUNDATION: RESEARCH AGENDAS FOR YELLOW FEVER

The involvement of the RF in yellow fever research in West Africa represents a unique element in the history of the disease in the region. Bolstered by its successes in South America, the RF saw West Africa as the next logical theatre of operations in its plans for global eradication. However, it never achieved this worthy and formidable goal. Although its work in the region commenced with the clear aim of implementing anti-yellow fever campaigns, the RF failed to initiate even moderate control work in West Africa. Instead, it focused on research that had little immediate practical application in the region. This chapter will examine the shifting directions of the RF's efforts in West Africa, and the numerous factors influencing its perspectives and activities. In particular, I will focus on the fundamental transformation of the RF's objectives, from ambitions for eradication to conducting research of little immediate benefit. I will argue that because of different aims and resources, the RF, as an institution, had a different perception of, and approach to yellow fever to the British medical community. The former prioritised the disease above others, conceptualising it in West Africa as a topic for research, the latter as one disease of many requiring attention, yet not the gravest threat to health.

As outlined in chapter one, the RF had considerable experience in disease control campaigns before it set its sights on yellow fever in West Africa. Beginning with hookworm in the Southern States of America in 1909, the RF then moved its activities into the global arena in 1913 with the creation of the International Health

Commission. The key focus of this analysis is the RF's West Africa Yellow Fever Commission (1925 to 1934). Its operation involved the interaction of various interest groups and individuals within the vast RF, with the IHD providing the overall direction. The IHD's remit was to concentrate on disease control campaigns, occasionally conducting research which it considered had an immediate practical application to disease control. Its sister body, the Rockefeller Institute for Medical Research concentrated on more fundamental research programmes. Underneath the umbrella of the IHD, the Commission received a flow of information and direction from several sources. The Director of the IHD, Frederick Russell was a central figure, and instrumental in determining the aims and direction of work in West Africa. It also received support from Wilbur A. Sawyer, the Director of the IHD's Laboratory Service and the IHD's yellow fever laboratory in New York created in 1928. Russell created this laboratory to provide the IHD with a central research base in New York.[1] Sawyer understood the complexities of yellow fever investigations and thus provided specialist advice. The work of the two groups in Africa and North America proved to be mutually beneficial, and reinforced the value of basic scientific research to the IHD's yellow fever control campaigns. There was less intellectual interaction with the IHD's operations in South America, although as this chapter will demonstrate, the results of its South American campaigns proved influential. In West Africa, the Commission was predominantly staffed by RF personnel, although occasionally, experts outside the RF temporarily joined the group. It remained independent of colonial authorities, who played little part in determining the Commission's aims and

[1] For an examination of the creation of the laboratory see J. Farley, "The International Health Division of the Rockefeller Foundation: The Russell Years, 1920-1934", in P. Weindling (ed.), *International Health Organisations and Movements, 1918-1939* (Cambridge: Cambridge University Press, 1995), pp.203-221.

directions. It did, however, interact with various members of the CMS, some of whom worked directly on the Commission's projects.

The activities of the RF in West Africa were fluid, and shaped by its changing perceptions of the disease and of the RF's role in yellow fever control. Events in South America were important to this process. As such, I outline the more critical developments in that region, and highlight the implications for activities in West Africa. I examine efforts in West Africa, arguing that they can be divided into three distinct phases, each representing a different approach to, and understanding of the disease. These stages culminated in a shift in the central aim away from control towards research. The reasons for this change are analysed, and include the impact of developments in South America; the availability of new scientific techniques; individual aspirations and personalities; and the perceived advantages of using West Africa as a research site. This is followed by a comparative analysis of the methods and perceptions of the British and the RF regarding yellow fever in West Africa. The limited research endeavours of the British medical community in this area are examined, demonstrating that it neither had the will nor the resources to conduct research on a scale similar to the RF.

The RF in South America

The IHB initially limited itself to the global problem of hookworm, but yellow fever in the Americas soon captured its attention. As discussed in chapter one, the RF's interest began in 1914 after Gorgas's assurance that the disease was eradicable in a "reasonable time and at a reasonable cost".[2] This prospect offered many benefits to the RF and the United States more generally. Freeing South American ports from the disease would ease North American trade with the region. Quarantine regulations would no longer hamper American imports and the exportation of South American raw materials would flow unhindered. It would allay common fears of yellow fever's reintroduction into the Southern States of America from South American ports. Economics aside, eradication was good publicity and would bestow prestige on the RF.

Plans for this disease represent a shift in ethos behind the RF's disease campaigns. Its efforts against hookworm had two aims: to eradicate the disease, and to promote local health boards, fostering interest in medicine and sanitation. With yellow fever, however, all the RF's aspirations pointed to eradication. As M. Cueto argues, this goal proved more elusive than initially believed, forcing the RF to revise its notions of eradication during its yellow fever and malaria campaigns: "Eradication went through cycles of boom, bust and boom which meant a continual reformulation of the concept. From the elimination of the disease, the concept changed to the reduction in the incidence of a disease and finally it ended as the eradication of one of the vectors that transmitted a disease".[3] This ever-changing objective of eradication is a central factor in understanding the nature of the RF's endeavours in South America. It also had implications for the direction of work in West Africa, ensuring that research took precedence, and that the IHD undertook no control or eradication projects in that region. The direction of the IHD's work in West Africa was sensitive

[2] W.A. Sawyer, "A History of the Activities of the Rockefeller Foundation in the Investigation and Control of Yellow Fever", *American Journal of Tropical Medicine* 17 (1937), p.35.
[3] M. Cueto, "The Cycles of Eradication: The Rockefeller Foundation and Latin American Public Health, 1918-1940", in Weindling, *International Health Organisations* (1995), p.238.

to several local and external factors, and critically to events in South America. The impact of key developments flowed from there to West Africa. Therefore, it is necessary to briefly outline these pivotal events and relate them to the activities of the RF's researchers in Africa. This exchange was predominantly one way. The nature and direction of the RF's work in Lagos had little immediate effect on South American campaigns, although the RF applied some of its research indirectly to later control campaigns in South America as well as to research programmes on both continents in the 1930s and 1940s.

The RF relied on the key centre theory developed by Carter.[4] This provided a relatively cheap and simple means of achieving control and/or eradication and avoided the more complex social problems of malnutrition, sanitation and poverty. It promised results by the single, straightforward method of reducing mosquitoes by destroying breeding places and larvae. Moreover, this method need only be applied in large urban centres where loci of endemic yellow fever were found. Once these were dealt with, remaining infections in smaller towns and villages would burn out naturally as the population gained immunity and lowered the numbers of susceptible people. Carter referred to this factor as the "failure of the human host". As long as anti-yellow fever efforts were maintained in the large urban centres, infection could not be transmitted to other towns, and the disease could not be reintroduced into less populous areas where there were no specific campaigns. Therefore, anti-yellow fever measures could be limited to discrete areas thought to be seed beds of infection: the theory held that it was unnecessary to conduct large widespread campaigns, particularly in rural areas awkward to access.

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[4] H. Carter, "Spontaneous Disappearance of Yellow Fever From Failure of the Human Host", *TRSTMH* **10** (1917), pp.119-129; *idem*, "The Mechanism of the Spontaneous Elimination of Yellow Fever From Endemic Centres", *ATMP* **13** (1919), pp.299-311.

Encouraged by these factors, in 1916, the RF appointed a yellow fever Commission which visited numerous suspected endemic regions in Colombia, Venezuela, Peru, Ecuador and Brazil. It concluded that the port of Guayaquil, Ecuador was the only endemic centre in South America at that time. Delayed by World War One, the RF finally initiated its plans for yellow fever eradication in the town in 1918. It first dispatched a research team to conduct the necessary preliminary investigations. In particular, it hoped that the team would discover the disease's causative agent. This was seemingly realised by Hideyo Noguchi, a member of the team from the RF Institute for Medical Research.[5] He claimed to have isolated spirochetes in the blood of guinea pigs, which he used as an animal model. He declared that these were the causative organism of yellow fever and named them *Leptospira icteroides*. He consequently developed a vaccine based on his findings, which the RF used in South America, although only as a secondary measure to anti-larval efforts.[6] His finding had no effect on the shape of anti-larval campaigns, but dominated research for many years. Some had their doubts about Noguchi's spirochetes, especially after numerous failed attempts by other researchers to isolate the organism. However, he managed to dismiss his critics, doubtless sheltered by the prestige of the RF, and his discovery became an established part of yellow fever knowledge. Cueto notes that the excellent reputation of his sponsor, Simon Flexner, the Director of the Rockefeller Institute, possibly gave credence to his work.[7]

[5] H. Noguchi was born in 1876. He was educated at a private medical school in Tokyo, and was sent to Flexner's laboratory by his patron, a local dentist. There, he conducted research into a variety of diseases, including yellow fever. He died of the disease in 1928, in Accra, which he contracted during his investigations in the region as part of the RF's Yellow Fever Commission.
[6] Noguchi also developed a curative serum based on his findings, which was used to a lesser extent than the vaccine.
[7] M. Cueto, "Sanitation From Above: Yellow Fever and Foreign Intervention in Peru, 1919-1922", *Hispanic American Historical Review* **72** (1992), p.6.

Noguchi's claim was pivotal to the RF's later activities in West Africa. There, isolating the organism in local cases of the disease was a major research aim of the RF researchers. Their consequent inability to find the spirochete led to a change of direction in West Africa; from control efforts to research.

The nature of the RF's campaigns in South America serve as a direct contrast to its activities in West Africa. In the former, efforts consisted predominantly of practical control campaigns, with some researchers conducting scientific studies. In the latter, the RF prioritised research, despite its original aim to initiate control measures. Its work in South America perhaps reflects what it originally intended to implement in West Africa. The IHB began control in Guayaquil in 1918 with the "hearty co-operation" of the government and local authorities.[8] Concentrating on reducing mosquito breeding by introducing larvae eating fish in large water containers, mosquito proofing tanks, and destroying larvae during weekly inspections, the campaign yielded spectacular results. In the eight years before the campaign began, the case rate ran at an average of 259 cases per year. In its first year there were 460 cases, and six months later, the last recorded case of the disease occurred.[9] The 1920s saw the extension of the IHB's equally successful efforts against yellow fever to other parts of South America: Guatemala, Peru, Colombia, Central America, Brazil and Mexico. However, in return for its financial assistance and expert personnel, the RF insisted on controlling its campaigns. Governments provided partial funding.[10] Although highly proficient at reducing mosquito breeding, and consequently, yellow fever, the RF campaigns left much to be desired in the realm of local relations. As Cueto asserts: "Americans directed operations with unlimited confidence in the

[8] Sawyer, "Activities of the RF", (1937), p.41.
[9] *Ibid.*, p.41.
[10] Cueto, "Sanitation From Above", (1992), p.5.

capacity of technological resources, little community awareness and limited assistance of locals in directive positions".[11] Conflicts between local populations and physicians were not uncommon as the RF endeavoured to stamp the benefits of western medicine upon yellow fever hit regions.[12]

By 1925, it appeared that the RF had eradicated yellow fever from South America except for a small region in northern Brazil. This apparent success boosted confidence in its wider eradication plans. It became optimistic about the possibilities of repeating efforts in West Africa. However, unforeseen events on the other continent thwarted these ambitions. After an absence of twenty years, the disease re-emerged in Rio de Janeiro in 1928, in a severe epidemic which lasted a year, resulting in more than 800 cases with 436 deaths. The disease then also occurred in other parts of Brazil, and in Colombia and Venezuela the following year. Clearly, celebrations of eradication were premature and doubts about the validity of the key centre theory began to emerge. The disturbing discovery of cases in rural areas, isolated and a considerable distance from endemic centres reinforced this new scepticism. According to the key centre theory, yellow fever could not have been sustained in these places, as there was no chance of it being introduced from the large urban "seed beds" of infection where anti-larval measures had stamped out the disease. The fatal blow to the key centre theory came in the early 1930s with the discovery that yellow fever occurred in regions free of *Aedes aegypti* mosquitoes. Named "jungle yellow fever",

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[11] *Idem*, "Cycles of Eradication", (1995), p.230.

[12] See essays by A. Solorzano and S.C. Williams in M. Cueto (ed.), *Missionaries of Science: The Rockefeller Foundation and Latin America* (Bloomington: Indiana University Press, 1994), pp.52-71 and pp.23-51 respectively; I. Löwy, "What/Who Should be Controlled? Opposition to Yellow Fever Campaigns in Brazil, 1900-39", in A. Cunningham and B. Andrews (eds.), *Western Medicine as Contested Knowledge* (Manchester: Manchester University Press, 1997), pp.124-146; and Cueto, "Sanitation from Above", (1992), for analyses of the RF's activities in South America, and consensus and conflicts between the local authorities and population.

this strain was identical to classic yellow fever except in transmission. These events forced the RF to admit that the key centre theory was an inadequate epidemiological model on which to base control campaigns. It recognised that plans for eradication required radical modification. This pessimistic mood had implications for the RF's activities in West Africa. The RF had lost its quick fix solution to yellow fever control and eradication. Without it, the problems and expense of implementing campaigns in West Africa seemed insurmountable. These developments also highlighted the need for further research to better elucidate the epidemiology of the disease. As the RF's laboratory in West Africa had a proven research record, the Foundation naturally conferred part of this role onto staff in that region.

It is interesting to note that in an article on the history of the RF's activities against the disease, written five years after the Foundation admitted the failure of eradication campaigns, Sawyer, then Director of the IHD, glossed over this serious setback. He allowed it a mere two sentences, and described it as revealing "the limited application of the key center [sic.] theory".[13] He highlighted instead the more visible successes of the RF such as the development of vaccines. Fred Lowe Soper, a key member of the RF team in South America, was more willing to admit the blow it represented and lamented several years later: "Were it not for the existence of jungle infection yellow fever might have disappeared permanently from the Americas in 1934!".[14]

The IHD was compelled to expand its operations into smaller towns and rural areas: an expensive undertaking. Two technical innovations accompanied the move into the rural hinterland. First, the RF controlled Brazilian Yellow Fever Service

[13] Sawyer, "Activities of the RF", (1937), p.44.
[14] F. Soper, "Yellow Fever: The Present Situation (October, 1938) with Special Reference to South America", *TRSTMH* **32** (1938), p.304.

rapidly developed a viscerotomy service in 1931. This used a tool called a viscerotome, developed in 1931, to provide post-mortem diagnosis of yellow fever. It punctured a cadaver, and removed a section of liver without recourse to an autopsy. The person using the instrument, the viscerotomist, did not have to touch the corpse or the liver tissue. They then labelled the sample and sent it to a central laboratory for examination looking for lesions characteristic of yellow fever. Soper contended that in the majority of cases, diagnosis was quite straightforward, with only a small percentage being open to dispute.[15] All fever cases proving fatal within eleven days after onset of illness were subjected to this technique, regardless of clinical diagnosis.[16] Results indicated yellow fever incidence, and the method was particularly useful in more isolated rural areas that did not enjoy a substantial medical presence. It was extended to other parts of South America: Bolivia, Peru, Colombia and to a lesser extent, Venezuela and Panama.[17] The IHD made some attempts to introduce it into West Africa, without success. Second, the RF's yellow fever vaccine gave the IHD an additional basis of control by the late 1930s. Initially, the RF restricted it to its own personnel working in yellow fever areas, but the development of the 17D vaccine, safer than previous techniques, allowed the mass inoculation of South American populations to begin in 1937. By 1950, 7,999,530 people had been inoculated with the RF's vaccine in Brazil, Colombia, Bolivia, Peru and Venezuela.[18] However, in the late 1930s, the RF's interest in the disease in South America was waning, and it began to relinquish its control of campaigns to the local authorities. Yellow fever had failed to provide it with the glory of achieving eradication as it had

[15] *Ibid.*, p.327.
[16] *Ibid.*, p.307.
[17] H.H. Smith, "Controlling Yellow Fever", in G. Strode (ed.), *Yellow Fever* (New York: McGraw Hill, 1951), p.593.
[18] *Ibid.*, p.614.

originally anticipated. With a more complex epidemiology, its eradication proved too great a task.

The RF in West Africa

The RF's involvement in West Africa started before the problems in South America emerged. Although the RF began its work in South America, it soon became clear that it did not intend to limit itself to one region, and it announced its wider ambitions. In 1917, the *Annual Report of the Rockefeller Foundation*, the official mouthpiece of the organisation, confidently declared that: "The real fight against yellow fever will come when the war is over. It is hoped wholly to exterminate yellow fever from the world".[19] As a suspected endemic area, West Africa was a logical site for the escalation of the RF's eradication plans.

The RF was confident that the British government would accommodate its plans as relations between the two were amicable. The first contact with the British empire came in 1914, when the RF collaborated on an existing anti-hookworm campaign in Egypt.[20] It consolidated its relationship with the Colonial Office and the British tropical medicine community in the 1920s with the creation of the London School of Hygiene and Tropical Medicine. This was formally opened in 1929 and incorporated the London School of Tropical Medicine. The RF donated a total of £462,000 from 1922 to 1927 which contributed to the costs of land, construction and equipment. D. Fisher argues that the RF was essential to the School's creation; its

[19] *Annual Report of the Rockefeller Foundation, 1917* (New York: Rockefeller Foundation, 1917), p.41.
[20] J. Farley, *Bilharzia: A History of Imperial Tropical Medicine* (Cambridge: Cambridge University Press, 1991), pp.75-80.

money and determination providing the key driving force.[21] R. Acheson and P. Poole also assert the centrality of the RF in the process, highlighting the key role played by Wickliffe Rose, the Director of the IHB.[22] It would seem that more than the RF's cash and zeal went into the project, as Farley claims that in the School, the RF had created a mirror of the tropical medicine department it had established earlier at John Hopkins University in America: "The London School of Hygiene and Tropical Medicine had become the John Hopkins of the British empire, carrying with it the mandate of the International Health Board to extend the benefits of scientific medicine to the British colonies".[23] The RF used its amiable association with the Colonial Office and the British medical community to facilitate the extension of its activities throughout the British empire. As the yellow fever case study demonstrates, the co-operation of the metropolitan and local colonial authorities was essential to the smooth running of RF operations in West Africa.

The RF's activities in the region can be analysed in three separate phases. The first was a four month expedition in 1920. The second, from 1925 to 1930, constitutes the bulk of the activities of the more permanent RF Commission. This group predominantly focused on research which the RF considered necessary before it could initiate control work. The third phase, from 1930 to 1934, encompasses the final years of the Commission. This period saw a number of crucial developments that affected the direction and nature of the RF's work in West Africa and South America. These events radically altered plans for eradication and, in West Africa, led to a

[21] D. Fisher, "The Rockefeller Foundation and the Development of Scientific Medicine in Great Britain", *Minerva* **16** (1978), p.27.
[22] R. Acheson and P. Poole, "The London School of Hygiene and Tropical Medicine: A Child of Many Parents", *Medical History* **35** (1991), pp.383-408.
[23] Farley, *Bilharzia* (1991), p.89.

concentration on more academic, less immediately practical studies. The analysis of the RF's work in West Africa addresses a number of key questions. What did the RF hope to achieve in West Africa? How did this change and why? What was its research methodology? What were its perceptions of yellow fever; how did this affect the nature of its work, and how did it differ from those held by British experts and the CMS?

Phase one: the expedition, 1920

In line with past experience, the RF established a yellow fever Commission in 1920 to form an expedition to investigate the disease in West Africa. Its remit was to determine whether yellow fever existed in the region, and if so, if control was feasible. Headed by Gorgas, the group combined expertise with experience. Members included Robert E. Noble, the Assistant General Surgeon, USA; and Juan Guiteras, an established yellow fever expert from South America and member of the original RF Yellow Fever Commission in 1916. The inclusion of Adrian Stokes, Assistant to the Professor of Pathology, Trinity College, Dublin, and W.F. Tytler of the Medical Research Council, London, represented British research. A.E. Horn of the WAMS provided crucial local knowledge. He was the SMO of the Gambia and had been an expert witness for the British YFWAC, 1913-1916. Noble and Gorgas sailed for Britain on 8 May 1920. On arrival, they took the opportunity to gather as much information as possible about the disease in West Africa. They secured interviews with various members of the Colonial Office, and questioned numerous British tropical medicine experts, including those who had served as investigators for the

YFWAC. Unfortunately, Gorgas fell critically ill during their stay in London and died just before they were due to sail to West Africa. Noble replaced him as Director, and joined the other members of the group in Lagos in July.

They remained in West Africa for fifteen weeks conducting various studies, analysing data from previous epidemics and searching for suspected yellow fever cases. They did not restrict themselves to British West Africa, but also visited Dahomey, Senegal, and the Belgian Congo as part of their investigation. Despite the broad geographical base the researchers failed to find any active cases. Guiteras commented on how surprising this was: "No visible yellow fever anywhere. Strange to say; the three things that we had thought most likely to find in Africa, yellow fever, intense heat, and troublesome insects, were looked for in vain".[24]

They believed that the available evidence confirmed the past existence of the disease in West Africa, and that many cases had gone unseen and unrecorded. However, in his report, Guiteras argued that the disease was losing its grip on the region. He contended that although yellow fever had existed endemically in the region, its hold at that time was "becoming extremely precarious" and confidently predicted its demise given present circumstances: "we should be prepared to regard the total extinction of yellow fever in Africa as not only possible but probable".[25] As outlined in chapter two, the members of this expedition differed in their view of yellow fever endemicity from the British. With few exceptions, the British medical community agreed that the disease existed in a permanently endemic form in some regions of West Africa. The RF's group in 1920, suggested a temporary endemicity in

[24] J. Guiteras, "Observations on Yellow Fever, in a Recent Visit to Africa", p.4. B52, SS495, S2, RG5. RFA, RAC.
[25] *Idem*, "General Situation on the West Coast of Africa with Respect to Yellow Fever, with Suggestions as to Subsequent Investigations", in *Report of the Yellow Fever Commission to the West Coast of Africa, July 19 to October 30, 1920*, p.47. B52, SS495, S2, RG5. RFA, RAC.

patchy areas, disagreeing that permanent, extensive areas of endemicity existed in West Africa: an optimistic view that fitted well with the RF's goal of global eradication. Noble's report concluded that the situation warranted further investigation by the IHB, and should be of a more permanent nature, advising that Lagos, Freetown or Dakar be selected as a base.[26] The RF implemented these recommendations five years later when it formed a second yellow fever commission to address the disease in West Africa.

Phase two: the "preliminary canter", 1925 to 1930

In the early 1920s, the IHB's efforts in South America were bearing considerable fruit. Confident that its struggle in that region seemed to be drawing to a close, it turned its attention back to West Africa. Having been in discussions with the CAMC and various other colonial authorities since 1923, the RF created the West Africa Yellow Fever Commission (hereafter referred to as the Commission) in 1925. The RF was very mindful of the drama and prestige associated with its plans for West Africa. Using language highly suggestive of dangerous and exciting exploits, the RF presented the project in the *Annual Report* thus:

> With gradual disappearance of yellow fever from the Americas, West Africa becomes the last stronghold of this stubborn enemy. An area as large as the United States east of the Mississippi, a tropical climate, the prevalence of many diseases, few and for the most part difficult means of travel, a population of thirty million natives - superstitious,

[26] R.E. Noble, "The Visit of the Yellow Fever Commission of the International Health Board to the West Coast of Africa", in *ibid.*, pp.25-26.

secretive, and suspicious - present a challenge that turns sanitary and health work into a high adventure.[27]

In this statement the RF proposed three separate hazards to conquer: the disease itself, the environment of West Africa, and the indigenous population.

It is important to note that the language in correspondence and the "Annual Reports of the Commission" was occasionally ambiguous about whether the aim was eradication or a lesser objective of control. The two terms sometimes became interchangeable during this phase. Confusingly, methods of achieving whichever aim were discussed in terms of "control work", rather than "elimination" or "eradication" efforts. To prevent confusion, I will follow this trend in this chapter; when discussing practical measures against the disease, be it aiming at control or eradication I will refer to efforts in terms of "control" measures, etc. The RF and the Commission clearly anticipated that their work in the region would involve anti-yellow fever campaigns as part of the wider ambition of yellow fever elimination. This was the central premise behind their efforts in the second phase.

Although the RF widely cited its goal of global eradication, the Commission initially limited its work to preliminary investigative studies considered necessary before control work could begin. The initial remit of the Commission was research, what one member later described to be a "preliminary canter" to the main goal of eradication.[28] This was not an unusual procedure within the IHB. In Guayaquil in 1918, a period of research preceded control work. The IHB selected Lagos as the base of operations, considering it to be the most likely endemic area on the West

[27] *Annual Report of the Rockefeller Foundation, 1925*, (New York: Rockefeller Foundation, 1925), p.20.
[28] O. Klotz, "Diary Notes on a Trip to West Africa in Relation to a Yellow Fever Expedition Under the Auspices of the Rockefeller Foundation, 1926", p.297. MS 144, vol.I. Thomas Fisher Rare Book Library, University of Toronto, Toronto.

Coast. Staff reflected the prioritisation of research, and consisted of a pathologist, entomologist, and survey personnel, one of whom, Henry Hanson, had considerable experience of IHB yellow fever control campaigns in South America. The Commission was headed by Henry Beeuwkes, who, as noted in chapter one, appeared to have limited experience of the disease, although was knowledgeable of other infectious diseases. Prior to his appointment to the Commission, he had been the Medical Director of the American Relief Administration for two years. He did not have any publications relating to yellow fever at that time. There are hints of his ignorance in a letter he wrote to Russell:

> I appreciate the great opportunities you have given me for study of the various questions in connection with yellow fever, and my contact with Dr. Carter and White, for I would have made a sorry impression if I had not secured a fairly comprehensive grasp of the history, epidemiology, and entomology in connection with the disease.[29]

Despite his inexperience, Russell and other members of the IHB had the fullest confidence in Beeuwkes's abilities, in particular his administrative skills and tactful discretion. Indeed one member suggested to Russell that the work in West Africa would be the most difficult the IHB had undertaken, yet was certain that Beeuwkes and his staff were up to the task. If they proved incapable, he argued, then "it may as well be given up as a hopeless job".[30]

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[29] Henry Beeuwkes, Director of the Commission, to Frederick Russell, Director of the IHD, 10.06.1925. F1361, B97, S1.1, RG5. RFA, RAC.
[30] Vaughn to Russell, 03.08.1925. F1482, B108, S1.1, RG5. RFA, RAC. See other correspondence in this series for high regard of Beeuwkes.

Before departing for West Africa, Beeuwkes spent a short period in Britain, securing the co-operation of colonial authorities and the good will of the British medical community. They appeared to have been enthusiastic about the RF's plans. Beeuwkes admitted that they did not agree about some aspects of the disease's epidemiology but was confident that this was not a barrier:

> the members of the Committee ... are willing to give us a chance to work out a scientific solution of the problem. They appear glad to see us and anxious for us to undertake the study. However, being conservative in the extreme, they will accept our theories only after we have established definite proofs to support them.[31]

He also visited colonial and medical authorities in France to discuss the possibility of conducting studies in French West African territories, and in doing so, encountered a different perspective of the disease. Although the French declared that the Commission would be welcomed in their colonies, they lacked a certain enthusiasm and according to Beeuwkes: "indicated that yellow fever is not of particular interest in the French West African territories as they do not consider the disease endemic there, but imported from British possessions".[32]

Beeuwkes arrived in West Africa in June 1925, followed by his colleagues during the next few months. By the end of November, the Commission was fully staffed with a complement of eight men. They had several immediate objectives which revolved around creating a basis for control campaigns using the key centre theory. They were to determine if yellow fever existed in West Africa, and whether it was the

[31] Beeuwkes to Russell, 01.06.1925. F1361, B97, S1.1, RG5. RFA, RAC. Beeuwkes refers to this Committee as the "Colonial Advisory Medical and Sanitary Committee. It is unclear whether he actually means the Colonial Advisory Medical Committee, or the Advisory Medical and Sanitary Committee for Tropical Africa, who advised the creation of the British YFWAC in 1913.
[32] "Annual Report of the Commission, 1925", p.5. B214, SS495, S3, RG5. RFA, RAC.

same as seen in the Western Hemisphere. If research could demonstrate the two diseases to be identical, then the IHB could assume that yellow fever in West Africa would be amenable to the same control measures used in South America. The essential factor for proof would be isolation of *Leptospira icteroides*. They were also to locate and delineate endemic areas. This would detect regions where the RF would need to implement anti-larval measures. The key centre theory dictated that only endemic zones required control efforts. The researchers were also to ascertain the breeding habits of the vectors. This would provide valuable information for anti-larval campaigns, particularly if habits differed from those found in South America.

Field work dominated the Commission's work during the second phase; four people were initially dedicated to this task. In the first year of its existence, the Commission established field stations at Ibadan and Warri in Nigeria, and Accra in the Gold Coast. Its staff undertook large surveys in the Gold Coast and Nigeria providing a broad spectrum of epidemiological data. Field work had a dual purpose. First, to determine endemicity by surveying numerous areas, questioning local people for information, taking medical histories when possible and studying available medical records. This was to help construct a picture of the past incidence of yellow fever in specific regions. The second was to identify ongoing cases of infection. This was central to the task of finding Noguchi's spirochetes, live cases provided critical pathological material, as well as useful clinical data. The Commission strove to investigate, in person as far as possible, every case suggesting yellow fever.

Field workers relied extensively on the co-operation and goodwill of colonial MOs. They provided a vital source of contact between the RF researchers and the local population, facilitating contact with indigenous people which may otherwise have proved troublesome. They also alerted the Commission to possible yellow fever cases. Working with local MOs during an epidemic in Nsawam, the Gold Coast in March 1926, Beeuwkes commented on the value of this: "we were given every facility to study this epidemic; to make accurate clinical observations, and to secure blood for culture, and material for serological and pathological investigations".[33] Colonial authorities also gave researchers access to colonial disease control systems and facilities, which furnished them with essential data. For example, in 1927, E.J. Scannell enlisted the help of the port Health Officer to examine passengers travelling through Lagos. Scannell briefly examined them all before allowing them to leave. Some had blood removed for later testing at the Commission's laboratory in Lagos.[34] The Commission also examined patients at African hospitals and dispensaries in its search for yellow fever cases. It seems that colonial authorities helped to ease the life of the RF researcher in many different ways. A.M. Walcott, stationed at the Commission's satellite laboratory in Accra summed up the beneficial relationship they enjoyed:

> It was generously arranged that all imports for the use of the Commission would, on request, have the duties remitted, that free transportation on the government railway line for my automobile, servants and self would be granted, and that a very comfortable bungalow would be allotted to me free of charge. The wards of the various hospitals have always been freely open for visits and examinations, while the records in the office of the Director of Medical and Sanitary Services were put at my disposal.[35]

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[33] "Annual Report of the Commission, 1926", p.3. B214, SS495, S3, RG5. RFA, RAC.
[34] "Annual Report of the Commission, 1927". B214, SS495, S3, RG5. RFA, RAC.
[35] "Annual Report of the Commission, 1926", p.87. B214, SS495, S3, RG5. RFA, RAC.

However, field work was difficult and unrewarding. Investigating diseases in West Africa involved many practical problems of distance, hostile environments and local populations who were suspicious and not obliged to co-operate. Misdiagnosis of yellow fever proved to be a problem shared by British medical personnel and the American researchers. The Commission tried to investigate all cases of illness reported as suspicious, yet few were actually yellow fever. Other factors wasted valuable time. Beeuwkes described one incident when researchers spent three days travelling to Benin to investigate a suspicious case and arrived to find that the patient had died the day before.[36] The investigators conducted their work under demanding conditions. Again, Beeuwkes described a typical study of an epidemic:

> The work in the native villages is time consuming and difficult. Patients are generally lying on the ground in a dark corner of a room and must either be moved into the yard for examination, or this must be made with the use of a flashlight or other artificial illumination. They are frequently moved from house to house and the examiner loses track of them. ... It is practically impossible to induce the patient to save the vomitus, stools and urine for examination.[37]

To overcome these problems, the Commission employed local people to act as scouts to search for yellow fever cases. These were first used in the Gold Coast in 1927. The Commission trained them to make rudimentary medical observations and then sent them to hunt for sufferers in various towns where yellow fever was

[36] *Ibid.*, p.2.
[37] "Annual Report of the Commission, 1927". B214, SS495, S3, RG5. RFA, RAC.

suspected. Researchers were convinced that scouts were a useful tool in their endeavours against yellow fever. The "Annual Report of the Commission" summarised their contribution:

> As the native has no fear of the scout, and he frequently has acquaintances in the town under observation, he can ferret out cases in persons that would not spontaneously apply to a white physician for treatment. He is helpful in allaying the fear of the natives when investigations are first made in a particular region.[38]

The Commission also engaged in substantial entomological studies. A particular focus was to determine any differences between the habits of mosquito vectors in South America and those in Africa, presumably to provide a basis for refining control efforts. Investigators studied breeding places, and collated and identified any larvae that they discovered. They undertook surveys in cities to determine the potential for, and incidence of, mosquito breeding in domestic environments. For example, in September 1925, Beeuwkes and Walcott conducted surveys in Lagos and the nearby town of Apapa. They noted a variety of details including the local environment and ecology, and the design and location of African and European houses. They considered the availability of piped water supplies and the necessity for, and predominance of stored water. In Lagos, they visited a total of 509 habitations, and tabulated the numbers and genre of mosquitoes, as well as detailing the receptacles they found containing larvae. Their report provided figures which distinguished houses by race of the inhabitants. Work in Apapa was on a considerably

[38] "Annual Report of the Commission, 1928". B215, SS495, S3, RG5. RFA, RAC.

smaller scale, reflecting the difference in the size of the town: they inspected only eighty two houses.[39]

However, in 1926, the Commission drew an uncomfortable conclusion from its findings to date. This had substantial implications for future work in West Africa, proving to be a determining factor in deciding the direction of work in phase three. In the search for the *L. icteroides,* the Commission's researchers had copied Noguchi's methodology, injecting infected blood into guinea pigs, and then examining the animals for signs of the spirochete. Despite extensive efforts, the Commission's staff had failed to isolate Noguchi's spirochete in any serum taken from suspected yellow fever cases in West Africa. All the pathological and clinical evidence pointed to the disease in West Africa being identical to that in South America, except for the missing spirochetes, and the insusceptibility of guinea pigs to infection. Two members of the Commission, H.R. Muller and I.J. Kliger had previously worked with Noguchi (Muller actually being present when Noguchi made his discovery) now failed to find them. However, the Commission was initially hesitant about its discovery:

> In spite of our negative findings, our laboratory was unwilling to face the situation and deny Noguchi his honours. There was always the doubt cast upon us that perhaps we did not have suitable cases, that our culture medium was not properly made up, that the guinea pigs were too old or that cases under examination were not truly yellow fever.[40]

[39] F334, B53, SS497, S2, RG5. RFA, RAC.
[40] Klotz, "Diary Notes, 1926", p.292. MS 144, vol.I. Thomas Fisher.

However, Oskar Klotz, Professor of Pathology at the University of Toronto, and a temporary member of the Commission was determined to push for an answer. He persuaded Muller and Kliger to admit that the disease in West Africa was indeed yellow fever, albeit without spirochetes.[41] It is worth noting that Klotz, as only a temporary addition to the Commission, may have been more willing to admit the possibility of Noguchi's failure, than a long serving member of the IHB. He had no previous experience with the RF's anti-yellow fever campaigns and thus had no prior established interest in the project. In his diary, he wrote of some early doubts about the quality of Noguchi's work, which arose on meeting the scientist, claiming: "I found that his analysis of the lesions of yellow fever is rather superficial. He is not a competent histo-pathologist".[42] He also expressed a dislike of Muller, Noguchi's former colleague, presenting him as a moaning, temperamental young man.[43] It would seem that Noguchi had not made a favourable impression on Klotz, a factor that perhaps unwittingly strengthened his conviction against Noguchi's spirochetes.

Klotz reported the Commission's conclusions to Russell, and thus created an acute dilemma for the IHB. As Noguchi was a well supported member of the Rockefeller Institute for Medical Research, Russell was reluctant to discredit him. The Commission's work had serious implications, not only for Noguchi, but for its future endeavours in West Africa. The absence of spirochetes in West African yellow fever created uncertainty about the possibility of initiating control work. If this meant that

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[41] O. Klotz was born in Ontario, Canada in 1878. He studied pathology at McGill, Bonn and Freiberg. He was Professor of Pathology for ten years at Pittsburg University, and became Professor of Pathology at Toronto University in 1923. He died of leukaemia in 1936.
[42] H.J. Barrie, "Diary Notes on a Trip to West Africa in Relation to a Yellow Fever Expedition Under the Auspices of the Rockefeller Foundation, 1926, by Oskar Klotz", *Canadian Bulletin of Medical History* 14 (1997), p.141. This contains selections from Klotz's diary which I consulted after reading this article.
[43] *Ibid.*, p.143.

West African yellow fever was indeed different to South American yellow fever, then the IHB may have to develop a new basis for control measures, a costly and time consuming undertaking. On the other hand, it would be highly embarrassing for the RF if Noguchi was wrong; both academically and in the context of its use of an ineffective vaccine. Russell ordered that the data was not to be published, nor mentioned at scientific or public meetings. Even the "Annual Report of the Commission" played down the discovery.[44] Noguchi himself was reticent about dealing with the issue. He preferred to suggest that the failure to find his spirochetes may indicate that the disease was different in West Africa than South America, rather than admit that they were not the causative agent of yellow fever. He refused to work with the Commission to settle the matter, arguing his other research took precedence.[45]

In response, the IHB decided to focus on the search for a susceptible animal. The Commission had failed to maintain infection in guinea pigs, Noguchi's preferred animal model. It needed to find an animal susceptible to West African yellow fever in order to maintain a strain of infection in a laboratory, thereby facilitating research. Klotz, Russell and the Commission deemed this crucial for future efforts in the region.[46] It would allow them to investigate the causative organism: a central factor to the development of control methods. It would also help clarify if the disease on the two continents were the same, either confirming or refuting Noguchi's work. The RF was now committed to remain in West Africa to undertake further scientific studies and postponed eradication efforts.

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[44] "Annual Report of the Commission, 1926", p.25. B214, SS495, S3, RG5. RFA, RAC.
[45] Klotz, "Diary Notes, 1926", p.296. MS 144, vol.I. Thomas Fisher.
[46] See W.F. Bynum, " 'C'est un malade': Animal Models and Concepts of Human Diseases", *Journal of the History of Medicine and Allied Sciences* 45 (1990), pp.397-413 for a history of the use of animal models in medical research.

The RF's situation in West Africa had changed. It now pledged itself to expanding and intensifying scientific research of a fundamental nature and delayed implementing control efforts which had been part of its original eradication ambitions. The Commission's new research ventures met with success in 1927 with the discovery of a susceptible animal: the *Macacus rhesus* monkey. Able to maintain a strain of infection in this animal, the Commission was then able to determine the causative organism in yellow fever, as it occurred in West Africa, as a filterable virus. Noguchi travelled to West Africa at the end of that year in an attempt to boost his flagging reputation, as Klotz commented: "to pick some of the plums remaining to offset his mistakes in South America".[47] It is unclear what Noguchi intended to achieve. Did he hope to find spirochetes, thus redeeming his theory, or perhaps provide further elucidation on the nature of the virus? As all the work conducted by the Commission revealed that the disease in West Africa was identical to that in South America, except for the absence of *Leptospira icteroides*, this organism's role in yellow fever was looking unlikely. Noguchi had only been with the Commission a month when Beeuwkes reported to Russell that his colleagues were convinced that yellow fever on the two continents were indeed the same, rendering Noguchi's spirochete invalid.[48] He certainly proved difficult to work with as well as unpopular. Klotz described a terrifying picture of his sloppy and haphazard procedures.[49] Despite access to vast numbers of monkeys (running into the thousands) and infected blood, Noguchi failed to produce results similar to those obtained by other members of the Commission and

[47] Barrie, "Diary Notes on a Trip to West Africa", (1997), p.153.
[48] Beeuwkes to Russell, 22.12.1927. F3890, B306, S1.2, RG5. RFA, RAC.
[49] O. Klotz, "Diary Notes on a Second Trip to West Africa in Relation to a Yellow Fever Expedition Under the Auspices of the Rockefeller Foundation, 1928", pp.156-160. MS 144, vol.II. Thomas Fisher.

his *L. icteroides* proved highly elusive. However, Noguchi died of yellow fever in May 1928 before he or anyone else could reach any definitive conclusions from his experiments in West Africa. That year, Klotz returned to New York with a virulent strain of the virus isolated by the Commission in West Africa. Consequent tests in the RF's New York laboratory proved that West African yellow fever and South American yellow fever were the same disease, and that Noguchi's spirochetes were unrelated to the disease. S.S. Koide provides a different interpretation of Noguchi's role in these events, presenting the researcher as a hero whose efforts "benefited humanity".[50] He insinuates that Noguchi was instrumental in confirming the virus as the causative organism. Despite the congratulatory tone of the account, Koide does allude to the dangerous nature of Noguchi's methods, mentioned by Klotz.

The Commission had achieved the most crucial of its original objectives: it had determined the causative organism and confirmed its relationship to South American yellow fever. However, in agreement with the IHD, it considered that additional investigations were necessary before the RF could instigate anti-yellow fever measures. It had not entirely abandoned its eradication/control aspirations, although its attitude on this issue was becoming more tentative. Beeuwkes recognised that the co-operation of colonial governments and the Colonial Office was essential if the RF was to implement control measures. The key to obtaining this was to map the endemic area, and demonstrate a wide incidence among the indigenous population. Discussing the possibility of endemicity in Ibadan, Beeuwkes commented to Russell:

> I do not think that the government could be interested in undertaking an intensive control campaign in that area under present conditions,

[50] S.S. Koide, "Hideyo Noguchi's Last Stand: The Yellow Fever Commission in Accra, Africa (1927-8)", *Journal of Medical Biography* **8** (2000), pp.97-101.

> but if our epidemiological, clinical and laboratory researches, which I am anxious to undertake there, demonstrate the presence of the disease among the natives, they will be more receptive to it.[51]

With this in mind, the Commission maintained its efforts in the field, in addition to conducting laboratory work on the virus. It continued to perceive yellow fever as being amenable to epidemiological techniques such as tracing cases and taking histories. The next two years saw extensive surveys in parts of Nigeria using these methods. It re-established the field station in Ibadan, which it had originally opened in 1925, and subsequently closed. Researchers investigated epidemics in Senegal, the Belgian Congo and throughout Nigeria in attempts to find pathological material and epidemiological data. It also used scouts extensively. These efforts signify a labour intensive methodology, relying on personal contact and sometimes tedious investigations, travelling vast distances to locate cases and secure data about past incidence. As Beeuwkes wrote:

> Field work is difficult; the investigator must learn how to secure the co-operation of the white man and how to overcome the fear and suspicion of the black, and how to instil interest in the medical men in the area in which he is working. Problems in differential diagnosis confront him daily, and their solution frequently requires fine judgement and intimate knowledge of yellow fever and of the various diseases which occur in the section in which he is working.[52]

[51] Beeuwkes to Russell, 16.03.1928. F6, B1, S495, RG1.1. RFA, RAC.
[52] Beeuwkes to Russell, 29.08.1929. F7, B1, S495, RG1.1. RFA, RAC.

That they were willing to work in such difficult conditions demonstrates their commitment to research.

The Commission also tried to identify yellow fever by placing susceptible monkeys in areas under observation to act as sentinels for infection. The animals were paired in unscreened cages and their health monitored. The appearance of yellow fever among the monkeys would demonstrate its presence in the area. This method, although innovative, proved unsuccessful and was not implemented on a large scale.[53]

By 1930, the commitment to field work began to wane and the Commission increasingly perceived its work on yellow fever in the context of basic biomedical research and laboratory based epidemiological studies, rather than research preliminary to control efforts, ushering in the third phase.

Phase three: the end of eradication ambitions

By 1930, the Commission had solved most of the questions preliminary to initiating control work. It had shown that yellow fever existed in the region and was identical to South American yellow fever. It had identified other mosquito vectors of the disease which researchers considered susceptible to *Aedes aegypti* control measures. It had demonstrated a large endemic area in Nigeria along with others in the Gold Coast, and Senegal. However, there is evidence that the Commission and the IHD were becoming increasingly hesitant about initiating anti-yellow fever work in West Africa. At the start of 1930, Beeuwkes asked Russell for his opinion on the possibility of initiating control measures. He argued: "I feel that though many

[53] "Annual Report of the Commission, 1929", p.11. B219, SS495, S3, RG5. RFA, RAC.

problems in connection with yellow fever in West Africa remain unsolved I do not think that their solution will materially change the general situation". He went on to reveal his doubts:

> Personally, I do not recommend that an attempt be made to exterminate yellow fever from West Africa unless the British are decidedly interested in the proposition and willing to co-operate technically and financially for the following reasons: it would involve enormous expense, the difficulties would be far greater than in Brazil and we would have no way to check results.[54]

The latter point referred to the low number of cases actually encountered by the Commission, which would make a very difficult yard stick to monitor the progress of any campaigns. It could potentially rob the RF of a visible display of its success against the disease. He dwelled on this aspect later in the year, stating: "I know of no part of the world where money could be used to greater advantage, where more could be accomplished but where one would get less credit for what was done than in Nigeria".[55]

Russell's response to Beeuwkes's request was equally reticent, ruling out the possibility of eradication, but not entirely dismissing ideas of control. He suggested that efforts could be made in ports to reduce mosquito breeding by improving water supplies and promoting efficient inspection of breeding sites, yet he did not say who would be responsible for implementation or costs. He expressed doubts of the efficacy of introducing anti-mosquito methods in non-coastal towns similar to those the IHD conducted in South America, although did mention the possibility of conducting a

[54] Beeuwkes to Russell, 06.01.1930. F9, B1, S495, RG1.1. RFA, RAC.
[55] Beeuwkes to Russell, 28.04.1930. F9, B1, S495, RG1.1. RFA, RAC.

study into the issue. He made it clear that only RF expertise, rather than RF finance, would be available: "I doubt, however, if we would care to pay very much, at any rate, of the cost of routine control measures that may be adopted".[56]

Beeuwkes's question came at a critical juncture in the RF's efforts against yellow fever. The disease's re-emergence in South America, and the appearance of rural cases, contrary to the key centre theory, had dashed the RF's optimism over its eradication efforts in that region. These events changed the RF's overall perceptions of yellow fever. It ceased to consider the disease eradicable in South America; instead believing that only control was now possible. The refutation of the key centre theory was a serious blow to the RF for it denied it the quick fix, technical solution to yellow fever. Instead, it left the organisation with the option of abandoning all efforts against the disease, or revising its approach in favour of more extensive and costly campaigns. The RF's new pessimistic view of yellow fever in South America extended to its view of the disease globally, as events in West Africa strongly suggest. This had an undeniable effect on ambitions for West Africa. From the Commission's inception, members of the IHD acknowledged that eradicating the disease from West Africa would be considerably more difficult than in South America. With the collapse of efforts in South America, the idea of eradication in West Africa became untenable. Thus, Cueto's framework of the RF's changing concepts of eradication: his "cycles of eradication", can also be applied to its efforts in West Africa. This effect was demonstrated in 1928 when Beeuwkes expressed his fears about the possible impact of events in South America on the Commission's efforts in West Africa. However, at this time, Russell dismissed his concerns.[57]

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[56] Russell to Beeuwkes, 07.02.1930. F9, B1, S495, RG1.1. RFA, RAC.
[57] Beeuwkes to Russell, 29.08.1928; and Russell to Beeuwkes, 05.10.1928. F7, B1, S495, RG1.1. RFA, RAC.

Russell was not alone in expressing a preference for small scale control over eradication. Sawyer in New York, agreed that control was the most viable option in West Africa. He proved to be a sympathetic audience to Beeuwkes's fears about the implications of events in South America for work in West Africa, commenting: "A scheme for eradication should not even be discussed until we understand the epidemiology better in South America and Brazil".[58] Interestingly, Russell did not allude to the situation in South America in his response to Beeuwkes's inquiry about the Commission's future, perhaps suggesting that, unlike Sawyer, he was reluctant to publicly acknowledge its ramifications for West Africa.

Russell outlined an additional plan for control in West Africa, giving further demonstration of his penny pinching attitude towards West Africa. Piped water supplies, he advocated, were the key to reducing mosquito breeding, in particular if made widely available to the African population. However, he was unprepared to commit any RF money to the project, making the rather miserly offer of an engineer with expertise in water supplies.[59] This serves as a direct contrast to the IHD's earlier yellow fever campaigns in South America where the RF commonly provided the bulk of the funding in return for total administrative and technical control. Deaf to Beeuwkes's arguments about the inadequate resources of the colonial governments, Russell refused to capitulate and provide the financial assistance Beeuwkes claimed was critical for the development of piped water supplies. Perhaps events in South America finally swayed him, or he considered that the colonial authorities were too great a barrier; the outcome was the same. In 1930, Russell sealed the fate of the RF's control ambitions in West Africa:

[58] Wilbur A. Sawyer, Director of the IHD's Laboratory Service and the yellow fever laboratory in New York, to Beeuwkes, 07.02.1930. F9, B1, S495, RG1.1. RFA, RAC.
[59] Russell to Beeuwkes, 05.04.1930. F9, B1, S495, RG1.1. RFA, RAC.

> So far as I can see very little progress in the control of yellow fever in the natives (which is after all the whole problem) is possible until something can be done which will prevent storage of water in and about native houses. Until therefore the colonial authorities are convinced of the necessity of adequate water supplies for native towns I do not see that there is anything that we can do.[60]

Thus, the RF abandoned its plans for control, and its perceptions of and responses to yellow fever in West Africa began a new phase. It once regarded the disease to be eradicable, then controllable, and finally reduced its evaluation to unmanageable. However, this was not the end of the Commission. It remained in West Africa for a further three years conducting research that was of little direct benefit to the region. The nature of its work altered accordingly, changing from a combination of field and laboratory studies preparatory to control measures to a concentration on basic science and epidemiology alone. Entomological studies were maintained with a particular concentration on the mechanisms of the virus' transmission. Laboratory research into the nature of the virus, which had been ongoing since its discovery in 1927 continued. This dwindled during 1931 when laboratory based epidemiological studies began to dominate the Commission's activities. Quite simply, the Commission became more important to the RF as an instrument of scientific research on yellow fever, than as a preliminary investigation for devising yellow fever control methods. The disease in West Africa became solely a subject of scientific study, rather than as a phenomenon to be eliminated or controlled.

[60] Russell to Beeuwkes, 09.07.1930. F9, B1, S495, RG1.1. RFA, RAC.

As already discussed, events in South America were critical to the transformation of the Commission's aims and direction. The resulting pessimism about the RF's ability to eradicate the disease in that region fed into perceptions of the disease in West Africa. There were several other concurrent factors which brought about the Commission's shift. The first was the availability of new laboratory techniques, which enabled new productive research ventures. The second was Russell's predilection for basic biomedical research. The third was a recognition within the IHD that West Africa was a convenient site for scientific research, providing valuable resources for experimentation. As a result of these factors, the Commission's work became firmly sited in the laboratory, as efforts in the field dwindled.

The discovery of a susceptible animal and the consequent isolation of the yellow fever virus in the laboratory, first achieved by the Commission in 1927, were critical to this transformation. Experimental infections permitted the manipulation of the disease within the laboratory, making scientific investigation in West Africa easier, especially considering the scarcity of cases encountered. It also made scientific research more productive, thus justifying the move towards research, where clear gains could be made. A number of developments resulted directly from this work including a diagnostic test for the virus, and an effective vaccine. The diagnostic, or monkey protection test, proved to be of particular significance as it provided information on past yellow fever infection and immunity. Blood from a suspected convalescent was injected into a monkey, which was then infected with the virus. If the animal survived, then the test was positive: the blood was said to contain immune bodies which protected the animal.[61]

The Commission acknowledged the test's potential value to its efforts, claiming that: "It seems like a reliable diagnostic measure, valuable in confirming positive cases, and especially in excluding the numerous conditions associated with jaundice which are commonly seen in the natives of West Africa".[62] The Commission began small scale surveys throughout 1928 and 1929, using the monkey protection test to assist in mapping the endemic area: one of its original goals. However, its limitations for widespread application quickly became obvious: "the test is cumbersome, time consuming and requires large numbers of animals".[63] This prevented the Commission extending its surveys further, and ensured that epidemiological field investigations continued to use reliable but labour intensive methodologies reliant upon clinical diagnosis and retrospective reports and histories.

However, in 1930, RF researchers in New York refined the monkey protection test. Mice replaced monkeys as the susceptible animal, making its widespread application practical.[64] The mouse protection test created a new dimension to yellow fever control by ushering in the new dynamic techniques of immunology and virology. There had been considerable breakthroughs in understanding anti-bacterial and anti-viral immunity since the turn of the century, and

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[61] A. Stokes, J.H. Bauer and N.P. Hudson, "Experimental Transmission of Yellow Fever to Laboratory Animals", *American Journal of Tropical Medicine* **8** (1928), pp.103-164.
[62] "Annual Report of the Commission, 1928", p.6. B215, SS495, S3, RG5. RFA, RAC.
[63] *Ibid.*, p.7.
[64] Max Theiler of the Harvard Department of Tropical Medicine made the original discovery of mouse susceptibility to yellow fever. See M. Theiler, "Neutralisation Tests with Immune Yellow Fever Sera and Strain of Yellow Fever Virus Adapted to Mice", *ATMP* **25** (1931), pp.69-77. His findings were modified by Sawyer and Wray Lloyd at the IHD's yellow fever laboratory in New York, who developed the consequent mouse protection test. See W.A. Sawyer and W. Lloyd, "Use of Mice in Tests of Immunity Against Yellow Fever", *Journal of Experimental Medicine* **54** (1931), pp.533-555.

provided a new basis for the control of several diseases. In 1895, Alexandre Yersin produced a vaccine which protected animals against the plague, to be followed by Waldemar Haffkine's work on the same disease; an anti-typhoid vaccine was used successfully in World War One.[65] The RF's work on yellow fever immune bodies occurred concurrently with developments on other viruses, such as typhus fever and measles.[66]

The mouse protection test was to have considerable implications for the Commission's work, effecting radical changes that the monkey protection test suggested but failed to realise, because of its limitations. Using mice made the test amenable to large scale use, even in an environment as trying to scientific research as West Africa. It rooted the efforts of the Commission firmly in the laboratory, away from the field. After all, why use bothersome and tiring field methods when a simplistic laboratory test can tell all that is required? Blood serum was all that was then needed from the field. As A. Cunningham argues, using plague as a case study, the availability of laboratory diagnosis transformed the identity of diseases and responses to them. He claims that the rise of bacteriology created a central role for the laboratory which transformed and dominated understandings of infectious disease.[67] His analysis provides a useful, if restricted, framework for yellow fever in West Africa. When the causal agent of plague was identified and isolated in the laboratory, it ensured that the disease would never be diagnosed solely on a clinical basis again. A

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[65] P. Weindling, "The Immunological Tradition", in W.F. Bynum and R. Porter, (eds.), *Companion Encyclopedia of the History of Medicine* (London: Routledge, 1993), p.198.
[66] See *ibid.*, for an overview of immunological developments during this period, and P.M.H. Mazumdar (ed.), *Immunology, 1930-1980: Essays on the History of Immunology* (Toronto: Wall and Thompson, 1989).
[67] A. Cunningham, "Transforming Plague: The Laboratory and the Identity of Infectious Diseases", in A. Cunningham and P. Williams (eds.), *The Laboratory Revolution in Medicine* (Cambridge: Cambridge University Press, 1992), pp.209-244.

laboratory diagnosis would always be sought to verify what the symptoms suggested.[68] The mouse protection test offered similar confirmation for a diagnosis of yellow fever, which suffered from a notoriously unreliable and problematic clinical identification. However, as H. Bell has accurately noted, there were crucial differences between plague and yellow fever imposing limitations on the application of Cunningham's case study, particularly regarding yellow fever in the Anglo-Egyptian Sudan. The practical difficulties of isolating the yellow fever virus in the region meant that diagnosis of the disease continued to depend heavily on clinical means and post-mortem analysis, despite the availability of a laboratory test. She also contends that although the mouse protection test was conducted in a laboratory, it still relied ultimately on an examination of symptoms in the animal infected with the virus, as microscopic identification of the virus was not then possible.[69]

Although of limited practical application for CMS dealing with current cases, the mouse protection test did transform retrospective diagnosis. Cunningham's arguments may be accurately applied within this context with specific reference to the RF in West Africa. The test relocated the epidemiological work of the Commission, i.e. determining the endemic area, from the field to the laboratory. This fortunate development coincided with a request from the OIHP to the RF at the end of 1930. Concerned with the potential for increased air traffic to spread disease, particularly yellow fever, the OIHP asked the RF to conduct large scale surveys across Africa to determine endemic areas. This data was to assist the OIHP to draft effective air transport regulations to protect public health.[70] Thus, the mouse protection test

[68] *Ibid.*, p.241.
[69] H. Bell, *Frontiers of Medicine in the Anglo-Egyptian Sudan, 1899-1940* (Oxford: Clarendon Press, 1999), p.166.
[70] *Ibid.*, pp.169-170.

provided the means, and the OIHP the reason, for the Commission to retreat from the field and into the laboratory for the remainder of its work.

Looking at the RF's anti-yellow fever campaigns in Brazil, I. Löwy gives a useful definition of the "field" and the "laboratory". She argues that the RF produced two accounts of its anti-yellow fever efforts in Brazil during the 1920s and 1930s: one that centralised the laboratory and the other, the field. The former focused on the RF's transformation of the virus within the laboratory, the latter on the eradication of the mosquito vector.[71] She provides a fascinating analysis of narratives produced by both the laboratory and field, yet it is her definition of the two spheres that is of particular interest here:

> "Laboratory" does not denote only the space where specialized researchers work but stands for the entire material and social culture of biomedical science, and includes far-reaching ramifications. "Field" is not only the geographical area covered by epidemiologists' observations but the entire domain of intervention of the public health worker *cum* politician, an indissociable mixture of scientific studies, manipulation of the nonhuman environment, and social engineering.[72]

These categories can be accurately applied to the Commission's work in West Africa. Löwy argues that the two activities occurred concurrently in Brazil, producing two narratives. This was also the case with the Commission's work in West Africa until 1931, which involved a combination of laboratory research and investigative studies in

[71] I. Löwy, "Epidemiology, Immunology and Yellow Fever: The Rockefeller Foundation in Brazil, 1923-1939", *Journal of the History of Biology* **30** (1997), pp.397-417.
[72] *Ibid.*, pp.413-414. See also O. Amsterdamska, "Standardising Epidemics: Infection, Inheritance, and Environment in Prewar Experimental Epidemiology", in I. Löwy and Y.P. Gaudilliere (eds.), *Transmission: Human Pathologies Between Heredity and Infection* (London: Harwood, forthcoming), for an analysis of experimental epidemiology which epitomised the prioritisation of laboratory methods. I would like to thank Helen Power for this reference.

the field, in particular to map the endemic area. However, this changed with the large scale use of the mouse protection test, which swung the activities of the Commission away from the field and into the laboratory. Throughout 1931 and 1932 there was a distinct difference in the work conducted by the Commission. Entomological studies of mosquito vectors continued as before, conducting experiments in the field and the laboratory. However, the Commission discontinued traditional field epidemiology and replaced it with a vast extension of protection test surveys. The application of the mouse protection test allowed it to greatly intensify the survey of the endemic area in southwestern Nigeria, carry the study through the majority of the Protectorate and to a lesser extent in the northern and southern parts of the Gold Coast.[73] Members of the Commission or MOs took blood samples which they forwarded to the Commission's laboratory in Lagos. Staff either tested the blood there, or sent to the IHD's yellow fever laboratory in New York for analysis.

Although mapping the endemic area was one of the Commission's constant objectives as a precursor to initiating control measures, the mouse protection test and the consequent extension of surveys did not lead to a revival of this goal. The OIHP's request for surveys cannot be regarded as a control measure. This was purely to map out the endemic area, providing information for new air regulations and preventing the spread of the disease across international borders, not reduce incidence in individual colonies or nations. Russell, the IHD and the Commission remained firm in their anti-control stance for West Africa. Indeed, Beeuwkes even doubted the value of delineating the endemic area using protection tests to any future practical control initiatives. He questioned the uncertain nature of some of the results: a positive result

[73] "Annual Report of the Commission, 1931", p.4. B215, SS495, S3, RG5. RFA, RAC.

did not necessarily indicate endemicity but may have resulted from an epidemic. He also expressed scepticism that surveys of different colonies would: "be followed by the initiation of necessary sanitary measures to effect their elimination or control or even to materially influence the picture. Certainly little is being done in southwestern Nigeria".[74] This contrasted with the high profile the IHD and the Commission gave to discovering the endemic area. Beeuwkes was dismissive of colonial efforts. The advent of mouse protection tests placed the Commission's methods firmly in the laboratory. It reinforced the move away from control efforts as it provided a means of conducting productive research with the promise of definite achievements: something control campaigns were failing to deliver in South America.

The personality and methodological preferences of Russell, as Director of the IHD, proved equally important to the Commission's shift. Russell was an advocate of scientific research, in contrast to the IHD's previous Director, Rose, who was a strong believer in practical measures. R.B. Fosdick outlined the principal differences between the two: "Russell had scientific experience and judgement, and he was at home in the laboratory; Rose was a philosopher with brilliant administrative gifts and a hard core of practical sense".[75]

Russell's commitment to laboratory science was felt soon after he became Director in 1924, boosting the IHB's laboratory services and arguing for their value. However, as J. Farley contends, yellow fever provided him with the opportunity to extend the role of the laboratory in the IHD beyond previous experience. Farley identifies the re-emergence of yellow fever in Rio in 1928 as the critical juncture: "At

[74] Beeuwkes to Russell, 18.07.1932. F11, B2, S495, RG1.1. RFA, RAC.
[75] R.B. Fosdick, *The Story of the Rockefeller Foundation* (London: Odhams Press, 1952), p.61.

this point Russell could have accepted the status quo, and continued with control work against the yellow fever vector in Brazil and West Africa, backed up now by two important field laboratories, but that was not to be".[76] Instead, Russell pushed for the creation of a central yellow fever laboratory in New York which, according to Farley, demonstrated the significance Russell placed on fundamental research as opposed to field related laboratory investigations. However, Russell pushed for even greater dominance of the laboratory within the IHD, moving away from its original ethos of using disease campaigns as a means of developing local and national health services, towards advancing knowledge of given diseases, relying increasingly on laboratory based science. In 1928, he argued that too many men in IHD campaigns were occupied with administrative and control work and that the IHD must conduct its future work imbued with the "scientific attitude of mind, that is the spirit of enquiry and the desire to increase knowledge".[77]

His strong inclination towards scientific research and away from practical control measures had an undoubted effect in West Africa as well as the United States. As the Director of the IHD, Russell had ultimate control of the Commission's work; Beeuwkes consulted him fully regarding the current and future directions of work. Russell was quite clear about the value he gave to protection tests, indicating his predilection for laboratory methods. In 1930 he declared that it was the most important undertaking of the Commission: "the results are clear-cut and from the knowledge gained we will avoid spending either ourselves or having the government spend large sums of money in the future".[78]

[76] Farley, "The International Health Division", (1995), p.213.
[77] *Ibid.*, p.213.
[78] Russell to Beeuwkes, 07.02.1930. F9, B1, S495, RG1.1. RFA, RAC.

He tried to convince Beeuwkes of the potential benefits to West Africa from concentrating on scientific research on the disease, rather than beginning control efforts. Beeuwkes remained somewhat resistant to his attempts. He was swayed by his experiences of the practical realities of yellow fever control in that region, and the severe financial restrictions placed on the CMS; a factor for which Russell had little appreciation. Russell argued that additional research could potentially save money, citing the RF's campaigns against hookworm as an example: "What made the difference in the cost and efficiency of hookworm work was additional knowledge from further research which showed that many of the things we were doing was really unnecessary".[79]

His yellow fever laboratory in New York was a further contribution to the Commission's interest in fundamental scientific research. The two groups proved to be mutually reinforcing, the work of one substantiating the value of the efforts of the other, confirming the significance of basic biomedical research in the IHD's endeavours against yellow fever. The Commission discovered an animal susceptible to the disease, enabling the manipulation of the virus in the laboratory, both in New York and Lagos. It also provided the strain of the virus, (known as the Asibi Strain) which researchers used for the development and manufacture of the vaccine produced in the New York laboratory.[80] The New York laboratory, in turn, developed the mouse protection test which the Commission used to map the endemic area in West Africa. New York personnel also analysed a proportion of sera samples collected by the Commission.

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[79] Russell to Beeuwkes, 09.07.1930. F9, B1, S495, RG1.1. RFA, RAC.
[80] W.A. Sawyer, S.F. Kitchen and W. Lloyd, "Vaccination Against Yellow Fever with Immune Serum and Virus Fixed for Mice", *Journal of Experimental Medicine* 55 (1932), pp.945-969.

The value of basic scientific data produced by the Commission since 1925 undoubtedly reinforced the move towards establishing the centrality of the laboratory. Its elucidation of the causative organism, the discovery of a susceptible animal, the maintenance of a strain in the laboratory, all proved highly useful in the IHD's efforts in South America, although the IHD did not apply them practically in West Africa. There is evidence to suggest that the IHD considered much of the Commission's work to be of either academic interest in helping to understand the disease, or of practical value to anti-yellow fever campaigns in South America. As the Commission was winding down in 1933, Sawyer wrote:

> The work of the commission has been most successful as a scientific study. Our experiments in control can be continued on a large scale in Brazil. Ultimately there may come out of this something practical on Africa. In the meantime the revelations regarding the epidemiology and distribution of yellow fever in Africa have kept us from making many mistakes.[81]

When the complexities of yellow fever began to emerge in 1928, and the IHD's desire to instigate control campaigns in West Africa was wavering, it may have developed a new perception of West Africa itself: that of a convenient site for scientific research. There were many advantages in conducting yellow fever research in West Africa. A large endemic area that promised, although in reality infrequently provided, large numbers of infected people: a source of valuable pathological and

[81] Sawyer to Beeuwkes, 22.09.1933. F13, B2, S495, RG1.1. RFA, RAC.

clinical data. The protection test also revealed previous sufferers whose blood contained precious immune serum: an essential ingredient in early inoculation techniques. The IHD experienced considerable difficulty in obtaining this in the early 1930s and tried to impress upon the Commission the importance of securing reliable supplies. Sawyer expressed dissatisfaction with current methods of procuring sera and hinted at the cost: "We are still depending entirely on members of staff with histories of recent attack or vaccination and are paying those below staff grades at the rates to professional donors".[82] West Africa had an established medical system operated by relatively friendly and co-operative colonial governments which permitted and indeed facilitated the Commission's access to the population. In one instance, the Commission debated the most extreme use of the local population: human experimentation. This came at a particularly low juncture in the Commission's history, before the discovery of a susceptible animal, when staff were desperate for results. Russell and Beeuwkes tentatively discussed the possibility in New York, and informal discussions between the Commission and the CMS in Nigeria found the latter willing, as Beeuwkes reported:

> Dr Alexander seemed favourably inclined to human experimentation. He does not believe that the Government would ever permit the use of condemned criminals, but seemed to feel that there would not be particular difficulty in securing volunteers in some area removed from endemic zones. I mentioned that though I feel that experiments of this kind might prove extremely valuable, there are nevertheless numerous pitfalls.[83]

[82] Sawyer to Beeuwkes, 25.08.1932. F25, B3, S4, RG5. RFA, RAC.
[83] Beeuwkes to Russell, 08.09.1927. F3887, B306, S1.2, RG5. RFA, RAC.

Fortunately, researchers found a susceptible animal and the issue went no further. Humans were not the only useful resource available to the Commission in West Africa. The region also had an abundance of vectors for study and experimentation. The RF could apply the knowledge gained from all the Commission's investigations to programmes being conducted in South America where it had direct economic interests.

The RF did not use any of the research conducted in West Africa to the benefit of the region, and the RF did not initiate or contribute to any control campaign in West Africa, although it did provide some funds for health work in Nigeria when it left the colony. A.E. Birn provides a parallel instance of the RF using an area's resources for the benefit of a different region. She argues that the RF used Mexico as convenient site for malaria research in the 1930s and 1940s, yet had no interest in controlling or eradicating the disease in that region, or being involved in any anti-malaria campaign there. She claims that the RF chose Mexico as a locale for research which the Foundation could then apply to anti-malaria campaigns elsewhere. This also enabled the RF to pursue its goal of committing Mexico to modern, western medical systems.[84] However, there is an important difference between the yellow fever case study in West Africa, and Birn's example. The RF had no intention of pursuing control efforts against malaria in Mexico. In West Africa, eradication was a clearly stated aim at the start of the Commission's work. Despite this, its laboratory work, which predominantly investigated the fundamental problems of the disease rather than devising control methods, became most useful to the RF. Once the Commission had

[84] A.E. Birn, "Eradication, Control or Neither? Hookworm vs Malaria Strategies and Rockefeller Public Health in Mexico", *Parassitologia* 40 (1998), p.147.

exhausted West Africa's research potential, it would decamp and move on. This was certainly the future envisaged by Russell in 1930:

> The yellow fever work on the investigative side has been extremely successful, but the time will come when the problems which are possible of solution by laboratory investigation will have been exhausted and when that time does come I suppose that there is nothing to do except to close the laboratory and come home.[85]

Russell's vision came true in early 1934 when the Commission finally closed. By then the RF had its eye on other areas, as Sawyer commented to Russell: "The survey of West Africa has been most instructive. I agree with your views regarding the limited value of continuing intensive work in Nigeria. There are other regions of Africa in which the same efforts would probably give greater results at present".[86] The RF achieved this in 1936 when it opened the Yellow Fever Research Institute at Entebbe, Uganda, in East Africa.

The presence of the Commission provided West Africa with little of practical, direct use. It did not undertake any control work, its studies and surveys, although of value to the scientific community did not materially alter the yellow fever situation in West Africa. This deficit suggests that despite its original good intentions, the RF came to regard and treat West Africa as a convenient location for research. Arguably, the Commission did stimulate some interest in the disease among the CMS in the region, but in reality, yellow fever did not threaten health to the same extent as diseases such as malaria. Moreover, by the 1930s, the colonial governments had branched out into indigenous health in areas such as maternal and infant welfare rather

[85] Russell to Beeuwkes, 09.07.1930. F9, B1, S495, RG1.1. RFA, RAC.
[86] Sawyer to Russell, 25.08.1932. F11, B2, S495, RG1.1. RFA, RAC.

than concentrating on specific diseases. Yellow fever never garnered colonial medical attention to the scale the IHD felt necessary. However, the IHD did attempt to leave some useful legacy after its departure. Its members in New York and West Africa were keen to leave the Lagos laboratory in the hands of the CMS in Nigeria for them to continue, albeit in a limited fashion, diagnostic and investigative work. The Commission trained a colonial MO in yellow fever virus techniques with this end in mind. W.B. Johnson, Director of the CMS in Nigeria doubted that it would be possible to conduct research but suggested that the laboratory be used for diagnosis and vaccination.[87] The IHD agreed and gave Johnson £200 per annum from 1934 to 1936 for this purpose. The laboratory only ever conducted diagnostic work and Johnson complained that it received very few blood samples despite wide knowledge of the laboratory's existence among MOs.[88] This under-use suggests a disparity between the importance the RF and the CMS attached to yellow fever. In addition, Russell also agreed to help finance a number of sanitary and medical schemes operated by the CMS in Nigeria, many unrelated to the disease. These included the establishment of training centres for midwives and sanitary inspectors; assistance for the dispensary system; completion of farm colonies for leprosy sufferers; and research on schistosomiasis and guinea worm. The token yellow fever gesture was the establishment of "sanitary demonstration work" in the endemic area.[89] The RF agreed

[87] W.B. Johnson was born in 1885. He joined the WAMS in 1912, and was soon involved in yellow fever control when he was appointed as an investigator for the YFWAC in 1913. He was also seconded to the Tsetse Fly Investigation in Nigeria in 1921. He served as DMS for Nigeria, 1929-1936, when he retired from the WAMS. He continued his career in tropical medicine, becoming Medical Advisor to the High Commissioner for Basutoland, Bechuanaland Protectorate and Swaziland. He died in 1951.
[88] Memo dated 22.09.1934. F6, B1, S495, RG1.1. RFA, RAC.
[89] "Annual Report of the Commission, 1931", p.2. B215, SS495, S3, RG5. RFA, RAC.

to provide £14,750 of the total cost of £114,600: a far cry from a grand vision of eradicating yellow fever from West Africa.[90]

The British research effort

The RF's and the Commission's perceptions of, and responses to yellow fever in West Africa varied from those of the CMS. The RF considered yellow fever to be worthy of considerable attention in that region, whereas to the CMS it was simply one more disease amongst many, and by no means the most serious. The original intention of the Americans was to eradicate yellow fever, the British only ever aspired to control: a view the RF was eventually to share, and then totally relinquish. The RF also made serious efforts to delineate the endemic area, initially using laborious and time consuming methods until the availability of protection tests. The British had made no efforts in this direction since the tentative efforts of the YFWAC in 1916, before the advent of diagnostic immunity tests.

The British remained unconvinced of the validity of the key centre theory, and as the previous chapter discusses, preferred a broad approach to control using many anti-mosquito methods with general sanitary improvements. This serves as a direct contrast with the narrow approach used by the RF in South America, which concentrated purely on mosquito larvae destruction. The Commission's activities in West Africa were at variance with the efforts of the CMS. The main activity of the Commission throughout, regardless of intention, was research. The CMS rarely engaged in such work. As the failure of Johnson's endeavours in the Lagos laboratory

[90] RF inter office correspondence, memo to Mr Beal, dated 11.04.1931.

after 1934 suggested, there was little support for pure research within the services. The Commission actively sought out cases for investigation: the CMS simply dealt with those that were visible to them. The Commission also had the luxury of a specialist well trained staff backed by the vast financial resources of the RF. The CMS battled with limited budgets and staff, often hampered by an indifferent colonial administration.

However, the CMS did not solely represent British medical science in the empire. A number of other parties, with or without direct colonial affiliation, operated in the tropics, including missionaries, the military and several research bodies. A number of scientific groups worked in the region and provide an interesting contrast with the RF. The Alfred Jones Laboratory in Sierra Leone, and Findlay of the Wellcome Bureau of Scientific Research were involved with yellow fever during the period of the Commission's operation, thereby allowing a useful comparison. They conducted investigations of a kind similar to the Commission although on a considerably smaller scale, and represent limited British scientific research. Their work in West Africa was opportunistic in nature, rather than part of an organised, concerted effort. The involvement of the Alfred Jones Laboratory in particular occurred only when circumstances warranted or dictated; yellow fever was not part of any overall research agenda. Findlay proved to have a more consistent interest in the disease. However, it was more by chance rather than design that he conducted research in West Africa as part of collaborative efforts with the Alfred Jones Laboratory. In the strictest sense, this was outside the period covered in this chapter as it occurred the year following the Commission's departure, however, it is included here because it is particularly pertinent to this analysis.

The activities of the Alfred Jones Laboratory were limited: a general mosquito survey of Freetown and Kissy in Sierra Leone from 1930 to 1931 and studies of two separate epidemics in the Gold Coast in 1923 and the Gambia in 1934-35 (Findlay was involved in the latter). The laboratory's researchers conducted the mosquito survey along lines similar to the RF's, although did not limit it to *Aedes* mosquitoes. They searched rooms, collected, identified and tabulated any mosquitoes they found. As with the Commission's mosquito surveys, they noted the local environment and estimated the effects of recent sanitary improvements.[91] Unlike the RF, the laboratory used this to provide information only, rather than to directly assist in devising control campaigns. In 1923, at the behest of the Colonial Office, the LSTM despatched Maplestone from the laboratory in Freetown to investigate an epidemic in the Gold Coast and to collect useful pathological data. He experienced similar problems to the RF's staff two years later, and the British YFWAC nearly a decade before. He arrived to find that the epidemic was over and was unable to secure fresh pathological specimens or make clinical observations. He examined material that MOs had previously secured from patients.[92] That he too had difficulty in observing ongoing cases suggests that this was a universal problem in studying yellow fever in West Africa, and not just suffered by the RF alone. Interestingly, he made recommendations that both supported and rejected the RF's approach to the disease in the region. He submitted ideas for possible directions of research that partly reflected the RF's research priorities and the British medical community, as represented by the YFWAC

[91] R.M. Gordon, E.P. Hicks, T.H. Davey and M. Watson, "A Study of House Haunting Culicadae Occurring in Freetown, Sierra Leone; and the Part Played by Them in the Transmission of Certain Tropical Diseases, Together with Observations on the Relationship of Anophelines to Housing and the Effects of Anti-Larval Measures in Freetown", *ATMP* **26** (1932), pp.273-345.
[92] LSTM. TM 13/56/10/1. P.A. Maplestone, "Report on Investigations into Yellow Fever in the Gold Coast Colony", 1923.

in 1916. He too considered endemicity an issue requiring further elucidation. Unlike the RF, his recommendations did not concentrate on delineating the geographical area; instead they focused on possible reservoirs of infection. He asserted the need to determine if Africans did suffer a mild form of the disease, and whether animals formed a reservoir. Before this work could be undertaken, Maplestone contended that research had to determine the existence of Noguchi's spirochete in West African yellow fever cases: one of the Commission's priorities. However, he disagreed with the RF's type of research approach. He argued that a visiting commission was not the most suitable method to research the disease at that time, and instead advised that the staff of the Research Institute at Accra, operated by the colonial government, should be increased. He went on to recommend that these men should be provided with the fastest possible means of transport to allow them to study all suspected cases of yellow fever: something the Commission was to prioritise later. Only when they had collected sufficient data from these cases did Maplestone feel a commission should then be formed.[93]

This tentatively suggests that although the British were unable to conduct research of a nature and scale approximating the RF's Commission, at least some members of its scientific community aspired to some similar methodologies. The work of Findlay and Davey of the Alfred Jones Laboratory were able to put RF methods in practice during the 1934-35 epidemic in Bathurst in the Gambia. The pair were seconded to Bathurst at the request of the Colonial Office to begin an inoculation campaign (to be examined in chapter four) and undertake research. They toured the Protectorate conducting inoculations and collecting blood samples for mouse

[93] *Ibid.*, p.7.

protection tests. These would provide epidemiological data relating to the possible endemicity of the colony.[94] Again, this was a small scale in comparison to the Commission's work. It was an opportunistic piece of research conducted by Findlay who already had an interest in the disease. Neither this, nor the Alfred Jones Laboratory's earlier contributions, represent elements of any organised British research agenda. The British conducted nothing of this kind against yellow fever during the Commission's operation. Instead, the work just discussed represented sporadic research efforts. This critical contrast between the RF and the British medical community reflects the fundamental difference of their perceptions of the disease, with the RF considering it more significant as a topic of investigation than the British.

Conclusion

The RF's ambitions for yellow fever in West Africa underwent considerable revisions during the three stages of its operation. Its perceptions and responses to the disease proved fluid, altering in response to a series of developments. Initially, it regarded yellow fever as a globally eradicable disease, and experiences in South America, until 1928, seemed to confirm this view. Confident in the theoretical basis behind its campaigns, and in its staff's technical expertise, the RF turned its attention to West Africa, the region it considered the last bastion of the disease. The initial investigation in 1920 confirmed the RF's opinion that yellow fever was indeed eradicable. However, the problems encountered by the Commission undermined this confidence. The practical realities associated with medical work and research in West

[94] G.M. Findlay and T.H. Davey, "Yellow Fever in the Gambia. II. The 1934 Outbreak", *TRSTMH* 30 (1936), pp.151-164. See also correspondence in LSTM. TM 13/67/34-38.

Africa proved considerably more problematic than originally realised. Despite its strenuous efforts, the Commission met cases infrequently. However, it retained tentative ambitions for eradication until external factors forced a revision of its plans by 1930. The re-emergence of the disease in South America after 1928, together with recognition of jungle yellow fever and rural cases forced a shift in the RF's perception of the disease. Yellow fever became merely controllable, rather than eradicable.

Yellow fever's new status coincided with and reinforced a transformation of the RF's activities in West Africa. There, the Commission's role had become increasing concerned with fundamental scientific investigation rather than devising control methods. This trend began with the need to discover the causative organism and an animal model and continued with the development of the protection test. In accordance with the RF's new, more pessimistic view of the disease, the staff of Commission and the IHD exchanged various suggestions for controlling the disease in that region, but Russell was soon to dismiss notions of control. This made the scientific focus of the Commission undeniable: it was in West Africa for research only.

Delineating the endemic area was a fundamental strand of the Commission's work throughout its operation. This concentration suggests a significant difference between the perceptions of, and responses to the disease by British and the RF during the 1920s. Both expressed interest in the endemic nature of the disease in the region. As discussed in chapter two, they held differing views of its extent; the RF's assessment favouring a more limited endemicity than the majority of the British medical community. However, the British did little to delineate the endemic area prior to the availability of the mouse protection test in the 1930s. The Commission, however, made serious efforts to map these zones: it was one of its initial primary goals. Even before the advent of the diagnostic immunity tests, the Commission made substantial inroads towards this aim, using laborious and time consuming epidemiological methods. This implies that the RF believed the question of endemicity important enough to warrant considerable attention. Locating endemic zones was a central element to the basis of the RF's control campaigns, the key centre theory, which contended that only endemic zones required control measures. Even after events in South America made this theory redundant, the Commission continued to ascertain endemicity albeit with the simpler methodology presented by protection tests. The RF regarded endemic yellow fever as the central focus of its efforts in West Africa. The British, although aware of endemic yellow fever, concentrated anti-yellow fever measures on epidemic yellow fever. This highlights the limits of the CMS and British scientific research regarding the disease. It suggests either an inability or unwillingness to contend with endemic yellow fever. They responded only to the immediate danger presented by epidemic yellow fever with temporary measures. The RF, in contrast, had intended to take a more long term approach to the disease in West Africa, although it failed to realise these ambitions.

The different perceptions and methodology of the RF combined to create a unique chapter in the history of yellow fever efforts in West Africa. Fuelled more by its experiences in South America, the RF strove confidentially to bring its influence to medicine and yellow fever control in West Africa. In defeat, it shifted the nature of its activities in both South America and West Africa.

CHAPTER FOUR

IMMUNOLOGY: A NEW BASIS FOR CONTROL?

Finding the causative organism of yellow fever in 1927 facilitated immunological research and ultimately control. The RF exploited the discovery of the virus and two key developments resulted: the mouse protection test and an effective vaccine. These offered a new dimension in controlling the disease, particularly in its endemic form. Protection tests provided the means to map endemicity, highlighting areas in need of control. Inoculation equipped medical personnel with an effective prophylaxis, reducing the number of susceptible people, thus decreasing the risk of epidemics. This chapter seeks to explore how these new methods affected perceptions of, and actions against yellow fever in West Africa. The analytical focus will be predominantly on inoculation, as it commanded greater attention from the British colonial and medical communities. I will contend that the availability of inoculation raised controversial issues for the various providers of medical care and research groups involved in yellow fever, revealing their interests, preoccupations and priorities. Safety fears and notions of compulsion occupied the colonial and medical authorities. I will argue that a haphazard response characterised the issue of inoculation. The Colonial Office was unable to devise a long term strategy. It dealt with many of the contentious issues surrounding the new procedure with temporary solutions, and failed to formulate cohesive initiatives. This chapter stops at the outbreak of World War Two when wartime expediencies established different priorities for the use of protection tests and inoculation.

This chapter also explores the response of the colonial governments, the CMS, the LSTM and Findlay. The focus is predominantly British, but although its priorities have been reviewed in the preceding chapter, I will make an appraisal of some of the activities of the RF. As a major developer of vaccines, its efforts are relevant in this context. This analysis demonstrates consensus and conflict between the various participants, revealing that neither the medical community nor the colonial community were homogenous. This examination highlights the interaction of various groups, illustrating decision making by colonial authorities and medical communities in this period.

The chapter begins with an examination of the significance of protection tests in the context of control of endemic yellow fever. I outline the protection test surveys of the 1930s, and their implications for understanding endemic yellow fever in West Africa and the rest of the continent. The initial scepticism of members of the British medical community is explored, followed by the ramifications of its members' acceptance for notions of African immunity and the indigenous population as reservoirs of infection. I then focus on inoculation. It is misleading to refer to a single vaccine. Rather there was a process of development and refinement during the 1930s involving different research groups, resulting in several series of easy to manufacture, increasingly safe, vaccines. The application of inoculation is then addressed, beginning with its first large scale emergency use in the Gambia in 1935. Inoculation proved contentious and invoked concerns over safety and compulsory administration. These are examined in turn; assessing the reactions of the Colonial Office, colonial governments and the medical community in Britain and West Africa. The racial dimensions of inoculation are explored, followed by an appraisal of the transfer of inoculation to the colonies using D. Headrick's framework provided in *The Tentacles of Progress.*[1]

Protection tests

At the end of 1930, the OIHP asked the RF to conduct widescale protection test surveys in Africa, as part of international efforts to devise air transportation regulations.[2] These surveys made use of the mouse protection test. This detected past incidence of the disease by injecting blood serum and virus into susceptible mice. If the animal failed to develop yellow fever then the test was positive: the serum was held to contain immune bodies from a previous infection that had protected the mouse against the virus.[3] This technique did not detect immunity in humans per se, rather it tested whether antibodies from human blood serum were sufficient to allow mice to develop immunity to yellow fever. Therefore, although contemporaries often referred to this process as immunity tests or surveys, they actually represent attempts to detect past infection, rather than assess the strength of human immunity, although the two were interlinked. The RF and other members of the wider medical community believed that positive results in an area free of reported epidemics, or in age groups that would not have experienced epidemics, indicated endemicity. Hence protection test surveys became a means of locating endemic areas.[4]

[1] D. Headrick, *The Tentacles of Progress: Technology Transfer in the Age of Imperialism* (Oxford: Oxford University Press, 1988).
[2] W.A. Sawyer and L. Whitman, "The Yellow Fever Immunity Survey of North, East and South Africa", *TRSTMH* **29** (1935), p.397.
[3] See chapter three for the development of this technique.
[4] IHD personnel involved in the surveys acknowledged that it was sometimes difficult to distinguish between past infections caused by endemic yellow fever or epidemics. Therefore, they used survey results in conjunction with other clinical and pathological data to try to overcome this problem.

The IHD of the RF was at the forefront of these new technologies and deployed them in the field. From its base in Lagos from 1929, the RF's Commission had already begun a number of small scale independent immunity surveys, to determine endemicity using monkey protection tests in limited areas of West Africa. The OIHP's request led to a vast expansion of the RF's surveys in West Africa; happily coinciding with the development of a mouse protection test which enabled surveys to be conducted on a large scale. These surveys ushered in a new dimension of understanding of endemic yellow fever in Africa. They seemingly provided scientific "proof" for major epidemiological contentions held in one form or another since Boyce's investigations in 1910. They demonstrated that the disease was endemic in parts of West Africa: that the disease was present among the population, thus justifying the notion that the indigenous population acted as a reservoir of infection. Of equal importance they marked out endemic areas, highlighting regions in need of anti-yellow fever measures. Although British experts in tropical medicine had long debated the nature of endemicity (see chapter two), their involvement in these surveys was limited to Findlay's work, discussed in chapter three. Protection tests were not the only means of mapping endemicity. As previously discussed, the RF had attempted this in West Africa prior to the development of the test, but protection tests offered a more simplistic technique to delineate endemicity.

Beginning in Nigeria in 1931, the IHD began systematic surveys for the OIHP. Colonial medical personnel or Commission staff took blood which was tested in either Lagos or the IHD's yellow fever laboratory in New York. They drew samples from indigenous children and adults in groups of twenty five in selected urban and rural areas. They took care to select people who were permanent residents of the region by "painstaking and tactful questioning of each prospective donor".[5] The size of the survey varied enormously between colonies. The Gambia warranted scarce attention: only sixty eight people were tested in 1932 from two selected areas. The Gold Coast fared better. In a survey spanning three years, from 1930 to 1933, 861 people had blood drawn; 743 of which were children, from thirty five areas, with 168, or 19.51 per cent giving a positive result. In Sierra Leone, an area relatively free from recorded cases so far that century, the IHD tested 149 samples from five areas; ninety seven belonging to children. Only nineteen: 12.75 per cent tested positive for immune bodies. Nigeria was the site of the largest IHD survey in West Africa: unsurprising given the long and widely held belief that it contained several endemic zones. In a three year survey beginning in 1931, 121 areas were selected for investigation. Blood was taken from 5,607 people; again children dominated the sample with 3,149 tested. In total, 1,508 or 26.89 per cent gave a positive result.[6] Beeuwkes commented that results demonstrated that the disease was more prevalent in West Africa then previously believed. They were certainly incongruous with the opinion of the 1920 RF Commission that held its grip on the region to be precarious. However, they were not at odds with the views of the earlier British YFWAC, and the more extreme picture presented by Boyce.[7] The RF initially limited its surveys to West Africa: the western medical community considered yellow fever absent from the rest of the continent. However, the OIHP was anxious for the RF to extend the survey beyond the region, and thus testing began in Central, East and South Africa.[8] The IHD later expanded its

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[5] H. Beeuwkes and A.F. Mahaffy, "The Past Incidence and Distribution of Yellow Fever in West Africa as Indicated by Protection Test Surveys", *TRSTMH* **28** (1934), p.49.
[6] All figures from *ibid.*, p.48.
[7] See chapter two for a discussion of the varying notions of the extent of endemicity in West Africa.
[8] H. Bell, *Frontiers of Medicine in the Anglo-Egyptian Sudan, 1899-1940* (Oxford: Clarendon Press, 1999), p.170.

efforts to South America, Asia and even Europe, although the latter was in effect used as a control group to test the specificity of the technique.[9]

Surveys elsewhere in Africa gave results seemingly at variance with the accepted epidemiology. They consequently reported parts of Africa assumed to be free of the disease, as having residents whose blood gave positive results when tested, indicating a previous infection. In light of this, the RF researchers therefore considered such regions potentially endemic. In 1936, Sawyer and Whitman who were involved in several IHD surveys in Africa, concluded that a vast area of the continent contained yellow fever immunity in humans. This "region of immunity", they contended, represented an endemic area which extended eastwards from the coast of Senegal, across Africa to the White Nile in Anglo-Egyptian Sudan. The southern border followed the coast of the Atlantic Ocean from Senegal, encompassing Angola and the Belgian Congo. To present a more subtle definition, they divided the endemic area into two regions: west and east. In the former, which extended to the eastern border of Nigeria and the coastal regions of Nigeria and Angola, yellow fever also existed in epidemic form. In contrast, the eastern region had but one suspected epidemic case. This led them to argue that the disease in this region existed in endemic rather than epidemic form, although they did not rule out the possibility that epidemics occurred in a previously undiagnosed and unrecognised form.[10] This all-encompassing definition of endemic areas, based on protection test results was later echoed by R. Kirk, of the Sudan CMS who suggested:

> In the present state of knowledge, it is probably a wise precaution to regard the endemic yellow fever area in Africa as co-extensive with the

[9] See H.H. Smith, "Controlling Yellow Fever", in G. Strode (ed.), *Yellow Fever* (New York: McGraw Hill, 1951), pp.569-588 for details of the RF's surveys.
[10] Sawyer and Whitman, "Yellow Fever Immunity Survey", (1935), pp.411-412.

> area of immunity. Within the region thus defined conditions vary from place to place. The immunity rate is high in some places, low in others, and there are even places in which no immunes are found. Epidemics may occur, but with the possible reservations indicated above the region as a whole may be regarded as endemic in the sense that the infection is always present and widely distributed.[11]

In this context the protection test enabled the diagnosis of entire geographical areas as potentially liable to suffer from yellow fever.

The IHD was confident of the value and accuracy of protection tests, however its personnel admitted that the tests had limits.[12] They could not detect whether infection had occurred recently and researchers sometimes had difficulty differentiating between cases resulting from endemic or epidemic yellow fever.[13] Initially, the western medical community did not universally accept the validity of the tests, particularly when they seemed to contradict all previous clinical information.[14] Examining the medical response to protection test results in the Anglo-Egyptian Sudan, H. Bell clearly demonstrates that there was considerable suspicion about the validity of the tests among medical personnel in the region. The IHD's immunity surveys directly conflicted with previous clinical and pathological evidence that indicated an absence of the disease. She argues this created issues surrounding the acceptance of definitions of what constituted medical knowledge:

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[11] R. Kirk, "Some Observations on the Study and Control of Yellow Fever in Africa, with Particular Reference to the Anglo-Egyptian Sudan", *TRSTMH* **37** (1943), p.132.

[12] See F.L. Soper, "Yellow Fever: The Present Situation (October, 1938) with Special Reference to South America", *TRSTMH* **32** (1938), pp.329-331, for an overview of Soper's unshakeable confidence in the technique, together with an acknowledgement of its possible limits.

[13] Prior to the Asamangkese epidemic in the Gold Coast in 1926, medical experts believed that yellow fever did not exist in epidemic form among the indigenous population. Asamangkese provided proof that epidemics did occur among African communities.

[14] Bell, *Frontiers of Medicine*, (1999), pp.173-177.

> Despite the obvious dominance of the laboratory, clinical evidence, medical preconceptions about disease epidemiology, fear of policy and health implications, and professional and imperial rivalries were among factors that policed the boundary between legitimate and illegitimate medical knowledge.[15]

This suggests that there, medical personnel did not relinquish old understandings of endemicity in their region easily. The RF embraced immunological means of diagnosis, and the implications of protection test surveys. However, many barriers: social and medical, prevented the medical services of the Anglo-Egyptian Sudan following its example.

In South America, the RF analysed its protection test findings in conjunction with corresponding evidence from viscerotomy services to map areas of endemicity. As described in chapter three, this used a viscerotome. This technique was advantageous as it permitted access to the liver without recourse to an autopsy. It acted to provide some reinforcement of protection test surveys as it could detect the presence of yellow fever in the absence of clinical signs. It also furnished information of recent fatal cases of the disease: valuable data that could not be ascertained by protection tests. In 1938, Soper called viscerotomy: "the most important factor in the recognition of the disease in South America in recent years".[16]

In the Commission's final years in West Africa, Russell pushed to introduce a viscerotomy service along similar lines to South America. However, colonial medical personnel displayed a lack of enthusiasm for this, and the Commission's efforts failed. The establishment of a viscerotomy service in the Anglo-Egyptian Sudan met with

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[15] *Ibid.*, p.174.
[16] Soper, "Yellow Fever: The Present Situation", (1938), p.307.

more success, possibly because the surprising results of protection tests conducted in the region prompted a recognition that more evidence of a yellow fever presence in the region was needed. To this end, colonial medical personnel in the region were required to report all suspicious fever cases, and use viscerotomes to provide histological diagnosis.[17] However, by the beginning of the war, only one case of the disease had been identified using this instrument. As medical experts had long acknowledged that West Africa was endemic, there was not the same impetus there for corroborative evidence for protection tests.

The British medical community was gradually accepting the validity of the protection test by the end of the 1930s. An epidemic throughout 1940 in the Nuba Mountains in the Anglo-Egyptian Sudan provided indisputable clinical proof that yellow fever existed in this region, confirming the results of the protection test surveys. This marked the final and irrefutable medical and scientific affirmation of immunological diagnosis.

Surveys provided a new dimension to understandings of the disease in Africa. The RF and the British medical community interpreted the results as indicating that vast areas of the continent were endemic: that yellow fever was constantly present to some extent, on the basis of positive protection tests among the indigenous population. This reinforced basic concepts of Africans and yellow fever held by the western medical community. Firstly, that Africans were reservoirs of infection as the disease was constantly present among them. Secondly, that Africans in endemic areas were, as a population group, immune, even though, strictly speaking, protection tests detected immunity against yellow fever in mice, rather than humans. However, some

[17] Bell, *Frontiers of Medicine* (1999), p.174.

of the scientific and medical experts involved in this arena displayed a more subtle understanding of endemicity and expressed an awareness that the entire African population did not enjoy a wholesale immunity in endemic regions (surveys had demonstrated that immunity ranged from twelve per cent in Sierra Leone to twenty six per cent in Nigeria). There was also a recognition, as indicated by Kirk's article of 1943, that some areas were more endemic than others, with numbers of positive results varying considerably throughout areas labelled endemic. Despite this, on the whole, protection tests served to enhance and strengthen the scientific classification of the African population within endemic areas as being immune. It also provided what many experts considered to be indisputable proof that Africans suffered from, and could harbour the disease, and as such constituted a danger to the white population.

Protection tests could locate and delineate endemic areas without lengthy and laborious investigations. This offered the CMS a new basis for controlling endemic yellow fever, allowing them to target efforts at areas with high endemicity. However, this new knowledge had little direct impact on yellow fever control in West Africa in the 1930s. The British medical community and colonial authorities had little involvement in the surveys, except for sporadic efforts by Findlay, and MOs collecting blood samples for testing. Indeed, the efforts of the RF somewhat negated further extensive surveys by other research groups. The British Government acted on the results on an international level by signing the 1933 International Sanitary Convention for Aerial Navigation which included yellow fever control regulations based on early surveys, as discussed in chapter one. This convention became rapidly outdated as the decade progressed, overtaken by additional survey results and the availability of inoculation. However, the Colonial Office made no effort to remedy this situation until the outbreak of World War Two, when wartime expediencies forced it to act. The Colonial Office and the British medical community were more involved in the other immunological development of the decade: inoculation.

Yellow fever inoculation: a vaccine history

If protection tests offered the means to map endemicity, inoculation offered protection against endemic yellow fever. Using C.A. Gill's framework of epidemiological understandings of disease, it prevented endemic yellow fever flaring into epidemics by targeting the "immunity factor" in communities.[18] The provision of a manufactured immunity reduced the number of susceptible people. This removed the potential for individual suffering, and reduced the likelihood of epidemics as susceptible people were required for infection to spread. As demonstrated in chapter two, the CMS's anti-yellow fever efforts focused upon epidemics. They did attempt to protect the susceptible European population from endemic yellow fever using measures incorporated into their day to day sanitary activities. However, this activity was sporadic, and difficult to sustain in the absence of visible infection. The development of an effective vaccine offered to reverse this trend.

There had been other attempts at vaccine developments before the 1930s: all unsuccessful. The most credible and widely used was the technique developed by Noguchi. As discussed in chapter three, it resulted from his mistaken labelling of a spirochete *Leptospira icteroides* as the causative organism of the disease based on his research conducted in Guayaquil in 1918. His findings were conclusively and publicly

[18] C.A. Gill, *The Genesis of Epidemics and the Natural History of Disease* (London: Bailliere, Tindall and Cox, 1928), p.37.

disproved in 1928 after confirmation of the RF Commission's discovery of the yellow fever virus the previous year. Until this time his vaccine had enjoyed a wide currency in the Americas and West Africa for nearly ten years.[19] An analysis of the application of his vaccine in West Africa is useful as it reveals encounters with similar problems and considerations to those experienced ten years later with its more efficacious successor. This demonstrates that inoculation, certainly in respect to yellow fever, could result in a repeated pattern of behaviours, issues and outcomes.

The RF distributed Noguchi's vaccine widely throughout the Americas and inoculated thousands of people. It always used inoculation as a complementary measure with other anti-yellow fever methods, and never as the sole method of prevention, a trait repeated with later vaccines.[20] The RF also made the vaccine available to the British for administration within the West African colonies themselves and in Britain. Both the London and Liverpool Schools of Tropical Medicine directly requested supplies from the RF to inoculate, on request, those about to embark for West Africa.[21] Not only does this indicate that there was a demand from members of the lay population, but that the leading tropical medicine experts in Britain were content to be involved in its administration, suggesting acceptance of the prophylaxis.

The four British West African colonies also held stocks of the vaccine although, as happened a decade later, the CMS tended to use it only in an emergency, when an epidemic threatened the lives of the European population. Even in Sierra Leone, where only small and very infrequent epidemics were experienced, the CMS

[19] Noguchi had also produced a curative serum which was occasionally used by the CMS in West Africa.
[20] M. Cueto, "Cycles of Eradication: The Rockefeller Foundation and Latin American Public Health, 1918-1940", in P. Weindling (ed.), *International Health Organisations and Movements* (Cambridge: Cambridge University Press, 1995), p.229.
[21] Andrew Balfour at the LSHTM to Noguchi, 21.09.1925; Russell to Noguchi, 07.12.1925. F1357, B96, S1.1, RG5. RFA, RAC.

requested and received serum and vaccine from the RF.[22] It is impossible to gauge how many Europeans were inoculated with Noguchi's vaccine. The *Annual Medical Reports* only commented on its emergency use during epidemics when it proved popular. After an epidemic in the Gold Coast in 1923, the medical authorities vaccinated 180 Europeans who voluntarily presented themselves.[23] Inoculation was also offered and taken up in the Gold Coast and in Nigeria in epidemics during 1926.[24] Clearly, people were willing to be inoculated, spurred on by the fears arising during epidemics. In all these cases, the CMS never used the vaccine in isolation, rather as part of a concerted anti-yellow fever campaign incorporating all the measures outlined in chapter two.

Exclusivity was a feature of the experiences regarding Noguchi's inoculation in British West Africa: to be repeated in the following decade. Europeans were the predominant privileged recipients of the procedure. There were some isolated incidents of African inoculation, for example, in the Gambia in 1927, twenty three Africans were inoculated with the vaccine. The *Annual Medical Report* did not specify whether medical personnel administered it on a voluntary or compulsory basis.[25]

Anxieties over associated side effects arose, an issue plaguing later vaccines. During an epidemic in Seccondee, the Gold Coast in 1925, the SMO, Dr Wade complained that the vaccine had caused a number of "very severe local reactions".[26] In response to this incident, and other reported side effects, Russell was quick to dismiss

[22] Russell to Noguchi, 09.10.1925. F1357, B96, S1.1, RG5. RFA, RAC.
[23] *Gold Coast Annual Medical Report, 1923-24*, p.11.
[24] *Ibid., 1926*, p.14; *Nigeria Annual Medical Report, 1926*, p.22.
[25] *Gambia Annual Medical Report, 1927*, p.44. There was no epidemic that year, but the CMS intensified anti-yellow fever measures in response to widespread cases in neighbouring Senegal.
[26] Russell to Noguchi, 29.07.1925. F1357, B96, S1.1, RG5. RFA, RAC.

any suggestion that the vaccine was responsible. Instead he blamed faulty inoculation technique, and poor storage conditions: placing the onus firmly on the CMS by insinuating their incompetence.[27]

It is difficult to gauge medical opinion of the vaccine. As discussed in chapter three, there had been wide, but not universal acceptance of Noguchi's spirochetes. Certainly, disquiet over side effects from inoculation would not have improved its popularity among medical and scientific circles. There is some evidence that suggests that although some members made the vaccine available, the British medical community did not wholeheartedly accept it. G.E.H. Le Fanu, who served in the CMS in the Gold Coast during the 1920s, some years later recalled his distaste at giving the vaccine in which he claimed to have never believed.[28] During his investigation of the 1923 epidemic in the Gold Coast, Maplestone expressed reservations about its effective application. He commented that the vaccine "has a distinct protective value" yet because of uncertainty about the duration of immunity conferred, he argued: "this precaution can only be used as an emergency measure in checking the actual outbreak of yellow fever".[29]

Eventually it became obvious that there were concrete grounds for concern about its efficacy. By 1926, the Commission had failed to find any of Noguchi's *Leptospira* in cases of West African yellow fever, casting serious doubts on his research. Beeuwkes expressed strong reservations about the vaccine. He

[27] Russell to Noguchi, 29.07.1925; Russell to Noguchi, 26.10.1925. F1357, B96, S1.1, RG5. RFA, RAC.
[28] PRO. CO 323/1217/15. G.E.H. Le Fanu, to A.J.R. O'Brien, Assistant Medical Advisor to the Colonial Office, 11.09.1933. Le Fanu was born in 1874 to a medical family: his father had been in the IMS. He had joined the WAMS in 1907, and served as an investigator for the YFWAC, 1913-1916. He left the WAMS in 1926, and became a Consulting Physician to the Colonial Office, based in Liverpool, two years later until 1945. He died in 1965.
[29] LSTM. TM 13/56/10/1. P.A. Maplestone, "Report on Investigations into Yellow Fever in the Gold Coast Colony", 1923. p.6.

recommended its use be discontinued in West Africa: "because of their somewhat questionable value and because of the fact that measures of this kind are apt to create a false sense of security and to induce personal carelessness".[30] Despite this, the CMS offered vaccine gratis to all Europeans during the epidemic in the Gold Coast in 1927. The DMS confessed his reluctance to abandon its use in the face of particularly high mortality, even if futile, arguing its availability gave comfort: "Many took advantage of this offer which, no doubt, had a useful psychological effect even if the vaccine confers little or no immunity".[31] This indicates that inoculation affected lay perceptions of the disease; the protection it promised reducing the disease's menace.

The discoveries that resulted in the refutation of Noguchi's vaccine were pivotal events in the development of its more efficacious successor in the 1930s. The discoveries of a susceptible animal and the yellow fever virus, were crucial to the vaccine's creation and subsequent refinements. Understanding of the causative agent, and the ability to maintain it in the laboratory gave a new dimension to anti-yellow fever campaigns. Previous endeavours had revolved around breaking the mosquito/human transmission cycle: focusing on the control of the mosquito. This new knowledge enabled the focus of efforts to expand and switch to manipulating the virus to produce vaccines: controlling the causative organism.

The discovery of a susceptible monkey was followed by a number of attempts to develop a vaccine using virus obtained from infected monkeys, producing unreliable and irregular results.[32] Theiler's subsequent replacement of monkeys with

[30] "Annual Report of the Commission, 1927". B214, SS495, S3, RG5. RFA, RAC.
[31] *Gold Coast Annual Medical Report, 1927*, p.135.
[32] See W.A. Sawyer, S.F. Kitchen and W. Lloyd "Vaccination Against Yellow Fever with Immune Serum and Virus Fixed For Mice", *Journal of Experimental Medicine* 55 (1932), pp.945-947 for a summary of these early efforts.

mice as a susceptible laboratory animal produced the breakthrough for much safer and dependable vaccines for the 1930s. Several strains of vaccine resulted from Theiler's work: some considered safer than others. There were two initial vaccination techniques of significance, developed separately in the United States and France, and employed in varying degrees throughout British and French West Africa.

The RF was a major contributor to vaccine development. Its initial effort in 1931 comprised a dose of virus, attenuated by passage through mice, together with a protective injection of human immune serum.[33] The latter was employed to lessen the possibility of reactions after inoculation and to prevent the presence of active virus in the blood stream. Both were administered subcutaneously on separate points on the abdomen. The RF began inoculating its personnel who worked with the yellow fever virus that year. As the method required large amounts of immune serum, it was not amenable to mass application. The RF was content to limit inoculation to its own staff, but was aware of future external demand. In particular it wanted a vaccine to be made available to Europeans about to embark for British West Africa but was reluctant to take on the responsibility for this task. The memory of the unfortunate outcome of the ineffective Noguchi vaccine, which the RF had willingly distributed to medical institutions in both Britain and West Africa, partly prompted the hesitance.[34] The IHD devised a solution in 1932 when it invited Stanton to select a member of the British medical community to visit its yellow fever laboratory in New York. This would allow a British researcher to learn the RF's inoculation administration and manufacturing techniques, providing the British colonial authorities and medical

[33] *Ibid.*, pp.945-969; and *idem*, "Vaccination of Humans Against Yellow Fever with Immune Serum and Virus Fixed for Mice", *Proceedings of the Society of Experimental Biology and Medicine* **29** (1931), pp.62-64.
[34] Sawyer to Beeuwkes, 08.01.1932. F11, B2, S495, RG1.1. RFA, RAC.

communities with a means of conducting inoculations in London for people leaving for West Africa. Stanton selected Findlay to work with Sawyer in New York.[35] On his return to London in November, Findlay began manufacturing and administering the vaccine at the Wellcome Bureau's laboratories using Sawyer's methods. Therefore, the vaccine used widely by the British was based on the RF's original vaccine developed in 1931. Findlay followed the RF's vaccine developments throughout the 1930s, mirroring its refinements, while manufacturing his own supply of vaccine. Human immune serum was used with the RF's and Findlay's series of vaccines. As this was in constant short supply, baboon or horse immune serum were used when necessary as an alternative. The technique underwent a significant refinement in 1936 when the vaccine's neurotropic and viscerotropic properties were reduced by cultivation in tissue culture, still accompanied by an injection of immune serum. Side effects and hepatitis infections resulted from both vaccines, with the accompanying immune serum held responsible.

During this period the French researcher J. Laigret, together with Andrew Watson Sellards, had developed an alternative vaccine commonly known as the Laigret method. This used a neurotropic strain of the virus attenuated by passage through mice, but omitted immune serum. It usually involved three separate injections of the virus given at twenty day intervals. This was used extensively in French West Africa but many among the British medical community remained unconvinced of its safety. Findlay was particularly critical, arguing that the injection of the live virus, in the absence of immune serum put the recipient in danger and made him or her a risk to the rest of the wider community. He contended that it could result in either the

[35] Sawyer to Beeuwkes, 25.08.1932. F11, B2, S495, RG1.1. RFA, RAC.

person developing the disease or infecting *A. aegypti* mosquitoes with live virus, which could then be transmitted to non-immune humans.[36] As will be analysed later, the Colonial Office, on the advice of Findlay and its own medical advisors, was very hostile to suggestions of using Laigret's vaccine.

The RF developed a safer method of inoculation without serum, known as 17D, at its New York laboratory by 1937.[37] Removing serum reduced the potential for side effects and solved serum supply difficulties. The vaccine was prepared using virus passed many times through chick embryos with the brain and spinal cord removed. This further reduced the neurotropic and viscerotropic properties of the virus and rendered the vaccine much safer. Human serum was still used in the vaccine's preparation to dilute chick embryo material, but unlike earlier vaccines, it did not require an accompanying injection of human serum, and was given subcutaneously. Without the necessity for large amounts of immune serum, the RF considered 17D amenable to mass administration, and subsequent RF campaigns began in South America in 1937. Findlay developed his own series of vaccines using this technique which became available in London from 1 November 1937. American and British medical communities were largely confident of the safety of 17D. However, it was not without problems. Reports of hepatitis infections arising from the use of human immune serum in its manufacture prompted the RF to concentrate on producing an aqueous based, rather than serum based variant of 17D. Its researchers

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[36] G.M. Findlay, "Immunization Against Yellow Fever with Attenuated Neurotropic Virus", *The Lancet* (1934), pp.983-985.
[37] W. Lloyd, M. Theiler and N.I. Ricci, "Modification of the Virulence of Yellow Fever Virus by Cultivation of Tissues *in vitro*", *TRSTMH* 29 (1935), pp.481-529; M. Theiler and H.H. Smith, "The Effect of Prolonged Cultivation *in vitro* Upon the Pathogenicity of Yellow Fever Virus", *Journal of Experimental Medicine* 65 (1937), pp.767-786; *idem*, "Use of Yellow Fever Virus Modified by *in vitro* Cultivation for Human Immunization", *Journal of Experimental Medicine* 15 (1937), pp.787-800.

met with success in 1941, and the new form of 17D replaced its predecessor the following year.[38]

Despite being cheap to manufacture (estimated in 1938 to cost $0.022 per dose when produced in New York and $0.025 in Rio de Janeiro[39]), the costs of operating mass campaigns were considerable owing to factors such as transportation, the need for refrigerated storage conditions and means of safe application. Thus in the mid 1940s, the RF re-examined 17D searching for a product that could be administered more cheaply. The scratch method of inoculation looked promising as it removed the need for subcutaneous administration, instead applying the vaccine to scratched skin. This method had been subject to considerable experimentation and trials in French West Africa in this decade using yellow fever virus alone and later in a combined vaccine against yellow fever and smallpox. It was the latter that the RF sought to emulate and began work in 1947 in the laboratory in Lagos. It consequently developed and applied a scratch vaccine, but safety considerations prevented long term use.

Findlay and the Wellcome Bureau were the sole manufacturers and administrators of the British series of vaccines until the end of 1937, when Charles Morley Wenyon, the Director of the Wellcome Bureau, requested in a change in procedure. In response, the Colonial Office arranged that future inoculations were to take place at the Hospital for Tropical Diseases in London, under the responsibility of its Assistant Physician, Dr Murgatroyd.[40]

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[38] Smith, "Controlling Yellow Fever", (1951), pp.611-612.
[39] *Ibid.*, p.615.
[40] PRO. CO 554/110/1. Murgatroyd to Stanton, 31.12.1937.

A test for Findlay's vaccine: the Bathurst epidemic of 1934-35

The British experience of large scale yellow fever inoculation began soon after Findlay's return from New York in November 1932. Unlike the RF who initially restricted its vaccine to those directly working on the disease, Findlay inoculated a wide variety of people, including medical personnel, missionaries, traders, civil and military officials and their wives.[41] The procedure he used was the one he had learned at the RF laboratory: separate injections of serum and virus subcutaneously into the abdomen wall. By June 1934 he had conducted a total of 302 inoculations: all in London at the Wellcome Bureau. Details of financial support at this early stage are somewhat hazy. Sources do not indicate whether the Colonial Office or the Wellcome Bureau was responsible for the costs of manufacture and administration, or if the recipient paid a fee. Certainly, the Colonial Office was aware of these bureaucratic issues. In August 1933, A.R. Fiddian, the Assistant Secretary of State for West Africa, expressed concern at imposing the associated trouble and expense onto the Wellcome Bureau and Findlay.[42] Stanton also worried at the lack of any concrete arrangements between the Colonial Office and the Wellcome Bureau. However, Findlay assured him that he was willing to conduct up to 500 inoculations before requiring any formal action.[43]

Before 1935, all inoculations were administered in London, preferably in the middle of the recipient's leave allowing sufficient time for any adverse reactions to develop before departure for West Africa. At this time there were no facilities

[41] G.M. Findlay, "Immunization Against Yellow Fever", *TRSTMH* **27** (1933), p.445.
[42] PRO. CO 323/1217/15. Memo by A.R. Fiddian, Assistant Secretary of State for West Africa (1931-1935), 28.08.1933.
[43] PRO. CO 323/1217/12. Memos by Stanton, 03.07.1933, 18.11.1933.

available for inoculations in West Africa itself. However, an epidemic in Bathurst, the Gambia, 1934-35, changed this pattern. The epidemic was remarkable with respect to inoculation for several reasons. It resulted in the first large scale use of Findlay's vaccine as part of a concerted and organised campaign against epidemic yellow fever and represented the first inoculations conducted in West Africa. The Laigret vaccine also played a role in this episode, provoking a unique response from the Colonial Office and the medical community in London.

The first recognition and diagnosis of epidemic yellow fever in Bathurst occurred on 3 October 1934 in a European who died three days later. A further five diagnosed cases followed: three British, all of whom died; and two Africans, one of whom survived, although diagnosis was not confirmed by a positive protection test. This was the last recorded case and occurred on 1 January 1935. The Governor, Sir Arthur Richards was clearly distressed at what he was witnessing. Early in the epidemic he intimated that he believed reported cases were merely the tip of the iceberg: " ... the sickness is appalling, even the usual African list being worse and longer than has been known of recent years".[44] His concern lay not only in the extent of the epidemic, but the racial makeup of the victims and consequent implications for the European population, as he explained: "Ibson died last night. This makes the third European death from yellow fever in the last month, rather many in a small place. There are too many women here to make it a comfortable position".[45] This evident fear goes some way in explaining his later actions relating to the Laigret vaccine. Medical personnel working in the colony widely believed that the six recorded cases were not representative of actual incidence, and that the epidemic was far more severe

[44] PRO. CO 87/239/15. Sir Arthur Richards, Governor of the Gambia, to Fiddian, 10.11.1934.
[45] *Ibid.*

than the figures suggested. Findlay contended that there were at least six other cases among Europeans.[46]

Richards recognised the limitations of the rather small colonial medical department in his colony and requested that the Colonial Office second personnel from the other West African colonies. J.A.A. Duncan, Assistant DMS of Sierra Leone arrived on 18 December 1934, followed three weeks later by W.N. Howells of the CMS in the Gold Coast. Together with the colony's medical staff, they waged an intensive anti-yellow fever campaign using the tried and tested techniques outlined in chapter two. CMS personnel evacuated European officials and their wives to an area considered safer, and advised non-official Europeans to do the same.[47] The availability of a vaccine added an additional dimension to yellow fever control during this epidemic.

As will be examined in greater detail later in the chapter, the Colonial Office had temporarily suspended the inoculation of colonial officials using Findlay's vaccine in the summer of 1934 owing to safety fears related to side effects. During the epidemic Richards was presented with the opportunity to protect the European population using an alternative: the Laigret vaccine. Just after the third death from the disease the French Consul, François Orcel offered him supplies of the French vaccine. Richards accepted and made it available for Europeans on a voluntary basis. He was concerned about an unfavourable reaction among colonial medical experts in London remarking: "I hope Stanton won't have 17,000 fits when he hears that I am making the French inoculation treatment available to all who care to have it".[48] However,

[46] G.M. Findlay and T.H. Davey, "Yellow Fever in the Gambia. II. The 1934 Outbreak", *TRSTMH* 30 (1936), p.155.
[47] *Gambia Annual Medical Report, 1934*, pp.55-57.
[48] PRO. CO 87/239/15. Richards to Fiddian, 10.11.1934.

such worries did not deter him from his decision. His stated fear of the disease and the consequent economic disruption (the colony was at a critical juncture in the ground nut season) were doubtless persuading factors. Orcel convinced him of the safety of the procedure, referring to its mass application in French West Africa, and its alleged sponsorship by the Pasteur Institute. Richards justified his decision to the Colonial Office arguing: "Presumably, a Pasteur Institute does not sponsor a treatment without adequate reason".[49] Inoculations began on 16 November and all Europeans in Bathurst with the exception of two people who had already had yellow fever, were inoculated. Thus 127 people received the first of the three inoculations of Laigret's vaccine. Twelve Syrians also took advantage of the procedure.

Stanton and Findlay did not share Richards's confidence. Within a week of learning of his actions, the Colonial Office advised him to cancel the planned second dose of vaccine because of Stanton's disapproval and recent research by Findlay suggesting dangers associated with the technique.[50] Richards complied and halted the inoculation procedure, yet evidence suggests he was reluctant to do so. Some years later, he expressed his disapproval of the Colonial Office's handling of the entire affair: "I was toying with this idea [i.e. using the Laigret vaccine] when the authorities in London heard about it and became quite hysterical and told me to leave alone matters which I obviously didn't understand. I informed them that it wasn't me it was the Pasteur Institute ...".[51]

However, the Colonial Office's objections were restricted to the Laigret method. After persuading Richards to halt the application of the French vaccine, the

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[49] *Ibid.*
[50] PRO. CO 87/239/15. Secretary of State to Richards, 24.11.1934.
[51] Rhodes House. MSS.Brit.Emp.s.368. Interview transcript with Lord Milverton, formerly Sir Arthur Richards, 22.02.1969. p.16.

Colonial Office reversed its ban on Findlay's technique imposed six months previously. Findlay was sent to the Gambia to begin an inoculation campaign using his vaccine, assisted by Davey of the Alfred Jones Laboratory. By February 1935 they, with other medical personnel, had inoculated the entire white population of Bathurst together with many other Europeans throughout the colony. Fears that using Findlay's vaccine in West Africa may have compromised safety standards were argued to have been groundless. The LSTM reported that the campaign proceeded successfully with few serious reactions although there were "a good many sore tummies".[52] However, as one of the chief inoculators, Davey was aware of a more personal reaction: "when I had finished the vaccination campaign I was the most hated man in the Gambia and held to be responsible for all their ills".[53]

Before the Bathurst epidemic inoculation was restricted by availability and the necessity of being in London to receive the injections. The opportunity to be inoculated had to be planned. At such a level, it operated minimally in the range of measures employed against endemic yellow fever: reducing slightly the potential for epidemics by decreasing the numbers of susceptible people. However, events in the Gambia transformed this: inoculation became another method against epidemics alongside fumigation and quarantine. It provides a classic example of the transfer of metropolitan technology to the periphery. Headrick argues that for such transfers to be successful a cultural diffusion has to accompany the geographical relocation of the technology.[54] The transfer of Findlay's vaccine in this instance was successful for several reasons. The increasing use of mouse protection tests by medical departments throughout the region rendered the immunological basis of the vaccine more familiar

[52] LSTM. TM 13/68/11/3. Gordon to Warrington Yorke, Director of the LSTM, 03.03.1935.
[53] LSTM. TM 14/DaT. Davey to LSTM, 31.08.1977.
[54] Headrick, *The Tentacles of Progress* (1988), p.13.

and acceptable to colonial medical personnel. The stimulus of an epidemic, i.e. a period of crisis, gave its use expedience in the eyes of the Colonial Office and the CMS, prompting the former to disregard earlier safety anxieties. The population were clearly prepared to be inoculated as the high take up of the Laigret vaccine indicates.

Safety concerns

The British medical community condemned Richards's use of the Laigret vaccine because of unease about its safety record.[55] The international community also expressed confusion, the Yellow Fever Commission of the OIHP could not agree on this contentious matter and thus would not recommend it as a preventive measure.[56] Despite the hostility to the method displayed by Findlay and others, including Stanton, they did not limit their fears of side effects to the French vaccine. Safety was to become an issue that plagued yellow fever inoculation throughout the 1930s. Within a year of its initial application in London, medical personnel expressed concern about the severity of side effects displayed after inoculation with Findlay's vaccine.

It was widely acknowledged that some mild side effects were likely to result from a dose of Findlay's vaccine. Serum sickness was by no means unusual, from the use of both human and animal immune serum, although the former was considered more desirable. Medical personnel usually warned potential recipients of side effects but reassured them that the procedure was "quite devoid of serious risk".[57] Common

[55] For example see Findlay, "Immunization with Attenuated Neurotropic Virus", (1934), pp. 983-985; and R.M. Gordon, "Notes on Yellow Fever, with Special Reference to the Possibility of its Recurrence in Sierra Leone", December 1934, p.20, in Collected Papers of Sir Alfred Jones Laboratory, Sierra Leone. Vol. III.
[56] PRO. CO 885/44. Minutes of the Meeting of a Sub-Committee of the CAMC, 01.01.1935.
[57] PRO. CO 323/1217/15. Article in Gold Coast Gazette, 27.05.1933.

side effects recorded were fever, headache, backache, nausea, lethargy and aching in the limbs. Before its use in the Bathurst epidemic, Findlay found that of 200 people inoculated, eighty six, or forty three per cent suffered a temperature above 99°F. Unperturbed by this statistic he concluded that of the 200, with a few exceptions, the reactions were of a "comparatively mild character" and went on to assert the value of the technique.[58]

Others were more disturbed by side effects. That year, troubled medical personnel reported a number of cases of serious sickness in recently inoculated people which they attributed to Findlay's vaccine. This concerned the Colonial Office and in response Stanton told Findlay to halt all inoculations for colonial officials. Findlay was quick to dismiss these stories and reassured Stanton that there was no problem. He contended that the illnesses were merely repeat infections of other diseases contracted in previous trips to West Africa, which were brought on by a decreased resistance resulting from inoculation. He argued for the popularity of the technique claiming that despite warning recipients of possible severe reactions, all remained enthusiastic and willing to receive it.[59] Findlay's arguments failed to sway Stanton and the ban remained. The Colonial Office was not prepared to extend its authority beyond the colonial service by prohibiting all inoculations and so civilians continued to receive the vaccine upon request. Indeed the Colonial Office intended to use the success or otherwise of on going inoculations of non-officials as a yard stick to determine when the service could be resumed for official personnel.[60]

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[58] Findlay, "Immunization Against Yellow Fever", (1933), pp.460-462.
[59] PRO. CO 323/1266/4. Findlay to Stanton, 18.06.1934.
[60] PRO. CO 323/1266/4. Memo by Fiddian, 19.09.1934.

However, the Bathurst epidemic forced its hand: fears regarding the use of the Laigret method in British colonies persuaded the Colonial Office to take action. After discussions between Findlay, Wenyon, Stanton and O'Brien, they decided to resume general voluntary inoculations administered at the Wellcome Bureau in London using Findlay's method, as well as allowing its emergency use in Bathurst.[61] The London medical community and the Colonial Office were clearly keen to use some form of inoculation: it is likely that they regarded this vaccine to be the lesser evil. As the sole manufacturer and administrator of the vaccine for British use, it was in the Wellcome Bureau's best interest to dissuade the use of Laigret's method and promote its own; this would have helped it to maintain its British monopoly. Certainly, there was no new evidence or research to alleviate the fears expressed earlier in the year; quite simply the Colonial Office and their medical advisors considered it a less dangerous alternative. Richards had few doubts regarding the ethical implications of this policy turnaround. Some years later he condemned what he evidently regarded as a panicked response by the Colonial Office to his use of Laigret's method: "their reply to this was to hurry on the Wellcome Institute to send out somebody at once with some of their serum to be inflicted - as a test - on some of our own people".[62]

Stanton and the Colonial Office remained committed to Findlay's method. In 1936, the RF devised its answer to safety fears by refining the vaccine, reducing its neurotropic and viscerotropic properties, still accompanied by immune serum: a seemingly safer option. Findlay took advantage of this technique and soon made the new vaccine available in London from mid 1936 with no objections from the Colonial

[61] PRO. CO 323/1266/4. Stanton to Wenyon, 15.12.1934.
[62] Rhodes House. MSS.Brit.Emp.s.268. Interview with Lord Milverton, 1969.

Office. However, the side effects continued, and it was evident that a number of jaundice cases had arisen following inoculation with the two virus/serum vaccines.[63]

How did the wider medical community respond to safety fears? The metropolitan medical community experienced some conflict until the introduction of 17D at the end of 1937. Gordon, Director of the LSTM's Alfred Jones Laboratory, commented on a curious situation involving six MOs posted to the Gold Coast. Four had attended the London School; inoculation had been advised to them and subsequently undertaken. The remaining two had attended the LSTM, and acting on its recommendation, had not received the vaccine. Given that Gordon was about to embark on an inoculation campaign in Freetown involving all European medical personnel, the School's stance contradicted its activities in West Africa. He commented that: "There certainly are risks associated with immunisation but I do not think that they are as great as the risk of contracting the yellow fever to which anyone working with the disease is exposed", and announced his intention to be inoculated that week.[64] Even the Consulting Physicians used by the Colonial Office did not agree, indicating inadequate direction or its absence from the Colonial Office.[65] It also demonstrates conflict within the British medical community on this issue. At the beginning of 1937, the Colonial Office revealed that only one Consulting Physician, a Dr Horn, advised the procedure when examining officers newly appointed to West Africa.[66] That other Consulting Physicians were failing to recommend inoculation was

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[63] See G.M. Findlay and F.O. MacCallum, "Note on Acute Hepatitis and Yellow Fever Immunization", *TRSTMH* **31** (1937), pp.297-308, and *idem*, "Hepatitis and Jaundice Associated with Immunization Against Certain Virus Diseases", *Proceedings of the Royal Society of Medicine* **31** (1938), pp.799-806, for contemporary analyses of this problem.
[64] LSTM. TM 13/68/12/1. Gordon to Yorke, 07.05.1935.
[65] Consulting Physicians were well reputed private practitioners with tropical experience who were employed by the Colonial Office to examine officers on leave and candidates for employment. There were usually two in London and one in Edinburgh, Liverpool, Belfast, and Dublin.
[66] PRO. CO 554/110/1. Memo by O'Brien and H.F. Downie, Assistant Secretary of State for West Africa, dated 04.01.1937.

a direct contradiction to the stance of the CMS who quite actively encouraged inoculation for European residents in West Africa.

The CMS were apparently more enthusiastic about inoculation, although Gordon did note in 1935 that the CMS in Nigeria were "shy" about inoculation.[67] Despite safety fears, it was a valuable addition to anti-yellow fever campaigns. It offered them a means of dealing with endemic and epidemic yellow fever. The procedure itself was straightforward and relatively simple, albeit with some possible risks for the recipient. It guaranteed protection of a relatively long duration: something unachievable by the most extensive and vigorous anti-mosquito measures. Unlike other anti-yellow fever measures, protection was gained within the body, at the immunological level, rather than by mechanical manipulation of the environment. It operated strictly at the level of the individual, and did not depend on community co-operation which the CMS considered essential for much anti-mosquito work. Its effectiveness did not rely on an individual's vigilance, unlike mosquito nets that had to be used nightly, and as with mosquito screens, maintained and repaired regularly (although was some debate on the duration of immunity inoculation conferred). As such, the CMS encouraged inoculation for all the non-indigenous population: official and otherwise, advising Europeans to undergo the procedure while on leave in London to minimise risks associated with side effects.[68] They used the development of the allegedly safer strain to persuade people to be inoculated with the newer vaccine.[69]

After the Bathurst epidemic they were keen to obtain local stocks for emergency use during epidemics, and by 1937 inoculation became an additional

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[67] LSTM. TM 13/68/12/1. Gordon to Yorke, 07.05.1935.
[68] For example, *Nigeria Annual Medical Report, 1937*, p.7; *Gold Coast Annual Medical Report, 1938*, p.21.
[69] PRO. CO 554/105/12. Circular by P.S. Selwyn-Clarke, Acting DMS of the Gold Coast, April 1936.

emergency measure against yellow fever epidemics. For example, during an epidemic in Nigeria in 1937 the CMS made the vaccine available, administered by the Senior Pathologist.[70] The Colonial Office had no apparent objections to the CMS maintaining their own stocks, but did advise that the procedure was best conducted in London. In light of the Bathurst epidemic, the CAMC decided that the Alfred Jones Laboratory of the LSTM should hold supplies of the vaccine and Stanton even discussed the possibility of the laboratory producing supplies for the entire region. Davey quickly dismissed this for safety reasons fearing the potential for epidemics resulting from laboratory accidents was too great.[71]

However, the CMS did express some reservations about the technique, together with the wider European population in West Africa. Richards referred to it as "Findlay's jaundice"; a title Davey later explained derived from associated cases of jaundice.[72] Some lay people attributed the death of a colonial official, a Mr Dunbar, in the Gold Coast in 1937, to his yellow fever inoculation. When questioned about the incident by the Colonial Secretary, the Acting DMS, J.M. Mackay, contended that there was no definitive proof that the vaccine was indeed responsible, but that he personally believed it was the cause of many reported associated illnesses, claiming many other MOs agreed. He expressed his reluctance to continue local inoculations, using either the vaccine of virus and serum mix, or the newly developed 17D.[73] However, the Colonial Office felt differently, claiming that Wenyon advised voluntary inoculations to continue regardless, although where possible in London rather than West Africa. Its medical advisors, it claimed, disputed the cause of Dunbar's death

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[70] *Nigeria Annual Medical Report, 1937*, pp.13-14.
[71] LSTM. TM 13/73/1/2. Davey to Yorke, 01.01.1935.
[72] LSTM. TM 14/DaT. Davey to LSTM, 31.08.1977.
[73] PRO. CO 554/110/1. J.M. Mackay, Acting DMS of the Gold Coast to the Colonial Secretary, Accra, the Gold Coast, 06.10.1937.

was "*entirely* due to yellow fever vaccination" (my italics), although this statement suggests that it could have possibly been a contributing factor.[74]

The CMS provided their own response to safety worries. For example, during the 1937 epidemic in Nigeria, staff isolated all the ninety seven vaccine recipients in screened quarters for ten days to prevent infection from the live virus vaccine in case the accompanying serum was inadequate. That year they also conducted a number of experimental inoculations using Findlay's vaccine to investigate the possible links with hepatitis infection, providing an additional indication of their anxieties over safety.[75] The CMS discussed their fears at the West African Medical Conference in 1938. The Minutes did not mention the potential for severe side effects, yet participants debated and dismissed worries of yellow fever transmission resulting from inoculations conducted locally. They stated the necessity of maintaining vaccine supplies in the West African colonies, with the concession that ideally, all inoculations administered in the region were best performed under hospital conditions, presumably to minimise risks of transmission and to monitor side effects.[76]

Inoculation did not replace other activities still considered essential to curb epidemics such as anti-mosquito measures, segregation, isolation and fumigation. In 1935, when inoculation was still in its early stages, both Findlay and P.S. Selwyn-Clarke, a senior member of the CMS in the Gold Coast, advocated its use only in conjunction with other measures.[77] This stance continued throughout the 1930s even

[74] PRO. CO 554/110/1. W.C. Bottomly, Assistant Secretary of State for West Africa, to Sir Arnold Hodson, Government House, Accra, 31.12.1937.
[75] *Nigeria Annual Medical Report, 1937*, p.5, p.57.
[76] LSTM. TM 13/79/9/6. Minutes of the Meeting of the Sub-Committee of the West African Medical Conference, 18.11.1938.
[77] See Selwyn-Clarke's paper presented at the Pan African Health Conference, Johannesburg, 1935 in *Gold Coast Annual Medical Report, 1935*, pp.87-97; and PRO. CO 323/1331/6. Report by Findlay, "The Control of Yellow Fever in Africa", 1935.

as the vaccine became safer and more widely applied. In 1937, the year the CMS in Nigeria were active in inoculation administration and research, the Governor of the colony reaffirmed a strong commitment to residential segregation to provide protection against malaria and yellow fever.[78] At the 1938 West African Medical Conference, participants echoed this view as they decided that segregation policy should remain unchanged despite the availability of the vaccine. The uncertain duration of immunity conferred by inoculation together with their conviction that yellow fever was only one insect borne disease among many that segregation provided protection against, were sufficient grounds for this stance.[79]

Britain's experience with vaccines can be compared with the Americans, as they were using similar strains. How did the RF respond to continuing safety concerns at virus/serum mix vaccines? It had initially restricted the procedure to personnel considered most vulnerable to infection: staff directly involved in yellow fever field or laboratory work. It began mass vaccinations early in 1936 as part of attempts to control jungle yellow fever in South America, but associated hepatitis infections prompted their suspension.[80] Its answer to safety issues lay in the laboratory. As described earlier, its first effort resulted in a new virus/serum mix with reduced neurotropic and viscerotropic properties. This failed to resolve safety problems and thus the RF continued its research, which in 1937 culminated with the development of 17D: a vaccine that could be used safely without a separate injection of human immune serum. This seemingly provided the answer to British and American safety concerns.

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[78] *Nigeria Annual Medical Report, 1937*, p.5.
[79] LSTM. TM 13/79/9/2. Minutes of the Meeting of the Sub-Committee of the West African Medical Conference, 18.11.1938.
[80] Soper, "Yellow Fever: The Present Situation", (1938), p.308.

Despite serious worries about associated side effects, the Colonial Office failed to act decisively on inoculation during the 1930s, seemingly preferring a 'wait and see' strategy. Only the initial scare in 1934 actually prompted the Colonial Office to take definitive action by banning the procedure for its own personnel. However, its resolve proved weak, and, together with its medical advisors, was quick to set aside its original and unresolved worries to permit the inoculation of European residents in Bathurst. Had this been an isolated relaxation of the ban it could simply be regarded as an emergency measure taken in the desperate times in response to an epidemic, rather than as an indictment of its commitment to safety issues. However, this was not the case. The decision to resume voluntary inoculation of colonial officials in London was made concurrently with the resolution to initiate the campaign in Bathurst, following discussions between the Colonial Office medical experts (Stanton and O'Brien) and those at the Wellcome (Findlay and Wenyon). Giving some insight into the decision making process in the Colonial Office, it informed members of the CAMC of this resolution rather then requesting it to debate and decide the matter themselves.[81] After this episode, developments in vaccine technology, rather than Colonial Office strategy, dictated inoculation usage. The Colonial Office, including its medical advisors, were somewhat noncommittal on inoculation safety fears. They gave pacifying responses to worried queries, failing to take positive action in developing a cohesive policy, seemingly content to await further refinements in the vaccine that would reduce side effects. In contrast, the RF stopped the mass use of the virus/serum mix vaccine (prior to 17D) due to serious side effects and hepatitis. The development of 17D proved fortuitous for the Colonial Office as it provided a

[81] PRO. CO 885/37. Minutes of the 355th Meeting of the CAMC, 18.12.1934.

solution to this contentious and unresolved issue in the form of a vaccine agreed to be safe.

The Colonial Office's reluctance to take any firm action on the safety issue reflects its general lacklustre attitude towards yellow fever so far in this period. For many years it had failed to develop a long term and coherent strategy against the disease. Its approach to yellow fever safety problems was in keeping with its past performance. However, the Colonial Office was only one part of the colonial and medical sphere. Reactions within this broad, mixed community were complex, revealing several interacting and conflicting layers of perceptions and responses. No group denied the enormous potential of the vaccine, yet some expressed a greater consideration of safety issues than others. The one concession to safety agreed upon by all groups alike was that people should be inoculated in London when possible. This proviso was flexible and abandoned during epidemics, which as demonstrated in chapter two, were capable of provoking a strong medical reaction. Although the CMS acknowledged that West Africa was not the ideal site to administer inoculations, they considered the risk of contracting yellow fever to be the lesser evil.

The question of compulsion

Compulsion proved to be the second contentious issue because of its possible intrusion on civil liberties and ethics of the enforcement of a procedure with a dubious safety record. The issue related only to the official white population in West Africa, although medical and colonial authorities strongly encouraged non-official Europeans to be inoculated. There was little question of extending compulsory inoculation to the indigenous population. All the varieties of Findlay's vaccine throughout the 1930s were associated with this issue, and therefore no distinction will be made between them here.

Attention was drawn to the problem almost immediately after Findlay made the vaccine available in London, when the procedure was very much in its infancy and Colonial Office policy on the matter was non-existent. In August 1933, the Colonial Office's Consulting Physician in Liverpool, Le Fanu, advised the colonial officer he was examining to be inoculated against yellow fever before proceeding to West Africa. Having previously been an MO in the Gold Coast and an investigator for the British YFWAC, Le Fanu was aware of the dangers the disease potentially presented to European residents in West Africa. His recommendation focused the attention of the Colonial Office, who had been previously untroubled by yellow fever inoculation. Even at this early stage, its medical advisors were quite intent upon avoiding any suggestion of compulsory inoculation, fearing that a non-commissioned officer would perceive a recommendation by a Consulting Physician as an order.[82] The Colonial Office initially took a cautious line advising Le Fanu that there could be no element of compulsion in inoculation: that the final decision should rest with the individual. Curiously, it denied that person a decision informed by the advice of the Consulting Physician. Le Fanu was instructed: "In the circumstances, while we do not wish to hamper your discretion in recommending yellow fever inoculation, we should be glad if, for the present, you would make your recommendation in the official report, leaving us, if it is so decided, to communicate with the individual".[83] The Colonial

[82] PRO. CO 323/1217/15. O'Brien to Fiddian, 25.08.1933.
[83] PRO. CO 323/1217/15. O'Brien to Le Fanu, 07.09.1933.

Office subsequently informed the official at the heart of the episode to ignore Le Fanu's advice.[84]

Compulsory vaccination had long been a controversial and thorny issue. The government provoked popular outrage in late nineteenth century England when they had attempted to enforce compulsory smallpox inoculation. As a consequence, an anti-inoculation movement developed which highlighted dangerous side effects and doubts over efficacy to strengthen their argument. Eventually, the government allowed conscientious objectors to avoid inoculation by declaring their objections officially before a magistrate.[85] It proved no more popular in the tropical colonies either. Attempts to effect compulsory smallpox vaccination in British India in 1870s and 1880s met considerable resistance and hostility among local governments and the indigenous population.[86] Undoubtedly, the Colonial Office was eager to avoid a repetition of such incidences in West Africa. It was however, keen to encourage its staff to be inoculated at their own behest. A pamphlet outlining conditions of service for officials in West Africa mentioned details of the procedure while stressing its voluntary nature. Its inclusion in such a publication was more than a strong hint of expectations of the Colonial Office.[87] It also provided financial inducements to ease uncertainties, making it free for all colonial officials assigned to West Africa and later their wives, and reimbursing their train fares to London (this offer did not extend to wives).[88]

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[84] PRO. CO 323/1217/15. Fiddian to Corporal Frost, 13.09.1933.
[85] E.P. Hennock, "Inoculation Policy Against Smallpox, 1835-1914: A Comparison of England with Prussia and Imperial Germany", *SHM* 11 (1998), pp.62-63.
[86] M. Harrison, *Public Health in British India: Anglo-Indian Preventive Medicine, 1859-1914* (Cambridge: Cambridge University Press, 1994), pp.82-87.
[87] PRO. CO 554/110/1. Pamphlet entitled, "The Colonial Service. West African Colonies and Protectorates, General Conditions of Service for Civil Servants", July, 1935.
[88] PRO. CO 554/110/1. Amendment to *ibid.* dated October 1937.

The colonial and medical authorities in British West Africa deviated from their metropolitan colleagues, demonstrating an increasing preference for compulsory yellow fever inoculation as the late 1930s progressed. The government of the Gambia made it mandatory for all its colonial officials and their wives in 1935. This suggests that Richards's initial hostility to Findlay's inoculation campaign did not arise from distaste for the procedure of inoculation itself. Perhaps, instead, it was fuelled by the manner of the Colonial Office's handling of the incident. Despite its dislike of compulsion, the Colonial Office did not oppose this move. This corresponds with the general administration of colonial rule which allowed colonial governments to direct policy in the colonies, rather than the Colonial Office. Perhaps the Colonial Office saw it as a possible test case for its extension to the other three West African colonies. The Colonial Office possibly regarded compulsory inoculation for officials in the Gambia to be more acceptable than in the other three colonies. The Gambia was a small, relatively unimportant colony with a less numerous official community than elsewhere in British West Africa. As all colonial personnel in the Gambia were inoculated during the 1934-35 epidemic, only a handful of official newcomers required the vaccine. The recent epidemic may have been instrumental in lessening any objections or uncertainties of colonial officials assigned to the colony. Compulsory inoculation did not extend to the civilian population of the Gambia. Instead, the CMS subjected them to intensive propaganda campaigns to persuade them to be inoculated. The colony's *Annual Medical Report* confidently declared in 1937 that as a result few, if any European civilians were unprotected by inoculation. It pledged a determination to extend the campaign to the Syrian population in the forthcoming year.[89]

[89] *Gambia Annual Medical Report, 1937*, p.7.

The other three colonies did not follow the Gambia's example, restricting themselves to active encouragement of officials and non-officials alike. In a strongly worded circular to its staff in 1939, the Colonial Secretary of Sierra Leone made it quite clear that although inoculation was not formally compulsory for colonial officials, it was expected: "While the Governor does not wish to issue any direct orders in the matter, unless compelled to do so, he trusts that every officer, if not already inoculated will arrange to be inoculated on leave".[90] By 1938, all three colonies were considering the possibility of compulsion, and even extending it to the non-official population: a measure not yet then resorted to by the Gambia. Colonial governments and the CMS were open supporters of compulsion by this time. As commented on by the CMS in the Gold Coast, compulsory inoculation would not only save lives but prevent the inevitable disruption to commerce that more traditional measures against yellow fever epidemics caused.[91] The outbreak of World War Two gave such considerations particular and special expediency and thus will be examined separately in the following chapter.

Racial groups and inoculation

Inoculation operated within a racial hierarchy, based largely on notions of African immunity to yellow fever. The colonial and medical authorities in Britain and West Africa almost exclusively restricted it to the susceptible European population in West Africa, as medical opinion held that the indigenous population did not require such protection. However, there is evidence of a social ranking within this preferential

[90] PRO. CO 554/119/9. Circular no.21/m/72/39. The Colonial Secretary, Sierra Leone, 16.09.1939.
[91] *Gold Coast Annual Medical Report, 1938*, p.21.

framework. It is evident that the Colonial Office gave its white officials privileged treatment as it provided the London based service free to its personnel and their wives on leave from West Africa. The Colonial Office and CMS encouraged non-officials to be inoculated while in Britain, but took no responsibility for costs.[92] The government of the Gambia practised the prioritisation of its officials to the extreme by making inoculation a condition of service. This preferential treatment of colonial officials was a feature of some aspects of the CMS's campaigns against the disease, as demonstrated in chapter two. For example, on some occasions, colonial medical personnel provided colonial officials with mosquito nets and screens free of charge, giving non-officials only the benefit of their advice.

However, it is the racial dimensions of inoculation that is pertinent here. The restrictive inoculation practices occurred as the CMS were extending their role in health care in the tropics to address the medical problems of the indigenous population. The Colonial Office expressed a greater acceptance of the health needs of the indigenous population accompanied by some determination to act in this previously under-resourced area. Certainly, there is much evidence to suggest that the CMS themselves had long been aware of this deficit but failed to alleviate the situation owing to an absence of funds and political commitment. The new direction stemmed from a concerted attempt by the Colonial Office in the 1930s to develop the colonies.[93] This was hardly a new policy. Various attempts had been made since the Secretary of State, Joseph Chamberlain, announced his ambition to develop the colonies using British capital in the 1880s. However, an uncooperative Treasury

[92] Sources do not indicate who was responsible for the cost of inoculations administered in West Africa during epidemics.
[93] See S. Constantine, *The Making of British Colonial Development Policies, 1914-1940* (London: Frank Cass, 1984) for an overview of the Colonial Office's activities in this area.

hindered Chamberlain's intentions, in addition to the many similar minded Secretaries of State that followed. For approximately the first thirty years of the twentieth century, colonial policy dictated that colonies must be financially self sufficient, receiving little assistance from the home government. The Colonial Office made some grants and loans available on an ad hoc basis but these efforts rarely represented a firm commitment to colonial development. It offered them mainly to stimulate British industry and commerce, as M. Havinden and D. Meredith claim: "to make the colonies better customers and suppliers".[94] This inextricably tied the development of the colonies with the economic fortunes of Britain. In West Africa, the move to capitalist development and investment was complicated by the colonial governments' occasional desire to protect the indigenous population from development, even if contrary to the home government's moves, particularly if development threatened to change traditional lifestyles and models of production. For example, when William Lever asked permission to build oil palm plantations in West Africa, local governments repeatedly denied him permission on this basis.[95]

However, the global depression in the late 1920s and 1930s prompted the Colonial Office to change its commitment to development. It made its first tentative moves with the introduction of the Colonial Development Fund in the 1929 Colonial Development Act. This provided up to one million pounds annually in the form of grants and loans to finance development schemes drawn up by colonial governments. It was administered by the Colonial Development Advisory Committee. Like earlier financial provisions, the Colonial Office initially created the fund to benefit the British economy, hoping that the schemes would create a demand in the colonies for British

[94] M. Havinden and D. Meredith, *Colonialism and Development: Britain and its Tropical Colonies, 1850-1960* (London: Routledge, 1993), p.152.
[95] *Ibid.*, p.158.

goods and labour stimulating the British economy and relieving unemployment. It believed that the multiplier effect would enhance this further.[96] Again, this linked the development of the colonial economy to the economic revival of the mother country. In practice this did not benefit the British economy to the extent anticipated yet did provide valuable financial assistance to the colonies, predominantly in the form of minor grants for relatively small scale projects. West Africa received £500,000 of the total £6,500,000 advanced; the largest single grant to the region went to Sierra Leone: approximately £250,000 to the Sierra Leone Development Company which mined iron ore.[97]

The trend of allocations reflects the Colonial Office's general attitude towards development in the colonies. Initially, the CDAC favoured schemes that were more likely to benefit the British economy. These included transport and communication schemes which received thirty three per cent of allocations from 1929 to 1930. This fell to ten per cent from 1933 to 1934, and a mere three per cent from 1936 to 1937. At the same time, allocations to schemes of social rather than economic development, such as public health, were increasing.[98] Havinden and Meredith reason that this change occurred because of the emergence of a new school of thought within the CDAC which recognised the need to improve social conditions in the colonies if development was to be successful. This group conflicted with the traditionally minded members who wanted to persist with their original remit of improving Britain's economic fortunes by prioritising schemes of economic development that would produce quick and tangible results. The dominance of one or the other group

[96] A.G. Hopkins, *An Economic History of West Africa* (London: Longman, 1973), p.261.
[97] *Ibid.*, p.261.
[98] Havinden and Meredith, *Colonialism and Development* (1993), p.165.

fluctuated throughout the CDAC's existence.[99] By 1937, the CDA was perceived to have failed: it had not reduced British unemployment, nor instrumentally affected colonial development. A better funded and more systematic approach was sought and in 1940 the fund was replaced by the Colonial Development and Welfare Act which allocated five million pounds per annum for ten years to be spent on schemes of colonial development and welfare, with an additional £500,000 per year for research projects with no time limitations.[100] This scheme targeted social welfare, as well as economic development. For the five years of its operation, welfare schemes including water supplies, housing, medicine, public health and education received fifty eight per cent of the total funds. This compares to schemes of economic development such as industrial development, transport and communications, agriculture, veterinary, forestry, fishing and public utilities receiving thirty four per cent.[101]

The new emphasis on colonial development inevitably had some effect on medical policy and provisions. The Colonial Office's earlier insistence that the colonies be self financing perpetuated the CMS's fundamental function as protectors of European health. Few colonies could afford the luxury of tackling indigenous health even if the political will existed. Certainly in West Africa, many MOs were aware that West Africans suffered from numerous diseases and varying degrees of ill health yet could do little without available financial resources together with the governor's support.

In the 1930s and 1940s moves began to provide concrete assistance to improve indigenous health: an integral part of increasing efforts to address social welfare for successful colonial development. This is reflected in surveys conducted

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[99] *Ibid.*, pp.165-167.
[100] *Ibid.*, p.218.
[101] *Ibid.*, p.223.

earlier in the period. These included Lord Malcolm Hailey's *African Survey* and the *Report of the Advisory Council on Nutrition in the Colonial Empire.*[102] It was also demonstrated in medical conferences during the 1930s. For example, the agenda for the West African Medical Conference in 1938 included maternal and child welfare, malnutrition, rural water supplies, provision of school meals and health education for the indigenous population.[103] These concerns extended beyond the medical community in West Africa. S. Gaseler at the Foreign Office urged the Health Organisation of the League of Nations to prioritise the problems of raising African living standards, and malnutrition as topics for discussion at the forthcoming health conference.[104] These debates highlighted that the British government could no longer ignore the well-being of the indigenous population of the empire. Slowly, the Colonial Office made provisions to tackle the issue. There were economic as well as humanitarian motives. Indigenous health was a central issue in colonial welfare, and crucial to the newer theories about colonial development. The Colonial Office was aware that a productive population was essential if it was to develop the colonies. Certain standards of health were necessary if a worker was to be reasonably productive. This had been a central rationale for much of the RF's work. E.R. Brown argues that Frederick Gates of the RF believed: "healthy workers are profitable because they are an employers' 'human capital' to be utilized for production of

[102] *Report of the Advisory Council on Nutrition in the Colonial Empire.* Cd. 6050-6051, 1938-9; Lord Hailey, *An African Survey: A Study of the Problems Arising in Africa South of the Sahara* (London: Oxford University Press, 1938). For an analysis of the recognition of nutritional problems in the empire see M. Worboys, "The Discovery of Colonial Malnutrition Between the Wars", in D. Arnold (ed.), *Imperial Medicine and Indigenous Societies* (Manchester: Manchester University Press, 1988), pp.208-225.
[103] LSTM. TM 13/79/1/3.
[104] PRO. CO 859/14/1. S. Gaseler at the Foreign Office to the Secretary General of the League of Nations, 17.07.1939. This conference was postponed because of World War Two.

saleable goods and services".[105] Applying this rationale, in order to fulfil the Colonial Office's ambitions for colonial development, it had to make the indigenous population healthy and productive. This complemented the new policy of British responsibility for the social welfare of the colonies.

Financial assistance to improve indigenous health was available from the CDF. There were two health related categories under which colonial governments could obtain grants and loans: one specifically for medicine and public health, the other for water supplies and sanitation. The latter would be of undeniable value to improve the health of the indigenous population as providing clean water and good sanitation is an essential element of public health. Such measures proved invaluable in improving general health in Britain in the nineteenth century. In the tropics however, the provision of clean piped water would have reduced the necessity for storing water, thus removing potential mosquito breeding areas, helping to lower incidence of mosquito borne diseases such as yellow fever.

The administration of yellow fever vaccine was consistently incongruous with this new direction. The medical community continued to target the white population for inoculation almost exclusively throughout the 1930s. The CMS rarely offered Africans the vaccine. The colonial and medical authorities of the Gambia hesitantly discussed this issue during the 1934-35 epidemic, but they quickly rejected the notion. Richards dismissed the possibility claiming that Africans would not allow themselves to be inoculated as they believed themselves to be immune from severe yellow fever and preferred to drink a "decoction of herbs".[106]

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[105] E.R. Brown, *Rockefeller Medicine Men: Medicine and Capitalism in America* (Berkeley: University of California Press, 1979), p.113.
[106] PRO. CO 87/239/15. Richards to Fiddian, 10.11.1934.

Members of the metropolitan medical community were not entirely oblivious to the possibility of African inoculation. Occasionally, its members discussed the possibility, yet this stemmed from a desire to remove the health threat presented by the indigenous "reservoir of disease", rather than from humanitarian driven attempts to prevent African ill health. For example, in 1938, Findlay speculated on the possibility of mass African inoculation in West African urban centres to prevent the transmission of infection to a larger area.[107] The following year, there were tentative moves within the Colonial Office to begin some African inoculation, encouraged by the RF's suggestions to begin a mass inoculation campaign. This did not represent a RF led control campaign as the RF did not intend to be heavily involved in such a project, but indicated that it would be "willing to lend a man" to assist.[108] Hesitant to commit themselves to a large scale programme, R. Briercliffe, the DMS in Nigeria suggested to O'Brien, who had, by then, replaced Stanton as Chief Medical Advisor, a more cautious plan of inoculating the servants of colonial officials.[109] This would have offered greatest protection to officials. Servants often lived on European premises, and thus were the closest "reservoirs of disease". In addition, as servants they were easier to subject to some element of colonial control. I have been unable to find any evidence regarding the outcome, if any, of this proposal, although it is possible that they altered or abandoned it at the outbreak of World War Two. There are parallel examples of this selective policy on indigenous inoculation. For example, D. Arnold has noted in nineteenth century British India, Indians who had the greatest

[107] Soper, "Yellow Fever: The Present Situation", "Discussion", (1938), p.325.
[108] PRO. CO 554/119/9. O'Brien, 09.01.1939.
[109] *Ibid.*

contact with whites, domestic servants, soldiers and labourers, were usually the first members of the local population selected for smallpox inoculation.[110]

There are several possible reasons for the neglect of African inoculation during the 1930s. Practical considerations were critical. The mass inoculation of Africans throughout West Africa was simply unfeasible and unworkable. It would have involved several million people (Findlay estimated 1.5 million in the larger urban centres[111]) in a region with an underdeveloped infrastructure. It would have been an impossible undertaking, even if limited to the more populous regions. Apart from the sheer practical and administrative barriers, stocks of vaccine would have been woefully inadequate for even a small part of such a campaign. However, there is no indication of any selective targeting of the indigenous population to receive the vaccine: a more realistic task. For example, in an early yellow fever inoculation campaign in Freetown in 1935, all European medical staff were selected for locally administered inoculation. This provided immediate protection for a group deemed particularly at risk from infection. However, it was restricted to European workers only. There is no mention of the inclusion of any African medical staff. There is no indication that medical personnel offered the vaccine to any Africans during epidemics when they made the procedure locally available to Europeans and usually Syrians too. Outside of epidemics, the CMS restricted themselves to encouraging only the white population to be inoculated as a general, non-emergent protective measure. The preference for London as the site for its administration reinforced its exclusivity to whites.

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[110] D. Arnold, *Colonizing the Body: State Medicine and Epidemic Disease in Nineteenth Century India* (Berkeley: University of California Press, 1993), p.135.
[111] Soper, "Yellow Fever: The Present Situation", "Discussion", (1938), p.325.

Practical issues were not the sole reason for this neglect. Medical and scientific assumptions regarding the pattern of the disease among the West African population played a significant role. As already demonstrated, ideas of Africans as a reservoir of yellow fever infection prompted sporadic considerations of African inoculation. However, theories of African immunity and mild yellow fever were dominant elements in the theoretical basis for racially restrictive inoculation practices. Western medical and scientific thinking throughout the period of this thesis contended that the indigenous population were largely immune to the disease. Although protection test surveys had produced a subtle picture of levels of past infection throughout West Africa and the rest of the continent, members of the medical community continued to perceive West Africans as a homogenous group who enjoyed an immunity to the disease. Therefore, its members did not consider that Africans needed inoculation. The observation of mild yellow fever in Africans, which resulted in lower mortality, reinforced this belief. Therefore, medical personnel regarded West Africans as immune to the disease, and/or less vulnerable to its deadly effects than whites, and in less need of inoculation than the allegedly more susceptible white population. This, together with limited supplies of the vaccine ensured that the inoculation of Africans did not become a reality until World War Two when wartime expediencies forced a revision of this trend.

While the CMS were trying to increase the accessibility of western medicine for Africans in other areas, theories of immunity and lower susceptibility were denying them access to inoculation. However, this practice and the theories behind it went unchallenged by the colonial and medical establishment. Even protection test survey results, which revealed that large sections of the African community did not demonstrate past exposure and therefore an immunity to yellow fever did not persuade them to re-examine their deeply entrenched assumptions on the matter.

A successful transfer from the metropole to the periphery?

How successful was the transfer of the new technology of inoculation from the metropole to the periphery? Statistics of the inoculations administered would provide a partial indication. Findlay recorded that since inoculations began in November 1932, to April 1937, 2,200 people had been inoculated using his vaccine, although he does not specify if this was in London alone, or if it included figures from inoculations conducted in West Africa.[112] Not all the vaccines performed in London would have been for people about to travel to West Africa; some recipients would have been destined for South America. Therefore, these figures cannot give an accurate estimate of its transfer to West Africa, but rather to both endemic areas in Africa and South America. However, evidence suggests that the majority of recipients were about to depart for West Africa.

There are indications that inoculations were increasing in popularity by 1937, suggesting that the transfer was gaining pace. By October that year, Findlay reported that a total of 3,100 people had been inoculated in Britain using his vaccine; an additional 900 people in six months since his previous report.[113] In the following five months a further 1,100 people underwent the procedure using 17D instead; the new vaccine perhaps a critical factor in explaining the increase, as it was safer. Unfortunately, there is little further evidence, although the CMS in the four colonies

[112] Findlay and MacCallum, "Note on Acute Hepatitis", (1937), p.297.
[113] *Idem*, "Hepatitis and Jaundice", (1938), p.799.

maintained and used vaccine stocks, which, together with Findlay's figures, suggest that there was some demand for the procedure among the white population of West Africa.

As these figures present only a rudimentary picture of the vaccine's transfer to West Africa, an indication of the complexities involved can be given by applying Headrick's model of technology transfer to the yellow fever case study. Headrick examines the process of the transfer of various technologies from Britain to the empire. There are characteristics of this particular analysis that produces deviations from his framework. He argues that the process of technology transfer to the periphery encountered both resistance and support.[114] Yellow fever inoculation during the 1930s reflected this experience, as it was marked by conflict together with a desire by many groups to accept the new technology. Headrick contends that successful transfer hinges more on the acceptance of the receiving society, than on the exporting one. This is problematic when applied to the yellow fever case study. How can these discrete groups be applied to yellow fever inoculation: who were the importers and exporters in this framework? Findlay and the Wellcome Bureau were exporters, manufacturing, administering the vaccine, and promoting the procedure within the relevant circles. However, the definition of importers is somewhat hazy. Can it be as straightforward as simply the vaccine recipients? Surely, this group would have to include the colonial governments and the CMS in West Africa as the authoritative representatives of the beneficiaries. They became vociferous advocates for inoculation although with occasional doubts arising, for example, at Dunbar's death. What was the role of the Colonial Office in this context? As the primary colonial authority it

[114] Headrick, *Tentacles of Progress* (1988), p.10.

could arguably be regarded as an importer, yet its dealings with the Wellcome suggest it acted as an exporter. Perhaps it transcended the two groups, playing as part of interested by-stander, forced into action reluctantly when called upon to deliberate on contentious issues such as safety and compulsion. Even in these matters it did not prove to be proactive in deciding their stance.

Headrick stresses the centrality of geographic transfer of technology in European imperialism. In this respect, inoculation represents a curious example of this process, as it was predominantly, and indeed, preferably conducted in the metropole. However, it did become a feature of anti-yellow fever campaigns against epidemics in West Africa, and thus its transfer in this context was relatively unhindered. Indeed, as in the Bathurst epidemic, it was able to overcome a considerable barrier imposed by safety fears. However, it is arguable that the physical site of its administration is, to a certain extent, irrelevant to this analysis of its transfer. It had to become, in the minds of the colonial authorities and medical communities in Britain and West Africa, an accepted means of protection against yellow fever. Once they had acknowledged its effectiveness and inoculation had become an established part of general measures against the disease in its epidemic and endemic form, then it can be argued as being effectively transferred. Certainly, a lack of consensus among the medical community, together with worries about potential health risks hampered this process. By the introduction of 17D by 1937, it can be convincingly contended that the transfer was in process, to be swiftly accelerated by World War Two.

Conclusion

The colonial and medical authorities alike received protection tests and inoculation with guarded enthusiasm. Protection test surveys offered them a means to map areas of endemicity in Africa. The results proved unpalatable, if potentially useful. There can be little doubt behind the reasons for their positive reaction to inoculation: it provided a new and seemingly effective response to the disease. It was relatively easy to administer, lasted several years, and could be targeted at individuals deemed to be at particular risk. It did not require community co-operation which was essential for many anti-yellow fever measures. It did not have any detrimental effects on trade or the otherwise effective operation of a colony. However, it was not without controversy and issues surrounding safety and compulsion provoked attention and mixed feelings throughout colonial and medical communities. Numerous interested groups responded differently giving insight into a complexity of priorities and interests. The discord and indecision surrounding inoculation in the 1930s clearly reveals the divisions within the medical community. It demonstrates that its members did not form a homogenous group, nor did they operate as one voice of expertise. Their conflicting opinions resulted from differing professional convictions and beliefs, yet were not alleviated by any definitive and comprehensive direction from the Colonial Office. Despite uncertainty about inoculation and protection tests, their transfer to the colonies was successful by the end of the 1930s, with the metropolitan and peripheral colonial and medical communities accepting their value.

Both measures engaged with endemic yellow fever: protection tests offered new understandings of endemicity in West Africa and beyond, and inoculation provided an effective means of contending with the problem. Together they ushered in a new dimension of yellow fever control. Previously, the colonial and medical authorities had taken little positive action against endemic yellow fever. As discussed in chapter two, the CMS failed to sustain efforts in this arena, allowing routine anti-yellow fever measures to lapse in the absence of visible infection. They concentrated their efforts on epidemics, when the disease was a discernible threat to European health. These new technologies offered an unrivalled means of dealing with endemicity: protection tests highlighted areas needing control, and inoculation reduced the numbers of susceptible people. The latter also proved a useful epidemic control measure, and colonial and medical authorities made it available in the colonies for emergency use. However, it did not replace tried and tested methods. Although vaccination provided an unrivalled means of prophylaxis, the CMS did not use it as a substitution for anti-mosquito measures, but as an additional recourse.

Although protection tests and inoculation were valuable against endemic yellow fever, colonial and medical communities were indecisive about their use, particularly inoculation. As I have argued, the Colonial Office failed to devise a coherent strategy regarding the contentious issues relating to inoculation such as safety concerns and compulsion. It took a decisive stance on safety fears in 1934, when it banned the procedure for its officials. However, it rapidly reversed its position during the Bathurst epidemic, again suggesting the ability of yellow fever epidemics to provoke anxieties and galvanise action. For the remainder of the 1930s, the Colonial Office sat on the fence, unresponsive to the worries of the colonial and medical communities in Britain and West Africa. Instead, it relied on scientific developments leading to increasing safer vaccines to provide a solution. The Colonial Office was equally hesitant about compulsion. Reluctant to impose a potentially unpopular policy, it allowed the colonies to determine direction in this area individually. This reflected the system which underpinned colonial rule in which the colonial government largely directed the day to day running of the colony. However, the conflict about safety and compulsion existed throughout the medical community in Britain and West Africa, suggesting a more active Colonial Office response was appropriate. The CMS were initially uncertain about inoculation because of safety issues. However, they became increasingly convinced of the technique's value and actively encouraged the white population to take advantage of the procedure. By the end of the 1930s, the Gambia had introduced compulsory inoculation for its colonial officials, with the other three colonies considering a similar policy. This signifies the popularity of inoculation among colonial governments and CMS.

Protection tests and inoculation had racial implications. Although initially sceptical, the medical community considered that protection test surveys revealed endemic areas, in the sense that the disease was present among the local population as demonstrated by positive results. Although medical personnel were aware that levels of positive results varied throughout the indigenous population, they usually lost this subtlety in practice. Consequently, survey results marked entire regions as endemic, and the indigenous population in these areas were consequently labelled immune. This justified and reinforced long held notions of Africans as an immune population group. It prevented the interested groups from regarding immunity as acquired and enjoyed at an individual level. Surveys also confirmed the view that Africans constituted a reservoir of infection, and were thus a danger to white health. Entrenched ideas of African immunity fed into inoculation practices that continued the CMS's ethos of prioritising white health. Colonial and medical authorities targeted inoculation towards Europeans. Medical personnel and colonial authorities in Britain and West Africa rarely discussed the possibility of African inoculation. When they did, it arose from beliefs that Africans were a reservoir of yellow fever. Inoculation would thus shrink the reservoir, decreasing the possibility of transmission to Europeans. Protection tests and inoculation represent new technologies and research in tropical medicine, offering control based on immunological techniques. It is ironic that these fresh directions reinforced old racist practices in West Africa.

CHAPTER FIVE

YELLOW FEVER CONTROL DURING WORLD WAR TWO

The war brought in a new era for yellow fever control. Specific wartime conditions forced a reappraisal of metropolitan perceptions of the disease in West Africa and elsewhere in the continent. It became an issue that the Colonial Office could no longer afford to side-step. Definitive strategies were required for its control, particularly regarding inoculation and transmission by aeroplane. This chapter examines how the Colonial Office and others responded to the threat of yellow fever during the war, and the factors that informed their reaction. How did their approach diverge from that during peacetime? Did they sustain their efforts after the war? I will argue that the Colonial Office overcame its previous complacency which had marked the last four decades, and enacted a number of measures and policies to aid yellow fever control. It was forced to play a greater role in yellow fever control than previously, resulting in a metropolitan based, centralised approach to the disease. World War One had little effect on anti-yellow fever efforts, except in hastening the end of the YFWAC. World War Two created unique conditions necessitating effective control of the disease.

I will contend that this change was accompanied by an acknowledgement among colonial and medical communities in Britain and Africa of the implications of endemic yellow fever. Experts had long been aware that endemic yellow fever existed in West Africa. The war gave the control of endemic yellow fever an urgency that was absent in the 1930s, and inoculation and protection tests provided effective means. This analysis demonstrates that British responses to the disease were sensitive to social, political and economic factors, not just epidemics. Unlike during the previous forty years, a visible and dramatic presence of the disease was not always required to provoke colonial and medical action.

The problem of yellow fever underwent an administrative expansion during the war, as additional groups became involved in control. As such, this analysis covers a broad range of institutions and players. It examines the interaction of the colonial, medical and military authorities in the context of wartime disease control. The focus is predominantly metropolitan, appraising the efforts of the Colonial Office in particular, the War Office and the specially created Inter-Departmental Committee of Yellow Fever Control. These groups did not respond solely to the disease in West Africa, but considered the endemic area throughout Africa, as delineated by protection test surveys. This examination focuses on their relevance to control in West Africa. To a more limited extent, I assess how the colonial and military medical services implemented metropolitan recommendations and policies. With some issues, such as the compulsory inoculation of residents, they had some autonomy from their British based colleagues, and thus devised strategies that they deemed appropriate. Medical personnel from the colonial or military authorities mainly implemented anti-yellow fever measures. There was little scope for the independent involvement of individuals such as Findlay who tended to be incorporated into the official wartime administration.

In contrast to this metropolitan emphasis, other historians have taken a more grass roots, field based approach to studying tropical diseases in war. M. Harrison has examined malaria control in both World Wars.[1] The efforts of senior officers in the

[1] M. Harrison, "Medicine and the Culture of Command: The Case of Malaria Control in the British Army During the Two World Wars", *Medical History* 40 (1996), pp.437-452.

field serve as his focus, offering a complementary account to this study. He stresses the importance of their attitudes to the disease for the implementation of effective anti-malarial measures. My study explores the impact of metropolitan efforts on yellow fever control. The war prompted an emergence of a centralised effort against the disease with British based groups as the driving force. This contrasts with prewar endeavours when the Colonial Office left control issues in the hands of colonial governments and medical services as it did with many other aspects of colonial rule. It also demonstrates that yellow fever control during the war involved the interaction of several governmental and medical authorities. The metropolitan focus is balanced by an examination of the activities of the IHD of the RF during their return to West Africa at the end of 1943. This provides the research context of yellow fever control, demonstrating the prominence of immunological techniques alongside vector control.

The chapter begins with an overview of the impact of the war on West Africa, socially and economically. Although not a site of hostilities, the region was of significant strategic value to the allies. The implications of the war for yellow fever control are considered, particularly in the context of endemic yellow fever. The Colonial Office's initial solution is examined. This focuses on the creation of an interdepartmental body, the IDCYFC, to study the problem of yellow fever control, and advise various colonial and military groups. The analysis then turns to two specific areas of control policy: inoculation and air transport. It reveals how the colonial and military medical authorities conducted campaigns on an unprecedented scale, using mass inoculations and anti-mosquito measures in West African aerodromes. In particular, how wartime expediencies prompted the Colonial Office to overcome its previous distaste for compulsory inoculation to establish a system of enforced vaccination, albeit recognising conscientious objectors. I then link this analysis to R. Cooter's work on medicine and war in which he deconstructs popularly held notions that war provided a number of benefits to medicine.[2] I contend that there were some positive aspects for yellow fever control arising from the war; especially the new urgency the Colonial Office gave the disease. This also relates to postwar control issues. Were the benefits only short term, or did they continue after the war? The re-emergence of the international community is briefly addressed. This is followed by an analysis of the RF's return to West Africa in 1943 with its Yellow Fever Institute. Although not an attempt to begin control campaigns, the RF Institute's research in the region was of value to both the British and American medical communities, particularly with respect to jungle yellow fever. This illustrates the RF's war and postwar research priorities. The Institute's methods and goals are examined, followed by its failed attempt to stimulate British interest in yellow fever research.

World War Two: the greatest threat? New perceptions and policies

The war had a substantial impact in Africa. A theatre of war; it was also a vital source of men and materials, and an essential component of supply routes to the East. Fighting occurred in several areas: North Africa from 1940 to 1943, Ethiopia and Somalia, 1940-1941. The allies gained control of Madagascar from the French in 1942 after small scale military action.[3] The war had several implications for British

[2] R. Cooter, "War and Modern Medicine", in W.F. Bynum and R. Porter (eds.), *Companion Encyclopedia of the History of Medicine* (London: Routledge, 1993), pp.1536-1573.
[3] D. Killingray and R. Rathbone, "Introduction", in *idem* (eds.), *Africa and the Second World War* (London: Macmillan, 1986), p.9.

West Africa. Although never a theatre of war, from 1940 it became of considerable strategic value to the allies as the site of vital trade and supply routes.[4] It became a key base for transports to the East as other alternatives were rapidly denied. The entrance of Italy into the fray in May 1940 rendered the supply route through the Suez Canal uncertain. The occupation of France after June 1940 affected relations with French colonies in West Africa. They were loyal to the Vichy regime in France and hostile to the Allies, destroying their potential as supply posts.[5] The French colonies changed their allegiance in November 1942, alleviating this problem, and permitted aerodromes in Dakar, Ouakam, and later Rustifisque to be used by Allied forces.[6] Thus, from 1940 to 1943, British West African ports and aerodromes played a vital role in shipping men and equipment to various theatres of war. The region was also an important source of manpower and resources; increasingly exploited in accordance with the prioritisation of metropolitan needs. The Royal West African Frontier Force came under the control of the War Office, its numbers increasing from 8,000 to 146,000. Although the British government never introduced conscription, M. Crowder argues that a thin line separated voluntary recruitment and compulsion.[7] Trade and commerce were subject to much tighter colonial scrutiny and colonial authorities established price controls.

Despite these restrictions, Crowder claims that the economies of British West Africa flourished during the war as demand for their goods boomed.[8] In addition, the metropolitan commitment to colonial development remained and was manifested in

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[4] *Ibid.*, p.9.
[5] M. Crowder, *West Africa under Colonial Rule* (London: Hutchinson & Co., 1968), p.491.
[6] S.C. Rexford-Welch (ed.), *The Royal Air Force Medical Services. Vol. I* (London: HMSO, 1954), p.391.
[7] M. Crowder, "The 1939-45 War and West Africa", in J.F.A. Ajayi and *idem* (eds.), *History of West Africa. Vol. II* (London: Longman, 1974), p.598.
[8] *Ibid.*, p.610.

the 1940 Welfare and Development Act, which provided financial aid for developmental projects in the colonies.[9] At first glance, colonial medical departments seemed to be benefiting from this boom as the general trend of medical expenditure in each of the four colonies increased during the war. However, this presents an inaccurate picture as the medical departments in West Africa faced a redirection of resources. Staff numbers dwindled as personnel were reassigned and their roles redefined. A.G.H. Smart, the Chief Medical Advisor to the Colonial Office, estimated that as many as a quarter of the MOs in the CMS in Africa transferred to the military were specialists, depriving the CMS of expert staff.[10] A worsening of working conditions with periods of leave shortened and the length between leaves extended, further compounded their burden.[11] They also faced a large influx of non-immunes for whom they had to provide quinine, yellow fever inoculations, a multitude of medical services as well as safe sanitary conditions, causing increases in expenditure.[12]

Fortunately, the CMS did not have to contend with any serious epidemics of yellow fever during the war: no major epidemics were recorded. The Gambia remained seemingly free of the disease, and medical personnel reported only two cases in Sierra Leone in 1942. In the Gold Coast and Nigeria, numbers did not exceed four per annum, except during 1939 when eight people in Nigeria succumbed to

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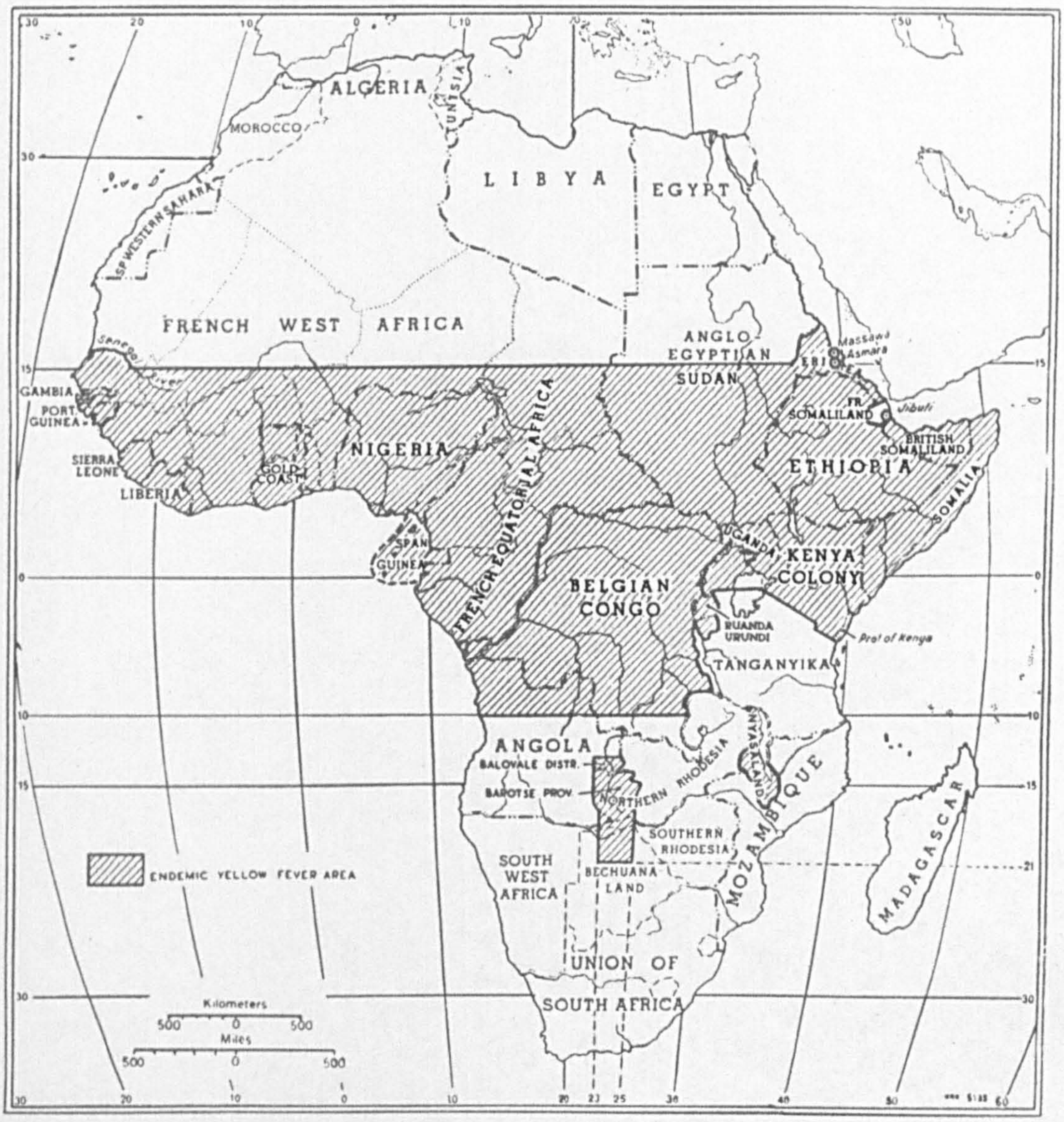
[9] See chapter four for a brief outline of the 1940 act, and more generally M. Havinden and D. Meredith, *Colonialism and Development: Britain and its Tropical Colonies, 1850-1960* (London: Routledge, 1993).
[10] A.G.H. Smart, "Some Medical Problems in the Colonies in Wartime", *TRSTMH* 36 (1942), p.321.
[11] *Ibid.*, p.321. Other colonial departments in West Africa suffered similar problems during the war. For an examination of the impact on the war on the Nigerian Colonial Service, see R.D. Pearce, "Morale in the Colonial Service in Nigeria During the Second World War", *Journal of Imperial and Commonwealth History* 11 (1983), pp.175-196.
[12] See A.S. MacNalty (ed.), *History of the Second World War: United Kingdom Medical Services*, 21 vols., (London: HMSO, 1952-1972), for official histories of the medical services during the war. For an overview of the bibliography of military medicine see F.N.L. Poynter, "The Evolution of Military Medicine", in R. Higham (ed.), *A Guide to the Sources of British Military History* (London: Routledge, 1972), pp.591-605. For more recent analyses of war and medicine see essays in R. Cooter, M. Harrison, and S. Sturdy (eds.), *War, Medicine and Modernity* (Stroud: Sutton Publishing, 1998).

infection. However, the specific conditions war created in West Africa provided a number of crisis points relating to the disease. This heightened existing tensions relating to issues such as inoculation and air transportation.

The CMS in West Africa, and wartime colonial and medical authorities in London focused on the new threat presented by endemic yellow fever. The colonial and medical communities had long acknowledged that the disease was endemic in West Africa, and in the last decade, parts of Central and East Africa. The British authorities had done little to alleviate endemic yellow fever in the 1910s and 1920s, but did encourage inoculation in the 1930s, albeit haphazardly. A new appreciation of endemic yellow fever emerged during the war, deriving from the interaction of three factors. The first, as examined in chapter four, was protection test survey results conducted throughout the 1930s and 1940s. These suggested that the disease existed beyond West Africa, extending into central and eastern areas previously believed to be free from infection. This created a geographical expansion of yellow fever control (see figure 5.1 on page 279 for a war and postwar definition of the endemic area). The second was the development of effective vaccines which provided individual prophylaxis and limited the risk of endemic yellow fever erupting into epidemics by reducing the size of the susceptible population. Both these elements were not unique to the war, and had been used during the previous decade. They were the means to deal with the endemicity: by highlighting zones, and providing a simple method of prevention. The third factor was the specific conditions created by the war which gave the Colonial Office and other various groups the motive and impetus to deal with endemic yellow fever. These included the influx of non-immune military personnel, the increase in air transportation, and the strategic value of West Africa to the Allies.

Figure 5.1: The endemic region as defined by the IDCYFC in 1944 (excluding the endemic areas in Northern Rhodesia and Nyasaland) and the WHO in 1949.



Source: H.H. Smith, "Controlling Yellow Fever", in G. Strode (ed.), *Yellow Fever* (New York: McGraw Hill, 1951), p.625.

Wartime emergencies forced the colonial and medical authorities to address the issue on an unprecedented scale making use of the new immunological techniques, as well as the more established methods of mosquito control and quarantine.

The British medical authorities faced two control issues. Firstly, to protect British personnel in West Africa from yellow fever, in order to prevent individual suffering and reduce numbers of non-immunes. This was essential as a yellow fever epidemic could close vital ports and aerodromes, crippling supply routes and seriously deplete the numbers of healthy armed personnel, most of which had no immunity to the disease. Smart summarised this dangerous situation:

> in wartime troops and other people go to intrinsically unhealthy places and that they themselves have no acquired immunity to tropical diseases, and usually no previous experience of a tropical climate. Thus they are not knowledgeable in this sense and are unable to look after themselves.[13]

An influx of large numbers of non-immunes into an endemic area created a perfect environment for an epidemic. Difficulties relating to the distribution of resources, medical supplies and equipment, and reductions in medical staff did little to alleviate this situation. Inoculation provided the key to protecting all non-immune personnel against the disease, alongside vigorous anti-mosquito measures, where practicable. However, the Colonial Office's haphazard stance on inoculation during the 1930s was an inadequate framework for wartime needs. The colonial and military authorities had to devise a new strategy for the effective application of this measure.

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[13] Smart, "Some Medical Problems", (1942), p.320.

Secondly, the authorities also had to guard against the spread of the disease from the endemic area. This matter was becoming increasing acute as protection tests conducted during the 1930s indicated that the disease existed in endemic form beyond West Africa, as far east as Uganda.[14] These areas also needed control measures. However, the war diminished the effectiveness of international preventive systems which had previously implemented regulations regarding the transmission of yellow fever. The OIHP became redundant during the Nazi occupation of France. This denied the British authorities a reliable mechanism of disease notification, preventing them from taking adequate steps to protect their territories from importation of diseases including yellow fever. They also lost the friendly co-operation of French West African colonies, provoking uncertainty and distrust in British West Africa.[15] The British authorities therefore, had to set in place their own structure to prevent the spread of yellow fever and devise criteria by which they could meet wartime supply needs without inducing yellow fever epidemics or spreading the disease. The safe operation of airfields and transportation of troops became of critical importance.

The Colonial Office and War Office recognised that the ineffectiveness of the OIHP left a gap in epidemiological intelligence, and that they required an organisational body to consolidate information and co-ordinate action against yellow fever in Africa. As a result, they created the IDCYFC. The Committee's purpose was to extend action against the disease beyond the Colonial Office by offering representation to many concerned government departments, providing true interdepartmental co-ordination. Members included staff of the Colonial Office, the War Office, the India Office, the Air Ministry, the Admiralty, and the Ministry of

[14] H.H. Smith, "Controlling Yellow Fever", in G. Strode (ed.), *Yellow Fever* (New York: McGraw Hill, 1951), pp.580-582.
[15] Crowder, "The 1939-45 War and West Africa", (1974), p.599.

Health. This broad participation is a clear indicator of the significance that the British government attached to the disease during the war. It had ceased to be merely a colonial problem, to be addressed only when crises prompted action. Participants had varying degrees of medical and scientific expertise. It was chaired by Smart, indicating a Colonial Office dominance, and invited speakers included Findlay and Hugh Smith of the IHD of the RF. The carefully selected membership indicates that the IDCYFC had the potential to play a central role against the disease, and that the various involved groups would take its recommendations seriously. The inclusion of experts in tropical medicine and yellow fever reveals the improved status given to science and medicine in wartime planning in World War Two: more so than during World War One.[16] It signified a centralised, metropolitan approach to yellow fever control, with members of the Colonial Office and other government departments directing policy from London.

The first meeting was held in October 1941 when members reviewed the current situation. They paid particular attention to inoculation, the ineffectiveness of the OIHP and lack of uniformity of anti-yellow fever measures locally and internationally. They also addressed issues relating to the international spread of the disease in response to concerns about the low standards in sanitary and anti-amaryl airports.[17] These problems preoccupied the IDCYFC throughout the war. Participants firmly established the Committee's function at the meeting: it was to convene regularly to discuss general yellow fever problems and to act as a liaison between the affected departments and armed forces to ensure co-ordination of effort.[18] The

[16] Harrison, "Medicine and the Culture of Command", (1996), p.452.
[17] The criteria for anti-amaryl airports were defined in the 1933 International Sanitary Convention for Aerial Navigation, as outlined in chapter one.
[18] PRO. CO 859/64/9. Minutes of the First Meeting of the Inter-Departmental Committee of Yellow Fever Control, 07.10.1941.

IDCYFC presented its findings and recommendations in a series of interim reports circulated around government departments, the armed forces, and colonies. From the topics for discussion, it is evident that by World War Two, the British Government no longer perceived yellow fever as being a problem exclusively limited to West Africa, instead highlighting the implications of the disease to all British colonies in Africa and India.

The IDCYFC played a central part in formulating policy made by the Colonial Office and British government against yellow fever during the war. Its creation was an unprecedented event in controlling the disease during the period covered by this thesis. Never before had such a wide ranging group of individuals been convened in an attempt to develop coherent responses to the disease. It can be argued that it was a positive aspect of the war in respect to yellow fever control. However, the IDCYFC was strictly a metropolitan body. As with many aspects of the history of tropical medicine, an important issue is how considerations of the mother country translated into action in the tropics themselves.

Wartime inoculation: past and present dilemmas

The IDCYFC was particularly concerned about inoculation which offered the most effective means of prophylaxis for incoming non-immune personnel. It gave individual protection and reduced the number of susceptible people, limiting the risk for endemic yellow fever to erupt into an epidemic. The development of the 17D vaccine had alleviated anxieties over safety, inducing the IDCYFC to declare its use trouble free, four years after its introduction.[19] The need to formulate a means of effectively inoculating such a large group of people became increasingly evident by the time of the IDCYFC's creation. There was seemingly little cohesive policy on inoculation administration before the IDCYFC's formation in 1941, and it inherited a situation governed only by confusion: a factor which troubled the War Office.[20] Inoculations were continuing in London, and supplies of Findlay's and the RF's 17D vaccine were being shipped to West Africa for use by the CMS, using the Alfred Jones Laboratory as the local distribution base. At the end of 1941 the IDCYFC believed that medical personnel gave only a few inoculations in the West African colonies. However, the IDCYFC concluded that by October 1941, most of the European official and non-official population in West Africa had been inoculated.[21] This suggests that many had been inoculated in Europe before departing for West Africa. The IDCYFC intimated that current arrangements were insufficient to meet increasing demand created by the war.

The IDCYFC also had to contend with prewar uncertainties about compulsory inoculation. For all its ethical implications, it would ensure that the maximum number of Europeans in, and embarking for, West Africa received this prophylaxis. As examined in chapter four, before the war, the Colonial Office had considered the possibility of instigating compulsory inoculation of its officials. Its extension to the indigenous and non-official European population had not been an issue. However, the Colonial Office had failed to provide clear directions on the matter. It made clear its objections to compulsion but left the four individual West African colonies to initiate policy for residents in West Africa. Consequently, the government of the Gambia

[19] *Ibid.*
[20] PRO. CO 859/64/7. Secretary of State for War to Lord Moyne, Secretary of State, 29.08.1941.
[21] PRO. CO 859/64/9. Minutes of the First Meeting of the IDCYFC, 07.10.1941.

made inoculation a condition of service for its officials. The remaining three colonies advised it for serving officials in the strongest terms possible without making it obligatory. During the war, the Colonial Office could not leave this matter in the hands of the colonial governments as it believed that the circumstances demanded some form of central guidance. It was no longer a question of just the compulsory inoculation of European colonial officials in West Africa. The debate expanded to include non-official whites, and selected groups of Africans.

This possibility had been raised even before the IDCYFC's creation. Early in 1940, Sir Wilfred T. Southorn, Governor of the Gambia, asked the Colonial Office to consider legislation for the compulsory inoculation of the non-official European population of the colony. He argued wartime necessity to justify the measure: "we only have one point of entry by sea which it would be disastrous, especially in war, to have closed to ships owing to quarantine against yellow fever".[22] O'Brien, as Chief Medical Advisor to the Colonial Office, agreed to the proposal "as a trial" to "see if it works". He warned against problematic legalities such as the definition of "non-African".[23] This was a reversal of O'Brien's previous stance on compulsory inoculation. Seven years earlier, as Assistant Medical Advisor, he had been anxious to avoid introducing this measure.[24] There was also hesitance among the higher echelons of the Colonial Office, suggesting a wider reluctance. The Secretary of State, Malcolm MacDonald expressed initial doubts and told Southorn of his dislike of compulsory inoculation in general. However, he still sanctioned the move and on 14 December 1940, the colony introduced legislation for the compulsory inoculation of

[22] PRO. CO 554/125/1. Sir Wilfred T. Southorn, Governor of the Gambia, to Malcolm MacDonald, Secretary of State, 12.01.1940.
[23] PRO. CO 554/124/21. Memo by O'Brien, no date.
[24] PRO. CO 323/1217/15. O'Brien to Fiddian, 25.08.1933.

all "persons of European or Asiatic race or origin".[25] A number of factors may have helped O'Brien and MacDonald overcome their doubts. Obviously, wartime expediency and the Gambia's vulnerability as outlined by Southorn would have been persuasive. Other matters may have figured, such as the improved safety record of the inoculation, or the small numbers of non-Africans in the Gambia rendering the whole operation fairly inexpensive and small scale. Indeed, in 1940 before legislation was introduced, 109 inoculations were conducted. This had increased only slightly to 128 in 1942.[26] Perhaps there was also a certain laxity towards the Gambia itself. After all, the Colonial Office did not object to the introduction of compulsory inoculation of officials in 1936. This may come from a belief that the Gambia was especially vulnerable to the disease. Perhaps its relative obscurity and unimportance compared to the other British West African colonies permitted a more casual approach to compulsory inoculation.

In 1941, Governor of Sierra Leone, Sir Hubert Stevenson, expressed his desire to introduce similar legislation in his colony, which he estimated, would involve approximately 700 doses of vaccine. Like Southorn, he appealed to the expediencies of war to forward his goal: "in view of Freetown as a naval base, convoy assembly point and also as a fortress, it would be even more disastrous to have an outbreak of yellow fever here".[27] He did not exaggerate the importance of Freetown, or the disruption likely to result from an epidemic.[28]

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[25] PRO. CO 554/125/1. Inoculation Against Yellow Fever Ordinance, 1940. The Gambia.
[26] *Gambia Annual Medical Reports, 1940, 1942.* Figures are not available for 1941. I could not obtain figures of inoculations conducted in Britain for people destined for the Gambia.
[27] PRO. CO 554/128/1. Sir Hubert Stevenson, Governor of Sierra Leone, to Lord Moyne, 22.08.1941.
[28] There are no related legislative ordinances introduced that year in the Sierra Leone Legislation books at the PRO.

Where do the military authorities fit into this framework, prior to the IDCYFC's creation? Given the available evidence, this is difficult to ascertain. In the earlier stages of the war, there were apparently no orders for compulsion at least in some areas of the armed forces. In the first meeting of the IDCYFC in October 1941, Surgeon-Commander Patterson of the Admiralty contended that although it was advised, it was not compulsory in the Navy. He also commented that his men eagerly seized the opportunity, and inoculations were commonly performed at base ports or in London ten days before sailing. The RAF representative made no reference to compulsion but alluded to the difficulties in keeping track of personnel embarking to West Africa owing to the need for secrecy which hampered effective inoculation procedures.[29] For example, troops being inoculated against yellow fever were clearly destined to travel to, or through, the endemic area.

The IDCYFC firmly encouraged compulsory inoculation, continuing the trend begun by the government of the Gambia. The First Interim Report, in December 1941, stressed the need for the measure. This demonstrates that there was a wider appreciation for compulsion, with members of the British government and various medical personnel sharing enthusiasm for the measure. The IDCYFC was somewhat ambiguous as to what constituted compulsion for different groups. It unequivocally recommended compulsion for colonial officers, advising that colonial governments make it a condition of service. This endorsed the earlier actions of the government of the Gambia. However, it was less clear about the indigenous and non-official European population. It recommended that all individuals who were likely to travel "by air, in or through" the endemic area "should" be inoculated. It made no racial

[29] PRO. CO 859/64/9. Minutes of the First Meeting of the IDCYFC, 07.10.1941.

distinctions and did not specifically refer to compulsory inoculation. It also stated "all non-Africans" visiting or living in the endemic area "should" be inoculated.[30] It then went much further by encouraging compulsory inoculation of selected groups of the indigenous and non-indigenous population. The report read:

> The Committee recommend that the Governments of the British East and West African Territories and of the Anglo-Egyptian Sudan should take powers to enforce compulsory inoculation against yellow fever in any specified area and of any specified group or groups of persons, indigenous or non-indigenous, within their territories.[31]

It advised that guards, staff and casual labour on aerodromes be inoculated regardless of race. This aimed to reduce the possibility of transmission of infection by air. Although this recommendation applied to all races, in practice it mainly targeted the indigenous population, and the influx of war-related personnel as most Europeans living in West Africa had already been inoculated by this time.[32] The IDCYFC intended this to be an all encompassing measure. Unlike many experts in the previous decade, it did not refer to notions of African immunity to determine who was to be inoculated. Instead it aimed to provide maximum protection by inoculating people in specific areas or whose occupational status rendered the spread of infection likely. It is possible that this signifies a more subtle understanding of immunity and a

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[30] PRO. CO 859/64/7. First Interim Report of the IDCYFC, December, 1941. In the First Interim Report, the IDCYFC defined the endemic area as areas where the disease existed "in a form clinically or biologically recognisable". It gave geographical details in the Third Interim Report, outlining it as a band extending across Africa from the Coast of Senegal, along the 15° North line of latitude to the eastern border of the Anglo-Egyptian Sudan, then South encompassing Uganda, along the eastern border of the Belgian Congo to the 10° South line of latitude, west along this line until reaching the west coast of Africa, then following the coast of West Africa until reaching Senegal. In its Fourth Interim Report, in December 1944 it expanded this area to include Eritrea and Kenya (PRO. CO 885/102).

[31] PRO. CO 859/64/7. First Interim Report of the IDCYFC, December, 1941.

[32] PRO. CO 859/64/9. Minutes of the First Meeting of the IDCYFC, 07.10.1941.

recognition that Africans could be vulnerable to the disease, based on a closer reading of protection test survey results.

In November 1942, nearly a year after the IDCYFC's First Interim Report, the medical members of West African War Council disputed the IDCYFC's advice about inoculating all population groups. They forced it to specify whether its advice that some people "should" be inoculated referred to compulsory inoculation. They also raised questions about the practicality of enforcing inoculation given an individual's ability to avoid the measure on the grounds of conscientious objections.[33] The IDCYFC effectively side-stepped these issues. In January 1943, in response to the West African War Council, it clarified its report arguing that it could not recommend compulsory inoculation for individuals travelling through endemic areas because of the recognition of the principle of conscientious objection in Britain. It argued that the situation for Europeans living in endemic areas was different, as they were subject to local legislation in the colonies, which may or may not abide by the principles of conscientious objection. Thus, the IDCYFC gave the colonial governments the responsibility of deciding about compulsory inoculation within the colonies themselves, in line with the general administration of colonial rule which permitted colonial governments to direct policy in the colonies. This echoes the Colonial Office's stance on the same issue in the 1930s when it was seemingly content to allow the colonies to direct policy on compulsory inoculation of officials. The Committee was more decisive about group inoculation, which included the indigenous population. It contended that this was different; the medical and colonial authorities

[33] PRO. CO 859/64/9. West African War Council, 24.11.1942. The signaturies of this document were all members of the colonial and military medical services in West Africa: the DMS of Sierra Leone, Nigeria and the Gold Coast (the Gambia did not have a DMS); Directors of the Army and RAF Medical Services, and the Chief Surgeon of the U.S. Army Air Corps in West Africa.

could apply compulsion to groups, rather than individuals, when the situation required "rather drastic measures".[34] It further justified this measure arguing that it was "in accordance with existing public health legislation in the colonies ... there was no question of exceeding ordinary practice".[35] Evidently, the IDCYFC considered indigenous inoculation too important to be decided by colonial governments and imposed centralised guidelines.

The report of the IDCYFC represented an undeniable change in colonial policy on compulsory inoculation. As examined in chapter four, the Colonial Office had rarely addressed the inoculation of the indigenous population in West Africa during the 1930s although there had been tentative discussions in 1940 resulting from suggestions by the RF. This omission partly derived from medical reports on the assumed immune status of Africans. The high cost of the inoculation coupled with limited supplies also made African inoculation prohibitive. The war altered this approach. As signified by the IDCYFC's report, selective inoculation of Africans became acceptable in the drive to maximise protective efforts for Europeans, and prevent transmission of the disease to uninfected areas. As the debate surrounding the compulsory inoculation of colonial officials in the 1930s demonstrated, compulsory inoculation of any population group, even those subject to direct Colonial Office control, was a contentious issue. The targeting of the indigenous population raised the stakes considerably, entering a policy arena fraught with political and racial controversy. Generally, previous experiences had established a pattern of caution on the matter of voluntary and compulsory inoculation of the indigenous population. It was rarely a popular measure. M. Vaughan examines compulsory smallpox

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[34] PRO. CO 859/64/9. Minutes of the Fourteenth Meeting of the IDCYFC, 28.01.1943.
[35] *Ibid.*

inoculation in Nyasaland during the 1910s and 1920s, which experienced many of the difficulties likely to be encountered in similar campaigns against yellow fever. She demonstrates that evasion was rife; that the procedure was unpopular because it was painful; a frequent complaint against yellow fever inoculation. She also reports that the vaccine was often ineffective by the time it was administered: again a problem common to yellow fever vaccine which required precise storage conditions difficult to maintain in the tropics.[36] There is nothing to suggest that the experience would be any better with yellow fever than smallpox.

Given the problems with other compulsory inoculation campaigns in colonial Africa, it is significant that the representatives of various government departments advocated compulsory yellow fever inoculation of the indigenous population in parts of the continent. It strongly suggests that the authorities in London began to perceive yellow fever as a disease dangerous to Europeans, particularly in relation to the war effort, after years of complacency. Arguably, at no other time in the period covered by this thesis, did the metropolitan authorities fear the disease as much as during World War Two. The recognition of the threat presented by endemic yellow fever in wartime conditions and the damage that an epidemic could cause strategically, undoubtedly stimulated this shift. It represented a potential danger to British health, and Britain's chances of victory in Africa. It demonstrates the tendency for wartime conditions to permit actions that would not have been possible or tolerable in peace. It is important to note that the report of the IDCYFC only recommended compulsory inoculation for selected groups, rather than a massive, all encompassing campaign. This may have been because this would have been a huge and costly undertaking, impossible to co-

[36] M. Vaughan, *Curing Their Ills: Colonial Power and African Illness* (Cambridge: Polity Press, 1991), pp.43–44.

ordinate and implement given wartime conditions and more appropriate to peacetime public health.

How did the various wartime, colonial and medical groups implement the IDCYFC's recommendations? What impact did they have in practice? The Colonial Office followed the Committee's advice on compulsory inoculation for individuals travelling to the African endemic area, with the introduction of Certificates of Inoculation. This established a system first suggested by the IDCYFC, that all people travelling to an endemic area must possess a certificate signed by an inoculator, verifying that the holder had been inoculated.[37] Anyone without a certificate was quarantined in screened quarters for six days on arrival from the endemic area. The military authorities applied this system to their personnel, producing their own certificates, thus solving any dilemmas over compulsory inoculation in the armed forces.[38] The British authorities also agreed to recognise an American certificate of inoculation.[39]

This system seems fairly comprehensive, but there was a mechanism in place which rescinded this rule for individuals in an emergency. A "certificate of urgency" could be obtained from the Secretary of State, the governor of the colony concerned, or if in foreign territory, from an accredited British representative. This allowed a non-inoculated individual to travel by air in the endemic zone without delay, if it was essential to the war. The IDCYFC was aware that certificates of urgency could potentially weaken security against the disease by creating loopholes in inoculation

[37] PRO. CO 859/64/7. Minutes of the Twelfth Meeting of the IDCYFC, 23.06.1942.
[38] *Ibid.*
[39] *Ibid.*

policy. It concluded that they should only be issued in "the most exceptional cases".[40] It did not consider that the claims of conscientious objectors against inoculation to be sufficient grounds for obtaining exemption. Certificates of urgency did not signify a relaxation in Colonial Office policy against yellow fever, instead they were regarded as an essential practical measure to be issued only when absolutely necessary. This pragmatic provision demonstrates that the Colonial Office could show a useful flexibility.

The colonial governors of West Africa had already displayed their active support of compulsory inoculation. They responded positively to the IDCYFC's advice on group inoculation and extended their commitment to the measure. In practice, this meant that the colonial government and the CMS selected groups of the indigenous and official and non-official European population for inoculation. In the Gambia in 1942, the government replaced the inoculation ordinance of 1940 with a Bill introducing compulsory yellow fever inoculation to all people, regardless of race, who resided in or entered certain scheduled areas in the colony, namely Bathurst, the Island of Cape St. Mary and the District of Cape St Mary. Colonial authorities denied access to these areas to all people not inoculated.[41] The following year, the number of inoculations conducted in the colony rose considerably, from 128 to 2,000, and 5,820 in 1944. However, a census that year recorded the non-European population of the Island of St. Mary to be 21,051, which left a considerable number uninoculated. The Medical Department admitted that there were some difficulties, mainly caused by a shifting indigenous population.[42] However, it was more confident by 1945 and

[40] PRO. CO 859/64/9. Minutes of the Fourteenth Meeting of the IDCYFC, 28.01.1943.
[41] PRO. CO 554/128/2. Ordinance to provide compulsory inoculation of persons against yellow fever, 14.11.1942. The Gambia.
[42] *Gambia Annual Medical Report, 1944*, p.10.

estimated that its staff had performed a total of 19,120 inoculations since the introduction of compulsion in 1942, and optimistically declared that they had inoculated nearly the entire population of Bathurst (i.e. the Island of St. Mary).[43] The government of Sierra Leone enacted similar legislation, which introduced compulsory inoculation of all people entering a "prescribed area", which the Ordinance did not specify.[44] This gave the government a degree of flexibility, allowing them to enforce the measure in any location it felt necessary. The medical services of the other West African colonies demonstrated their approval of the measure in application to travellers passing through the endemic area. They pledged their support of the system of issuing certificates of inoculation to all people travelling though or in the endemic area.[45] The Governor of the Gold Coast, Sir A.C.M. Burns, reiterated this stance directly to the Secretary of State a month later, indicating the support of the non-medical colonial authorities.[46] However, neither the Gold Coast nor Nigeria introduced legislation for compulsory inoculation during the critical years of the war.[47]

There is evidence of considerable numbers of inoculations being conducted elsewhere in West Africa. The *Annual Medical Reports* of Nigeria detail that in 1941, its medical staff administered 2,775 doses of vaccine; recipients included aerodrome staff and troops, in addition to further inoculations carried out by military medical personnel.[48] This figure steadily rose to 4,330 the following year, and 5,654 in 1943.

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[43] *Ibid., 1945*, p.8.
[44] PRO. CO 269/13. Inoculation Against Yellow Fever Ordinance, 19.05.1942, Sierra Leone.
[45] PRO. CO 859/64/9. West African War Council, 24.11.1942.
[46] PRO. CO 859/64/10. Sir A.C.M. Burns, Governor of the Gold Coast, to the Secretary of State, 03.12.1942.
[47] By 1945, the Gold Coast had not introduced compulsory inoculation, but the DMS, F.J.C. Johnson claimed that most Europeans and Syrians had been inoculated. PRO. CO 994/1. Minutes of the 429th Meeting of the CAMC, 27.09.1945.
[48] *Nigeria Annual Medical Report, 1941*, p.14.

The numbers then declined: 2,371 in 1944, and 1,840 in 1945, perhaps signifying the easing of urgency as the war ended.[49] The *Reports* did not specify whether these were conducted on a compulsory basis.

The RAF also acted directly on the IDCYFC's advice about inoculation of personnel on aerodromes. In July 1942, it confidently reported the inoculation of all staff, including Africans, employed or resident on their aerodromes in West Africa, as well as crew and passengers flying to endemic areas.[50] C.B. Symes, the Inspecting Officer of Aerodromes in West and East Africa and formerly the Senior Entomologist to the government of Kenya reported on this issue. He stated that by April 1942, the majority of military personnel in West and East Africa had been inoculated.[51]

The support for compulsory inoculation by those colonial and military groups involved indicates a widespread recognition of the danger endemic yellow fever presented. Conditions specific to the war prompted the Colonial Office to overcome its distaste for compulsion. The IDCYFC's recommendations represent a coherent stance on the issue, in contrast to the Colonial Office's previous lack of direction.

International transmission and air transportation

During the 1930s, the colonial and medical authorities were becoming increasingly aware of the danger posed by expanding air transport for the transmission of yellow fever from West Africa. Previously, other systems of transport were too slow to overcome the safety barrier provided by the six day incubation period. Planes

[49] *Ibid., 1942-1945.*
[50] PRO. CO 859/64/2. Report entitled "Anti-Amaryl Measures - RAF Aerodromes", dated 07.07.1942.
[51] PRO. CO 859/108/7. Report by C.B. Symes, Inspecting Officer of Aerodromes in West and East Africa, 15.08.1944.

could travel further and faster. In particular, the Colonial Office and the India Office feared transmission to India. The recognition of endemicity beyond West Africa served to heighten this anxiety, as sources of infection were closer to the East than realised. Before the war, the CMS in West Africa were responsible for the maintenance of sanitary standards at aerodromes, to meet regulations laid down in international conventions. In 1940, the first RAF personnel arrived in West Africa, and faced the task of implementing yellow fever control measures on their aerodromes with little previous experience. The presence of the RAF and general wartime needs significantly increased air traffic in West Africa, enhancing the possibility of transmission either by infected humans or mosquitoes. Many wartime air routes went from endemic to non-endemic areas: from West Africa through the Sudan to Egypt and India; from South Africa travelling north through the endemic area, and other air routes throughout Africa.[52]

The Colonial Office and the War Office sought to exert control over the spread of yellow fever across international borders by regulating civilian and military air transportation. They did not have to start entirely from scratch in devising their approach. The 1933 Aerial Navigation Convention had set in place many of the necessary mechanisms and guidelines. However, extensive use of yellow fever vaccine had long superseded the convention's provisions which were also inadequate in the light of wartime requirements. Some observers quickly recognised the limitations of the 1933 Convention regarding yellow fever inoculation. S.P. James commented on the potential of inoculation to alter the current air traffic regulations:

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[52] Rexford-Welch, *The RAF Medical Services. Vol. II* (1955), p.404.

In this traffic the real practical risk is concerned with the human case in the incubation period of the disease, and it is clear that this risk can be entirely eliminated by the effective immunization of the personnel of aircraft and all intending passengers. As this is so I am sure it will be agreed that the spread of yellow fever from West to East Africa and to India may be prevented by less drastic measures than that of placing an embargo on all air traffic between those countries.[53]

The laxity in maintaining anti-amaryl and sanitary aerodromes in British West Africa was a further complication the Colonial Office had to address. Careless disinsectisation, ineffective anti-*Aedes aegypti* measures and the use of uninoculated casual labour were not unusual at West African aerodromes. In 1941, before the establishment of the IDCYFC, Findlay noted that anti-mosquito measures at aerodromes in endemic areas including West Africa were inadequate. He also complained at the lack of screened facilities for passengers.[54]

That year, William Henry Kauntze, the Assistant Medical Advisor to the Colonial Office, and former DMS of Uganda, inspected numerous aerodromes in East and West Africa, as part of a wider investigation of the problems of yellow fever control during the war.[55] He reported his findings to the IDCYFC.[56] In response, the Committee recommended several measures which targeted the two possible factors of

[53] G.M. Findlay, "Immunization Against Yellow Fever", "Discussion", *TRSTMH* **27** (1933), p.465.
[54] *Idem*, "The Present Position of Yellow Fever in Africa", *TRSTMH* **35** (1941), p.63.
[55] W.H. Kauntze was born in 1887, and educated at the Universities of Manchester and London. He worked as an MO in WAMS, 1914 to 1916, gaining valuable experience of the region. He served in the West and East African Forces until 1919. He then joined the Medical Services of Kenya, initially as a bacteriologist, becoming Deputy Director of the colony's laboratory service in 1919. In 1932, he was promoted to DMS of Uganda, until he returned to England as Assistant Medical Advisor to the Colonial Office, becoming Chief Medical Advisor in 1944 until his death in 1947.
[56] PRO. CO 859/64/9. Minutes of the Fifth Meeting of the IDCYFC, 06.11.1941.

transmission: infected humans, and infected mosquitoes. The IDCYFC made use of many of the regulations stipulated in the 1933 Sanitary Convention for Aerial Navigation, updating and redefining some measures in accordance with contemporary needs and methods. It focused on implementing controls over passengers and air traffic in areas designated endemic, together with the maintenance of sanitary standards of aerodromes. As already discussed, the IDCYFC advised that the colonial and military medical authorities use inoculation to deal with the human aspect of transmission by inoculating passengers, crew and aerodrome staff, of all races. It called for the maintenance of anti-amaryl standards at aerodromes within the endemic area using strict anti-mosquito measures at aerodromes as outlined in the 1933 Convention. These included measures preventing mosquito breeding; the introduction of piped water supplies; mosquito screening of passenger areas; and restrictions on African employees and African residential areas within a designated vicinity.[57] It advocated mosquito destruction methods such as "disinsectisation" which rendered aircraft interiors mosquito free before leaving endemic areas. In addition, it advised the use of "flit guns" to remove mosquitoes from aircraft with a blast of insecticide, and the spraying of all passengers and crew arriving from endemic areas.

However, the problems facing military and medical staff in West Africa for controlling aerodrome standards were considerable. Staff found it difficult to achieve and maintain anti-amaryl standards as laid down by the IDCYFC. The First and Third Interim Reports of the IDCYFC bemoaned current conditions in British colonial and RAF aerodromes in Africa calling for improved methods of disinsectisation and tighter anti-*Aedes aegypti* controls. In his report on the condition of aerodromes in

[57] PRO. CO 859/64/7. Interim Report of the IDCYFC, December 1941.

Africa, Symes heavily criticised civilian and military efforts before 1942, condemning the poor provision of mosquito proof buildings and lack of flitting and disinsectisation procedures. He blamed the RAF's lack of specialist staff for its shortfalls. Reproaching the civilian authorities, he noted that: "In the old endemic areas, in fact, there existed an unfortunate and rather unshakeable complacency, born of years of contact with yellow fever".[58]

One obstacle was the designation of responsibility. The IDCYFC may have solved problems of interdepartmental co-ordination in London, but it was proving more difficult in the colonies. During the war, aerodrome standards were the remit of the colonial and RAF medical services. The issue of who was accountable for what, and where, soon arose. In 1942, the CMS raised the question of who should maintain standards in West African aerodromes. They argued that they did not have the resources to undertake this substantial task. They requested that disinsectisation of all aerodromes in West Africa, RAF and civilian, should be the responsibility of the RAF.[59] The medical departments were already under significant pressure by additional war related work. They were understaffed, with many of its personnel being seconded elsewhere. They also lacked specialist staff, suffering a shortage of entomologists. In 1941, there were only two entomologists in the whole of West Africa: one on the Gold Coast and the other in Nigeria.[60] This prevented much valuable entomological work: it made it difficult to conduct effective anti-mosquito campaigns on and off aerodromes, and hampered the training of subordinate staff. This proved to be a persistent problem. In 1942, Symes highlighted this shortfall. He stressed the need for specialist staff: "The prevalent idea that anybody from an "ACH" to a Pathologist can

[58] PRO. CO 859/108/7. Report by Symes, 15.08.1944.
[59] PRO. CO 859/64/2. W.H. Kauntze to Smart, 23.02.1942.
[60] PRO. CO 859/64/9. Minutes of the Fifth Meeting of the IDCYFC, 06.11.1941.

plan and carry out effective measures against mosquitoes as a spare time occupation must be stamped out if we are to make even a minimum of progress".[61] However, as already discussed, the RAF also lacked expert personnel.

The RAF resolved the matter when it agreed to conduct disinsectisation in all RAF controlled aerodromes, and co-operate with medical departments in civilian ones where manpower permitted.[62] Within months, the RAF produced a report which listed precautionary measures against the disease at its aerodromes in British West Africa.[63] It intended this to counter criticisms of its anti-yellow fever measures. It claimed that on aerodromes under RAF authority there was 100 per cent inoculation of all personnel, Africans included, employed or residing on aerodromes, as well as all passengers and crew. RAF staff sprayed all aircraft on landing and before taking off to kill mosquitoes. They sprayed all houses on and around the aerodromes. As far as supplies allowed, they rendered all buildings on the aerodrome mosquito proof, and finally, where possible, established a building-free zone of 440 yards wide around the aerodrome and runway. This provided a zone around the aerodrome free of mosquitoes and non-inoculated humans: both possible sources of infection. Regardless of whether this list was an exaggeration, it provides an indication of what the RAF thought necessary. The RAF's lack of specialist staff was also alleviated that year when it provided each of its stations with seven European staff dedicated to anti-amaryl and anti-malarial work.[64]

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[61] PRO. CO 859/62/2. Symes to Smart, 03.07.1942.
[62] PRO. CO 859/64/2. C. Evans, the Air Ministry, to the Under Secretary of State, 19.03.1942.
[63] PRO. CO 859/64/2. Report entitled "Anti-Amaryl Measures - RAF Aerodromes", dated 07.07.1942.
[64] PRO. CO 859/108/7. Report by Symes, 15.08.1944. For an account of the interaction of military and civilian medical services in the colonies during an earlier conflict see M. Sutphen, "Striving to be Separate? Civilian and Military Doctors in Cape Town During the Anglo-Boer War", in Cooter, Harrison and Sturdy, *War, Medicine and Modernity* (1998), pp.48-64.

However, not all difficulties were administrative. The most mundane, practical matters could be potential obstacles to effective anti-yellow fever measures. For example, sanitary staff considered the "phantomyst", the flit gun widely used in East and West Africa, unequal to the task of removing mosquitoes from aircraft. It failed to give adequate penetration because the cloud of insecticide diffused too rapidly. Consequently, the IDCYFC recommended an alternative hand spray with a pressurised mechanism, providing the force required for penetration.[65] RAF personnel at Takoradi aerodrome in the Gold Coast devised their own modified spray heads for the phantomyst, which gave good results during tests. They produced and distributed twenty of the special heads which were unfortunately mislaid before they could be used.[66] The process of disinsectisation was generally problematic. Shortages of insecticide, and complaints from flight crews about consequent delays were common.

The use of casual labour, a necessity colonial governments found unavoidable, was an additional problem.[67] As stated previously, the First Interim Report of the IDCYFC recommended that staff and guards at aerodromes be inoculated: a measure that would help keep the areas virus free. Casual labour represented a gap in that cordon. They proved an elusive group to inoculate, as there was a high turnover of employees. This impeded the maintenance of the newer post-inoculation definition of anti-amaryl. One suggestion was for aerodromes to temporarily lose their anti-amaryl status when unimmunised casual workers were employed, and at the same time, pay particular care of disinsectisation measures.[68] This idea was never realised, and the

[65] PRO. CO 859/64/7. Third Interim Report of the IDCYFC, September 1942.
[66] Rexford-Welch, *RAF Medical Services. Vol. III* (1955), p.377.
[67] PRO. CO 859/64/2. Sir B. Bourdillon, Chairman of the West African Governors Conference, to the Secretary of State, 13.10.1941.
[68] *Ibid.*

debate continued as the IDCYFC advised colonial governments to inoculate as many casual labourers as possible.

Was the war good for yellow fever control?

R. Cooter argues that war brings few benefits to medicine, a stance which contradicts popular notions that war is good for medicine and it advances medical practices and research. For example, the introduction of blood transfusions is commonly attributed to the stimulus provided by World War One.[69] However, the war did improve some aspects of yellow fever control. It brought many of the critical issues relating to the disease to the fore, ensuring that the Colonial Office no longer ignored them and instead took a greater role in yellow fever control. It also forced the colonial and medical authorities in West Africa and Britain to address the problem of endemic yellow fever: a factor they had long neglected. The Colonial Office attempted to devise cohesive policies on yellow fever control, providing a metropolitan directed policy. It participated in the creation of the IDCYFC which made specialist recommendations about the problem. The interdepartmental membership of the Committee ensured that the wider problems of yellow fever were addressed, such as the danger to India. Although it was merely an advisory body, it clearly played a strong role in anti-yellow fever policies. With the help of the IDCYFC, and in response to the needs of other departments, the Colonial Office created a series of cohesive initiatives, albeit with ethical implications, that aimed to deal with the problem. It abandoned its previous hesitancy over compulsory inoculation, allowing

[69] Cooter, "War and Modern Medicine", (1993), p.1544.

colonial governments to enforce it broadly in their territories. It introduced certificates of inoculation which effectively imposed compulsory inoculation for all travellers to and from endemic areas. The expansion of inoculation practices to target groups of the indigenous population could be regarded as a step forward in yellow fever control, as some sections of the local population were then protected from infection. However, the purpose of this policy was to primarily protect white health, and the war effort.

War gave expediency to many of the problems relating to the disease in West Africa. It created a heightened awareness of the disease, and forced a concerted effort by various government groups in the metropole to tackle the issue. In practice, this resolve had an uneven application in the colonies. Military and colonial medical services conducted inoculations on an unprecedented scale, providing large scale protection against the disease. However, other control measures were less successful. The maintenance of anti-mosquito efforts at aerodromes proved particularly difficult for the colonial and RAF medical services in West Africa.

The long term impact of war on yellow fever control provides further illumination on this issue. Did the benefits last into peacetime? This analysis now addresses international and British medical responses to the disease during the immediate postwar years.

Postwar conditions and the reconstruction of the international community

The British government did not abandon the problem of yellow fever control in Africa when hostilities ceased in 1945. The Colonial Office and colonial governments maintained and even extended some wartime measures, suggesting that they sustained their heightened perception of the yellow fever problem in peacetime. This contrasts with Cooter's recognition that many of the benefits to medicine did not extend into the postwar period. He notes that wartime interest into specific medical problems dwindled during peace-time, or wartime improvements in medical care were inapplicable to civilian health needs.[70] The IDCYFC continued to meet and make recommendations. However, there was little of urgency to occupy them. The termination of vaccine production by the RF after 1945 caused some anxieties. Until that time, the RF had been a large supplier of vaccine to the British empire. However, the Colonial Office made alternative arrangements, and no crisis arose as a result. The selective compulsory inoculation of the indigenous population was one aspect of wartime yellow fever control that the CMS continued and expanded during the postwar period. The 1946 epidemic in Nigeria saw the greatest mass vaccination of the indigenous population in West Africa. Prompted by forty nine recorded cases and eleven deaths in the Oyo Ondo Area, the colonial authorities enacted compulsory vaccination orders and consequently colonial medical staff performed 400,000 inoculations in the Oyo Province, and a further 47,471 in the Northern Province.[71] The expansion of indigenous inoculation campaigns indicates that the CMS's view of African immunity had retained the subtlety demonstrated by wartime inoculation policy. Medical personnel no longer regarded Africans as an immune population group, but instead as a potentially susceptible group requiring protection during epidemics. This view, and the practice of inoculating Africans may have resulted from protection test surveys which suggested varying numbers of immune Africans. The

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[70] *Ibid.*, p.1550.
[71] *Nigeria Annual Medical Report, 1946*, p.9.

increased availability of supplies of vaccine, particularly with the decline of military demand was possibly a contributory factor.

The first stirrings of a new international medical community began in the final years of the war, relieving the Colonial Office of some of the burdens of yellow fever control. In 1944, the 1933 Convention for Aerial Navigation was revised. The new convention stipulated that governments should ensure that travellers departing endemic areas be inoculated, and possess a valid inoculation certificate.[72] This continued the Colonial Office's wartime system of inoculation. In 1945, the United Nations Relief and Rehabilitation Administration temporarily assumed the functions of the OIHP. It created a yellow fever advisory panel which focused on vaccine standards and delineating endemic areas.[73] The establishment of WHO in 1948 superseded UNRRA, marking the end of the period studied in this thesis. The CMS and the Colonial Office continued to implement health care in West Africa as before, albeit within this new international framework.

The return of the Rockefeller Foundation

The RF's renewed activities in West Africa bridged the period between war and peace, and provides an appropriate postscript to World War Two. It gives the research context for yellow fever control during the war and postwar period. Its activities contrast with that of the British colonial and military medical services who were mainly concerned with the immediate wartime control of the disease. The RF

[72] *International Sanitary Convention for Aerial Navigation, 1944*. Cd. 6638, 1944-45. The British representative stipulated that its signature did not bind its colonies. The Gold Coast, Nigeria and Sierra Leone agreed to be bound by its regulations from February 1945.
[73] The World Health Organisation, *The First Ten Years of the World Health Organization* (Geneva: WHO, 1958), pp.60-61.

was able to address less pressing, more academic questions of yellow fever epidemiology. Negotiations between the IHD, the Colonial Office and colonial governments to establish some form of IHD presence in West Africa began in 1942, and followed a request from the Colonial Office for the IHD to be involved in a co-operative yellow fever organisation in West Africa. Typically, the IHD insisted on being in control, and to this end it proposed that it should contribute the bulk of the funding, together with specialist personnel.[74] In November 1942, the IHD and the colonial authorities decided to open a yellow fever laboratory in West Africa under the direction of the IHD, with the colonial governments initially providing £1,000 between them and the RF furnishing £7,000.[75]

Although generous in its provision of finance, equipment and staff, the IHD stood to gain considerably from this venture. The answer to the effective control of jungle yellow fever was proving elusive. This was the endemic form of the disease affecting humans that did not require *Aedes aegypti* mosquitoes for transmission, and had an animal reservoir of infection. As discussed in chapter three, jungle yellow fever was seriously hampering the IHD's anti-yellow fever campaigns in South America, and had induced it to resort to more elaborate, extensive and costly measures. Its research into the disease in the 1920s and 1930s in West Africa had proved particularly fruitful, providing the key to many of the epidemiological and immunological breakthroughs of the 1930s. Perhaps West Africa could again be a productive site of research for the IHD. Sawyer, Russell's successor as Director of the IHD also hinted of a more direct practical dimension to the IHD's return to the

[74] Memo entitled, "West Africa yellow fever service designation", dated 12.09.1942. F15, B2, S495, RG1.1. RFA, RAC.
[75] Cable from Andrew J. Warren, Assistant Director of the IHD - to become an Associate Director in 1945, to A.F. Mahaffy, Director of the IHD's Yellow Fever Research Laboratory at Entebbe, Uganda, 02.11.1942. F16, B2, S495, RG1.1. RFA, RAC.

region. He contended that some form of yellow fever base in West Africa would be of military value. When pressed to explain his position he commented: "The success of the venture is really important, in our opinion as the control of yellow fever would be a protection to troops and lines of communications in that area".[76] Presumably he was referring to the role the IHD envisaged that the Institute would play in vaccine distribution and control. Certainly there was a large American military presence in West Africa. On a more political level, it would also guarantee an American interest in postwar West Africa. This would be a valuable asset in a region where the grip of British colonialism was widely assumed to be weakening, and independence for her colonies on the horizon. Its return to West Africa can be seen in this context.

The benefits were not all one way. It would permit investigations into the disease in the region of value to the British authorities. The IHD had maintained a presence in British colonial Africa before the war. From 1936, the IHD ran a yellow fever research organisation in Entebbe, in Uganda, with the co-operation of the British colonial and medical authorities. Its remit was to conduct research on the disease in the area, particularly on jungle yellow fever. This group's work met with mixed success; answers to jungle yellow fever were elusive, although staff managed to isolate the yellow fever virus from local patients, proving the disease's existence in the region. The IHD's proposal for West Africa promised a similar direction, again focusing on jungle yellow fever; a project the IDCYFC had been recommending since its creation. Many experts, including Findlay and Kirk argued that evidence strongly suggested jungle yellow fever's presence in West Africa, but that investigations had

[76] Wilbur A. Sawyer, Director of the IHD, to John C. Bugher, Director of the Institute, 17.02.1943. F17, B3, S495, RG1.1. RFA, RAC.

not yielded definitive proof.[77] Its possible existence in West Africa had implications for the control of endemic yellow fever. Inoculation could not affect an animal reservoir, and thus infection could still be perpetuated. As Hugh Smith, an experienced member of the IHD campaigns in South America commented:

> It is known that by vaccination of the individual we can protect the individual, but I am not sure that even by the vaccination of a whole rural community you can prevent yellow fever spreading through that area - certainly not, if it can be spread, for example by mosquitoes and animals without human cases. So it does not seem possible that we can prevent altogether the spread of jungle yellow fever in any area by immunizing people.[78]

The IHD's proposal allowed the British to be privy to such investigations, with minimal cost and effort.

The Nigerian government provided the buildings, the same used by IHD researchers the previous decade. In November 1943, the Yellow Fever Research Institute (hereafter referred to as the Institute) was opened at Lagos, under the directorship of the IHD's John C. Bugher, an experienced yellow fever researcher. There were three main elements to its programme: to investigate the distribution of the disease in the region; to study the epidemiology of yellow fever, in particular jungle yellow fever; and routine organisation of vaccine distribution and control.[79] There were no allusions to the possibility of initiating any form of control work in

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[77] Findlay, "The Present Position of Yellow Fever in Africa", (1941), pp.57-60; R. Kirk, "Some Observations on the Study and Control of Yellow Fever in Africa, with Particular Reference to the Anglo-Egyptian Sudan", *TRSTMH* 37 (1943), p.134.
[78] Findlay, "The Present Position of Yellow Fever in Africa", "Discussion", (1941), p.74.
[79] "Annual Report of the West Africa Yellow Fever Research Institute, 1944", pp.3-4. B216, SS495, S3, RG5. RFA, RAC.

West Africa: research dominated. The direction of studies demonstrates the preoccupation with jungle yellow fever and the dominance of the laboratory using new techniques developed in the 1930s after the discovery of the yellow fever virus. The use of protection tests and, to a lesser extent viscerotomy, by the Institute, demonstrates that the IHD had not lost their preoccupation with delineating the endemic area in West Africa. Researchers were particularly eager to use protection tests to determine any new activity since the IHD's departure from the region in 1934, thus detecting any changes in the disease environment. They were apparently successful, as results suggested that there had been a recent epidemic of "appreciable proportions" near to Lagos. This and other results prompted Bugher to comment that the apparent lack of yellow fever in Nigeria was illusory and that there was a widespread incidence in the area.[80]

The Institute's ambitions for establishing a viscerotomy service were less productive. In October and November 1945, the Institute created fourteen viscerotomy posts in four Provinces in Nigeria: Ilorin, Benin, Warri, and Ogoja where the MOs were considered "aggressive" and generally interested in the programme.[81] It acknowledged that the service faced considerable obstacles:

> Here, with a minimum of central government, tribal customs predominate and the collection of vital statistics takes place in only a few population centers[sic]. Deaths are not registered and are commonly not known until after burial has taken place. Viscerotomy is thus essentially voluntary and depends to a far greater extent than in South America on local cooperation and good will.[82]

[80] *Ibid.*, p.3.
[81] "Annual Report of the Institute, 1945", p.7. B216, SS495, S3, RG5. RFA, RAC.
[82] *Ibid.*, p.8.

The Institute established the service in an atmosphere of doubt and pessimism, with assumptions by the CMS and the Institute that indigenous objections would prove its downfall. Despite their misgivings, the colonial authorities agreed to co-operate. Bugher also claimed to have the support of indigenous councils yet contended that the level of co-operation depended on "their degree of civilization".[83] This effectively absolved the Institute or any colonial organisation of culpability should the service fail. In some areas, local people were able to select their own viscerotomist; a move designed to alleviate possible objections. The Institute also hoped that it would ensure that: "too much roguery, bribery and corruption with consequent troubles will be eliminated".[84] However, it considered the indigenous population in other areas too unreliable to make this choice. African personnel already attached to the CMS acted as a viscerotomist in these cases. They were paid for their services, either on a monthly basis, or per specimen received. The service was not a success. In 1948, the Institute rather ungraciously admitted defeat, blaming the local people: "It had become gradually clear that viscerotomy would never give us an indication of the occurrence of the true jungle yellow fever even if we could make a viscerotomy service work which was clearly impossible in the present state of civic development of the Nigerian population".[85]

Entomological investigations provided a more reliable focus for the Institute as it set out to identify additional vectors as well elucidating the habits of *Aedes aegypti* mosquitoes. Of particular interest were larval diets, factors affecting longevity, feeding habits and transmission mechanisms. These studies bridged the divisions between laboratory and field, as the Institute conducted work in both. They

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[83] *Ibid.*, p.107.
[84] *Ibid.*, p.106.
[85] "Annual Report of the Institute, 1948", p.70. B216, SS495, S3, RG5. RFA, RAC.

also signify the continuity and centrality of the role ascribed to the vector life cycle in yellow fever control, even in light of increasing reliance of immunological techniques such as inoculation and protection tests.

The greatest, and most elusive mystery remained jungle yellow fever. Bugher wrote that he found the opportunity for its study in West Africa "intriguing".[86] However, the Institute's investigations were sufficiently unproductive to urge a methodological rethink at the end of 1946. This led to discussions within the IHD and the Institute about the possibility of a: "short cut in the study of jungle yellow fever if we are willing to accept some hazards".[87] This short cut manifested itself in a potentially dangerous experiment in which the Institute's researchers introduced yellow fever virus into a jungle area inhabited by monkeys, to permit observation of the transmission of the virus to mosquitoes and animals. The site chosen was Kumba, in the British Cameroons, which had been previously free of the disease. To protect the nearby local population, the Institute conducted an inoculation campaign. However, unable to resist the opportunity, it used an experimental yellow fever and smallpox mix scratch vaccine rather than the tried and tested 17D. Its staff inoculated a total of 4,431 people: approximately eighty two per cent of the local population.[88] The local environment and arguably its own sloppy research defeated the Institute's experiment, as Bugher explained to Andrew J. Warren, the Associate Director of the IHD: "We have our virus focus started but I am pessimistic about our being able to get anything started. In a forest where monkeys are so abundant, we have not been able to find a single mosquito!".[89] Without mosquitoes, there could be no virus

[86] Bugher to Warren, 13.02.1946. F19, B3, S495, RG1.1. RFA, RAC.
[87] Richard C. Hahn, Assistant Director of the Institute, to Warren, no date. F20, B3, S495, RG5. RFA, RAC.
[88] "Annual Report of the Institute, 1948", p.49. B216, SS495, S3, RG5. RFA, RAC.
[89] Bugher to Warren, 13.06.1948. F22, B3, S495, RG1.1. RFA, RAC.

transmission and thus the Institute declared the experiment a failure. Bugher commented that the researchers learned an important lesson: "A lot of hard work went into that experiment and the one thing that we learned was that so-called bacteriological warfare is not so easy. There are obviously many factors controlling the success of an epidemic of which we are not aware".[90] Clearly, the IHD had not lost its propensity to consider, and indeed treat, West Africa as a convenient site for research: a habit it had acquired during its forays into the region in the 1920s and 1930s. This episode demonstrates that the IHD focused primarily on the virus and its transmission and less on a clinical view of the disease in terms of human suffering.

The IHD ceased activities in West Africa in 1948, but as in 1934, it hoped to leave a useful legacy by persuading the British colonial and medical authorities to continue its work in some form. As examined in chapter three, its earlier efforts failed to culminate in any long term venture but perhaps there were grounds for more optimism in 1948. The war had aroused some serious colonial interest in, and efforts against the disease. Andrew Mahaffy, Director of the IHD's operations in Uganda, commented on changing attitudes in British East and West Africa: "The early scepticism concerning yellow fever has disappeared and the authorities now appreciate that the threat from this disease does exist and cannot be ignored".[91] As early as 1946, the IHD was making plans for the Institute's future after its staff's departure. It submitted that it should eventually become a centre for virus research for West Africa, with yellow fever as its initial focus. Fearing that research would languish if left entirely to the Nigerian government, the IHD proposed that the centre be affiliated with the newly created Colonial Medical Research Service based in

[90] Bugher to Warren, 13.10.1948. F23, B3, S495, RG1.1. RFA, RAC.
[91] Mahaffy to Warren, 09.01.1945. F18, B3, S495, RG1.1. RFA, RAC.

London.[92] The RF and the CMRS would provide joint financing, with the latter taking increasing, and eventually total responsibility for costs. This would have continued the trend of centralised metropolitan led efforts against yellow fever seen during the war. However, the IHD's optimism was ill placed, and the CMRS failed to seize the opportunity presented them. In the final year of the Institute's operation, Bugher lamented its future:

> ... unless the London service gets going quickly, this place will be handed over to the Nigerian Government to do as they will. It makes me sad to think of it for a lot of hard work has gone into the effort to make this a permanent virus research institute. No research will be done by the Nigerian government. The equipment and staff would soon be scattered for routine purposes.[93]

Bugher's gloomy predictions came true. The Nigerian Government did take over the laboratory and the virus centre was not established. However, in 1957, the colonial government created a yellow fever vaccine centre in Lagos, and conducted some experiments on a scratch vaccine: not quite the centre of excellence envisaged by Bugher and members of the IHD.[94]

The failure of the colonial medical community in London to act positively on this matter suggests that in London at least, yellow fever in West Africa had receded back to its prewar status. Had it retained the significance prescribed to it by the various metropolitan groups during the war, then surely, they would have welcomed and facilitated the IHD's plans for the Institute. Perhaps this provides the final

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[92] Bugher to Warren, 01.04.1946. F19, B3, S495, RG1.1. RFA, RAC.
[93] Bugher to Warren, 16.03.1948. F22, B3, S495, RG1.1. RFA, RAC.
[94] R. Schram, *A History of the Nigerian Health Services* (Ibadan: Ibadan University Press, 1971), p.333.

conclusion to the analysis of whether war was in any way beneficial to yellow fever control in West Africa. World War Two may have changed the perceptions of the disease held by various authorities in London, giving greater weight to its potential danger. However, as the experiences of the IHD suggest, this was merely a short term response, and after the crisis had passed, the recognition of the threat diminished. This was a phenomenon often repeated in the history of yellow fever control in this century, although more commonly in association with epidemics. The onus for developing an overall policy for yellow fever control shifted from the British authorities in London back to the CMS in West Africa. Events during the war demonstrated that perceptions and reactions to endemic yellow fever were also sensitive to a range of factors including social, political and economic circumstances as well as to changes in the disease environment.

Conclusion

The war created a unique situation for yellow fever control in West Africa, ushering in changes in understandings of and approaches to the disease, particularly for the metropolitan colonial and military authorities. In previous decades, the Colonial Office had a lacklustre approach to yellow fever, initiating sporadic investigations such as the YFWAC of 1913-1916. It failed to develop cohesive strategies for the use of inoculation during the 1930s allowing technological developments and colonial governments to take the lead. However, war forced the Colonial Office to take action on unprecedented levels. It formed an interdepartmental body, the IDCYFC, to devise definitive strategies against the disease. This signified a shift in responsibility for yellow fever control away from the colonies, towards London, with the Colonial Office and the IDCYFC providing centralised directions and policy. The creation of the IDCYFC also signified an expanded administrative structure to deal with the disease. It was no longer the sole remit of the colonial authorities, but also became the concern of other governmental departments such as the War Office and the RAF. Under the recommendation of the IDCYFC, these groups forged a decisive approach against the disease, conducting campaigns using new measures, such as compulsory inoculation of Europeans and members of the indigenous population. This action demonstrates that the war gave yellow fever a new menace, which was sufficient to galvanise a previously complacent Colonial Office into constructing definitive control policies. However, some of these measures were difficult to implement evenly in West Africa.

There was also an expansion of knowledge with recognition of the threat presented by endemic yellow fever. This had its roots in the 1930s. Previously, the CMS had mainly focused their efforts against epidemic yellow fever; their measures against the disease lapsing in the absence of visible infection. The war created ideal conditions for endemic yellow fever to take epidemic form, and to be transmitted to previously uninfected areas such as India. It led to a large influx of a non-immune population, and an increase in air transportation. It was evident that prewar efforts were insufficient for wartime needs. Therefore, the various authorities in Britain and Africa sought to limit the danger of endemic yellow fever with selective inoculation campaigns of the white and indigenous population, mainly on a compulsory basis. The IDCYFC provided recommendations to update the 1933 Aerial Navigation Convention to allow for wartime needs.

An analysis of World War Two reveals a further complexity in perceptions and responses to yellow fever. As demonstrated in previous chapters, epidemics served to sharpen the menace that the disease was believed to present in West Africa, and resulted in an intensity of anti-yellow fever measures. However, events during the war demonstrate that other factors had a similar effect. In this study, the strategic value of West Africa, the increased awareness of endemic yellow fever, the loss of international frameworks of control, and the possibility of international transmission served to increase the menace presented by the disease in West Africa, generating an unprecedented intensity of action.

In some respects, the war proved beneficial to yellow fever control as various groups designed and implemented a range of cohesive measures. Inoculation, particularly of the indigenous population continued as part of international systems of disease control and campaigns by the CMS. However, the Colonial Office's commitment to controlling the disease proved short-lived in the postwar era, as demonstrated by its hesitance to take over the IHD's Institute. In contrast, the return of the RF demonstrated its continued research interests in the disease in West Africa.

CONCLUSION

This thesis demonstrates that colonial medicine was a complex activity, involving the interaction of several groups of researchers and health care providers, at local, national and international level. The groups involved in yellow fever control in West Africa held varying perceptions of, and responses to yellow fever. The examination of the approaches to and ideas of yellow fever held by each group provides a multi-layered analysis that informs about their perceptions of the disease, and their priorities and preoccupations.

West Africa had certain characteristics unique to the region. Arguably, it was not considered as important as other parts of the empire such as India and South Africa. Until World War Two, it was of little strategic value to the empire. As such, it did not command the same attention of the Colonial Office. The four colonies had mainly agricultural economies, although the Gold Coast and Sierra Leone produced some minerals for export. The region also differed in terms of its experience of yellow fever. Until the mid 1930s, medical opinion held that West Africa was the only part of the British Empire was endemic. The disease was regarded as a problem specific to that region.

The colonial governments and their medical departments determined and led action against yellow fever in West Africa, with limited direction from the colonial authorities in Britain. Their methods can be divided into two categories: those part of day to day routine sanitary measures to guard against endemic yellow fever, and responses to an epidemic. The latter dominated anti-yellow fever efforts from 1900 to 1930. The CMS responded to epidemics with a considerable sense of urgency, enacting repressive measures unlikely to have been tolerated another time. This factor was not exclusive to yellow fever epidemics. M. Swanson and M. Lyons highlight the power of epidemics to elicit a strong reaction from the colonial authorities. In Swanson's case study, fear of epidemic plague permitted the expulsion of the African population from large urban centres in South Africa.[1] In Lyons's account, epidemic sleeping sickness provoked a mass medical campaign of social control. Without a visible presence of yellow fever, the CMS's zeal flagged, and their measures against the disease lapsed until the next epidemic. This suggests that the sense of urgency was dependent on the epidemic form of the disease, indicating the short term nature of the CMS's response to the disease. Although they acknowledged the long term problem that endemic yellow fever presented to health in West Africa, they did not have the resources or perhaps the will to maintain a constant effort against this aspect of yellow fever control. There were other, more pressing health problems.

The CMS's measures prioritised Europeans, especially colonial officials, in large urban centres. This demonstrates the overriding preoccupation of the CMS: the protection of white health: a common feature of colonial action against other tropical diseases in the early twentieth century. However, this prioritisation was a constant characteristic of colonial anti-yellow fever measures throughout the period. This conflicts with the extension of colonial medical provision to the indigenous population during the interwar period, as noted by many historians including M. Worboys.[2] The yellow fever case study shows that this move was not uniform, and that the process was, in fact, more subtle. Despite the CMS's efforts to provide the indigenous

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[1] M. Swanson, "Sanitation Syndrome: Bubonic Plague and Urban Native Policy in the Cape Colony, 1900-1909", *Journal of South African Studies* **18** (1977), pp. 387-410.
[2] M. Worboys, "Tropical Diseases", in W.F. Bynum and R. Porter (eds.), *Companion Encyclopedia of the History of Medicine* (London: Routledge, 1993), pp.512-536.

population with medical care from the 1930s, their approach to yellow fever signifies that the protection of Europeans was still their central priority. This was demonstrated during the 1930s when the colonial medical authorities restricted inoculation exclusively to the white population: a practice contrary to measures during that decade aimed at indigenous health. The indigenous population only received inoculation during World War Two, when new priorities emerged.

These issues were particularly acute in anti-yellow fever measures because of assumptions about the disease's epidemiology. Notions of African immunity, endemicity in West Africa, Africans as a reservoir of infection, and of a mild form of the disease suffered by Africans, created an epidemiological profile that suggested that the non-indigenous population was particularly vulnerable to the disease, and that Africans were potential reservoirs of yellow fever. The historiography has particularly associated these notions with ideas about other tropical diseases, especially malaria. That they were also central to perceptions of yellow fever suggests that they were perhaps fundamental in shaping the way colonial and western medicine perceived indigenous populations and tropical diseases. They certainly affected the nature of anti-yellow fever campaigns. As Africans were assumed to be immune, they were seen as less in need of protection against the disease, yet as reservoirs of infection, they were regarded as potential threats to European health.

The CMS instigated a number of anti-yellow fever measures that focused on controlling humans and mosquitoes: the possible sources of infection. Community based measures such as the destruction of mosquito sites benefited all, but more individual methods of prophylaxis were aimed at Europeans who were encouraged to live in segregated housing and use mosquito nets. The use of these measures against malaria has been well documented in the historiography. The yellow fever case study links to and extends these accounts. The use of segregation against yellow fever suggests the limits of analysing this measure in terms of malaria prevention alone. J. Cell and P. Curtin have argued that segregation as an anti-malarial measure waned after 1910.[3] However, this thesis suggests that its favour among the CMS continued into the 1930s, against yellow fever at least.

The Colonial Office played only a sporadic role in yellow fever control. For the majority of the period it was content to allow the CMS to deal with the disease. This partly reflects the general administration of the colonies, which allowed colonial governments to dictate the day to day running of their territories. It also demonstrates that the Colonial Office did not consider yellow fever a particular threat, and worthy of its attention. However, periods of crisis would reverse this approach, provoking a reaction from the Colonial Office. For example, a number of epidemics throughout the region in 1910 persuaded the Colonial Office to initiate a series of investigations, beginning with Boyce's expedition in 1910 and leading to the creation of the YFWAC in 1913. The Colonial Office's attention was again called to yellow fever during the 1930s to contend with the implications of inoculation, particularly regarding safety concerns and its possible compulsory administration. Its approach was haphazard, and failed to provide a coherent strategy for its use. Instead, it left the colonial governments and the medical communities in Britain and the colonies to use the technique as they saw fit. As a result, confusion about its safety occurred among the medical profession, and its application throughout the colonies was uneven, only the government of the Gambia making it compulsory for officials as a condition of their

[3] P. Curtin, "Medical Knowledge and Urban Planning in Tropical Africa", *American Historical Review* 90 (1985), pp.594-613; J. Cell, "Anglo-Indian Medical Theory and the Origins of Segregation in West Africa", *American Historical Review* 91 (1986), pp.307-335.

service. This demonstrates that the practice of colonial medicine was not uniform. In the case of inoculation, a variety of colonial and medical groups influenced its application, including the RF, the Colonial Office, colonial governments and Findlay; all demonstrating their own interests and preoccupations.

The Colonial Office reversed its ad hoc approach during World War Two, when strategic necessities and the conditions created by war forced it to take an unprecedented role in the disease's control, as its perceptions of the disease altered. It considered the disease too significant to be left in the hands of the colonial governments and medical departments and therefore created the IDCYFC to impose centralised directions on its control. However, the Colonial Office did not sustain this level of action during the post-war period. For example, it failed to seize the opportunity presented by the RF to create a metropolitan directed research programme in West Africa. This, together with the other examples of Colonial Office intervention, suggests that the Colonial Office required a specific crisis to force it to take action against the disease.

The Colonial Office initiated some limited research activity in West Africa. Findlay dominated British efforts, focusing on the immunological techniques of inoculation and protection tests. He became the acknowledged expert on the disease, and frequently acted on the behest of the Colonial Office, conducting research and investigations and providing advice. The LSTM played a more limited role, with its involvement opportunistic rather than part of any research strategy. The activities of both Findlay and the LSTM can be regarded as colonial in the sense that they were frequently instigated at the behest of the Colonial Office and colonial governments. They also helped, in a limited fashion, to make the tropics safer for colonial personnel.

The RF offers an additional dimension to yellow fever control in West Africa. Its involvement, like that of Findlay and the LSTM, demonstrates that there were various layers to tropical medicine, as it related to yellow fever control. It was not limited to formal colonial groups. The RF's research activities were more extensive than British efforts and initially undertaken as preliminary to control efforts as part of its plans for global eradication. In contrast to the CMS, it was not limited by budget and staff restrictions, nor did it concern itself with the other health problems of the region. Its focus was solely yellow fever, and it had vast resources at its command. Its aims were fluid and moved from hopes for eradication, to more modest control plans, and eventually to a concentration on research alone which was not intended as part of any control efforts in West Africa. This shift was reinforced by several factors internal and external to the RF. These included the development of the mouse protection test, Russell's predilection for laboratory based, biomedical research, the productive nature of the Commission's work and developments in South America. Whatever the initial intention of its work in West Africa, the RF soon saw it in terms of research alone. As a consequence, it used West Africa as a site for research. The RF continued this practice when it returned to the region in the 1940s, unequivocally stating its purpose was research only. The RF's activities in West Africa contrasted with its anti-yellow fever campaigns in South America. In the latter, the RF aimed to eradicate, and later control yellow fever. This would help secure American economic interests in the area, and reduce the associated commercial costs of the disease. In West Africa, the focus was on research. The RF's investigations in the region did, however, prove valuable later in the development of new control technologies. My study of the RF adds to the considerable historiography examining the RF's work in South America. Much of this work focuses on the operation of practical campaigns of disease control.[4] My thesis provides a further dimension to these accounts, exploring a RF research programme, rather than its control efforts. It also demonstrates the limits of E.R. Brown's contention that the RF's disease control campaigns were a form of colonialism, as its activities in West Africa did not manifest an obvious colonial drive.[5]

The RF's methods highlight the key division between British efforts against the endemic and epidemic form of yellow fever. The IHD stressed the importance of mapping the endemic area as this would allow it to locate urban areas needing control efforts. The Commission investigated epidemics only for their potential to provide clinical and pathological data. It dedicated considerable resources into delineating the endemic area, illustrating its commitment to the task. Its researchers initially used time and labour intensive methods of field investigation including taking histories and studying medical records. The development of monkey and mouse protection tests facilitated the investigation and the RF conducted a vast global survey of endemicity following requests from the OIHP.

In contrast, the British medical and colonial community prioritised the control of epidemic yellow fever, which presented the more immediate threat to European health. The availability of inoculation provided a further measure against endemic yellow fever as it reduced the numbers of susceptible, non-immune people. However, as discussed, the colonial authorities were undecided about its use, with the Colonial

[4] See for example, S.C. Williams, "Nationalism and Public Health: The Convergence of Rockefeller Foundation Technique and Brazilian Federal Authority During the Time of Yellow Fever, 1925-1930", pp.23-51; A. Solorzano, "The Rockefeller Foundation in Revolutionary Mexico: Yellow Fever in Yucatan and Veracruz", pp.52-71. Both in M. Cueto (ed.), *Missionaries of Science: The Rockefeller Foundation and Latin America* (Bloomington: Indiana University Press, 1994).
[5] E.R. Brown, "Public Health in Imperialism: Early Rockefeller Programs at Home and Abroad", in J. Ehrenreich (ed.), *The Cultural Crisis of Modern Medicine* (New York: Monthly Review Press, 1978), p.253.

Office failing to provide any clear direction. The war provided the stimulus necessary for colonial action against the endemic form of the disease. The availability of these new techniques combined with conditions specific to the war persuaded the British colonial and medical authorities to deal with endemic yellow fever.

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