Soil Science and the Politics of Expertise: Empire, Land and Fundamental Research

Theo Tomking

PhD

University of York

History

September 2025

Abstract

Accounts of the history of soil science in the tropics have tended to present a story of linear scientific progress, moving from past generalisations toward an appreciation of the variety of soils in the tropics from roughly the mid-1970s. This thesis presents a different narrative, showing the wide range of attempts to generate nuanced understandings of the varieties of tropical soils as part of visions of colonial development earlier in the century.

This thesis examines the ambitions for soil science at the major centres for agricultural science and education in the British Colonial Empire between 1920 and 1965. These include the Imperial College of Tropical Agriculture (Trinidad), the Amani Station (Tanganyika) and the East African Agriculture and Forestry Research Organisation (Kenya). Soil science, particularly soil surveying, was afforded significance at these institutions for a variety of reasons, reflecting personal ambitions, wider political developments and economic imperatives. A range of approaches to the study of soils were taken, and the connections between soil science and the aims and objectives of empire differed geographically and historically.

By paying close attention to the trajectory of programmes of colonial soils research in practice, this thesis highlights the contrast between ambition and implementation. Factors such as shortages of funding, difficulties of recruiting qualified personnel and a lack of coordination between institutions undermined efforts to generate scientific knowledge of soils. Rather than being an exception, this thesis suggests that the gap between visions of large-scale scientific projects and the more limited nature of work on the ground was the norm.

Contents

Abstract 2

List of Figures 5

Acknowledgements 6

Author's Declaration 7

CHAPTER 1. Introduction 8

1.1 Science and Development in the Twentieth Century Colonial Empire 11
1.11 Science and Power 16
1.12 Colonial Science or Science in the Colonies? 18
1.13 Fundamental Research 20

1.2 Field Sciences: Space, Place, Land 22

1.3 Sources and Methodology 26

1.4 Outline of Chapters 27

CHAPTER 2. Masters of All They Surveyed? Geoffrey Milne, the Amani Station and the East African Soil Map Project, 1920-40 30

2.1 Introduction 30

2.2 Ambitions Behind Soil Mapping in East Africa 32

2.3 Building the Map Part I: "Citizen Science"? 44

2.4 Building the Map Part II: Reconnaissance Journeys 49

2.5 Creating (Blank) Space for Soil Science in East Africa 57

2.6 Conclusion 67

CHAPTER 3. The Trinidadian School of Soil Science: Fred Hardy, the Imperial College of Tropical Agriculture and "Physiological-Ecological" Survey, 1922-36 69

3.1 Introduction 69

3.2 A "Tropical Training Ground" in the British West Indies 70

3.3 The Hardy Approach: Physiological-Ecological Soil Survey 80

3.4 A Conservative Politics of Soil Science 85

3.5 Analysis as a Way of Knowing Caribbean Soils 93

3.6 Conclusion 97

CHAPTER 4. Postwar Soil Survey in the British West Indies: Anglo-American Relations and Agricultural Diversification, 1938-58 99

4.1 Introduction 99

4.2 Tipping Point 101

4.3 A Colonial Development and Welfare Scheme 111

4.4 “Much More Receivers than Givers”: Getting the Resources and Expertise 120

4.5 The Regional Research Centre and Reforms to the Soils Research Scheme 128

4.6 Land Capability Appraisal and a Pragmatic Approach 134

4.7 Conclusion 140

CHAPTER 5. The Politics of Tropical Soils Research at the East African Agriculture and Forestry Research Organisation, 1945-53 142

5.1 Introduction 142

5.2 A Regional Research Organisation for East Africa 144

5.3 Bernard Keen, Tropical Soils and EAAFRO 148

5.4 From Local Utility to International Soil Science 152

5.5 "A Complete Rift"? 156

5.6 Manpower and Money 164

5.7 Mau Mau 172

5.8 Conclusion 176

CHAPTER 6. Between Colony and Continent: The Inter-African Pedological Service and the Tensions of Integrated Soils Research, 1948-65 178

6.1 Introduction 178

6.2 Reception of the Inter-African Pedological Service in East Africa and London 180

6.3 Toward a Soil Map of Africa … and the World 188

6.4 “A Cultural Exercise” 199

6.5 Conclusion 209

Conclusion 211

Abbreviations 217

Bibliography 218

List of Figures

Figure 2.1 Shantz, Homer L. and Curtis F. Marbut. *Vegetation and Soils of Africa*. Map. New York: American Geographical Society, 1923 *page* 42

Figure 2.2 Diagram representing "a residual granite hillock and the soils around it, in the plateau region south of Lake Victoria," 16/7/36 *page* 53

Figure 2.3 Photograph showing "complete catena", with a caption describing vegetation, soil types and other landscape features, 1/1/36 *page* 55

Figure 2.4 Milne, Geoffrey et al. *A Provisional Soil Map of East Africa (Kenya, Uganda, Tanganyika & Zanzibar)*. Map. Amani: EAARS, July 1935 *page* 64

Figure 3.1 Map of La Vega Estate, showing the names of previous proprietors of consolidated plots, circa 1920s *page* 90

Figure 4.1 Roberts, R.C. *Soil Map of Puerto Rico Eastern Sheet*. Map. USDA Bureau of Chemistry and Soils, 1936 *page* 108

Figure 6.1 D'Hoore, Jules, L. *Soils Map of Africa Sheet 3*. Map. Bruxelles: Institut Géographique Militaire, 1963 *page* 198

Acknowledgements

There are many people without whom this project would not have been possible. Firstly, I would like to thank my supervisors Sabine Clarke and Calvin Dytham for their continued support, guidance and encouragement. The Leverhulme Centre for Anthropocene Biodiversity at the University of York has been a welcoming academic home throughout this project, and I am grateful for colleagues' feedback and intellectual exchanges. I would like to thank Gerard McCann as a member of my Thesis Advisory Panel for his feedback on earlier drafts of chapters. I am also indebted to the Centre for the History of Science, Technology and Medicine at the University of Manchester for my time there as an undergraduate student.

This project has benefited from the help of staff at archives and other institutions in the UK, Trinidad and Tobago, Kenya, and Italy. It has also benefited from the generosity of people who have shared their understanding of soils, soil science and the past in conversations during research trips, workshops and elsewhere. Thanks go to Gaius Eudoxie, Grafton Dick and Christopher Voss at the University of the West Indies, St Augustine; Noémi Ujházy and Murray Lark at the University of Nottingham; and Peter Wakaba and Hillary Rotich at KALRO; and others.

I would finally like to thank my parents, Vicky Hobart and Emmanuel Tomking, and the numerous family members, friends and loved ones who have supported me over the past four years. This thesis is dedicated to Elfrida Tomking.

Author's Declaration

I declare that this thesis is a presentation of original work and I am the sole author. This work has not previously been presented for an award at this, or any other, University. All sources are acknowledged as References.

Some of the research conducted for this thesis has contributed toward the publication of the following edited book chapter: Theo Tomking, "Soil Science, Tropicality and Conceptualizations of the Agricultural Potentialities of the Tropics, 1920-39," in *Weathering Fields: Climate, Food & Famine in History*, ed. Eleanor Shaw and Robert Naylor (Berghahn Books). (Manuscript submitted for publication).

CHAPTER ONE

Introduction

We are often told a narrative of the history of soil science in the tropics that starts with past generalisations and ends with contemporary appreciation of the diversity of such soils. We are told, particularly by soil scientists, that many in the past held onto ideas about either the ubiquitous fecundity or infertility of "tropical soil". Making reference to the concept of scientific paradigms developed by Thomas Kuhn, a recent textbook on soils in the tropics suggests that a "laterite paradigm" dominated the study of soils in the tropics throughout the nineteenth century until roughly the mid-1970s. This supposed paradigm was characterised by an understanding that a single type of soil prevailed in the tropics; a soil characterised by its red colour, acidity, infertility and tendency to turn into solid elements of "laterite" when cleared of vegetation. As further studies progressed, the textbook argues, a new paradigm emerged by the 1970s that recognised the variety of soils in the tropics.[1] A similar narrative is presented in other accounts from within the discipline of soil science; namely, one of progress from past ignorance to contemporary enlightenment, albeit with some caveats. As emphasised in an article from 1991: "soils in the tropics can no longer be generalized as being universally fertile or dangerously fragile; they can, however, be generalized by their remarkable diversity."[2]

This thesis shows that these narratives fail to recognise attempts to generate nuanced understandings of the varieties of tropical soils as part of visions of colonial development earlier in the century. By looking at the place of soil science in British colonial development during the late colonial period, as well as the realities of implementing programmes of soils research in practice, this thesis presents a different narrative of the history of soil science in the tropics. It shows the varying ways in which empire provided impetus to wide ranging and in-depth soils research programmes, particularly in the Caribbean and East Africa.[3] A key

[1] Pedro A. Sanchez, *Properties and Management of Soils in the Tropics*, 2nd ed. (Cambridge University Press, 2019), 69-72.
[2] Daniel Richter and Liana Babbar, "Soil Diversity in the Tropics," *Advances in Ecological Research* 21 (1991): 316. See, also, Rattan Lal and Pedro A. Sanchez, ed., *Myths and Science of Soils of the Tropics* (Soil Science Society of America, 1992). Alfred Hartemink notes that significant soil research took place in Trinidad, East Africa and India during the interwar years but does not go into detail about what this involved. See Alfred E. Hartemink, "Soil Science in Tropical and Temperate Regions: Some Differences and Similarities," *Advances in Agronomy* 77 (2002): 274-5.
[3] The term "empire" is used here to refer to the British Colonial Empire which came under the purview of the Colonial Office in London, and not India or the Dominions which were dealt with separately.

argument of this thesis is that the emergence of tropical soil science as a scientific specialty in its own right was in large part a product of the space created for soils research in European colonies.

The work of the historians Joseph M. Hodge and Helen Tilley has previously brought some of these existing narratives about the history of soil science in the tropics into question. Both Hodge and Tilley have shown that scientific researchers working from British institutions in tropical Africa during the 1920s and '30s developed nuanced understandings and representations of soils in the tropics that took into account local ecological complexity and diversity.[4] Their work has indicated that the questioning of generalisations about soils in the tropics is not as recent a phenomenon as some accounts suggest. Their work also shows that this knowledge was a product of networks of science and expertise connected with empire. This historical work, like others in the field that has come to be known as the history of science and empire, demonstrates the complex and contingent relationships that could exist between scientific endeavours and European imperial projects.[5]

The focus of Hodge's and Tilley's work is on the broader relationship between scientific expertise and British colonialism without providing a deeper exploration of soil science as a particular scientific specialty. Relatively few studies have paid sustained attention to the history of soil science in British colonial contexts. Anthony Young's *Thin On the Ground* (2007) is an exception. Young's extensive study highlights the varying institutional locations and achievements of soil and ecological surveyors working in British Overseas Territories from the 1920s to 1960s.[6] It provides an unparalleled picture of the scale of research work that was undertaken and the networks underpinning soil science across the British empire, including India. Young's account does not address some of the more fundamental questions that have informed historical studies of the relationship between science and empire,

---

[4] Joseph M. Hodge, *Triumph of the Expert: Agrarian Doctrines of Development and the Legacies of British Colonialism* (Ohio University Press, 2007), 154-7; Helen Tilley, *Africa as a Living Laboratory: Empire, Development, and the Problem of Scientific Knowledge, 1870-1950* (University of Chicago Press, 2011), 115-68.

[5] For overviews of the scholarship on science and empire, see, for instance, Joseph M. Hodge, "Science and Empire: An Overview of the Historical Scholarship," in *Science and Empire: Knowledge and Networks of Science Across the British Empire, 1800-1970*, ed. Brett M. Bennett and Joseph M. Hodge (Springer: 2011), 3-29; Andrew Goss, "Introduction: An Imperial Turn in the History of Science," in *The Routledge Handbook of Science and Empire*, ed. Andrew Goss (Routledge, 2021), 1-9; Pratik Chakrabati and Michael Worboys, "Science and Imperialism since 1870," in *The Cambridge History of Science Volume 8: Modern Science in National, Transnational, and Global Context*, ed. Hugh Slotten, Ronald Numbers, and David N. Livingstone (Cambridge University Press, 2020), 9-31.

[6] Anthony Young, *Thin On the Ground: Land Resource Survey in British Overseas Territories* (Memoir Club, 2007).

however. It does not address broader questions about the relationship between soil science and imperial power, for instance.

The relative paucity of historical studies that focus on the relationship between soil science and empire is surprising given the significance afforded to soil science, particularly soil surveys, in the arrangements for British colonial research during the late colonial period. Soil science was one of numerous disciplines prioritized within institutions that played key roles in the development of agricultural science and education in the Colonial Empire. During the interwar period, such institutions included the Imperial College of Tropical Agriculture (ICTA) in Trinidad and the East African Agricultural Research Station at Amani (Amani Station) in Tanganyika. Both institutions were of unparalleled significance for Britain. They were the centres of scientific expertise in the tropics seen as capable of undertaking the sort of research or training deemed necessary for the broader goals of development during the early-twentieth century.[7] In terms of international status, they were comparable, at least in intent, with institutions in other European empires such as Buitenzorg in the Dutch East Indies.[8]

Soil science was afforded even more significance as an area of colonial research after 1940 with the creation of the Research Fund of the Colonial Development and Welfare (CDW) Acts. This Fund provided unprecedented financial support for research throughout the Colonial Empire. Soil science was a key area of research alongside other disciplines. This was reflected in the inclusion of soils research, particularly soil surveying, within the research programmes of new research institutions and schemes established in British colonies. This is in addition to a plethora of institutional arrangements introduced in the metropole (United Kingdom) to promote and coordinate soils research throughout the Colonial Empire after 1940.

This all raises a number of questions. Why was soil science was afforded so much significance as an area of scientific research of importance to the future of the Colonial Empire? In what ways were developments in soil science, particularly soil surveying, connected with the various aims and objectives of empire? What differences in wider regimes of production shaped soil science, such as plantation agriculture or a more mixed model of European farms and independent small-scale production? Not least, it raises the question of

[7] Hodge, *Triumph of the Expert*, 90-116; Michael Worboys, "Science and British Colonial Imperialism, 1895-1940," (Ph.D. thesis, University of Sussex, 1979), 191-232.
[8] Florian Wagner, "Inventing Colonial Agronomy: Buitenzorg and the Transition from the Western to the Eastern Model of Colonial Agriculture, 1880s–1930s," in *Envrionments of Empire: Networks and Agents of Ecological Change*, ed. Ulrike Kirchberger and Brett M. Bennett (University of North Carolina Press, 2020), 103-28.

why soil science came to prominence as an area of research in British colonies so late. British imperial networks played a key role in creating the conditions whereby natural sciences such as botany and geology could prosper during the nineteenth century and earlier.[9] What was it about the late colonial period that meant the study of soils in the tropics was able to achieve professionalisation?

1.1 Science and Development in the Twentieth Century Colonial Empire

"Development" as a specific set of ideas and practices is often understood as having emerged within the context of the Cold War with American programmes of technical assistance and the rising authority of the United Nations specialised agencies.[10] Yet, scholarship has shown the ways in which development can be seen as a policy pursued by European colonial powers since at least the turn of the twentieth century. This is particularly the case with regards to Britain and its Colonial Empire. The introduction of policies centred on the provision of state support for the development of the productive resources of the Empire, as opposed to a laissez faire approach, has been attributed to the work of Joseph Chamberlain as Secretary of State for the Colonies (Colonial Secretary) between 1895-1903.[11] Chamberlain is recognised for championing the importance of state support for infrastructure projects in the colonies, such as the construction of roads, bridges and railways. Perhaps most significantly, Chamberlain also proposed a more central role for scientific research in the broader project of unlocking the productive potential of Britain's "tropical colonies". Research was positioned as a way of overcoming barriers to the augmentation of production, particularly of tropical agricultural commodities. Increased production, it was argued, would benefit Britain by providing reliable sources of food and raw materials and expanded markets for manufactured goods, whilst the colonies would benefit from economic growth and their supposed assimilation into world civilisation.[12]

---

[9] Lucile H. Brockway, *Science and Colonial Expansion: The Role of the British Royal Botanic Gardens* (Academic Press, 1979); Richard Drayton, *Nature's Government: Science, Imperial Britain, and the 'Improvement' of the World* (Yale University Press, 2000); Robert A. Stafford, "Geological Surveys, Mineral Discoveries, and British Expansion, 1835–71," *Journal of Imperial and Commonwealth History* 12, no. 3 (1984): 5-32.

[10] Amy Staples, *The Birth of Development: How the World Bank, Food and Agriculture Organization and World Health Organization Changed the World, 1945-65* (Kent State University Press, 2006).

[11] Stephen Constantine, *The Making of British Colonial Development Policy 1914-40* (Frank Cass, 1984), 9-12.

[12] Michael Havinden and David Meredith, *Colonialism and Development: Britain and its Tropical Colonies, 1850-1960* (Routledge, 1993), 86-90; Hodge, *Triumph of the Expert*, 54-55.

Ideologies of science for development similar to those promoted during the tenure of Chamberlain circulated during the interwar period and were expressed in ambitions for the greater coordination of colonial research. Arrangements were introduced in the Colonial Office during the 1920s aimed at coordinating agricultural development and scientific research throughout the Colonial Empire. This included the setting up of the Colonial Advisory Council on Agriculture and Animal Health (CAC) in 1929. The ambitions behind the CAC were for it to act as a central coordinating body for colonial agricultural development. Many of its members, some of whom were high profile scientists from the United Kingdom, held ambitions reminiscent of the Chamberlainite view of the relationship between scientific expertise and development. The creation of space for specialist research into problems of tropical agriculture was intended, in part, to provide the knowledge that would underpin colonies' economic development and the prosperity of Britain itself.[13] The CAC endorsed plans for the setting up of an empire-wide network of central research stations, of which the ICTA in Trinidad and the Amani Station in Tanganyika were meant to be the first links. This system was not introduced in practice, however. Hodge shows how much of the "science for development" ambitions of those in the Colonial Office and its novel agricultural advisory networks received significant setbacks during the 1930s, not least due to economic conditions of austerity precipitated by the Great Depression.[14]

The period after 1940 has come to be recognised by historians as a time in which a number of new institutional arrangements were put in place for the coordination and promotion of development and "welfare" in the Colonial Empire. Principal among these was the passing of the CDW Act of 1940, followed by the second Act of 1945 and numerous others into the 1960s. These Acts made available unprecedented funds for the supposed purposes of developing colonial resources and improving human welfare.[15] The scale of the overall increase in government activity and deployment of staff to work on development programmes in Africa after the Second World War has led some to refer to this period as that

[13] Joseph M. Hodge, "Science, Development, and Empire: The Colonial Advisory Council on Agriculture and Animal Health, 1929-43," *Journal of Imperial and Commonwealth History* 30, no. 1 (2002): 7-9; Hodge, *Triumph of the Expert*, 97-116; Worboys, "Science and British Colonial Imperialism," 191-232.
[14] Hodge, "Science, Development, and Empire," 7-8.
[15] D.J. Morgan, *The Official History of Colonial Development Vol. 1: The Origins of British Aid Policy, 1924-45* (Clarendon Press, 1976), 80-206; P.J. Cain and A.G. Hopkins, *British Imperialism, 1688-2000*, 2nd ed. (Pearson Education, 2002), 589-90; Havinden and Meredith, *Colonialism and Development*, 218-27; *Colonial Development and Welfare Acts 1929-70: A Brief Review*, cmnd. 4677 (London: HMSO, 1971).

of the "second colonial occupation" in the case of Africa.[16] Existing scholarship shows that scientific research occupied a central place in the vision of colonial development behind the passing of these Acts. Included with the funds for development and welfare in the Acts was a significant Research Fund, intended to support an expanded programme of research throughout the Colonial Empire. Many new research institutions were established in British colonies using these funds.[17] New arrangements in the Colonial Office were also put in place to oversee this expansion in colonial research, including a plethora of new advisory committees, sub-committees and councils.[18]

Discussions around soil science were shaped by changing political and economic conditions for the Colonial Empire, as well as changing ideas about what Britain ought to be doing with its colonies. Increased calls for more soil science accompanied wider developments, such as ambitions for developing the agricultural potential of East Africa and the fears of soil erosion that characterised the interwar period. Since agricultural activities were the backbone of most colonial economies, soil science had clear economic value. This was combined with a desire among some individuals to see soil science emerge as a more fully formed scientific discipline. Soil surveying, as such, was the product of both personal visions for soil science as a discipline and wider political and economic ambitions for the Empire. This thesis shows that there was not one vision of soil science. Empire provided people with enough freedom in their work to pursue soil science along their preferred lines, particularly during the interwar period. Science in the Caribbean operated under different conditions to East Africa.

The existing scholarship tells us that soil science was one of numerous disciplines afforded a place in the new colonial agricultural advisory networks of the 1920s. Hodge shows that the British chemist E.J. Russell, as a member of the CAC and head of the Imperial Bureau of Soil Science, emphasised the importance of soil surveys and mapping as a precursor to "resource development planning" and resisted the pressure on soil scientists to produce practical results until they had sufficient knowledge of the "fundamental nature of

[16] This was a term originally used in reference to experiences in East Africa. See D.A. Low and John Lonsdale, "Introduction: Towards the New Order, 1945-1963," in *History of East Africa: Volume Three*, ed. D.A. Low and Alison Smith (Clarendon Press, 1976), 13.
[17] Sabine Clarke, *Science at the End of Empire: Experts and the Development of the British Caribbean, 1940-62* (Manchester University Press, 2018), 61.
[18] Sabine Clarke, "The Research Council System and the Politics of Medical and Agricultural Research for the British Colonial Empire, 1940–52," *Medical History* 57, no. 3 (2013): 338-58; Sabine Clarke, "Experts, Empire and Development: Fundamental Research for the British Colonies, 1940-1960," (Ph.D. thesis, University of London, 2005); Hodge, *Triumph of the Expert*, 196-206.

the soil".[19] We are told that Russell was involved in formulating a plan for a West African soil survey in the early-1930s; a plan that was eventually shelved due to its rejection by the West African colonial governments in light of "financial constraints caused by the Depression."[20] This contrast between the ambitions for and realities of soils research in West Africa corresponds with the broader trend of the 1930s in which visions of "science for development" were often undermined. But what about the trajectory of soil science at Britain's chief imperial centres for agricultural science and education in the Colonial Empire: the Amani Station and the ICTA? Very little attention has been paid to the trajectory of soils research at the ICTA during the interwar period.[21] Given its role as an educational centre for the training of colonial agricultural recruits, this opens up questions about what ideas of the relationship between soil science and colonial development students would have left Trinidad with. Accounts of the history of soils research at the Amani Station in Tanganyika during the interwar years have pointed out the achievements of the institution's soil chemist, Geoffrey Milne, noting his involvement in the production of basic knowledge of soil types in East Africa and the ways in which he was part of a broader trend among British environmental researchers in interwar East and Central Africa toward ecological approaches.[22] Indeed, it is this work that has called into question narratives of linear scientific progress in the study of soils in the tropics. Relatively little attention has been paid to the barriers to soils research at Amani, however. Were there similar financial and other conditions to those in West Africa that had to be navigated in East Africa? If so, how was the culture of soil science in East Africa and the trajectory of research shaped by these broader conditions?

Questions also remain about the place of soil science in the novel arrangements for colonial research after 1940. Sabine Clarke shows that a number of bodies were established under the Colonial Office during the 1940s to oversee the spending of the CDW Research Fund. Principal among these was the Committee for Colonial Agricultural, Animal Health and Forestry Research (CCAAHFR). The CCAAHFR, Clarke shows, was different to the CAC in that it had greater executive powers. A number of sub-committees were formed under the CCAAHFR, including one for soils.[23] We have little understanding of the role played by

---

[19] Hodge, *Triumph of the Expert*, 111-2. The Imperial Bureau of Soil Science was one of numerous imperial agricultural bureaux set up in 1928 to act as clearinghouses for the interchange of information among research workers throughout the empire. The Imperial Bureau of Soil Science was housed at Rothamsted Experimental Station; Britain's chief agricultural research institute at the time, located in Harpenden, England.
[20] Ibid., 112.
[21] An exception is Young, *Thin On the Ground*, 13-6.
[22] Hodge, *Triumph of the Expert*, 154-6; Tilley, *Africa as a Living Laboratory*, 155-6.
[23] Clarke, "The Research Council System and the Politics of Medical and Agricultural Research for the British Colonial Empire," 343-4.

members of this sub-committee on soils in initiating or determining the direction of soils research projects in the colonies in the postwar period. Moreover, were there other metropolitan arrangements put in place to oversee soils research in the colonies after 1940? What sort of vision of the relationship between soil science and colonial development was promoted by these novel metropolitan networks?

The period after 1940 was not just characterised by novel arrangements in the metropole. It was also shaped by the establishment of new research institutions and schemes in the colonies. In this regard, another goal of this thesis is to give a more in-depth account of the place of soil science within these novel institutional arrangements in the colonies after 1940, including the trajectory of programmes of soils research on the ground. East Africa was the locus of a major new research institution after 1945, with the establishment of the East African Agriculture and Forestry Research Organisation (EAAFRO) in Muguga on the outskirts of Nairobi, Kenya, during the late-1940s. We are told that EAAFRO was one of the, if not the, most significant institutions established in the Colonial Empire to facilitate research on a regional basis after the Second World War. It was a successor to the Amani Station in Tanganyika and embodied the sorts of bureaucratic and professional arrangements that were central to visions of colonial research promoted by the Colonial Office after 1940.[24] If "long range" or "fundamental" studies of tropical soils were to take place in the Empire during the 1940s and '50s, then EAAFRO was likely to be a major centre for such studies. We also know that the ICTA in Trinidad was afforded significance as a centre for research after 1940; particularly for research into novel sugarcane products with the opening of the Sugar Technology Laboratory at the ICTA in 1951.[25] What about agricultural research at the ICTA after 1940? Did the ICTA move to the background as an imperial centre for agricultural research and education in the Empire, or was it imbued with an invigorated sense of significance in this regard? If so, what was the place of soil science at the ICTA? By paying close attention to the trajectory of soils research within new research institutions and schemes established in the Colonial Empire after 1940, this thesis aims to give a more detailed account of the ways in which the implementation of visions of colonial research had to come to terms with local circumstances. Was Britain able to pull off large-scale programmes of soils research in the colonies? Furthermore, how were these programmes navigated within a shifting geopolitical context of growing American influence and decolonisation? Whilst the

[24] Ibid., 343-8; Hodge, *Triumph of the Expert*, 203.
[25] Clarke, *Science at the End of Empire*, 111-9.

issue of funding seemed to have been solved in the postwar period, there was a new problem, the availability of qualified manpower.

1.11 Science and Power

Looking at the relationship between a scientific specialty, such as soil science, and British colonialism opens up questions about the connections between scientific knowledge on the one hand, and imperial power and colonial control on the other.[26] Christophe Bonneuil has foregrounded the various ways in which science was deployed as a tool of control over environments and peoples in European colonies.[27] Take Bonneuil's study of the relationship between science and state building in colonial and post-colonial Africa. Bonneuil highlights the role played by "experts" (defined by Bonneuil as scientists or technical officers) in producing knowledge that supported the implementation of large-scale agrarian development schemes in Africa; particularly those aimed at settling African peoples into standardised, regimented forms of habitation and agricultural production.[28] Bonneuil's argument is that science was a central feature in the emergence of a "development regime" in late colonial Africa, which persisted into the post-colonial period. The creation of space for scientific work in Africa, Bonneuil argues, was entwined with colonial states' efforts to intervene in, govern and "improve" agrarian societies along specific developmentalist lines.[29] The account of the relationship between science and colonialism given by Bonneuil is one in which science can be seen as part of a broader project of coercion; shaping African peoples' lives and transforming modes of production. Though not focusing on the role of science per se, Corey Ross, in *Ecology and Power in the Age of Empire* (2017), paints a similar picture of late European empires as hegemonic forces in the ways they transformed the ecologies of the "tropical world".[30]

---

[26] Hannah Arendt describes power as "the human ability not just to act but to act in concert." See Hannah Arendt, *On Violence* (Harcourt, 1969), 44.
[27] Christophe Bonneuil, "Development as Experiment: Science and State Building in Late Colonial and Postcolonial Africa, 1930-1970," *Osiris* 15, no. 1 (2000): 258-81; Christophe Bonneuil, "Crafting and Disciplining the Tropics: Plant Science in the French Colonies," in *Science in the Twentieth Century*, ed. John Krige and Dominique Pestre (Harwood Academic Publishers, 1997), 77-96. For an example of scholarship that has foregrounded science and technology as tools of European imperial domination on a much broader front, see Daniel Headrick, *Tools of Empire: Technology and European Imperialism in the Nineteenth Century* (Oxford University Press, 1981).
[28] Bonneuil, "Development as Experiment," 265.
[29] Ibid., 258-81.
[30] Corey Ross, *Ecology and Power in the Age of Empire: Europe and the Transformation of the Tropical World* (Oxford University Press, 2017).

Bonneuil's account of the role of experts and scientific knowledge in programmes of state intervention shares some similarities with James C. Scott's analysis in *Seeing Like a State* (1998). Both works position experts' efforts to make places "legible" to state intervention as underpinned by processes of simplification and standardisation. Unlike Bonneuil, though, the focus of Scott's critique is not "colonial science" but "high modernism"; a hubristic ideological stance underpinned by a set of beliefs about the linear connection between scientific and technical progress and societal advancement.[31] Scott contrasts high modernist thinking with "mētis", which he describes as the sorts of practical skills people acquire through adapting to their capricious environments.[32] Scott's analysis emphasises the ways in which experts' knowledge has often failed to capture the complexity of societal phenomena. This is epitomised by maps, which Scott describes as providing a myopic view from afar, obscuring the interdependencies, contingencies and complexity of the world as experienced on the ground.[33]

One of the most influential critiques of the role of "the expert" in late colonial Africa has been John McCracken's article on experts and expertise in colonial Malawi.[34] In the article, McCracken portrays experts in colonial Malawi as largely out of touch with local ecological and social conditions, and often representative of metropolitan and academic interests rather than addressing environmental and health related problems on the ground in nuanced and locally sensitive ways. According to McCracken, colonial experts' work was flawed because they were often hubristic. Rather than learning from Africa and Africans, they assumed that transferring knowledge *to* Africa would be sufficient to deal with problems such as soil erosion. As McCracken writes: "The colonial experts I have studied may have been frequently misconceived, though no more so than their post-colonial successors, but their faults lay less in their belief that some skills and techniques could be transmitted effectively to Africa than in their assumption that Africa had nothing to offer them."[35]

Much work on this area has focused on how authoritarian forms of control were imagined and how certain types of totalising project were implemented in colonies, but less on the incompleteness or failure to achieve hegemony. Where failure is described, such as by McCracken, it is attributed to the arrogance of experts who believed that they did not need to

---

[31] James C. Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (Yale University Press, 1998), 87-90.
[32] Ibid., 313. Scott's definition of mētis shares some similarities with the types of tacit knowledge described in Harry Collins, *Tacit and Explicit Knowledge* (University of Chicago Press, 2010).
[33] Scott, *Seeing Like a State*, 87-8.
[34] John McCracken, "Experts and Expertise in Colonial Malawi," *African Affairs* 81, no. 322 (1982): 101-16.
[35] Ibid., 116.

pay attention to local knowledge. This thesis shows a set of more mundane constraints. Soil science, like science in general, required workers, money and equipment, and sometimes "the field" that was under study was very big. Scientific research in the Colonial Empire never received unlimited funds or personnel, even at its most well-funded after 1940. Whilst historians have tended to emphasise the large amounts of money going toward Colonial Research after 1940, this thesis shows that the size of the problems under investigation were often still bigger than the funds available.[36]

1.12 Colonial Science or Science in the Colonies?

Some scholars have provided accounts of the relationship between science and colonialism in which experts and scientific knowledge are presented as less of a hegemonic force than that suggested by Bonneuil and others. Tilley's *Africa as a Living Laboratory* (2011) has been significant in this regard. Tilley's study focuses primarily on the trajectory of Lord Hailey's African Research Survey and its interactions with researchers, technical and other staff on the ground in Africa during the interwar period.[37] Tilley draws attention to the ways in which some British researchers and technical specialists, through their experiences producing scientific knowledge in Africa, came to adopt convictions, approaches and views that could work to subvert imperial ideologies and practices. Take Tilley's account of environmental sciences. In contrast with scholarship that has foregrounded colonial scientists' "misreadings" of African environments,[38] Tilley shows that some environmental researchers and technical specialists adopted approaches that took into account local ecological nuances and even Africans' environmental knowledge.[39] Such studies, Tilley argues, "unsettled colonial certainties", calling into question long held European assumptions about the fertility of tropical environments and the suitability of African farmers' cultivation practices to local ecologies.[40] The impression of science in colonial Africa we are left with by Tilley is one in which scientific knowledge can be seen, in many cases, as antagonistic to European imperial projects. As Tilley writes: "the process of producing new knowledge and synthesizing its

[36] Clarke, *Science at the End of Empire*, 50-3.
[37] The report of the Survey was published in 1938 as Lord Hailey, *An African Survey: A Study of Problems Arising in Africa South of the Sahara* (Oxford University Press, 1938).
[38] James Fairhead and Melissa Leach, *Misreading the African Landscape: Society and Ecology in a Forest-Savanna Mosaic* (Cambridge University Press, 1996); Kate B. Showers, *Imperial Gullies: Soil Erosion and Conservation in Lesotho* (Ohio University Press, 2005).
[39] Tilley, *Africa as a Living Laboratory*, 115-68.
[40] Ibid., 168.

results often had the unexpected and unintended effect of prompting epistemic *decolonization*. […] epistemic decolonization, combined with the kinds of auto-critique scientists periodically expressed, weakened the rationale for empire and had lasting effects on the political will to maintain colonial structures of rule."[41]

On a similar front, William Beinart, Karen Brown and Daniel Gilfoyle have asked whether Africanists' preoccupation with interpretations of colonial scientists and technical officers primarily as agents of imperialism has precluded the use of a more complex framework for thinking about "the operation of scientific modes of rationality in the empire".[42] Whilst acknowledging the centrality of science to processes of imperialism and settler colonialism, they highlight the value of expanding the framing of historical enquiry to include the question of "whether science and technology can be partially detached from, rather than collapsed into the immediate priorities of colonialism?"[43] At the time their article was published in 2009, this was not a new suggestion for some historians of science, for whom the utility of the term "colonial science" to describe the full spectrum of scientific activities practised in European colonies had already been brought into question. These reservations were largely due to the affiliation of the term "colonial science" with a sort of science that was inherently exploitative, instrumentalist and most likely underpinned by racist assumptions.[44] Could the nature of science in colonies be shaped by more than colonialism alone? Writing in relation to colonial Africa, Beinart, Brown and Gilfoyle argue that paying closer attention to the laboratory and fieldwork practices through which scientific knowledge was generated, and the activities of scientists themselves, is valuable along numerous fronts. They argue that it can show the somewhat surprising ways in which scientists were open to local knowledge, for instance, as well as help uncover the roots of key scientific concepts that historians and social scientists take for granted in their own work today. Not least, they argue that it can help provide a foundation for interdisciplinary research.[45]

Inspired in part by the work of Tilley which described the ecological survey work undertaken by Colin G. Trapnell and others in Northern Rhodesia during the interwar period, a recent study involving scientists from different disciplines evaluated the relevance of legacy soil information from the colonial period to contemporary stakeholders in Zambia, including

---

[41] Ibid., 322.
[42] William Beinart, Karen Brown and Daniel Gilfoyle, "Experts and Expertise in Colonial Africa Reconsidered: Science and the Interpenetration of Knowledge," *African Affairs* 108, no. 432 (2009): 413-19.
[43] Ibid., 418-9.
[44] Mark Harrison, "Science and the British Empire," *Isis* 96, no. 1 (2005): 55-63; Roy MacLeod, "Introduction, *Nature and Empire: Science and the Colonial Enterprise*," *Osiris* 15 (2000): 1-13.
[45] Beinart, Brown and Gilfoyle, "Experts and Expertise in Colonial Africa Reconsidered".

people actively engaged in agricultural research and development.[46] The study found that stakeholders perceived this legacy information as valuable for numerous reasons, particularly as a model for the ways in which information could be provided in a way that better matches farmers' needs than contemporary information infrastructures.[47]

Whilst we should be critical of the processes in which knowledge was created during the colonial period, we should not just merely reject that knowledge as irrelevant. Such knowledge can be interesting, and can sometimes offer opportunities for 'positive appropriation'. British scientists worked as part of a wider project of imperialism that was supposed to benefit Britain, but now their findings are repurposed.

1.13 Fundamental Research

This thesis aims not to situate soil science along a binary spanning instrumentalist, authoritarian, "colonial science" on the one side, and a science disconnected from the interests of colonial states and capitalist forces on the other. This is not least because very different approaches to the study of soils were taken in East Africa and the Caribbean at particular times. Rather, this thesis shows that the advancement of soil science as a scientific discipline and profession was often as significant a component of the ambitions for soil science in the Colonial Empire as was the belief that soil science would be of practical relevance to agriculture and land-use and thus of economic utility. These are two goals that could exist alongside each other.

The work of Clarke has done much to advance understanding of the place of "fundamental research" in visions of British colonial development, particularly after 1940. Clarke unpacks the multiple meanings that were attributed to fundamental research; an expression that was increasingly used by advisers within the Colonial Office to describe the research that would be carried out by staff employed within the new research institutions established in the colonies after 1940 using money from the CDW Research Fund. According to Clarke, fundamental research held connotations of the sort of scientific activity that would provide the knowledge upon which the long-term development of colonial territories would be based. It was often affiliated with planning and the investigation of "widely occurring,

[46] Ikabongo Mukumbuta et al., "Accessing and Assessing Legacy Soil Information: An Example From Two Provinces of Zambia," *Geoderma* 420 (2022): 1-15.
[47] Mukumbuta et al., "Accessing and Assessing Legacy Soil Information," 14. For more on the concept of information infrastructures, see Geoffrey C. Bowker and Susan Leigh Star, *Sorting Things Out*: *Classification and its Consequences* (MIT Press, 2000).

general problems", and was differentiated, at least in rhetoric, from other sorts of scientific activity, such as "problem solving and routine testing" and more specific local investigations.[48]

Key to the idea of fundamental research was the notion that it required freedom for researchers from external direction; from colonial government administrations, for instance. Clarke shows that this reflected the convictions of elite metropolitan scientists who were afforded a greater say over the direction and coordination of colonial research after 1940 through the new councils, committees and roles set up within the Colonial Office. The promise of freedom, Clarke shows, was a way of raising the professional status and prestige of research work in the colonies, and attracting high calibre personnel to work within the new research institutions.[49]

Clarke's work on the politics of fundamental research raises two interrelated points that are relevant to the history of soil science presented in this thesis. Firstly, it indicates the sorts of "sociotechnical imaginaries" in which the advancement of soil science as a discipline and profession could be equated with the goals of colonial development.[50] It shows how a space was created for scientists in British colonies in which their research work was not necessarily expected to produce results of immediate practical utility. Nevertheless, the creation of space for fundamental research in the colonies was understood as providing the conditions for the generation of a foundation of knowledge upon which future programmes of development (and exploitation) could end up being based. It is from this view that it becomes possible to understand the connections between the pursuit of seemingly "academic" problems by soil scientists in British colonies (tropical soil classification, for instance) and the aims and objectives of empire.

Secondly, Clarke's work highlights the different relationships that could exist between colonial states and personnel undertaking technical work in the colonies. The sort of

---

[48] Sabine Clarke, "Fundamental Research and New Scientific Arrangements for the Development of Britain's Colonies after 1940," in *Basic and Applied Research: The Language of Science Policy in the Twentieth Century*, ed. David Kaldewey and Désirée Schauz (Berghahn Books, 2018), 144; Clarke, *Science at the End of Empire*, 50.

[49] Sabine Clarke, "'The Chance to Send Their First Class Men Out to the Colonies': The Making of the Colonial Research Service," in *Science and Empire: Knowledge and Networks of Science across the British Empire, 1800-1970*, ed. Brett M. Bennett and Joseph M. Hodge (Springer, 2011), 187-206; Clarke, *Science at the End of Empire*, 49-63.

[50] Sheila Jasanoff and Sang-Hyun Kim define sociotechnical imaginaries as "[…] collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology." See Sheila Jasanoff and Sang-Hyun Kim, ed., *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power* (University of Chicago Press, 2015), 4.

personnel that the Colonial Office sought to employ within the new research institutions established after 1940 were those who typically had specialist training in a specific discipline such as entomology, biochemistry or, as this thesis shows, soil science, and were already working within a university or research institution in the United Kingdom.[51] The relationship that these personnel had with colonial government administrators and private enterprise could differ greatly to those employed within local Departments of Agriculture, for instance, whose terms of employment could involve agricultural extension work and other more applied matters rather than fundamental research. As Clarke puts it:

> a diverse group of medical and technical officers existed in Britain's colonies by the 1950s that included doctors, medical researchers, agricultural extension officers, plant breeders, entomologists and a range of other grades and specialists. […] The fact that such variety existed amongst British officers in terms of their qualifications, institutional locations and also their relationships with colonial and metropolitan governments makes the use of the term 'expert' in much existing historical scholarship on scientific and medical aspects of empire problematic.[52]

This thesis builds upon this work, highlighting the disconnect that often existed between the visions of fundamental soils research promoted in colonial research institutions after 1940 and the interests of Departments of Agriculture. It aims to provide a more granular picture of the various functions that were attributed to soil studies in British colonies, and how these various functions were connected with individuals' institutional settings and personal ambitions. Fundamental research in fact meant rather different things in different places.

1.2 Field Sciences: Space, Place, Land

Another aim of this thesis is to expand historical understanding of the practices and networks it took to enable reliable knowledge of soils to circulate beyond their specific sites of production. Each chapter will examine a case study in which a particular configuration of sites, people and resources were mobilized to conduct research into tropical soils. These will focus on East Africa and the Caribbean, given the location of key institutions such as the ICTA, the Amani Station, and EAAFRO. Most of the case studies will focus on soil survey

[51] Clarke, "The Research Council System and the Politics of Medical and Agricultural Research for the British Colonial Empire," 357.
[52] Ibid., 339.

projects that involved mixed methods in a variety of locations, from sugar plantations to farmers' fields, laboratories, cartography rooms, motor vehicles and more.

The range of practices, instruments, resources, people (and more) that it can take to conduct soil surveys has been illustrated by Bruno Latour in his ethnographic study of a soil survey expedition undertaken in the Brazilian Amazon. Latour shows the ways in which soil samples had to be collected and ordered meticulously, observations on the colour of soils partly standardized through the use of Munsell Colour Charts, and much more, in order for knowledge of soil to circulate and Amazonia to be "absorbed" into pedology.[53] Latour's analysis indicates the many spatial aspects of soil survey work, showing the complex networks of human and non-human actors involved in the generation of scientific knowledge of soils.

Some historians have come to stress the significance of "space" and "place" for the production and circulation of scientific knowledge. In *Putting Science in its Place* (2003), David N. Livingstone uses a framework he terms "geographies of scientific knowledge" to unpack the ways in which science is always "located".[54] One of the questions Livingstone asks is, if science is always embedded in local social and material circumstances, how does knowledge move "from its point of origin to general circulation", and thereby transcend locale? Livingstone argues that this is an inherently spatial question that requires taking into account the various situated practices aimed at achieving "scientific ubiquity". The disciplining of scientists' and witnesses' senses, the deployment of standardised measurement and statistics, as well as the use of maps and photographs, he argues, are just some of the strategies that have been used to overcome the "tyranny of distance", enabling reliable knowledge to circulate beyond its site of origin and become universal.[55]

Space and place have also figured prominently in histories of field sciences.[56] In *Landscapes and Labscapes* (2002), Robert E. Kohler examines the various practices and cultural dynamics in what he calls the "lab-field border zone" of biology in the US during the

[53] Bruno Latour, "Circulating Reference: Sampling the Soil in the Amazon Forest," in *Pandora's Hope: Essays on the Reality of Science Studies* (Harvard University Press, 1999), 24-79.
[54] David N. Livingstone, *Putting Science in its Place: Geographies of Scientific Knowledge* (University of Chicago Press, 2003), 179.
[55] Livingstone, *Putting Science in its Place*, 181-2.
[56] Erika Lorraine Milam, "Making Place in the Field," *Isis* 113, no. 1 (2022): 121-7; Raf de Bont and Jens Lachmund ed., *Spatializing the History of Ecology: Sites, Journeys, Mappings* (Routledge, 2017); Jeremy Vetter, ed., *Knowing Global Environments: New Historical Perspectives on the Field Sciences* (Rutgers University Press, 2010).

nineteenth and early-twentieth centuries.[57] Some examples given in the book are the "practices of place" adopted by physiographic ecologists during the early-twentieth century, who, Kohler argues, approached particular places (glaciated peat bogs and dunes, for example) as instances of "nature's experiments". Visual imagining of such places undergoing changes through time was key to how physiographic ecologists produced knowledge, Kohler argues. This was a practice that "was performed in the mind but was stimulated by the direct experience of particular places".[58] For Kohler, "practices of place" are part of a repertoire of practices that have been key to biologists' construction of knowledge of particular phenomena. Kohler's argument is that these practices ought to be seen within a broader cultural context of tension between "the laboratory" and "the field" as the most authoritative sites of scientific practice.[59]

These contributions have been extremely valuable in highlighting the spatial and cultural dynamics of scientific practices, particularly those that take place outside the laboratory in sites that have come to be known collectively, although not unproblematically, as "the field".[60] This said, they have left questions of power largely unattended. In recent years, some historians have called for closer integration of environmental history with the history of field sciences. Megan Raby has made the case for the use of "land" as an analytic concept to attend more closely to the political dynamics of field sciences.[61] Referring to Tania Murray Li's description of land as an "assemblage" of social relations and materialities, Raby's rationale for the use of land as an analytic concept is partly based on its paucity in existing histories of field sciences.[62] Where it does exist, such as in Kohler's references to fieldwork

---

[57] Robert E. Kohler, *Landscapes and Labscapes: Exploring the Lab-Field Border in Biology* (University of Chicago Press, 2002), 18-9.
[58] Kohler, *Landscapes and Labscapes*, 240.
[59] For more on laboratories as sites of scientific practice, see Bruno Latour and Steve Woolgar, *Laboratory Life: The Construction of Scientific Facts* (Princeton University Press, 1986); Jan Golinski, *Making Natural Knowledge: Constructivism and the History of Science*, 2nd ed. (University of Chicago Press, 2005), 79-91.
[60] Cameron Brinitzer and Etienne Benson argue for a conceptualisation of "fields" as "situated historical phenomena" rather than "the field" as a Weberian ideal type. See Cameron Brinitzer and Etienne Benson, "Introduction: What Is a Field? Transformations in Fields, Fieldwork,and Field Sciences since the Mid-Twentieth Century," *Isis* 113, no. 1 (2022): 108-13.
[61] Megan Raby, '"Slash-and-Burn Ecology': Field Science as Land-Use," *History of Science* 57, no. 4 (2019): 441-68.
[62] As Tania Murray Li writes in regards to land: "Although it is often treated as a thing and sometimes as a commodity, it is not like a mat: you cannot roll it and take it away. To turn it to productive use requires regimes of exclusion that distinguish legitimate from illegitimate uses and users, and the inscribing of boundaries through devices such as fences, title deeds, laws, zones, regulations, landmarks and story-lines. Its very 'resourceness' is not an intrinsic or natural quality. It is an assemblage of materialities, relations, technologies and discourses that have to be pulled together and made to align." See Tania Murray Li, "What is Land? Assembling a Resource for Global Investment," *Transactions of the Institute of British Geographers* 39, no. 4 (2014): 589.

as land-use in *Landscapes and Labscapes*, Raby observes, it figures more as a metaphorical analogy or as a way to think about the "spatial relations of science than to interrogate its relationship to the broader political economy."[63] As Raby writes:

> Land specifically directs our attention to issues of ownership and access, labor and resource use, governance, and management, as well as to people's livelihoods and identities. If space highlights the abstract relations of locations and place highlights the meanings humans attribute to spaces, land is a peculiar type of place. As much a political economic concept as a cultural one, land places emphasis on power.[64]

For Raby, conceptualizing scientists' field sites as lands with "deep histories of territorial governance, land tenure, and human use", rather than just "environmental settings", can complement spatial approaches to the history of field sciences, furthering understanding of the production and circulation of knowledge. Raby argues that it can sharpen understanding of how scientists "choose, access, and interpret their field sites", for instance.[65]

Rather than taking a solely network-based or spatial approach to the study of scientific knowledge, this thesis aims to show how wider political and economic questions of land-use are relevant to understanding the processes through which soil knowledge was produced and circulated. The work of Li suggests that land is not a given but rather something that is produced through a variety of mechanisms. This opens up a range of questions about the differing relationship between soil science and land-use in the Caribbean and East Africa. In what ways was soil science shaped by wider systems of agricultural production in these regions? To what extent can we see individual soil scientists' approaches to the study of soils as an expression of their ambitions for the relationship between science and land-use in the colonies? If so, were there differences between East Africa and the Caribbean, or between the interwar and postwar periods? The Colonial Empire was not a homogenous place with only one type of agricultural system in place. Soil science in relation to the maintenance of plantations and soil science in relationship to a move away from subsistence farming to settled forms of agriculture are very different political economic challenges. Here, the aim of

---

[63] Raby, '"Slash-and-Burn Ecology'," 447.
[64] Ibid., 445-6.
[65] Ibid., 467-8. For further discussion about scientific knowledge and the politics of land, see Elizabeth Hennessey, "The Politics of a Natural Laboratory: Claiming Territory and Governing Life in the Galápagos Islands," *Social Studies of Science* 48, no. 4 (2018): 483-506; Sarah B. Pritchard, Steven A. Wolf and Wendy Wolford, "Knowledge and the Politics of Land," *Environment and Planning A: Economy and Space* 48, no. 4 (2015): 616-25.

this thesis is to expand analysis of soil science to include political and economic questions of land-use within the context of empire, whilst still paying attention to the spatial aspects of soil science in practice.

1.3 Sources and Methodology

The main primary source base of this thesis is archival material held within a range of collections in Europe, Trinidad and Tobago, and Kenya. It includes material held by the National Archives at Kew, London, particularly Colonial Office correspondence and documentation; the Oxford Bodleian Libraries, such as the soil scientist Geoffrey Milne's "documents of practice";[66] UCL Special Collections, London; the Archives of the Food and Agriculture Organisation of the United Nations (FAO) in Rome; the Kenya National Archives in Nairobi; the Library of the Kenya Agricultural and Livestock Research Organisation (KALRO) in Muguga; and the West Indiana and Special Collections at the Alma Jordan Library of the University of the West Indies, St Augustine, Trinidad and Tobago. This is in addition to various material consulted at the British Library in London, such as conference proceedings and books; command papers accessed online through UK Parliamentary Papers; as well as soil maps and other visual material accessed through journals and centres such as the World Soil Survey Archive and Catalogue (WOSSAC) and the European Soil Data Centre (ESDAC); and others.

The rationale behind making the effort to visit collections in Trinidad and Tobago and Kenya was to gain a more granular picture of past experiences on the ground in the colonies than that which could be afforded by source material held in the United Kingdom alone. Knowledge of the history and power dynamics of the collections were integral to the interpretation of archival material. The histories of KALRO and the University of the West Indies, for instance, are connected directly with institutions under examination in this thesis, namely EAAFRO and the ICTA. This said, they have undergone numerous changes since the colonial period.

Informal conversations with researchers working on soil problems in the Caribbean and Africa have also been an invaluable part of the research process. Many contemporary soil scientists have much interest in the history of soil science in their areas of work, including during the colonial period. Analysis of their testimony, though not formally represented in

[66] James A. Secord, "Knowledge in Transit," *Isis* 95, no. 4 (2004): 667.

this thesis, has helped inform the interpretation of archival collections and material. Not least, these conversations have helped point toward source material of relevance to the project.

1.4 Outline of Chapters

The structure of this thesis proceeds as follows. Chapter two follows the trajectory of a soil mapping project that took place in East Africa during the early-1930s. Led by the soil chemist at the Amani Station in Tanganyika, Geoffrey Milne, in collaboration with chemists employed within the East African Departments of Agriculture, the project marked Britain's first major commitment to promoting soil science in East Africa. The chapter shows that soil science came to be promoted in East Africa due to a confluence of reasons. These included a discourse of development that afforded a role for soil studies, anxiety that Britain was falling behind other nations in terms of research, as well as the personal ambitions of Milne for a more central role for soil science in colonial agriculture. The chapter follows the practices through which the map was constructed, highlighting the ways in which various non-soil-specialists were incorporated into the project, and providing an account of what soil survey work in the field involved. It shows how the final soil map itself was an attempt to demonstrate the accuracy, empirical focus and reliability of the East African school of soil science as defined by Milne.

Chapter three shows how a very different vision of soil science to Milne's was promoted by the soil scientist Frederick (Fred) Hardy in the British West Indies during the interwar period. As head of the Department of Chemistry and Soil Science at the Imperial College of Tropical Agriculture in Trinidad, Hardy championed an approach to the study of soils that was highly analytical and politically conservative in terms of its relationship with established forms of land-use in the region. This approach, which formed the methodology of numerous soil surveys undertaken in the British West Indies throughout the interwar period, was underpinned by a conceptualisation of soils in the region as objects to be understood primarily through determinations of their physical and chemical properties, giving these properties numerical expression and relating them to crop growth. It was also geared towards the immediate goals of increasing yields of the Caribbean colonies' principal export crops. The chapter examines the institutional setting of this "Trinidadian" school of soil science, foregrounding the much closer links between the ICTA and agricultural practice in the Colonial Empire than was the case with the Amani Station. Overall, the chapter draws

conclusions about what experiences in East Africa and the Caribbean tell us about the broader state of soil science in the Empire during the interwar period.

Chapter four focuses on a programme of soil surveys initiated in the British West Indies during the postwar period using funds from the CDW Acts. This venture was launched initially under the "Soils Research Scheme" at the ICTA in 1947, and later came under the umbrella of the "Regional Research Centre" established at the ICTA in 1955. The chapter examines the impetus for an expanded programme of soil survey in the region, focusing on the changing political atmosphere in the Caribbean from the late-1930s, and Britain's awareness of US accomplishments in Puerto Rico. It shows how a new type of soil science came to be promoted, breaking with the former emphasis on estate agriculture and laboratory analysis in the Caribbean from the interwar period. By following the trajectory of efforts to initiate soil surveys in practice, the chapter demonstrates the stark contrast between ambition and implementation. It shows how the venture was hindered by a shortage of personnel; a problem experienced elsewhere in the Colonial Empire at the time.

Staying with the postwar period, chapter five shifts the attention toward East Africa once again, this time examining the place of tropical soils research at EAAFRO in central Kenya. EAAFRO was one of the largest, most expensive, and longest lasting of the new research institutions established in the Colonial Empire after 1940 using CDW funds. Soil science was one of the organisation's key areas of research. The chapter shows how the first Director of EAAFRO, the British soil physicist Bernard A. Keen, tried to position the organisation as a place that would be making contributions to knowledge of tropical soils. It shows how Keen's ambitions for this research were partly practical. He used tropical soil studies as an example of the sort of fundamental research activity that would underpin agricultural and land-use planning in East Africa. Yet, it also shows how the rhetoric that claimed EAAFRO was contributing to the advancement of tropical soils knowledge was also symbolic, presenting EAAFRO as a world leading research institution, and demonstrating the power of British science and thus the supposed efficacy of new programmes of colonial development and agricultural exploitation. Similar to experiences in the British West Indies after 1945, the chapter shows how ambitions for soil science at EAAFRO were thwarted by numerous obstacles. These included local social and bureaucratic circumstances in East Africa, staffing and funding issues, as well as the political situation in central Kenya with the Mau Mau rebellion.

Chapter six focuses on the tensions between the vision of integrated soils research promoted by the Inter-African Pedological Service, and the expectation that soil science

ought to serve the needs for development at the level of the individual colony. Inaugurated in 1953, the Pedological Service was one of numerous schemes launched under the Commission for Technical Cooperation in Africa South of the Sahara (CCTA). Its function was to promote cooperation and collaboration between colonial governments in Africa in pedological research.[67] The chapter examines the original perception of the Pedological Service in East Africa and in the Colonial Office in London, exploring the contrast between metropolitan officials' enthusiasm for East African governments' involvement and the scepticism expressed by many within those very governments, particularly in Kenya. By the mid-1950s, the main activity of the Pedological Service had become the preparation of a continental soil map of Africa. The chapter traces the trajectory of efforts to build this map. It shows how a network of regional committees and conferences formed the basis for collating soil information collected by specialists across the African continent, and how this information was centralised at the headquarters of the Pedological Service at the Institut National pour l'Etude Agronomique du Congo Belge in the Belgian Congo, albeit with eventual changes due to the political situation connected with the end of empire in the Belgian Congo in the early-1960s. The chapter then examines the disconnect between the rhetoric that claimed the African soil map would be of utility for continent-wide development planning and the perception within the Kenya Department of Agriculture that the mapping project was disconnected from Kenya's needs for development.

In summary, this thesis shows that empire provided impetus to a wide range of attempts to produce knowledge of soils in the tropics during the early- to mid-twentieth century, particularly soil surveying. Numerous visions of the relationship between soil science and development were promoted in the British Colonial Empire. A variety of approaches to the study of soils were taken by soil scientists. Ambitions, however, often stood in contrast with the realities of implementing programmes of in-depth soils research in practice. Seemingly mundane issues such as shortages of qualified manpower and a lack of coordination between institutions often constrained the implementation of grand plans for soil science.

[67] Pedology is a branch of soil science that deals with the study of soils as natural bodies. Pedologists are typically interested in the varieties and genesis of different types of soils. Key practices in pedology include soil classification and mapping.

CHAPTER TWO

Masters of All They Surveyed? Geoffrey Milne, the Amani Station and the East African Soil Map Project, 1920-40

2.1 Introduction

The 1930s were a time in which Britain made its first significant commitment to promoting soil science in East Africa. Between 1931 to 1935, a large-scale effort aimed at surveying and mapping soils throughout British East African territories was undertaken, covering Zanzibar, Tanganyika, Kenya and Uganda. The project was led by a British soil scientist by the name of Geoffrey Milne, in collaboration with a handful of agricultural and soil chemists working within the East African Departments of Agriculture. It was organised under the auspices of the Amani Station, where Milne was employed as the soil chemist. Located high up in the Usambara mountains of northern Tanganyika, the Amani Station was one of the (if not the) only British centres of technical agricultural expertise in Africa during the interwar period where staff members were employed to carry out scientific research full-time.[1]

This chapter examines why soil science came to be afforded significance in East Africa during the 1930s. What combination of factors led to the building of the "provisional" soil map of East Africa that was finally printed in 1935? It shows that there was a confluence of factors at play. These included a broader discourse of development that afforded soil studies a role in unlocking East Africa's agricultural potential; anxiety that Britain was less supportive of research than other nations; and the personal ambitions of Milne and others to see soil science more closely aligned with colonial agriculture.

In some ways, the East African soil map project can be seen as similar to imperial mapmaking endeavours of the nineteenth century. Historians' accounts of nineteenth century surveyors, explorers and geographers tell us that the relationship between mapping and imperialism can be understood, in part, in imaginative and symbolic terms. Take D. Graham Burnett's account of the work of British explorers in search of El Dorado in nineteenth century British Guiana, for instance. In the analytical framework that Burnett develops, maps

[1] For more information on British research centres in Africa during the late-1930s, see Edgar B. Worthington, *Science in Africa: A Review of Scientific Research Relating to Tropical and Southern Africa* (Oxford University Press, 1938).

are seen as an integral component of the "geographical construction" of colonial territory.[2] For Burnett, the work of nineteenth century surveyors and explorers in producing texts such as maps and travel narratives can be understood as a means through which colonial territory "came into being" and land was made "possessable".[3] The similarities between the East African soil map project and Burnett's account of imperial cartography become clearer when we consider the fact that the final soil map of East Africa was not primarily intended to be a tool for agricultural or land-use planning. If the map was not of explicit utility for development in East Africa, then what was its function?

An account of this project that focuses solely on the way in which it was supportive of metropolitan imperial imaginaries, however, would fail to recognise how and why local circumstances in East Africa influenced its trajectory. Historians have pointed out the ways in which some British researchers and technical officers working in interwar Africa adopted stances and approaches that undermined imperial assumptions. Helen Tilley notes how some researchers and officers came to re-appraise assumptions about the inefficacy of Africans' cultivation practices and the inherent fertility of soils in Africa, for instance. According to Tilley, this arose partly from British researchers' and technical officers' prolonged experiences of working on the spot in Africa.[4] On a global scale, Joseph Hodge similarly notes that the challenging and calling into question of "earlier images of and assumptions about the 'tropics' which had informed previous colonial development doctrines" was, in part, a product of the work of British technical and research personnel based in colonial territories during the interwar period and the wide circulation of their findings.[5] Hodge points out that, by the late-1930s, a new appreciation of the "complexity and diversity of tropical environments" even permeated high policy debates at the Colonial Office in London.[6] Existing scholarship suggests that local circumstances and the contingencies of conducting research in colonial territories during the interwar period could lead to the emergence of convictions, ideas and knowledge that were not necessarily supportive of entrenched imperial ideologies.

---

[2] D. Graham Burnett, *Masters of All They Surveyed: Exploration, Geography, and a British El Dorado* (University of Chicago Press, 2000), 3.
[3] Ibid., 2.
[4] Tilley, *Africa as a Living Laboratory*, 115-68; Helen Tilley, "African Environments and Environmental Sciences: The African Research Survey, Ecological Paradigms, and British Colonial Development, 1920-1940," in *Social History and African Environments*, ed. William Beinart and Joann McGregor (James Currey, 2003), 109-30.
[5] Hodge, *Triumph of the Expert*, 151-2.
[6] Ibid., 152.

As soil chemist at an institution that garnered international attention, Milne's activities held significance for how audiences perceived the state of British soil science in Africa. This was particularly so at a time in which the study of tropical soils was still a field of scientific enquiry in its infancy. This chapter shows the ways in which Milne and his colleagues attempted to use the East African soil map project to demonstrate the accuracy, empirical focus and reliability of the East African school of soil science as defined by Milne. This was Milne's vision, though. Elsewhere in the Colonial Empire, different visions of soil science were being promoted.

2.2 Ambitions Behind Soil Mapping in East Africa

Whilst part of the initial rationale behind building a soil map of East Africa was connected to the map's practical utility as a knowledge base for future colonial intervention in the region, the project can also be seen as influenced by symbolic considerations.

A key strand in the origin of the project to build a soil map of East Africa was a conference held at the Amani Station in February 1931 to discuss the current and future state of agricultural research work across British East African territories. The conference was convened by the Colonial Secretary and in attendance were Directors of Agriculture from across Central and East Africa, the Director of the Amani Station (William Nowell), the Agricultural Adviser to the Colonial Secretary (Frank Stockdale), as well as representatives from the Colonial Office in London, the Royal Botanical Gardens at Kew and staff based at the Amani Station.[7]

Located in the Usambara mountains of northern Tanganyika, the Amani Station was a key centre of technical expertise in Africa for Britain during the interwar period. It had originally been established in 1902 during the days of German colonial rule as a biological and agricultural institute. An estimated £120,000 went toward the establishment of the institute.[8] Following the end of the First World War, Britain took over the institute along with the territory that had previously been German East Africa.[9]

---

[7] *Proceedings of Agricultural Research Conference Held at Amani Research Station, February 2nd to 6th, 1931* (Nairobi: Government Printer, 1931), 1-2.
[8] *Report of the East Africa Commission*, cmd. 2387 (London: HMSO, 1925), 86. This is approximately £9.4 million in contemporary terms according to the National Archives currency converter https://www.nationalarchives.gov.uk/currency-converter/.
[9] William Nowell, "The Agricultural Research Station at Amani," *Journal of the Royal African Society* 33, no. 131 (1934): 3.

The Amani Station came to hold a significant place in ambitions for the development of British East African territories. By the late-1920s, it was being positioned as a central research station for "long range" research into problems relevant to British territories across the East African region. It was intended to be a site from which more prolonged research of inter-territorial relevance could be undertaken than was possible by staff within the East African Departments of Agriculture, who often lacked the time to balance in-depth research alongside other routine duties.[10]

One of the topics under discussion at the conference held at the Amani Station in February 1931 was soils research. Included in the research programme at Amani was a soils division, headed by the British soil scientist Geoffrey Milne and his laboratory assistant W.E. Calton. From Yorkshire in England, Milne had held positions at Leeds University and the University of Aberdeen before taking up the role of soil chemist at Amani.[11] Delegates at the conference discussed what they thought should be the research priorities for the soils division and came up with some recommendations. They argued that some of the main lines of work for the soils division ought to be the study of the physical and chemical properties of soils in East Africa known to be susceptible to "serious erosion", as well as the establishment of a collection of soil types with a corresponding reference list "with a view to the production of soil maps for East Africa, and the special studies of important soil groups".[12]

That the study of soils prone to "serious erosion" came up as a main line of work for the soils division is not surprising. Reports of soil erosion in British colonial territories captured European imaginations and anxieties about the loss of the substrate of agricultural production and even the future viability of colonial rule during the 1930s.[13] Fears were particularly acute in East Africa, where soil erosion was understood to be part of a confluence of factors undermining the productive capacity of lands. David Anderson notes how the "devastation" that could be wrought by soil erosion was made all the more clear to Europeans in East Africa

[10] Ibid., 4. For more on the ambitions to establish a chain of central research stations during the 1920s, see Hodge, *Triumph of the Expert*, 99.
[11] Kathleen Milne, "Geoffrey Milne 1898-1942," n.d., Oxford, Bodleian Libraries, Papers of Geoffrey Milne, MSS.Brit.Emp.s.457.
[12] Other lines of work included studies of cover crops and green manures, studies of soil factors limiting the productivity of tea, cloves and coffee in East Africa, and investigations into shifting cultivation. See *Proceedings of Agricultural Research Conference Held at Amani Research Station*, 4-5.
[13] For reports on soil erosion in British colonial territories during the 1930s, see, for instance Elspeth Huxley, "The Menace of Soil Erosion," *Journal of the Royal African Society* 36, no. 144 (1937): 357–70; G.V. Jacks and R.O. Whyte, *The Rape of the Earth: A World Survey of Soil Erosion* (Faber and Faber, 1939); "Land Usage and Soil Erosion in Africa," *Journal of the Royal African Society* 37, no. 146 (1938): 3-19.

through the arrival of images of the Dust Bowl on the southern plains of the US.[14] Anderson shows how it became, in a sense, "fashionable" for Agricultural Officers in East Africa to be aware of soil erosion, and that its prevention became "a prime justification for interfering in customary patterns of African land use."[15] If there was an issue that an agricultural research station in East Africa charged with "long range" research ought to be addressing, then soil erosion would have been, and indeed was, one of the top priorities.

The prioritisation of soil mapping in the agenda of the soils division is also somewhat unsurprising. By the time of the conference in February 1931, there had been numerous efforts by the Colonial Office and members of Britain's scientific establishment to promote soil surveys in British African territories. As the Director of Britain's chief agricultural research institute, Rothamsted Experimental Station, the chemist E.J. Russell had been a key advocate of the role that soil surveys could play in the planning of agricultural development in Africa. Following discussions with T.F. Chipp (Assistant Director at the Royal Botanic Gardens, Kew), A.F. Joseph (Government Chemist in the Anglo-Egyptian Sudan) and F.J. Martin (Agricultural Chemist in Sierra Leone) in the mid-1920s, Russell had prepared a memorandum on a proposed soil survey of British Africa that was circulated by the Colonial Office to colonial governments in Africa in 1927.[16] For Russell, the value of soil surveys lay in their provision of a foundation of knowledge of soil as a precursor to agricultural development projects, as well as the correlation of the results of experimental work.[17] Around the same time as the conference at the Amani Station, a scheme was also devised by the Imperial Bureau of Soil Science (IBSS) for a systematic soil survey of West Africa, covering the whole of Gambia, Gold Coast, Nigeria and Sierra Leone.[18] The West Africa soil survey scheme was eventually shelved in May 1932 due to complaints from the West African Departments of Agriculture. Criticisms of the scheme ranged from the impracticalities of surveying the soils of such a large area, to colonial governments' financial restrictions.[19]

---

[14] David Anderson, "Depression, Dust Bowl, Demography, and Drought: The Colonial State and Soil Conservation in East Africa during the 1930s," *African Affairs* 83, no. 332 (1984): 326-8.
[15] Ibid., 327.
[16] The National Archives of the UK (TNA): CO 554/72/12, F.J. Martin to Ormsby-Gore, 26/9/26; CO 554/74/7, "Memorandum on a Proposed Soil Survey of those parts of Africa associated with the British Empire," by E.J. Russell, 5/2/27.
[17] CO 554/74/7, "Memorandum on a Proposed Soil Survey of those parts of Africa associated with the British Empire," by E.J. Russell, 5/2/27, p 1. For more on Russell's views on soil surveys, see Hodge, *Triumph of the Expert*, 112.
[18] CO 554/87/8, "Scheme for Co-ordinating and Completing Soil Surveys in West Africa," by the Imperial Bureau of Soil Science, February 1931.
[19] CO 554/87/8, H.B. Waters to Colonial Secretary, 13/10/31; A.C. Burns to Sir Philip Cunliffe-Lister, 26/11/31.

Ambitions to promote soil surveys were not just focused at East Africa but were also directed at other parts of the African continent.

There was also a metropolitan precedent for soil surveys. Detailed soil mapping had been conducted in Britain in earnest since the First World War with the support of grants from the Ministry of Agriculture and, in some instances, private money as part of the general postwar reconstruction. By 1926, regular soil survey conferences were being held, attended by chemists linked to agricultural advisory centres and others interested.[20] There was also a soil survey committee under the Ministry of Agriculture, of which Geoffrey Milne happened to be a member before moving to the Amani Station in 1928.[21]

Soils received so much attention during the conference at Amani in 1931 that plans were made to hold a conference of soil chemists the following year. Milne, who was present during discussions about a future soil chemists conference, drew delegates' attention to a proposal for a soil map of the British Empire that had been made during the Imperial Agricultural Research Conference in London in 1927. This was a project that was also of interest to the International Society of Soil Science. Milne pointed out that one soil map of East Africa might meet the requirements of both these bodies. A conference of soil chemists, Milne claimed, would be a chance to form some agreement on the classification and naming of soils and to consider how to go about building a soil map of East Africa more generally.[22]

As head of soils research at Amani, Milne had been an advocate for establishing some autonomy for soil specialists in East Africa from institutions and scientists based in Britain. When the IBSS circulated a memorandum on a proposed soil survey of British Africa in 1929, Milne expressed his disagreement at their suggestion that soil workers in Africa ought to prepare reports on their field observations and laboratory analyses for the IBSS each year. Milne argued that this would be too burdensome for local workers. Furthermore, any premature collation of field observations without thorough laboratory analyses, he claimed, would be insufficient to determine specific soil types. Milne proposed that soil workers in Africa send results to the IBSS every four years rather than annually.[23] This was a somewhat controversial move from Milne, as some members of the IBSS held views on how research in the tropics ought to be organised. On hearing Milne's views, A.F. Joseph (then Deputy

---

[20] Agricultural Research Council, *Soil Survey Research Board Report No. 1: Soil Survey of Great Britain* (London: HMSO, 1950), 1-3.
[21] Kathleen Milne, "Geoffrey Milne 1898-1942," n.d., Oxford, Bodleian Libraries, Papers of Geoffrey Milne, MSS.Brit.Emp.s.457.
[22] *Proceedings of Agricultural Research Conference Held at Amani Research Station*, 159-60.
[23] CO 554/84/1, Memorandum by G. Milne on the proposed soil survey of Africa, 31/12/29.

Director of the IBSS) expressed that he was "rather nervous regarding work carried out in the tropics which has not some regular stimulus behind it such as is provided by regular writing up of reports".[24] Joseph's comment about the need for some "regular stimulus" was perhaps an allusion to a conviction that research work in the colonies ought to have some practical benefit, as well as a concern about not wasting effort. Milne's rebuke to the IBSS's proposals can be seen as marking a tension between metropolitan ambitions to centrally direct soils research in Africa and a conviction from researchers based in Africa, at least by Milne, that they required a level of autonomy and freedom.

Following on from the recommendation made in 1931, a conference of soil chemists was held at the Amani Station from 21-6 May 1932. In attendance were senior Agricultural and Government Chemists from Kenya, Uganda and Zanzibar (V.A. Beckley, W.S. Martin and L.W. Raymond respectively), Geoffrey Milne as Soil Chemist at Amani and as representative of the Tanganyika Department of Agriculture,[25] D.R. Grantham as Assistant Geologist to the Tanganyika Geological Survey, William Nowell as the Director of Amani, and R.R. Worsley and H.H. Storey (Biochemist and Plant Pathologist at Amani respectively).[26]

On Saturday 21 May 1932, in a laboratory at the Amani Station specially strewn with soil profile exhibits across its benches, Nowell addressed delegates of the soil chemists conference with some opening remarks. "Soil science, as seen by the agriculturist," Nowell proclaimed, "might be held to have failed to arrive at any results of economic usefulness, at least in the Tropics."[27] Nowell went on to argue that this was due to past attempts to take "short cuts" and "convert a half-understood subject into an applied science before its due time". According to Nowell, it had been found necessary in recent years to "begin again" and "establish fundamentals more firmly before attempting to build a superstructure". The conference, Nowell argued, would be a way of establishing such lines of enquiry for the benefit of East Africa, with the hope that "profitable applications would in due course be evolved".[28] Nowell's comments are indicative of the ways in which the project of building a soil map of East Africa was embedded in ideas about the potential relationship between soil science and colonial development. Indeed, in the opening discussions of the conference, Milne alluded to the practical applications that soil maps could serve. As the proceedings

[24] CO 554/84/1, A.F. Joseph to F.A. Stockdale, 25/2/30.
[25] There was no agricultural chemist employed within the Tanganyika Department of Agriculture at the time.
[26] *Proceedings of a Conference of East African Soil Chemists Held at the Agricultural Research Station, Amani, Tanganyika Territory, May 21st to 26th, 1932* (Nairobi: Government Printer, 1932), 1-2.
[27] Ibid., 2.
[28] Ibid.

record, Milne explained that "soil maps were desirable for various purposes of government within the dependencies and ultimately for the assistance of agricultural practice in particular areas."[29] The function of soil mapping in interwar East Africa could be presented in terms of its practical relevance to agricultural and land-use planning.

Historians have attended to the broader relationship between scientific research and British colonial development during the interwar period. The period following the First World War has come to be seen as a time in which a "science for development" movement emerged in Britain, whereby the deployment of state-funded scientific research and expertise was seen as a way of unlocking the untapped potential of many British colonies.[30] Hodge shows that there were views within the Colonial Office in the 1920s (by the Colonial Secretary Leopold Amery, for instance) that scientific research could be applied to "maximize" colonial agricultural productivity and improve the poor health conditions that were seen as "holding back the tropical dependencies".[31] This was not completely novel. Similar ideas about state-funded scientific research, particularly agricultural research, as a means toward the development of the productive resources of the tropics had existed since at least the late-nineteenth century with Joseph Chamberlain's ideology of "constructive imperialism". As Hodge writes, this was an "ideology of improvement" in which "the diffusion of Western scientific knowledge, expertise, capital, and man power would stimulate agricultural production of much-needed raw materials and foodstuffs in the colonies, while at the same time raising the purchasing power and demand for manufactured goods from Britain."[32] Chamberlain is recognized for his use of an agrarian analogy, describing the British Empire as a "great estate" awaiting development by its landlords.[33]

Ambitions of using state-funded scientific research to unlock the untapped potential of colonial territories were particularly present in East Africa. In July 1924, a commission of inquiry was appointed by the Colonial Secretary to tour British territories in Central and East Africa (Nyasaland, Tanganyika, Northern Rhodesia, Kenya and Uganda) and report on their prospects for development. Published in 1925, the report of the East Africa Commission emphasised the important place of scientific research in providing the knowledge upon which the development of the region could be based. In a section of the report entitled "Scientific

---

[29] Ibid., 3.
[30] Worboys, "Science and British Colonial Imperialism," 191-232.
[31] Hodge, *Triumph of the Expert*, 94
[32] Ibid., 54-5.
[33] George Bennett, ed., *The Concept of Empire: Burke to Attlee, 1744-1947*, 2nd ed. (Adam & Charles Black, 1962), 313-314.

Research and Amani Institute", the authors argued that there was a need for greater efforts from the British and local governments to organise scientific services in East Africa.[34] "In our opinion", as put in the opening line to the section, "there are few subjects of greater importance to the development of the East African territories than scientific research."[35] The authors of the report expressed a profound disappointment at how the world famous station at Amani, once comparable with the Pusa Institute in India and Buitenzorg in the Dutch East Indies during the days of German colonial rule, had been allowed to lie virtually derelict. "Instead of supplying the five territories in particular, and the scientific world in general, with contributions to their knowledge of tropical plants, soils, and insects, of the greatest scientific and economic importance," the authors wrote with regards to Amani, "its only output at present consists of penny packets of seeds."[36]

Much of the potential of East Africa that scientific research, it was hoped, would unlock was related to the production of agricultural commodities. Some of the principal export crops of the region during the 1920s were cotton and coffee (Kenya and Uganda), sisal (Kenya, Uganda and, in particular, Tanganyika) and cloves (Zanzibar).[37] The idea that the development of East Africa ought to be based first and foremost on the development of its agricultural resources was given clear expression in the British politician Major Archibald G Church's book *East Africa, a New Dominion* (1927). Church's book was published following his time spent as a representative of the Labour Party on the East Africa Commission. The book laid forth Church's vision for the future development of East Africa; a project he termed "an experiment in tropical development". In the book, Church claimed it could not be over-emphasised that East Africa was an "agricultural country" and that "the surest and safest form of development of the territory will be in this direction."[38] In Church's view, this was partly justified because of the region's agricultural potentialities. He wrote of the "illimitable" variety of crops which East Africa was capable of producing, claiming that it was "not unreasonable to look forward to this area becoming the greatest agricultural centre in the world, furnishing from its excess, for industrial Europe and America."[39] His rhetoric about

[34] *Report of the East Africa Commission*, 80-94.
[35] Ibid., 80.
[36] Ibid., 85-86. For further exploration of the views of the East Africa Commission on the Amani Station, see Hodge, *Triumph of the Expert*, 94-7; Worboys, "Science and British Colonial Imperialism," 215-6; J.W. Gregory, "Science and Administration in East Africa," *Nature* 115, no. 2898 (1925): 753-5.
[37] Havinden and Meredith, *Colonialism and Development*, 155; and Peter J. Martin, "The Zanzibar Clove Industry," *Economic Botany* 45, no. 4 (1991): 450-9.
[38] Archibald G. Church, *East Africa, a New Dominion: A Crucial Experiment in Tropical Development and its Significance to the British Empire* (H.F. & G. Witherby, 1927), 63.
[39] Ibid., 62.

East Africa becoming a breadbasket for the world also, unsurprisingly, included invocations of tropes about the fertility of the region's soil. As one excerpt from the book reads: "Europe, America, and Asia are already in need of the products of our million square miles of East African soil, most of which is abundantly fertile, so fertile it is a common expression 'if you plant a walking-stick it will strike roots and grow'."[40] Such representations of the inherent fertility of soil in East Africa share similarities with older and wider ideas about the fecundity of tropical nature.[41] For Church, it was through scientific research, such as resource surveys, that East Africa's agricultural potential would be unlocked.[42]

Returning to the opening of the soil chemists conference at the Amani Station in May 1932, Nowell's and Milne's comments about the importance of soil mapping for the future of East Africa can now be understood as part of a broader context in which scientific research and the Amani Station were positioned as key to the development of East Africa. Seen in this light, the project of producing a soil map of East Africa might be understood as a result of particular ideas about the process of colonial development, ones in which scientific research would provide the information on which the colonial territories could be better governed and their resources exploited.

Such a view, however, would obscure some of the other ambitions behind soil mapping in East Africa, which were less about its practical applications and more about contributing to international science. Milne alluded to these ambitions throughout the rest of the opening discussion of the 1932 conference. After explaining that there was a demand for soil maps for purposes of government and for assisting agricultural practice in the dependencies, Milne went on to explain that there was also an "intrinsic interest in tropical soils" and a "desire for further information about them on the part of learned societies or individuals not necessarily actively engaged upon East African problems nor working upon East African material."[43] In particular, there were three projects interested in the production of world and empire soil maps; namely, that put forward during the Imperial Agricultural Research Conference in 1927, that of the Fifth Commission of the International Society of Soil Science, and a then recent geographical project under the British Association for the Advancement of Science.[44]

---

[40] Ibid., 87.
[41] See, for instance, Nancy Leys Stepan, *Picturing Tropical Nature* (Reaktion Books, 2002); Paul S. Sutter, "The Tropics: A Brief History of an Environmental Imaginary," in *The Oxford Handbook of Environmental History*, ed. Andrew C. Isenberg (Oxford University Press, 2014), 178-204.
[42] Church, *East Africa, a New Dominion*, 59.
[43] *Proceedings of a Conference of East African Soil Chemists Held at the Agricultural Research Station, Amani, … 1932*, 3.
[44] Ibid., 3.

The idea that soil mapping could be a contribution to international science was also based upon a claim that the production of a soil map of East Africa would be achieved using an approach that was more accurate than previous attempts to map the soils of large areas of the African continent. Previous attempts had been reliant upon extrapolating from pre-existing information. They had essentially involved a lot of guess work. The most significant prior attempt was Curtis F Marbut's 1923 soil map of Africa, which was the result of a project supported by the American Commission to Negotiate Peace to survey the vegetation and soils of Africa.[45] Marbut, a soil scientist based within the United States Department of Agriculture (USDA), had built the map using very limited information and without having actually visited the African continent. His colleague, the ecologist Homer L Shantz, had visited Africa between 1919-20, undertaking a journey from Cape Town to Cairo to collect data and make ecological observations. This included the taking of some twenty soil samples which were then transported to the USA for analysis by the USDA's Bureau of Soils.[46] Marbut built the map using the results of these analyses, together with information available within the existing literature. His approach was to apply principles concerning the influence of factors such as topography, climate, vegetation and geology on the formation of soil to the limited information at his disposal.[47] This was an approach influenced by Russian soil science. Working during the late-nineteenth century, the Russian pedologist Vasily Dokuchaev had contributed to the emergence of a distinct Russian tradition of soil science. Among other things, this centred on an understanding of soils as natural historical bodies, the formation of which were determined by the complex interaction of factors such as climate, relief, organisms and parent material.[48] David Moon notes that Marbut was a key advocate for the incorporation of Russian concepts such as soil "horizons", "profiles" and "great soil groups" into American soil science.[49] Alfred E Hartemink similarly highlights the fact that Marbut translated a book by the Russian soil scientist Konstantin Glinka (one of Dokuchaev's students) into English during the early-1910s, and the way in which Glinka's book "transformed Curtis Marbut's thinking about soils".[50] Marbut's final soil map of Africa, based

[45] Homer L. Shantz and Curtis F. Marbut, *The Vegetation and Soils of Africa* (American Geographical Society, 1923), vii.
[46] Ibid., ix, 137. For an account of Shantz's research work in Africa, see Tilley, *Africa as a Living Laboratory*, 134-7.
[47] Shantz and Marbut, *The Vegetation and Soils of Africa*, 137-41.
[48] Alfred E. Hartemink, *Soil Science Americana*: *Chronicles and Progressions, 1860─1960* (Springer, 2021), 39-44; David Moon, *The American Steppes: The Unexpected Russian Roots of Great Plains Agriculture, 1870s–1930s* (Cambridge University Press, 2020), 226.
[49] Moon, *The American Steppes*, 227-8.
[50] Hartemink, *Soil Science Americana*, 50.

as it was upon scant information and influenced by Russian concepts, was included as an inset to a vegetation map of Africa accompanying the book *The Soils and Vegetation of Africa* (1923), published by the American Geographical Society (Fig. 2.1).

For many of those present at the 1932 soil chemists conference at the Amani Station, Marbut's 1923 map was seen as an example of an approach to soil mapping that was more speculative than empirical. Comparisons between the way in which the 1923 map was built and the way in which the proposed soil map of East Africa would be built were made to frame the latter as a novel and important contribution to international science. Take the following remarks made by Milne during the opening discussion:

> It was fair to say that almost nothing was known about the soils of by far the greater part of East Africa, and the view might reasonably be held that it would at present be better to say so outright than to attempt to map the whole by extrapolation from fragmentary data. The classic example of the latter method (Marbut's map of 1923) had been stimulating, and would continue to be so, but the next approach to the problem should be a setting down of known facts rather than the further demonstration of a method of doing without them.[51]

Milne's claim that Marbut's 1923 map had been built without "a setting down of known facts" was based upon the way in which "assumptions about soils from knowledge" had not been verified "on the actual ground".[52] Whilst Marbut had consulted much literature and information about what might have shaped the characteristics of soils in certain areas of Africa, he had not observed those soils on the spot himself. Indeed, Marbut had admitted himself that his attempt could not be considered "a real soil map".[53] He presented his map as "merely a statement of the possible distribution of the soils [of Africa]" and that its value laid "not in what it shows but in what it offers by way of suggestion to future investigators and travelers."[54] According to Milne, the proposed soil map of East Africa would garner greater credibility by being based upon actual inspection of soils, both in the field and the laboratory.

---

[51] *Proceedings of a Conference of East African Soil Chemists Held at the Agricultural Research Station, Amani, … 1932*, 3.
[52] Ibid., 3.
[53] Shantz and Marbut, *The Vegetation and Soils of Africa*, 138.
[54] Ibid., 138.

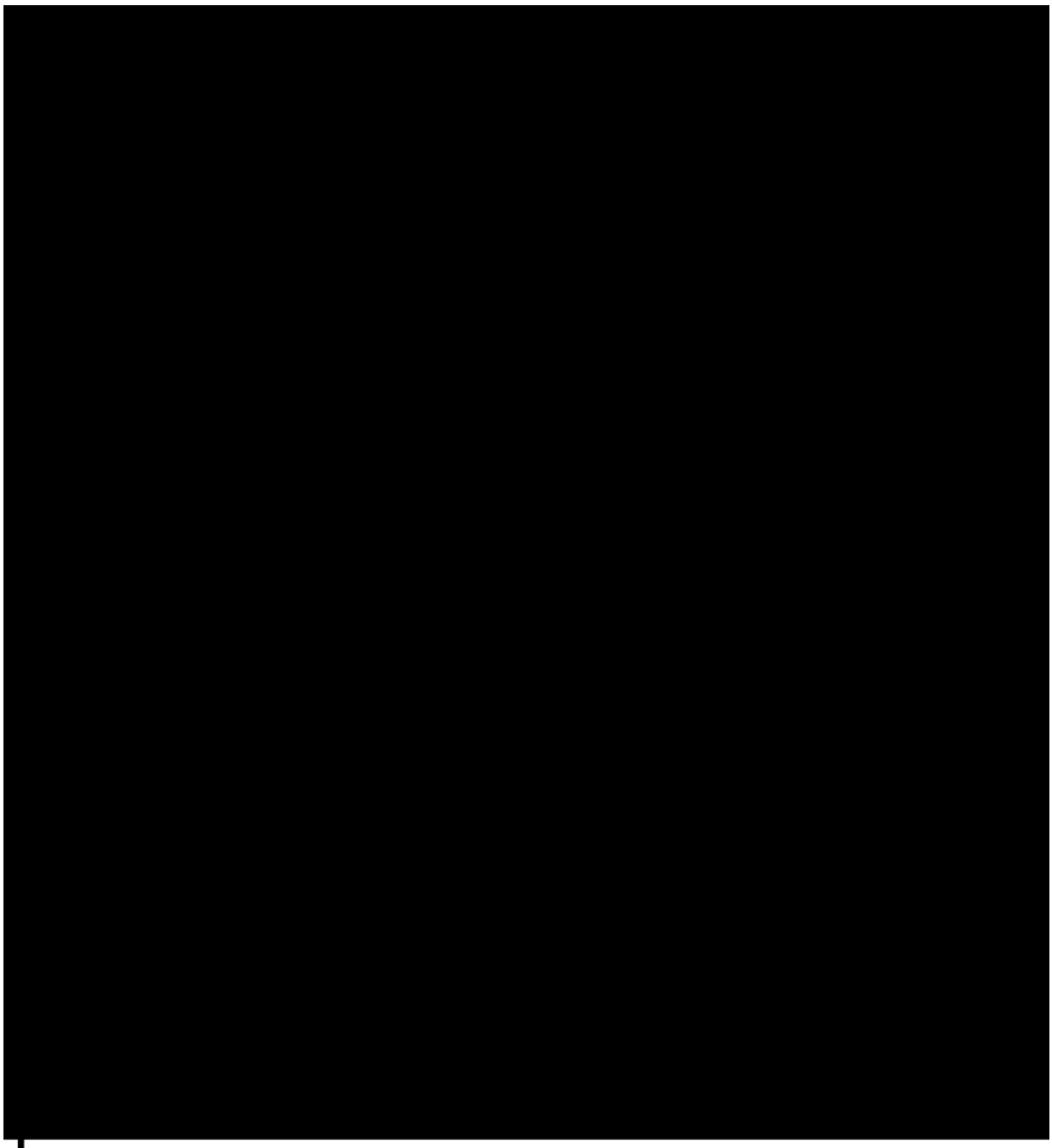

Figure 2.1. Shantz, Homer L. and Curtis F. Marbut. *Vegetation and Soils of Africa*. Map. New York: American Geographical Society, 1923. From University of Wisconsin-Milwaukee Libraries, *American Geographical Society Library Digital Map Collection.* Digital ID: am015018 (accessed 21/9/25).

By the end of the conference at the Amani Station, it was agreed that the East African soil map ought to be built in time to be presented at the third International Congress of Soil Science, due to be held in Oxford in July 1935.[55] These Congresses provided a platform for international exchange and cooperation in soil sciences. They were (and still are) held roughly every three to five years (with exceptions); the first being held in Washington, D.C. in 1927 and the second in Leningrad in 1930. Each Congress received wide publicity, and the holding of the Third Congress in Oxford in 1935 was a chance for Britain to be seen to be facilitating the global exchange of soil knowledge.[56]

Though it was not made that explicit during the soil chemists conference at Amani in 1932, the framing of the project of building a soil map of East Africa as underpinned by a more empirical epistemology than previous attempts had political significance. For some with interests in British colonial policy, the fact that the only survey of the agricultural resources of large areas of Africa had been conducted by US scientists (Shantz and Marbut) was a source of embarrassment. Church, in *East Africa, a New Dominion*, wrote of how "It is somewhat humiliating to find that the only comprehensive survey of the agricultural resources of East Africa has been made as the result of a hurried visit paid by Dr. Schantz of the United States Department of Agriculture to East Africa in 1923."[57] Furthermore, when the Under-Secretary of State for the Colonies, William Ormsby-Gore, visited Rothamsted Experimental Station in January 1927, E.J. Russell had mentioned that the only published work on the soils of Africa was by a US scientist; "printed and published in Washington", as Ormsby-Gore remarked in a note a day after the visit.[58] As mentioned above, Shantz's and Marbut's project had its origins in American contributions to peace negotiations following the First World War. In particular, their project was started at the instigation of the Commission of Inquiry; a body of technical advisers established by President Woodrow Wilson in 1917 to gather knowledge in preparation for the US Government's peace program after the First World War.[59] The claim that the East Africa map would be based upon "known facts" had political expediency, portraying Britain as in touch with its East African territories during a

[55] *Proceedings of a Conference of East African Soil Chemists Held at the Agricultural Research Station, Amani, … 1932*, 19.
[56] For more on these congresses, see Hartemink, *Soil Science Americana*.
[57] Church, *East Africa, a New Dominion*, 62.
[58] CO 554/72/12, Note by William Ormsby-Gore, 14/1/27.
[59] Lawrence E. Gelfand, *The Inquiry: American Preparations for Peace, 1917-1919* (Yale University Press, 1963); Thomas F. O'Connor, "Library Service to the American Commission to Negotiate Peace and to the Preparatory Inquiry, 1917-1919," *Libraries and Culture* 24, no. 2 (1989): 144-6.

time of heightened international attention on the resources and territorial boundaries of Africa.

The fact that there was a legacy of German soil science in East Africa also suggests that part of the motivation behind soil mapping in East Africa was a fear that Britain was failing to catch up with other countries in terms of research. Soils in East Africa had been paid scientific attention by the Prussian soil scientist Paul Vageler, who had worked as an agricultural expert to the German government in Dar-es-Salaam before the end of the First World War.[60] Vageler was an active researcher, publishing numerous articles about soils and agriculture in East Africa.[61] During the days of German colonial rule, staff at the Amani Station had overseen the publication of the journal *Der Tropenpflanzer*, which had wide circulation.[62] As soil chemist at the Amani Station from 1928, Milne was well aware of Vageler's and other German scientist's prior research in East Africa. Milne even made notes on some of their findings in a personal notebook.[63] As shown by Peter Alter in his study of the relationship between science and the state in Britain, the unfavorable comparison of the power of British science with that of Germany on the international stage is something that can be seen as occurring since at least the late-nineteenth century.[64] Germany's legacy of soil science in East Africa prompts questions about whether anxieties about the more advanced level of German science (and, considering Marbut's work, perhaps also the US) than that of Britain was a motivating factor behind soil mapping in East Africa during the early-1930s.[65]

2.3 Building the Map Part I: "Citizen Science"?

At the soil chemists conference in May 1932, Milne's initial idea of how to build the soil map of East Africa was to survey and map sample areas in detail so as to gradually build up a bigger picture of the entire region's soils through a series of large-scale maps (showing smaller areas in greater detail). This was part of his conviction that the map ought to be based upon actual inspection of soils in the field and the laboratory. For others present at the

---

[60] Paul Vageler, *An Introduction to Tropical Soils*, trans. Herbert Greene (Macmillan and Co., 1933), vii.
[61] E. Welte, "Professor Dr. Paul Vageler, 30.10.1882- 3.12.1963," *Journal of Plant Nutrition and Soil Science* 105, no. 3 (1964): 193.
[62] Christopher A. Conte, *Highland Sanctuary: Environmental History in Tanzania's Usambara Mountains* (Ohio University Press, 2004), 60.
[63] Geoffrey Milne, miscellaneous written notes, 1938, Oxford, Bodleian Libraries, Papers of Geoffrey Milne, MSS.Brit.Emp.s.457(3), p 72.
[64] Peter Alter, *The Reluctant Patron: Science and the State in Britain, 1850-1920* (Berg, 1987).
[65] It is interesting to note that Tanganyika was still labelled "German East Africa" in Marbut's 1923 soil map of Africa.

conference, however, this approach was seen as unrealistic given the limited resources and personnel available in East Africa at the time. In the report of the conference, it was noted how "Not even one person could at present be employed solely on soil survey in East Africa," and how "the small staffs in each territory who were able, as specialists, to devote time to it, had of necessity to frame their programmes and plan their journeys mainly with other objectives of immediate economic importance in view."[66] It was, after all, the middle of the Great Depression and slumps in the prices of commodities on global markets had left many colonial economies, including those in East Africa, in significant debt and with reduced export earnings.[67] A compromise was made between Milne and others at the conference. Whilst the approach was still to be based upon first hand inspection of soils, it was agreed, at least in theory, that more room would be allowed for "generalisation". As put in the report:

> it would be impolitic to postpone the production of a general map until the detail available should be enough to make it scientifically satisfying even in the above limited sense. […] The principle of consolidating detail before announcing a generalisation could not be followed at present, and the map might not satisfy those who knew the country at first hand; but it would at any rate show approximately, to others not so placed, the state of East African soil knowledge.[68]

These developments at the conference are interesting along numerous fronts. They suggest that a particular audience for the soil map was in mind; one which was external to East Africa. They also point toward the constraints that a lack of specialist staff available to actually undertake soil surveys placed upon the project of building the soil map of East Africa.

Indeed, as a result of the limited number of specialist staff available to carry out systematic soil surveys in East Africa, one of the key ways through which the map was built involved the contribution of various non-soil-specialists. As lead on the project, Milne called upon various actors with little to no technical soils expertise to contribute information toward building the map. In this regard, the project can be seen as having become somewhat of a "citizen science" undertaking; a term that, whilst not used at the time, refers to the active

---

[66] *Proceedings of a Conference of East African Soil Chemists Held at the Agricultural Research Station, Amani, … 1932*, 4.
[67] Constantine, *The Making of British Colonial Development Policy*, 228-9; Havinden and Meredith, *Colonialism and Development*, 160-86; Anderson, "Depression, Dust Bowl, Demography, and Drought," 323-6.
[68] *Proceedings of a Conference of East African Soil Chemists Held at the Agricultural Research Station, Amani, … 1932*, 4.

participation of members of the general public or non-professional scientists in the production of scientific knowledge[69].

One of the ways in which various people were called upon to contribute was through the collection of soil samples. As early as 1930, Milne had prepared a memorandum on soil description and sampling which was circulated to Directors of Agriculture throughout East and Central Africa.[70] This memorandum was intended to act as a guide for staff within the various Departments of Agriculture on to how to collect soil samples in the field and the sorts of contextual details that ought to accompany samples when sent to a soil chemist. It was prepared in response to E.J. Russell's proposals for a soil survey of British Africa from 1927. Milne saw his memorandum and other adjoining material circulated to Directors of Agriculture as part of the early process of defining the function of the Amani Station as a central station for coordinating soil surveys in East Africa. In the memorandum, Milne emphasised the need for descriptions of "particulars" such as the local topography, the visual appearance of the profile from which a sample(s) was taken, and more (eight more, in fact) to accompany samples when sent to a soil chemist's laboratory.[71] He also described the various methods through which people ought to collect samples. Take the collection of "profile samples", for instance. These were defined as discrete samples of each distinguishable horizon (i.e. layer) of a soil profile. Milne described how these "are conveniently taken with a trenching-tool or bush knife from the wall of a pit six feet deep and wide enough for the sampler to drop into."[72] In a similar memorandum (based upon Milne's earlier one of 1930) circulated at the conference of soil chemists at Amani in 1932, details were also given on how to prepare soil samples before sending them to a laboratory for analysis. If they were "very wet when sampled", for instance, it was suggested that they should be "air-dried on newspapers under cover before packing."[73] The memorandum also recommended the use of calico bags as containers, with a minimum of one kilogram of soil per sample, although, as the memorandum put it, "when transport facilities allow, at least double this amount is desirable."[74] These attempts to discipline agricultural staff in East Africa emerged from a

[69] Caren Cooper, *Citizen Science: How Ordinary People Are Changing the Face of Discovery* (The Overlook Press, 2016).
[70] Geoffrey Milne, "Appendix 3. Memorandum on Soil Description and Sampling", in circular to East African Directors of Agriculture and the Imperial Bureau of Soil Science, 24/4/30, Oxford, Bodleian Libraries, Papers of Geoffrey Milne, MSS.Brit.Emp.s.457(14), pp 12-4.
[71] Ibid., pp 12-3.
[72] Ibid., pp 13-4.
[73] *Proceedings of a Conference of East African Soil Chemists Held at the Agricultural Research Station, Amani, … 1932*, 25.
[74] Ibid., 25.

context in which there was a very limited number of soil specialists available to carry out soil survey work.

An index to a summary of soil acidity data prepared by Milne in February 1933 is illustrative of the extent to which various actors were called upon to collect soil samples for the project. The summary contained information on the pH, colour and other characteristics of soil profiles from various localities in the Tanga, Bukoba, Northern and Iringa Provinces of Tanganyika, as well as two profiles from Kiambu in central Kenya.[75] Samples of these profiles, along with contextual information, had been collected and sent to Milne's and Calton's laboratory at the Amani Station for analysis. More than one hundred profiles had been analysed in total, some to a depth of fourteen feet. Sixteen different collectors were recorded in the report. Some of these were Amani staff, noted in the report using the abbreviation "A.S.". Other collectors included individuals who were not affiliated to Amani. F.R. Sanders, a District Agricultural Officer who was later affiliated with the Coffee Research Station established at Lyamungu in northern Tanganyika in 1934, collected samples from over fourteen different soil profiles spread across the Moshi and Arusha Districts between 1930-2.[76] Other collectors included C. Harvey, G.S. Cowin, P.J. Greenway, F.W. Thomas, G.W. Lock and others.[77] Who these people were, exactly, is not that clear from the document. They could have been Agricultural Officers or maybe even settler farmers. Either way, Milne's summary shows how a variety of actors contributed to the project by collecting soil samples and sending them to central laboratories for analysis, such as that of Milne's and Calton's at the Amani Station.

Whilst soil sampling was valuable for Milne as a way of broadening the areas in East Africa over which soils could be mapped, there were caveats. One of these was the potential for details about the broader ecological context from which a soil profile was sampled to be lost. Whilst laboratory analyses could provide valuable insight into the chemical and physical processes determining soil properties, and thus help with the classification of soils into different types, Milne considered soils the product of complex ecological interactions which

---

[75] Geoffrey Milne, "A Summary of the information available to date (February 1933) on soil acidity for localities in the Tanga, Northern, Iringa, and Bukoba Provinces, Tanganyika Territory," February 1933, Oxford, Bodleian Libraries, Papers of Geoffrey Milne, MSS.Brit.Emp.s.457(17).
[76] Ibid., pp 6-7; S.M. Gilbert, "The History of a Herd at the Coffee Research Station, Lyamungu, Moshi, 1935–1944," *East African Agricultural Journal* 10, no. 3 (1945): 164-7. Sanders had previously attended the Imperial College of Tropical Agriculture in Trinidad. See R.H. Fraser and F.R. Sanders, "The Labour Supply of Sugar and Cocoa Estates, Trinidad," (Diploma thesis, ICTA, 1928-9).
[77] Geoffrey Milne, "A Summary of the information available to date (February 1933) on soil acidity for localities in the Tanga, Northern, Iringa, and Bukoba Provinces, Tanganyika Territory," February 1933, Oxford, Bodleian Libraries, Papers of Geoffrey Milne, MSS.Brit.Emp.s.457(17), pp 6-7.

were equally as important in establishing classifications as were the results of chemical and physical analyses carried out in a laboratory. This is why Milne emphasised the importance of the inclusion of details on certain "particulars" alongside a sample when sent to a soil chemist. As written in the memorandum on soil description and sampling circulated at the 1932 soil chemists conference (which was based upon Milne's earlier memorandum of 1930):

> In interpreting his laboratory data, the chemist is as much concerned with the local circumstances of the site as with the properties of the few pounds of earth which are sent to him. It should be considered just as necessary to supply full notes on the profile, field conditions and natural history of the soil as to attach a label to the sample. Without such notes the sample loses its identity, as it would without a label; and no analysis of it is worth doing, for it would be uninterpretable.[78]

The inclusion of "particulars" such as the local topography, natural vegetation and rainfall alongside a soil sample was a way of bringing knowledge about the broader ecological context of soil to the confines of the laboratory. It was part of a repertoire of practices aimed at capturing some of the complexity of field conditions and making them legible for those who might not have seen them first hand. A similar method was the creation of soil monoliths. These are three dimensional vertical displays of a soil profile made by binding the different layers of a profile onto a backboard. A collection of soil monoliths representing various profiles throughout East Africa was kept at the Amani Station to help with soil classification.[79]

In some instances, Milne even called upon people to send him their observations on soil and field conditions without any samples. Take Milne's correspondence with a Medical Officer based at the Malaria Unit in Tanga on the Swahili Coast in 1933, for instance. In response to a letter from Milne, this Medical Officer prepared a short summary of his own observations on soils in Tanga. Being a medical specialist, however, the officer's response reveals his difficulty understanding certain terms used by Milne. Whilst the officer could confirm that "At Gombero itself the soil is apparently quite sandy", he was confused about what Milne meant by "coastal" in his previous correspondence, claiming that "this needs

[78] *Proceedings of a Conference of East African Soil Chemists Held at the Agricultural Research Station, Amani, … 1932*, 23.
[79] *Proceedings of a Conference of East African Soil Chemists Held at the Agricultural Research Station, Amani, … 1932*, 21-2.

definition."[80] The officer's overall view was that he had "little useful to comment" to Milne's previous correspondence concerning Tanga soils.[81]

Whilst people with little technical soils expertise were brought into the project of building the map by contributing soil samples and descriptions of field conditions, this process had its limitations. The case of the Medical Officer in Tanga shows that despite efforts to instruct people in soil sampling and description methods, not all were adept at providing the information required centrally. It did nonetheless provide a valuable way of obtaining information for the project when there was a limited number of soil specialists available to undertake soil survey work in the field.

2.4 Building the Map Part II: Reconnaissance Journeys

The fact that Milne afforded significance to the disciplining of non-soil-specialists in soil survey methods does not mean that he or the chemists employed within the East African Departments of Agriculture did not conduct field work themselves. In fact, Milne and these chemists carried out field visits, independently of each other, when possible. Milne saw these visits, sometimes termed "reconnaissance journeys", as invaluable for gaining an understanding of the nature of soils in East Africa. This was a conviction that influenced his research work even after the East African soil map project ended.

For an example of the rationale behind the field work undertaken by Milne in connection with building the soil map of East Africa, take Milne's report of a "journey" made to the Meru and Kilimanjaro Districts in northern Tanganyika between 4-31 March 1932. The purpose of the journey, according to Milne, was to "make a first field acquaintance with the soils of the area", which were already "represented at Amani" by some sixty samples (eighteen different profiles) collected by F.R. Sanders toward the end of 1930.[82] The journey started on Friday 4 March with a train ride from the Usambaras westward toward Moshi. Over the proceeding weeks, Milne, with the assistance of Agricultural Officers, visited some thirty-five European estates and farms and spent two days in areas of African farming. Reflecting on the trip, Milne wrote of how it was planned as a way of turning his "bottled samples into field realities." "In some instances," he reflected,

---

[80] Medical Officer, Malaria Unit, Tanga, to Milne, 29/6/33, Oxford, Bodleian Libraries, Papers of Geoffrey Milne, MSS.Brit.Emp.s.457(11), p 32.
[81] Ibid., p 32.
[82] Geoffrey Milne, "Report on a Journey in the Meru and Kilimanjaro Districts, 4th to 31st March, 1932," 16/4/32, Oxford, Bodleian Libraries, Papers of Geoffrey Milne, MSS.Brit.Emp.s.457(11), p 45.

> puzzling properties fell naturally into place on seeing the soils in situ; in others, uncertain features in the profile were cleared up and the horizons sampled in more detail; in all, the introduction at first hand to the soils in action and to those concerned in handling them has been most valuable.[83]

A key part of the value that Milne was referring to here was the way in which the journey aided the process of forming classifications of soils. Later in his report, Milne explained how the trip had helped him establish some possible groupings for soils on the slopes of Mount Kilimanjaro and Mount Meru in line with the American system of soil series and soil types. These were ways of classifying soils on a local scale based upon an inspection of their morphology and laboratory analysis of samples. They typically involved giving soils place names, alongside a short description of other characteristics, such as soil texture.[84] In and of itself, however, the journey was not enough to classify soils in a way that reflected their differences and resemblances from the perspective of how they were formed. These were the sorts of groupings that Milne described as having "a classifying significance to that of the botanical natural orders or families.[85]" The reason for this, Milne claimed, was a lack of information "from the laboratory side", which limited the extent to which "observed soil properties" could be deduced to their "prime causes".[86] This particular journey for Milne was valuable for advancing his understanding of soils in situ and forming classifications, yet it had to be followed up by further laboratory analysis if he was to form the type of broad, higher level classifications that could encompass soils throughout East Africa as a whole.

Other reports on field journeys prepared by Milne during the early-1930s included those on soils in Tanga Province (June 1933), Mpwapwa (May 1934) and Tengeni (January 1930).[87] There were likely many more, especially given the fact that Milne later remarked that, as soil chemist at Amani, he had been given "instructions to devote time to reconnaissance survey work".[88]

---

[83] Ibid., p 45.
[84] David Rice Gardner, "The National Cooperative Soil Survey of the United States," (D.P.A. thesis, Harvard University, 1957), 41-5.
[85] Geoffrey Milne, "Report on a Journey in the Meru and Kilimanjaro Districts, 4th to 31st March, 1932," 16/4/32, Oxford, Bodleian Libraries, Papers of Geoffrey Milne, MSS.Brit.Emp.s.457(11), pp 48-9.
[86] Ibid., p 49.
[87] Geoffrey Milne, "First report on a soil survey of the Amani Sub-station estate at Tengeni," 29/1/30, Oxford, Bodleian Libraries, MSS.Brit.Emp.s.457(11), pp 8-11; Geoffrey Milne, "The Soils of the Tanga Province, Tanganyika Territory," 5/6/33, Oxford, Bodleian Libraries, MSS.Brit.Emp.s.457(11), pp 25-31; Geoffrey Milne, "A Note on Three Soil Profiles at Mpwapwa, North-Eastern Ugogo, Tanganyika," 19/5/34, Oxford, Bodleian Libraries, MSS.Brit.Emp.s.457(11), pp 67-75.
[88] Geoffrey Milne et al., *A Provisional Soil Map of East Africa (Kenya, Uganda, Tanganyika, and Zanzibar) with Explanatory Memoir* (Amani: EAARS, 1936), 8.

The significance that Milne afforded to seeing things for himself in "the field" can be seen as part of a broader trend among British researchers in Africa during the interwar period toward ecological thinking. Tilley shows how numerous researchers and technical staff came to adopt ecological approaches that took into account the interdependence of natural phenomena. Tilley points out how Colin G. Trapnell and Neil Clothier, working as part of the Ecological Survey of Northern Rhodesia during the 1930s, conducted field research into the relationship between soils and vegetation types, as well as African cultivators' knowledge of these relationships and their associations with agricultural practices.[89] Field work was central to Trapnell's and Clothier's research. During their "safaris", they covered a daily average of eighteen miles, "almost always on foot", and employed upwards of a dozen porters and at least one translator.[90] Hodge highlights the similarities between the work of Milne in East Africa and Trapnell, Clothier and others in Northern Rhodesia, noting their shared use of "ecological concepts" to understand "the relationship between vegetation and soils and its bearing on land utilization.[91]" Rather than just a "concept" or a "discipline", Tilley argues that ecology was positioned by many of its adherents as a "tool of environmental management and a way of organizing knowledge about complex phenomena."[92] Hodge locates the impetus for the "extension of ecology as a colonial science" primarily in concerns about soil erosion and the need for "broader investigations of soil conditions" in response to land degradation.[93]

When in the field, some of the practices deployed by Milne included those similar to that of "panoramic vision" as described by Robert E. Kohler in *Landscapes and Labscapes* (2002). Kohler describes panoramic vision as a field practice, often deployed by physiographic ecologists, involving the act of "visual conjuring, imagining places moving fast forward through time."[94] As Kohler explains, physiographic ecologists might imagine "a visual trip into deep time and back, from the moment when a place emerged from beneath the retreating ice sheet, through stages of re-vegetation, to its present state and beyond into a distant future."[95] He argues that panoramic vision ought to be seen as a "laboratory paradigm enacted in field practices of reading places".[96] Similar to how scientists might be interested in

[89] Tilley, *Africa as a Living Laboratory*, 146-53.
[90] Ibid., 148.
[91] Hodge, *Triumph of the Expert*, 157.
[92] Tilley, *Africa as a Living Laboratory*, 116. See also, Pedr Anker, *Imperial Ecology: Environmental Order in the British Empire, 1895-1945* (Harvard University Press, 2001).
[93] Hodge, *Triumph of the Expert*, 157-8.
[94] Kohler, *Landscapes and Labscapes*, 238.
[95] Ibid.
[96] Ibid., 240.

the results of an experiment conducted in the controlled environment of a laboratory, panoramic vision is underpinned by a similar ethos of reading experimental results. What makes it different to traditional laboratory practices, however, is that places in the field are taken as instances of "nature's experiments".[97] It involves a conceptual extension of the laboratory to places that would typically be conceptualised as field sites.

Practices similar to panoramic vision were used in the elucidation of the concept of the soil "catena" by Milne and the chemists working on the soil map of East Africa project. Now a widely used concept in a variety of natural science disciplines, a "catena" refers to a regular sequence of associations between soils and vegetation along a topographic sequence or slope.[98] W.S. Martin (Agricultural Chemist in Uganda) raised the point of the existence of consistent patterns in the distribution of soil types across slopes as early as the soil chemists conference held at Amani in May 1932. Martin even brought along seven soil profiles from Uganda to Amani to demonstrate the transition between soil types from the crest of a hill to the bottom lands.[99]

Take Milne's description of a soil catena in an area south of Lake Victoria in an article in the journal *Nature* in 1936 (Fig. 2.2). Although the article was published a year after the soil map of East Africa project had ceased, it illustrates the ways in which Milne deployed practices similar to that of panoramic vision. In the article, entitled "Normal Erosion as a Factor in Soil Profile Development", Milne described the presence of seven different soil types across a slope (a hillock to be more precise) and how those soils had come to be formed over time partly through processes of denudation (i.e. erosion by rainfall, gravity etc).[100] As Milne wrote, at the top of the slope at point (1) lies a "shallow skeletal dark grey loam" which "works downhill by creep and slow erosion, to serve at the hill foot as the parent material on which a deeper soil (2) of the red earth group develops". As Milne explained further, the top soil of this red earth at point (2) is gradually pared off due to "occasional storm water running over the surface", the "spoil" travelling "differentially according to particle size, so that by cumulative effect a zone of washed sand (4) covers the footslope below, silty or clayey sand (5, 6) lies beyond it, and a level clay floor fills the bottom-land —

[97] Ibid., 212-51.
[98] For more on the history of the concept of the soil catena, see R. Wayne Borden et al., "The East African Contribution to the Formalisation of the Soil Catena Concept," *Catena* 185 (2020), 1-7.
[99] *Proceedings of a Conference of East African Soil Chemists Held at the Agricultural Research Station, Amani, … 1932*, 22. Borden et al. point out that similar observations on the existence of regular sequences of soils had also been raised by scientists working in German East Africa before the First World War. See: Borden et al., "The East African Contribution to the Formalisation of the Soil Catena Concept," 1.
[100] Geoffrey Milne, "Normal Erosion as a Factor in Soil Profile Development," *Nature* 138 (1936): 548-9.

the *mbuga* (7)."[101] There was an element of imagination involved in understanding the distribution of soil types across the slope. To understand how the catena formed, one had to imagine materials slowly moving down the slope due to erosion, the effect that rainfall might have had on this movement, how particles of smaller size might move further than others, and other factors. These were processes that had to be deduced. One could not (or at least was not likely to) witness the differential movement of clay, sand or silt particles down the slope itself, or the gradual disintegration of the washed debris of "skeletal dark grey loam" into "red earth". Rather, it took prior knowledge about soil forming processes and inspecting soil profiles in situ to deduce how those soil types had come to be formed and their spatio-temporal relationship with each other. The spatial distribution of soil types as Milne saw them on the spot was read as the result of a much longer and still continuing process. It was this sort of visual conjuring that Milne was likely referring to when he wrote elsewhere about seeing soils "in action".[102]

Figure 2.2. Diagram representing "a residual granite hillock and the soils around it, in the plateau region south of Lake Victoria," 16/7/36. Source: Milne, "Normal Erosion as a Factor in Soil Profile Development," 549. Reproduced with permission from Springer Nature.

In some instances, Milne used photography to support his claims to knowledge of soil in East Africa. This was the case with a soil reconnaissance journey that Milne undertook throughout parts of Tanganyika between December 1935 to February 1936.[103] During the journey, Milne ensured that photographs of various landscapes were taken which he later

[101] Ibid., 549.
[102] Geoffrey Milne, "Report on a Journey in the Meru and Kilimanjaro Districts, 4th to 31st March, 1932," 16/4/32, Oxford, Bodleian Libraries, Papers of Geoffrey Milne, MSS.Brit.Emp.s.457(11), p 45.
[103] This journey took place after the East African soil map had first been printed and did not form contributory information to the map.

compiled into a personal collection with details on the location and date, as well as short descriptions of the local ecology represented within each photograph (Fig. 2.3). Milne's idea was to use these photographs to illustrate his "reconnaissance report", which contained written descriptions of soils, vegetation types and other landscape features as seen throughout the journey.[104] Milne's use of photography in this way can be seen as a type of "memory practice", helping him recall the specificities of the different environments from which he might have taken soil samples, or be describing retrospectively in his written reconnaissance report.[105]

Photography was also a way in which Milne sought to project his authority to speak about soil. Lorraine Daston and Peter L. Galison place photography within a broader repertoire of scientific practices that are used to achieve a sense of objectivity through "mechanical" means, "transferring images from objects to the page without human interference."[106] Where written testimony can carry with it a potential sense of distortion, photographs appeal to the idea of an unfiltered portrayal of natural phenomena. Given that Milne's intention was to use these photographs to accompany his written report (image complementing text), they can be seen as an effort to back up his written testimony by appealing to a sense of objectivity through "mechanical" means. At the least, the photographs were evidence that Milne had seen the soils in situ for himself.

[104] This report was eventually published in 1947, five years after Milne's death. The report laid unpublished for some time given more pressing work for Milne after returning from a trip to the Americas in 1938 and his deployment to other duties with the outbreak of the Second World War. For the published report, see Geoffrey Milne, "A Soil Reconnaissance Journey Through Parts of Tanganyika Territory December 1935 to February 1936," *Journal of Ecology* 35, no. 1/2 (1947): 192-265.
[105] Geoffrey C. Bowker, *Memory Practices in the Sciences* (MIT Press, 2006).
[106] Lorraine Daston and Peter L. Galison, *Objectivity* (Zone Books, 2007), 368.

Figure 2.3. Photograph showing "complete catena", with a caption describing vegetation, soil types and other landscape features, 1/1/36. Source: Geoffrey Milne, "Photographs of Vegetation Types etc. to Illustrate Soil Reconnaissance Report (Parts of Tanganyika Territory)," 1935-6, Oxford, Bodleian Libraries, MSS.Brit.Emp.s.457(18), p 7.

Milne's extensive field experience in East Africa meant that he came to develop an appreciation for certain cultivation practices used by African farmers, at least in upland areas of northern Tanganyika. When reporting to the Director of Amani on a visit to the West Usambaras in June 1934, Milne commented on how there was significantly less soil erosion on slopes farmed by Africans than on those farmed by European settlers. In one instance, Milne noted how a European estate owner had harrowed over the "scars" of an eroded slope so that the thin remaining layer of top soil filled in the ditches of gullies. In Milne's view, this was destructive and pointless as the top soil in the gullies would be washed away with the next storm.[107] In contrast, Milne observed how the amount of erosion on certain African farmers' slopes in the area was altogether much less than those on many European farms because they had left more "weed and bush growth" amongst their crops and tilled less land. Milne also observed how, when the rains had come and washed away some of the soil, many

[107] Note by Geoffrey Milne for W.M. Nowell on soil erosion in the West Usambara, 7/6/34, Oxford, Bodleian Libraries, MSS.Brit.Emp.s.457(11), p 44.

African farmers had left their surviving soil in situ, "so that the next rain would merely course down the already formed channels and do relatively little further damage."[108]

African farmers' environmental knowledge was important for how some of those involved in the East Africa soil map project acquired an understanding of soils in their respective areas. By 1934, Milne had come to advocate the standardized use of certain indigenous names for "black soils" in East Africa, such as "mbuga" and "bonde". Others involved in the project, however, thought that this was more liable to "introduce than dispel confusion" and a final decision was made to distinguish black soils in the soil map according to a chemical categorisation; whether they were "calcareous" or "non-calcareous".[109]

Milne later documented his use of indigenous soil classification frameworks as a lens through which to better understand the nature of soils in East Africa in the report of his soil reconnaissance journey through parts of Tanganyika between 1935-6. In the report, Milne drew comparisons between types of soils recognised in the Sukuma language (spoken mainly in north-western Tanganyika) with some of the broad classifications of soils used by scientists internationally at the time. Milne described the "ibushi" type ("dark grey-brown to black friable loams over concretionary limestone") as recognised in Sukuma, for instance, as a "zonal climatic type in the Russian sense" and "probably a near relative of the south-European chernozem".[110] For Milne, at least in this instance, it was Sukuma soil nomenclature, rather than any classification system that he had built himself, that he used as a framework from which to make comparisons between soils in East Africa and soils elsewhere in the world. Milne wrote that it had been possible to identify most of the Sukuma soil types "in the field" under their Sukuma names thanks to the help of Agricultural Officers and their "native instructors".[111]

In addition to collecting information sent in from various non-soil-specialists throughout East Africa, the carrying out of his own journeys in the field was also a key way in which Milne approached the task of building a soil map of East Africa during the early-1930s. Milne presented the value of seeing things for himself in ways that can be seen as connected to broader ideas about the importance of researchers taking into account local ecological

---

[108] Note by Geoffrey Milne for W.M. Nowell on soil erosion in the West Usambara, 7/6/34, Oxford, Bodleian Libraries, MSS.Brit.Emp.s.457(11), pp 44-5. For more on British technical officers' and researchers' appreciation of the suitability of African farmers' cultivation practices to local environments during the interwar period, see Tilley, *Africa as a Living Laboratory*, 115-68.

[109] *Proceedings of the Second Conference of East African Agricultural and Soil Chemists held at Zanzibar, August 3rd to 9th, 1934* (Nairobi: Government Printer, 1935), 12.

[110] Milne, "A Soil Reconnaissance Journey Through Parts of Tanganyika Territory," 253-4.

[111] Ibid., 241. For more on Milne's and Agricultural Officers' use of Sukuma names for soils, see Tilley, *Africa as a Living Laboratory*, 157.

nuances in Africa at the time. Some of the knowledge disseminated by Milne in the course of building the map, and afterwards, shows that work in "the field" was entwined with cross cultural exchanges of knowledge between himself and a variety of people in East Africa, including African farmers and Agricultural Officers.

2.5 Creating (Blank) Space for Soil Science in East Africa

By the time the East African soil map project was nearing its culmination toward the end of 1934, it had become apparent to those involved that a complete picture of the soils of East Africa would not be possible. In August 1934, a second conference of soil chemists was held in Zanzibar as a successor to the previous conference that had been held at the Amani Station in 1932.[112] One of the main rationales behind the Zanzibar conference was to provide a platform for discussion and the compilation of information toward building the final soil map of East Africa. The strategy up until this point had been for the soil and agricultural chemists in Uganda (W.S. Martin and G. Griffith), Kenya (V.A. Beckley and G.H. Gethin Jones), Zanzibar (L.W. Raymond) and Tanganyika (Milne) to compile draft soil maps of their respective areas of work with the idea that these would later be compiled to form a joint soil map covering the whole of East Africa.[113] Numerous draft soil maps were presented at the Zanzibar conference, including those for Uganda and parts of Tanganyika at 1:1,000,000 scale, one showing the "better known parts" of Kenya at 1:2,000,000 scale, as well as a "sketch of soil conditions in Zanzibar and Pemba".[114] Despite this wide range of material, Milne thought there was insufficient information. During the opening discussion to one of the sessions of the conference, Milne commented on the "slenderness" of their information for some parts of East Africa, and the fact that there were parts of the region in which their soil knowledge was "defective".[115] As chairman of the conference, Nowell also commented on the differing amounts of detail shown in different areas of the maps, such as where districts had been more "intensively worked".[116] The view of the soils of East Africa collectively

[112] *Proceedings of the Second Conference of East African Agricultural and Soil Chemists held at Zanzibar, ... 1934.*
[113] There was talk of including Northern Rhodesia, Nyasaland and Southern Rhodesia in the map, but this was precluded due to the absence of representatives from those territories at the Zanzibar conference due to "financial reasons". See ibid., 2.
[114] Ibid., 10.
[115] Ibid., 11.
[116] Ibid., 12.

provided by the draft soil maps presented at the Zanzibar conference was patchy and incomplete.

The notion that those involved in the project might not be able to build a complete picture of the soils of East Africa was not new by the time of the Zanzibar conference in August 1934. When Milne had proposed his approach of mapping sample areas of East Africa in detail so as to gradually build a bigger picture of the entire region's soils during the first soil chemists conference at Amani in 1932, he had suggested that there might be differential coverage. He had pointed out that there would end up being "large intervening blank spaces" on the final map, with a notation discontinuous with those areas that had been "properly mapped".[117] Other delegates' conclusion that an approach that allowed more room for generalisation should be taken, given the limited availability of staff, had somewhat precluded the inevitability of there being such blank spaces. The fact that there might not be full coverage in the final map was not certain, however.

The extent to which certain areas had been mapped in greater detail than others was crystallised in the build up to the Zanzibar conference. In a statement on the "present position of the project for an East African soil map" prepared in March 1934, Milne distinguished three degrees of accuracy of available information on soils in East Africa.[118] The first consisted of places where soils were "becoming fairly well known" and could be "classified and mapped with some confidence". These included "closely-settled areas" such as the Usambaras, Kilimanjaro and Meru in Tanganyika, and parts of the Kenya Highlands and of Uganda.[119] Milne described places in the second degree of accuracy as those in which "scattered observations of good survey value" were available, but the "extent of occurrence" of various soil types remained "uncertain".[120] Finally, the third degree of accuracy applied to places in which no direct soil observations of survey value were available. "For such areas", Milne wrote,

[117] *Proceedings of a Conference of East African Soil Chemists Held at the Agricultural Research Station, Amani, … 1932*, 4.
[118] *Proceedings of the Second Conference of East African Agricultural and Soil Chemists held at Zanzibar, … 1934*, 43-5.
[119] Milne noted that Mlanje in Nyasaland could also fit under this category. See Ibid., 43.
[120] Ibid., 43.

> recourse has to be had to a deductive method, in which the generalisations established as true for the better known areas, and relating soil properties to climate, geology, vegetation, topography, population, etc., are extended to the region to be mapped with the aid of whatever is known about its general geography.[121]

This method was somewhat similar to that taken by Curtis Marbut when building his 1923 soil map of Africa in that it was reliant upon extrapolating from existing information about soil forming factors. It went against Milne's principle that accurate soil knowledge required first hand inspection of soils. In Tanganyika, the places that fitted within this category included almost the whole of the central plateau, as well as large parts of Mbeya, Mahenge, Songea and Lindi. Milne noted how it also included "immense stretches" in the other territories.[122] Somewhat disconcertingly for those concerned with the "development" of East Africa at the time, Milne warned that this included "some of the most important areas of native production, the areas of accelerated erosion due to cattle, the great game plains, and the potentially productive country of the tsetse belts."[123] Whilst some areas had been mapped in great detail, others had not, and Milne purposefully foregrounded the vast size, agricultural potential and problems of those places in the third degree.

The rhetorical function of cartographical representations of "terra incognita" have been paid much attention by historians. In her study of the French mapmaker Jean-Baptiste d'Anville during the early modern period, Lucile Haguet shows how the specification of ignorance on maps in the form of blank spaces could be used by mapmakers to elevate their authority.[124] By leaving blank those areas of maps in which they possessed little knowledge rather than filling them in speculatively or through guesswork, Haguet shows how mapmakers such as d'Anville could demonstrate their integrity and enhance audience's perceptions of the accuracy of their work. "By proudly admitting his ignorance," Haguet writes, "d'Anville showed himself to be the embodiment of the new positive scholar, by asserting an equivalence between knowledge and certainty."[125] In the particular case of d'Anville, Haguet argues that this "specification of ignorance" could enhance not only d'Anville's authority as a mapmaker but also the standing of the entire field of geography at a

[121] Ibid., 43.
[122] Ibid., 43-4.
[123] Ibid., 44.
[124] Lucile Haguet, "Specifying Ignorance in Eighteenth-Century Cartography, a Powerful Way to Promote the Geographer's Work: The Example of Jean-Baptiste d'Anville," in *The Dark Side of Knowledge: Histories of Ignorance, 1400-1800*, ed. Cornel Zwierlein (Brill, 2016), 358-81.
[125] Ibid., 358-9.

time and place (nineteenth century France) in which it was struggling to exist as a scholarly field in comparison with other fields such as mathematics, physics and history. Haguet argues that d'Anville's work helped promote the national reputation of geography as a "positive science".[126]

Milne's ambitions for the East African soil map were similar to the ways in which d'Anville's blank spaces had a rhetorical function. Since at least the middle of 1933, Milne was in correspondence with Marbut in the US about the progress being made on the East African soil map project.[127] By June 1934, the subject of their correspondence had started to focus on arrangements for the upcoming International Congress of Soil Science, which was planned to be held in Oxford in July the following year. Marbut was to be chairman of Commission V of the Congress (on soil genesis, morphology and cartography). This was the commission in which Milne and his colleagues planned to showcase their East African soil map. When notifying Marbut that the East African soil map would be ready in time to showcase at the Congress at Oxford, Milne drew attention to the limited extent of his and his colleagues' knowledge.

> It may be objected by some, and from one point of view quite fairly, that we still have far too few facts for so ambitious a project as a published map. But it seems to me and my colleagues that it will be worth doing, if only as a considered and detailed statement of the extent of our knowledge and our ignorance, in order to draw the attention of our Governments to the need for more systematic investigation of soils, and to attract material additions to our ridiculously meagre resources for soil work.[128]

As alluded to by Milne in his letter to Marbut, he and his colleagues planned to use the map as a tool to raise awareness about the limited extent of their knowledge of soils and to garner more resources for soil studies in East Africa. Milne's suggestion that this would be achieved by showcasing the contrast between their "knowledge" and "ignorance" shows that there was a similar rhetorical strategy at play to that described by Haguet in regards to d'Anville's "specifications of ignorance". Designating the areas in East Africa for which Milne and his colleagues possessed a lack of soil knowledge rather than attempting to hide their "ignorance" could draw attention to the accuracy of information for those areas that had been

[126] Ibid., 374-80.
[127] Geoffrey Milne to Curtis F. Marbut, 18/5/33, Oxford, Bodleian Libraries, MSS.Brit.Emp.s.457(12), pp 57-65.
[128] Geoffrey Milne to Curtis F. Marbut, 27/6/34, Oxford, Bodleian Libraries, MSS.Brit.Emp.s.457(12), p 86.

mapped in detail. For Milne, at least, this was seen as a strategy for elevating the standing of soil science in East Africa. Indeed, in a previous letter to Marbut in May 1933, Milne had suggested that the final East African soil map "will in part be a vehicle for work done at Amani".[129]

There was an acute awareness at the Zanzibar conference of the lack of public support in East Africa for certain lines of scientific research, particularly that organised through the Amani Station. During his opening address to the conference, S.B.B. McElderry (Acting British Resident in Zanzibar) commented on the connections between a lack of public understanding of the value of scientific research in East Africa and the wider conditions of financial austerity.

> It is difficult sometimes for outsiders to see what relation a particular line of scientific research bears to the advancement of human welfare; and for this reason and because nowadays we have to look twice at every rupee before we spend it, funds are but grudgingly accorded to institutions such as Amani whose inhabitants appear to the uninitiated to live in the clouds or on the hill-tops like Greek gods 'careless of mankind'.[130]

McElderry's comments on the occasional difficulties of "outsiders" understanding the relationship between scientific research carried out by institutions such as Amani and the wider objectives of colonial development (couched by McElderry in terms of advancing human welfare) reflected the politics of research at Amani; an institution that was promoted as a centre for conducting research that, whilst maybe not of immediate practical relevance, would underpin the long term development of British territories in East Africa. McElderry's comments suggest that, given broader austerity-like economic conditions in East Africa precipitated by the Great Depression, there was not necessarily a consensus on the value of supporting this sort of "long range" (occasionally termed "fundamental") research over matters of immediate practical importance.[131] Christopher A. Conte argues that a tension over whether the Amani Station ought to be a centre for "applied" or "pure" science had permeated much of the history of the institution up to this point, including during the days of German colonial rule.[132]

---

[129] Geoffrey Milne to Curtis F. Marbut, 18/5/33, Oxford, Bodleian Libraries, MSS.Brit.Emp.s.457(12), p 64.
[130] *Proceedings of the Second Conference of East African Agricultural and Soil Chemists held at Zanzibar, … 1934*, 7.
[131] Nowell, "The Agricultural Research Station at Amani", 4.
[132] Conte, *Highland Sanctuary*, 55-67.

In some ways, soil science was seen as having it better than other areas of research in East Africa. During the Zanzibar conference, the Director of Amani was reported as having commented on how "The soil is so obviously fundamental to agriculture and so to the existence of mankind, that the advantages of knowledge regarding it are self-evident".[133] For Nowell, at least, there was a sense that the value of soil science was less likely to be questioned and brought under public scrutiny in East Africa given the place of soil as the substrate of agriculture.

Whether or not Nowell's comments about the value of soil science being less likely to be questioned than other areas of research were representative of public opinion in East Africa, the East African soil map project revealed the paucity of available resources required to build a complete, detailed picture of the distribution of East African soils. This had been clear since at least the first soil chemists conference in 1932 and was related to the lack of specialist personnel. At one point, Milne calculated that it worked out at 0.77 soil chemists per 100,000 square miles of soil surface in East Africa. Milne wrote the following in a draft argument for advocating for soil survey:

> Anyone who, on the field side, knows the complexity of soil-distribution on even a single plantation, and has glimpsed, in a soils laboratory, the laboriousness of the beaker-and-flask side of the work, will […] be impatient, as he would be if 0.77 of a person were thought sufficient for the […] of 100,000 soils. This is a just subject for amazement.[134]

Milne's personal notes allude to the quotidian realities of carrying out a soil survey of an area as vast in size as that of East Africa in practice. Soil surveying was labour and resource intensive and time consuming. These were realities that became increasingly apparent to Milne and others as the East African soil map project progressed.

Decisions about the methods of representation to be used in the joint East African soil map, as well as its publication, were made during the Zanzibar conference. A "sub-committee on notation" made up of Beckley, Martin and Milne met twice over the course of the conference, ultimately agreeing upon the main soil types to include in the map legend and the colours (crimson, orange, violet and more) and hatching patterns (horizontal, vertical, oblique

[133] *Proceedings of the Second Conference of East African Agricultural and Soil Chemists Held at Zanzibar, … 1934*, 8.
[134] Miscellaneous written note, n.d., Oxford, Bodleian Libraries,, MSS.Brit.Emp.s.457(12), p 232.

NW-SE, square check, etc.) to represent them.[135] Discussions were also had during the conference about where the map could be printed. After contacting the Imperial Bureau of Soil Science, Milne had received estimates for the cost of printing from the Ordnance Survey at Southampton in the United Kingdom. In an effort to save costs, Clement Gillman (Chief Engineer to Tanganyika Railways and a friend of Milne's) suggested that the work of preparing fair drawings of the map could be done locally by a skilled African draughtsman. Gillman noted how the preparation of these drawings in East Africa had its potential issues, however, due to the shrinkage of the tracing cloth when sent to England. Milne agreed to enquire with the Ordnance Survey whether this would be an issue.[136]

By July 1935, the map had been published (Fig. 2.4). One of its most striking features were the large areas left blank or with only brief written notes. These were the places in which the information on soils available to Milne and his colleagues fell within the third degree of accuracy mentioned above. They took up a significant portion of the map, forming a stark contrast with the intricate hatching and spectrum of colours representing soils of places of which more accurate information was available. A further distinction of accuracy of knowledge was made by representing in a stripe pattern places in the second degree. The map was an embodiment of the sort of "considered and detailed statement of the extent of our knowledge and our ignorance" that Milne had claimed it would be in his letter to Marbut in June 1934.[137]

[135] *Proceedings of the Second Conference of East African Agricultural and Soil Chemists Held at Zanzibar, ... 1934*, 15-7.
[136] *Proceedings of the Second Conference of East African Agricultural and Soil Chemists Held at Zanzibar, ... 1934*, 14.
[137] Geoffrey Milne to Curtis F. Marbut, 27/6/34, Oxford, Bodleian Libraries, MSS.Brit.Emp.s.457(12), p 86.

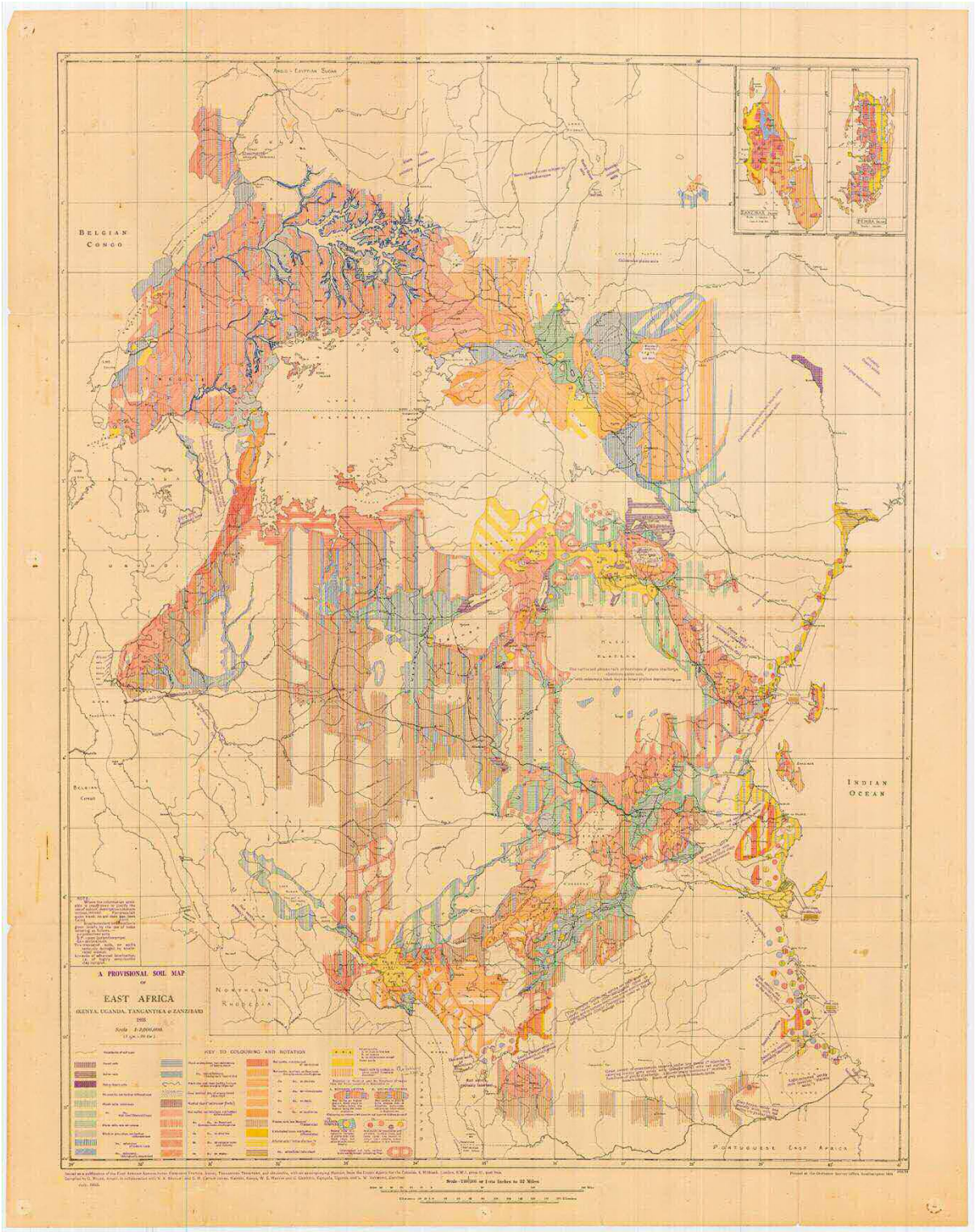

Figure 2.4. Milne, Geoffrey et al. *A Provisional Soil Map of East Africa (Kenya, Uganda, Tanganyika & Zanzibar)*. Map. Amani: EAARS, July 1935. From the World Soil Survey Archive and Catalogue (WOSSAC), *item 42187*. https://www.wossac.com/search/wossac_detail.cfm?ID=42187 (accessed 26/1/24).

As intended, the map was presented at the Third International Congress of Soil Science in Oxford in July 1935. At an exhibition in a newly established Soil Science Museum and Laboratory split between the School of Rural Economy and Rhodes House at Oxford University, Milne showcased the map to an audience that included soil scientists from across the world.[138] In the Congress transactions, the map was praised as "the first serious attempt to produce a soil map of Central Africa", and as being "remarkable for including the principle of the soil 'catena' as a principle of the region."[139] Milne and his colleagues (Gethin Jones, Beckley, Raymond, Martin and Griffith) had also prepared a paper introducing the map which was circulated to Commission V of the Congress beforehand. In the paper, they presented the map as "provisional and experimental", foregrounding their principle of having based the map upon "ascertained properties of the soils rather than on assumed factors in soil formation."[140] The Congress provided a platform for Milne to introduce the map and convey the principles upon which it had been built to a global audience.

The map, along with an accompanying memoir, became available to purchase in 1936 as a publication of the Amani Station (as part of the *Amani Memoirs* series).[141] A review in the *Geographical Review* (a publication of the American Geographical Society) praised the effort exerted by those involved in the project and "their careful discrimination of the quality of the data used."[142] Another review, in the *Geographical Journal* (a publication of the Royal Geographical Society), described the appearance of the map as "an event for the geographer" and expressed gratitude for Milne's "courage" and "enthusiasm". In a more cautionary tone, the reviewer also noted that the map could not "be of much use to the practical tiller of the soil".[143] The map and accompanying memoir were received, in part, as a valuable contribution to international science, yet also as something of rather limited immediate utility for agriculture in East Africa.

The extent to which the mapping project succeeded in drawing the attention of governments to the "need for more systematic investigation of soils" or in attracting "material additions" to the "meagre resources for soil work" in East Africa, as Milne had hoped it would, is difficult to tell. Milne's professional career as a soil scientist certainly advanced in

---

[138] *Transactions of the Third International Congress of Soil Science, Oxford, England, 1935, Vol. III* (London: Thomas Murby & Co., 1936), 268-9.
[139] Ibid., 269.
[140] *Transactions of the Third International Congress of Soil Science, Oxford, England, 1935, Vol. I* (London: Thomas Murby & Co., 1935), 266-7.
[141] Milne et al., *A Provisional Soil Map of East Africa*.
[142] "A Soil Map of East Africa," *Geographical Review* 26, no. 3 (1936): 522.
[143] C.G., "A Provisional Soil Map of East Africa by G. Milne," *Geographical Journal* 88, no. 5 (1936): 465.

the years following the publication of the map. Milne secured funding from the Carnegie Corporation of New York to visit the West Indies and the US for the study of soils between February to August 1938, for instance. This was a trip that enabled him to observe, first-hand, the soil research work being conducted by staff within institutions such as the Imperial College of Tropical Agriculture in Trinidad, the USDA, and the University of California at Berkeley.[144] Whether these opportunities for international travel and networking were opened up by the fact that Milne had been lead on the East African soil map project is not clear, however.

Issues concerning the public perception of scientific research in East Africa remained; including of soil science. In September 1937, for instance, Milne received a complaint from a planter at Ngambo Estate in the Usambaras that one of Milne's recent articles in the *East African Agricultural Journal* was so esoteric that it would be unintelligible to local coffee planters. According to the planter, the article was "hard going" and the summary of the argument for the layman "much too brief".[145] The planter's comments frustrated Milne, who drafted a response in which he drew parallels between himself as a soil scientist and that of a hypothetical doctor in terms of their shared use of chemical terminology and "unfamiliar reasoning".

> if you would like us Amani people to develop a bedside manner, of course it could be done. But so far, agricultural science has preferred to be honest; and if at times not immediately intelligible to the lay man, at least genuinely so because of intrinsic complexities in the subject and the inadequacy of common language to express them.[146]

The view that the Amani Station was facilitating research work that was not meeting immediate practical needs in East Africa was still very much in circulation. Milne's view of the long term value of his work for the development of agriculture in East Africa did not necessarily align with the view of others such as the planter at Ngambo Estate. Milne's published material could be seen as an example of "ivory tower" research symptomatic of the place of the Amani Station in East Africa more broadly.

---

[144] Geoffrey Milne, *A Report on A Journey to parts of the West Indies and the United States for the Study of Soils, February to August 1938* (Dar es Salaam: Government Press, 1940).
[145] Tait to Geoffrey Milne, 3/9/37, Oxford, Bodleian Libraries, MSS.Brit.Emp.s.457(12), p 139.
[146] Draft written letter to Tait from Geoffrey Milne, 9/9/37, Oxford, Bodleian Libraries, MSS.Brit.Emp.s.457(12), pp 140-1.

Soil work at Amani was severely disrupted by the outbreak of the Second World War in 1939. Milne documented the war time situation at Amani in a letter to Clement Gillman on 25 September 1939. He described the overall feeling at Amani as that of "suspense", with many staff not knowing whether they were to "wind up on research work" or carry on.[147] The result of the ambiguous situation at Amani, Milne wrote, "is a feeling of uselessness and not-wanted-ness, which depresses me at times but which I keep down by pegging away at my soils".[148] By November 1939, Milne had been posted to the Coffee Research Station at Lyamungu, Moshi at the request of the Tanganyika Director of Agriculture (A.J. Wakefield). The purpose of Milne's transfer was to relieve a worker previously based at Lyamungu so that they could undertake sisal control work in Tanga District. In another letter to Gillman dated 17 November 1939, Milne recorded how his days were now spent undertaking tasks such as building haystacks, pruning coffee and looking after six donkeys, "a span of oxen" and "a dairy herd".[149] This was a far cry from the arrangements for soil science in East Africa for which Milne had hoped during the mid-1930s. By this point, Milne's soil work at Amani had ceased altogether. Milne's laboratory assistant, W.E. Calton, was even posted to the Kenya Regiment (a unit of the British Army) in August the following year.[150]

2.6 Conclusion

Rather than merely being a tool for the planning of agriculture or land-use, or a demonstration of British mastery over the soils of colonial territory, the East African soil map came to be seen by Milne and others in East Africa as a means for raising the standing of soil science. Milne's conviction that authoritative soil knowledge was acquired through first hand inspection of soils in the field and the laboratory meant that the process of mapping soils over an area as vast in size as that of East Africa (Uganda, Zanzibar, Tanganyika and Kenya) required a significant amount of resources, particularly specialist personnel. Whilst the paucity of these resources was navigated somewhat by enrolling non-soil-specialists into the project through the collection and sharing of soil information, not everywhere could be surveyed at the threshold of detail Milne deemed worthy of cartographical representation. In

[147] Geoffrey Milne to Clement Gillman, 25/9/39, Oxford, Bodleian Libraries, MSS.Brit.Emp.s.457(16).
[148] Ibid.
[149] Geoffrey Milne to Clement Gillman, 17/11/39, Oxford, Bodleian Libraries, MSS.Brit.Emp.s.457(16).
[150] Geoffrey Milne to Clement Gillman, 11/8/40, Oxford, Bodleian Libraries, MSS.Brit.Emp.s.457(16). Milne died at Nairobi on 16 January 1942.

the end, the printed map, with all of its blank spaces and stripe patterning, presented much of the soils of East Africa as beyond the reach of both Britain and international soil science.

Milne and the other chemists were very much aware of how the map might be received by audiences. Their differentiation on the map of areas in which soils had been surveyed in varying degrees of accuracy was done with rhetorical intent. This visual contrast between knowledge and ignorance drew attention to the certainty of the knowledge of soils in those areas that were mapped in full. With this certainty being largely predicated upon the fact that those soils had been inspected first hand, the map carried with it a call for a future where Britain might be more fully in touch with one of the most important colonial resources in East Africa, its soils.

The case of the East African soil map project demonstrates the importance of paying close attention to local circumstances and contingencies in colonial territories in our accounts of the relationship between agricultural research and British imperial power during the interwar period. The trajectory of the project was shaped by the limits on personnel and resources available for in-depth research work in East Africa. A lack of soil survey staff, coupled with the vast size of the area under investigation, placed barriers on the production of authoritative soil knowledge. The fact that a project aimed at surveying and mapping soils through first hand inspection over an area as vast as East Africa was convened in the first place points toward an overestimation, particularly by Milne, of the capacity of the Departments of Agriculture in East Africa. The characteristics of soil science in East Africa were largely a product of Milne's vision. As the next chapter shows, a very different vision of soil science was being promoted in the Caribbean.

CHAPTER THREE

The Trinidadian School of Soil Science: Fred Hardy, the Imperial College of Tropical Agriculture and "Physiological-Ecological" Survey, 1922-36

3.1 Introduction

A very different approach to soil science to that which was being taken by Milne in East Africa was in use in the British West Indies during the interwar period. This chapter explores some of the key features of this approach, examining the way in which it was constituted by a particular view of soils as objects to be understood through analytical practices, as well as its focus on producing knowledge of soils in so far as they related to the performance of specific crops. This chapter also seeks to provide an explanation for why this approach emerged. It argues that it was partly a product of the wider political economy of the British West Indies. Yet, an understanding of why it emerged must also pay attention to the power of individuals in shaping the discipline of soil science and their institutional settings.

The particular approach under examination is the "physiological-ecological soil survey", spearheaded by the British soil scientist Fred Hardy; head of the Department of Chemistry and Soil Science at the Imperial College of Tropical Agriculture (ICTA) in Trinidad. Put simply, it involved identifying a country's main export crops, consulting estate or plantation managers on the places in which they obtained their best yields of that crop, and then studying the soil profiles in those respective places through field observation and description, sampling and laboratory analysis. Hardy positioned it as a way of producing knowledge of soils that would be of use for farmers and planters.

The Trinidadian school of soil science created by Hardy had a more direct and applied relationship with colonial agriculture than was the case in East Africa. Where Milne's vision for soil science in East Africa was connected to the idea that it would be a means of acquiring a foundation of knowledge that would underpin the long-term development of the region (at least in theory), Hardy positioned the value of soil science in the Caribbean in the narrower terms of it being a tool for increasing yields. Significantly, these were yields of the region's principal export crops: sugarcane, cacao, bananas and others. Soil science was not, for the most part, understood as a way of increasing yields of local food crops or as a way of supporting smallholder farmers. The politics of the approach was about augmenting the power of plantations and estates in the region. Hardy was less interested in the way in which

factors such as geology, vegetation and topography had informed the formation of different types of soils in the Caribbean, and more interested in whether things such as the acidity, organic matter content or nutrients present in different layers of soil profiles were connected with the performance of certain crops.

The concept of "land" as a distinct phenomenon is useful in understanding why this local culture of soil science emerged. If we take Tania Murray Li's conceptualisation of land as something which is produced through certain material and social relations connected with things such as ownership, labour, resource use and management, then much of the British West Indies during the interwar period can be seen as already land, at least from a European perspective.[1] British colonies in the Caribbean were old colonies compared with those in East Africa. By the interwar period, there had already been centuries of British colonial presence in the region connected with plantation agriculture.[2] Though labour arrangements had changed since the days of the Atlantic slave trade and later indentureship in colonies such as British Guiana and Trinidad, this chapter shows that the fundamental idea that social order in the region was dependent upon particular forms of land-use was still present. The concept of the physiological-ecological soil survey was rooted in a perception of the potential relationship between soil science and land in a way that was different to that in East Africa. Where approaches similar to those in use in East Africa can be seen as a way of turning environments into land, the approach in the British West Indies was shaped by a perception that land was already in existence in much of the region. This was a distinction that Hardy drew himself. Hardy argued that approaches similar to that taken by Milne in East Africa were suitable for "undeveloped tropical countries", whereas the physiological-ecological approach was suitable for "established agricultural areas".[3] The ethos of the approach to soil science in the British West Indies was less about opening up territory, and more about sustaining existing forms of land use.

3.2 A "Tropical Training Ground" in the British West Indies

Before examining the characteristics of the physiological-ecological soil survey approach, this chapter will introduce the institutional setting from which it emerged. The ICTA opened in the St. Augustine area in central Trinidad in 1922 as a centre for teaching, research and

[1] Li, "What is land?" 589.
[2] Eric Williams, *Capitalism and Slavery*, 3rd ed. (Penguin Classics, 2022).
[3] F. Hardy, "Tropical Soil Surveying: Part I," *Tropical Agriculture* 7, no. 9 (1930): 235.

agricultural advisory work. Its chief function was educational.[4] It provided postgraduate training in tropical agriculture, and in some cases specialist subjects, for students who were intended to go on to work as Agricultural Officers or technical staff throughout the Colonial Empire. This imperial, educational function was formalized in 1925 when the Colonial Office introduced the Agricultural Scholarships Scheme, requiring agricultural recruits to the Colonial Service to take a two year post-graduate course. The first year of the course was typically spent in the United Kingdom in the School of Agriculture at Cambridge University. The second year was spent at the ICTA in Trinidad.[5]

The ICTA was a different sort of institution to the Amani Station in Tanganyika. The remit of the Amani Station was very much about research, and its fate was related to wider anxieties about whether Britain took research as seriously as Germany or other European colonial powers.[6] The ICTA, on the other hand, was connected much more closely to agricultural practice through the training of agriculturists for work throughout the empire. The training that students received at the ICTA was meant to equip them with the skills and knowledge necessary to oversee agricultural development in any corner of the "British Tropics".

The founding of the ICTA was rooted in imperial concerns about a lack of qualified colonial agricultural staff. Following the First World War, there was a shortage of trained personnel within the colonial technical services, including Departments of Agriculture.[7] As Geoffrey B. Masefield notes in his history of the Colonial Agricultural Service, in 1925, the colonial agricultural departments were staffed by only "150 agricultural officers, 80 specialists, and 70 other appointments to serve dependencies which covered nearly 2 million square miles and were inhabited by 51 million people."[8] In 1920, a committee was appointed by the Colonial Secretary (then Alfred Milner) to look into the staffing of colonial agricultural departments. The report of the committee made clear the issues that a lack of technical expertise would create for the broader project of developing the agricultural resources of British colonial territories. "The conditions of cultivation, the inherent constitution of the plants (and animals), and especially the problems of disease", the report

[4] It was originally called the West Indian Agricultural College. The name changed to the Imperial College of Tropical Agriculture in 1924. See Bridget Brereton, *From Imperial College to University of the West Indies: A History of the St Augustine Campus, Trinidad & Tobago* (Ian Randle, 2011), 13.
[5] Geoffrey B. Masefield, *A History of the Colonial Agricultural Service* (Clarendon Press, 1972), 41-2; Hodge, *Triumph of the Expert*, 98-9.
[6] Clarke, "The Research Council System and the Politics of Medical and Agricultural Research for the British Colonial Empire," 345.
[7] Hodge, *Triumph of the Expert*, 97-8.
[8] Masefield, *A History of the Colonial Agricultural Service*, 5.

reads, “call for skilled scientific assistance on a scale much larger than heretofore in order that more rational methods of treatment and of practice may be devised and adopted.”[9] This problem was made all the more pertinent given the supposed vast, untapped agricultural resources that were awaiting exploitation throughout the Colonial Empire:

> It is not generally realised how rich a harvest may be reaped if the agricultural resources of the Colonies and Protectorates are properly developed, nor how small a part of the Empire has been so far subjected to such development. These colonies, situated as they are in the tropical or semi-tropical zones, are full of all manner of valuable economic products, and though the development of agriculture in recent years in many places has been rapid, a vast amount of country which has so far only been lightly ‘scratched over’ still remains to be developed.[10]

The founding of a tropical college was seen as a route toward the provision of adequate numbers of trained agricultural staff. These staff were seen as key to Britain’s development of the agricultural resources of the tropics and the consolidation of imperial power.

The value of the ICTA was often understood in terms of it being a site from which students would obtain the first-hand experience of tropical conditions that would prepare them for future work in any part of the tropics. For the committee that was appointed by Milner in 1920 to investigate the staffing of colonial agricultural departments, a tropical college was seen as a place from which the more practical knowledge relevant to work in the tropics could be passed on to students. In their report, they suggested that whilst the “broad lines of scientific education” could probably always “be best laid in the fully equipped laboratories at home”, a tropical college was a place in which “more ad hoc. instruction” could take place. Such ad hoc instruction, as the report went on to explain, “will save much time that now has to be spent in his district before a young officer is able to utilise fully the scientific knowledge he actually possesses, so as to concentrate it on the specific problems which confront him under new and unfamiliar surroundings.”[11] Similar ideas about the ICTA being a place in which students would acquire practical, experiential familiarity with work under tropical conditions were held by Frank Engledow, a Lecturer in Agriculture at Cambridge University. Engledow made similar comments before visiting the ICTA in 1929 at the bequest of the Empire Marketing Board. In addition to describing the ICTA as the future

[9] *Report of the Committee on the Staffing of the Agricultural Departments in the Colonies*, cmd. 730 (London: HMSO, 1920), 8.
[10] Ibid., 9.
[11] Ibid., 8.

"tropical training ground" for the colonial agricultural services, Engledow situated the value of the year in Trinidad in practical and experiential terms.

> The cadet agricultural officer takes to Trinidad a good scientific foundation, an extensive knowledge of agriculture, and an understanding of the methods of field experimentation. Educationally, therefore, he is well formed. But his teaching has been illustrated and his outlook inspired by home circumstances and practices. What he needs then is not further education, but essentially tropical illustrations of fundamental principles and a tropical complement to his practical knowledge.[12]

From the perspective of it being an imperial educational institution, what made the ICTA valuable was heavily enmeshed with ideas about the fundamental difference between tropical and temperate nature. There was a sense that tropical conditions presented unique challenges for agriculture, as well as technical work more generally. By having a foundation of experience of tropical conditions in Trinidad, students were supposed to be better prepared for future work in the Colonial Empire.

Masefield observes the "fillip" that the founding of the ICTA gave to the morale of colonial agricultural staff.[13] "The existence of the Imperial College", Masefield writes, "appeared to them to be a recognition of tropical agriculture as an academic discipline in its own right, a fact which greatly enhanced the prestige of the subject."[14] Those who underwent postgraduate training in Trinidad during the 1920s and '30s carried with them a "new confidence and pride in their own specialized branch of applied biology."[15] According to Masefield, an ICTA graduate himself, this was largely due to staff working at the ICTA, who had experience throughout the tropics and some of whom were "at the height of their research powers" during the 1920s and '30s.[16]

Among the numerous departments at the ICTA, such as those for Botany and Economics, was a Department of Chemistry and Soil Science. Staff within this Department taught some of the courses to postgraduate students enrolled on the Associateship of the ICTA programme (AICTA). These were the students who would typically later go on to work within

---

[12] CO 295/565/14, "Mr Engledow's visit to Trinidad: Memorandum and draft instructions," 17/1/29, p 1. For more on Engledow, see George D.H. Bell, "Frank Leonard Engledow, 20 August 1890 - 3 July 1985," *Biographical Memoirs of Fellows of the Royal Society* 32 (1986): 187-219.
[13] Masefield, *A History of the Colonial Agricultural Service*, 41.
[14] Ibid., 41-2.
[15] Ibid., 42.
[16] Ibid., 42.

agricultural departments or research stations elsewhere in the Colonial Empire. The training delivered by staff within this Department held global significance, introducing future colonial agricultural staff to the study of soils in the tropics. By the early-1930s, these students were required to take three courses out of a choice of eight. These choices were: 1) Agriculture in the Tropics, 2) Botany of Tropical Crops, 3) Tropical Crop Products, 4) Tropical Soils, 5) Crop Ecology, 6) Economics of Peasant Agriculture, 7) Diseases of Tropical Crop Plants, and 8) Tropical Agricultural Entomology.[17] The courses on tropical soils, crop ecology and tropical crop products were taught by staff within the Department of Chemistry and Soil Science.[18] All postgraduate students were required to write a thesis and take a short course on tropical sanitation and hygiene. There was an expectation that these students would attend an average of 100 lectures over the year spent in Trinidad, which was split into three terms.[19]

In addition to providing postgraduate training for future colonial agricultural staff, the ICTA also ran Diploma courses which were designed to provide training at a "less advanced level" (in the words of Engledow) in either agriculture or sugar technology.[20] Diploma courses were framed more toward those who would remain based in the West Indies, such as those aspiring for future careers as planters or various roles in the sugar industry. Initially, there was only one Diploma course. This changed during the early-1930s when multiple courses were introduced in response to complaints that the previous course was too "academic" and the standard of entry too high for "West Indian educational conditions".[21] Complaints had also been raised about the financial accessibility of Diploma courses for students. The price for approved lodgings within the vicinity of the College, for instance, were often too high for many students to afford, let alone the College Hostel where

[17] CO 323/1203/4, "Report by Mr. F. A. Stockdale, C.M.G., C.B.E., Agricultural Adviser to the Secretary of State for the Colonies, on his Visit to the West Indies, Bermuda, British Guiana, and British Honduras, 1932," September 1932, p 15.
[18] F. Hardy, "A History of the Department of Soil Science of the Imperial College of Tropical Agriculture, Trinidad, Vol. II," n.d., St Augustine, West Indiana and Special Collections of the University of the West Indies, WI LE15 .W627 H37, p 496.
[19] CO 323/1203/4, "Report by Mr. F. A. Stockdale, C.M.G., C.B.E., Agricultural Adviser to the Secretary of State for the Colonies, on his Visit to the West Indies, Bermuda, British Guiana, and British Honduras, 1932," September 1932, p 15.
[20] Frank L. Engledow, *West India Royal Commission Report on Agriculture, Fisheries, Forestry and Veterinary Matters*, cmd. 6608 (London: HMSO, 1945), 166.
[21] CO 323/1203/4, "Report by Mr. F. A. Stockdale, C.M.G., C.B.E., Agricultural Adviser to the Secretary of State for the Colonies, on his Visit to the West Indies, Bermuda, British Guiana, and British Honduras, 1932," September 1932, p 18.

postgraduate students stayed, which, in 1932, cost £12 and 10sh per month.[22] For most years up until the 1950s, the Diploma course made up the majority of the student body.[23]

There was a whole team of staff within the Department of Chemistry and Soil Science responsible for the smooth running of courses during the interwar period. Head of the Department was the British soil scientist Fred Hardy. Hardy had been educated at Bradford Grammar School in England, and later Cambridge University, where he specialized in Geology, Botany and Chemistry.[24] Before joining the ICTA, Hardy had held positions as Lecturer in Natural and Agricultural Sciences at Harrison College in Barbados (1911-17), as a chemist at H.M. Factory Oldbury in England throughout the remainder of the First World War, and as a demonstrator at the Cambridge School of Agriculture (1919-20).[25] Before working as a demonstrator, he had taken the Diploma in Agriculture course at Cambridge.[26] In 1920, he returned to the West Indies to work as Soil Scientist to the Imperial Department of Agriculture for the West Indies (IDA), based in a government laboratory in Antigua. Hardy later recalled that his appointment as Soil Scientist to the IDA had been made after the Mycologist to the IDA, William Nowell (later Director of the Amani Station), had insisted that certain root diseases of crop plants in the West Indies were being caused by a lack of soil aeration.[27] Hardy then moved to St Augustine, Trinidad, to work as a Professor and Head of the Department of Chemistry and Soil Science at the West Indian Agricultural College (later termed the ICTA) when it opened in 1922.[28]

Hardy had started to gain an international reputation by the late-1920s. He was one of only a handful of British soil scientists based in the tropics present at the First International Congress of Soil Science in Washington, D.C. in 1927.[29] He attended this Congress as

---

[22] Ibid., 18. Based on the National Archives currency converter, this was roughly the equivalent of £570 in 2017. https://www.nationalarchives.gov.uk/currency-converter/.
[23] Brereton, *From Imperial College to University of the West Indies*, 14.
[24] Nazeer Ahmad, "In Memoriam: Emeritus Professor F. Hardy - Honorary Member I.S.S.S. (1889-1977)," *Bulletin of the International Society of Soil Science* 52 (1977): 30-1.
[25] Edward W. Russell, "Fred Hardy," *Nature* 269 (1977): 93-4; F. Hardy, "A History of the Department of Soil Science of the Imperial College of Tropical Agriculture, Trinidad, Vol. II," n.d., St Augustine, West Indiana and Special Collections of the University of the West Indies, WI LE15 .W627 H37, p 502.
[26] Ahmad, "In Memoriam", 30-1.
[27] F. Hardy, "A History of the Department of Soil Science of the Imperial College of Tropical Agriculture, Trinidad, Vol. II," n.d., St Augustine, West Indiana and Special Collections of the University of the West Indies, WI LE15 .W627 H37, pp 291, 502.
[28] Ibid., 502.
[29] Other delegates from British tropical colonies included, but might might not be limited to: C.H. Knowles (Director of Agriculture, Gold Coast), C.L. Whittles (Director of the Sugar Planters' Experiment Station, British Guiana) and W.S. Martin (Agricultural Chemist, Uganda). See *Proceedings and Papers of the First International Congress of Soil Science*, *June 13-22, 1927, Washington, D.C., U.S.A.: Transcontinental Excursion and Impressions of the Congress and of America* (Washington, D.C.: American Organizing Committee of the First ICSS, 1928), 22-39.

"Professor of Chemistry and Soil Science" at the ICTA.[30] This was at the bequest of the Foreign Office and Colonial Office in London who, from the intimations of the US Chargé d'Affaires in London, were under the impression that the Congress was intended to be an "international gathering of specialists for the presentation and consideration of fundamental contributions to research in soil sciences and those closely related."[31] In the Proceedings of the Congress, Hardy was framed as someone "who has made important contributions to soil science, which deal chiefly with the colloidal condition of the soil and relation between sugar cane plant [sic] and soil conditions affecting resistance to certain diseases."[32] The Proceedings also noted how Hardy had gained a reputation during the Congress for his witty poems. One such poem, entitled "In Quest of Prof. Ile", alluded to delegates' experiences travelling and inspecting soil profiles during the Congress excursion throughout parts of the US and Canada.[33]

Some accounts of the influence that Hardy had on postgraduate students at the ICTA have referenced the ecological emphasis in his teaching of soil science. In an obituary for Hardy published in the *Bulletin of the International Society of Soil Science* in 1977, one of his former students, the Guyanese soil scientist Nazeer Ahmad, reflected on Hardy's teaching approach. As Ahmad recalled, it involved considering "the whole environment — the soil, the plant and the atmosphere as components of a single system."[34] Similar allusions to the ecological emphasis in Hardy's teaching of soil science were made in an obituary for Hardy in *Nature* that same year, written by Edward W. Russell.

> His enthusiasm, his great friendliness and approachability, and his gift for picking out the most important points in any discussion, all left their mark; and his appreciation of the relation of the soil and the crop to the natural landscape must have influenced the ecological approach to agricultural development shown by many outstanding colonial agricultural officers.[35]

Exactly why Hardy emphasised an ecological understanding of soils in his teaching could have been related to his time spent as a student at Cambridge University. The ecologist Arthur

---

[30] Ibid., 22.
[31] CO 323/972/5, S. Gaselee to the Under Secretary of State, Colonial Office, 21/1/27.
[32] *Proceedings and Papers of the First International Congress of Soil Science, … Transcontinental Excursion and Impressions of the Congress and of America*, 22.
[33] Ibid., 175. See also Hartemink, *Soil Science Americana*, 421-2.
[34] Ahmad went on to note that "Those who were fortunate to have been his students, and these number in the hundreds, have all been impressed and influenced by this approach but few, if any, have had the capacity to integrate the components of the system so completely." See Ahmad, "In Memoriam," 30.
[35] Russell, "Fred Hardy," 94.

Tansley, known for coining the term "ecosystem", was a Lecturer in the Botany School at Cambridge during the period that Hardy was a student there.[36] Indeed, one of the subjects that Hardy specialised in whilst studying at Cambridge was botany, and he was likely exposed to the ideas and approaches of Tansley. By the mid-1920s, Tansley, along with others such as the botanist T.F. Chipp, were framing ecology as a science that could underpin British colonial planning.[37] Similar views were shared by the "Oxford School of Imperial Ecology" during the interwar period; a term coined by the Pedr Anker. These were a group of ecologists based at Oxford University (including, for instance, Charles Elton and Julian Huxley), who, among other things, according to Anker, aimed "to establish a new social order according to the aims and values of their patrons within various British colonial agencies and commercial companies, who saw ecology as a means to enlarge and improve the management of the empire."[38] For someone charged with training nearly all future colonial agricultural staff, ideas about the role that ecology could play in the management and planning of colonial territories likely had great appeal for Hardy.

Whilst Hardy had a significant degree of control over the direction of teaching and content of the courses, he had a large team working under him. Some staff members were employed specifically to deliver lectures. Take P.E. Turner, for instance, who was appointed Lecturer in Chemistry at the ICTA in 1924 after leaving Reading University in England. Turner was replaced by H.H. Croucher in 1926 after being seconded to a committee investigating the relation between soil and the froghopper pest affecting sugarcane in Trinidad.[39] Croucher left the ICTA in 1931 to work as soil chemist to the Department of Agriculture in Jamaica, later going on to be Director of Agriculture in Jamaica.[40] The work of teaching assistants was also key for the teaching of Diploma students, although their role in postgraduate teaching is not as clear. The first assistant appointed to the Department was J. Narine, who made the arrangements and preparations needed for the teaching of many of the Diploma courses, such as practical inorganic chemistry, soil science, geology and physics. Narine worked at the ICTA from 1922-67. Another key role was the preparation of cytostyled

[36] Laura Cameron, "Histories of Disturbance," *Radical History Review* 1999, no. 74 (1999): 8.
[37] Anker, *Imperial Ecology*, 35-40.
[38] Ibid., 77.
[39] F. Hardy, "A History of the Department of Soil Science of the Imperial College of Tropical Agriculture, Trinidad, Vol. II," n.d., St Augustine, West Indiana and Special Collections of the University of the West Indies, WI LE15 .W627 H37, p 502.
[40] Ibid., p 503.

sheets as lecture note hand outs. This was done by C. Baboolal, who worked at the ICTA from 1923-65.[41]

Whilst having a clear educational function, the ICTA was also part of a legacy of efforts to align scientific research with the needs of agricultural industries in the British West Indies. Principal among this legacy was the IDA, established in 1898 with headquarters in Barbados. The IDA had been established following the economic crisis that afflicted the West Indian sugar industry during the late-nineteenth century, when increased competition from European produced beet sugar had caused the price of West Indian sugar on global markets to slump.[42] The effects of this were felt throughout much of the British West Indies, challenging long-established social relations built around plantation-based and export-oriented agriculture. Following the recommendations of a Royal Commission that was appointed to investigate the economic depression in the West Indies in 1897, the IDA was established with the function of overseeing agricultural research and promoting "development" in the region.[43]

Similar assumptions about the relationship between science and social order in the British West Indies lived on through the ICTA. When the College in Trinidad opened in 1922, part of the vision behind the institution was that it would take on some of the functions of the IDA. This was reflected in the creation of space within the ICTA for the provision of agricultural advice to colonial governments and Agricultural Officers in the Leeward and Windward islands. Much of this work was overseen by the College's Advisory Department; staffed by the Professor of Entomology as a part-time Commissioner of Agriculture, and an Assistant Commissioner.[44] It was also reflected in the idea that the institution would act as a place from which research into agricultural problems affecting the British West Indies would be pursued. Similar to the Amani Station in Tanganyika, by the late-1920s, the ICTA was also a part of conversations within the Colonial Office and elsewhere about the possibility of establishing an empire-wide chain of "central research stations" which would serve the needs of British territories within their respective regions.[45] Perhaps the best illustration of the close links

---

[41] Ibid., p 497.
[42] Clarke, *Science at the End of Empire*, 24-5; William K. Storey, "Plants, Power and Development: Founding the Imperial Department of Agriculture for the West Indies, 1880-1914," in *States of Knowledge: The Co-Production of Science and the Social Order*, ed. Sheila Jasanoff (Routledge, 2004), 109-30.
[43] Storey, "Plants, Power and Development," 109-30.
[44] CO 323/1203/4, "Report by Mr. F. A. Stockdale, C.M.G., C.B.E., Agricultural Adviser to the Secretary of State for the Colonies, on his Visit to the West Indies, Bermuda, British Guiana, and British Honduras, 1932," September 1932, pp 23-4.
[45] Hodge, *Triumph of the Expert*, 101-5; *Agricultural Research and Administration in the Non-Self-Governing Colonies: Report of a Committee Appointed by the Secretary of State for the Colonies*, cmd. 2825 (London: HMSO, 1927), 41; *Colonial Agricultural Service: Report of a Committee Appointed by the Secretary of State for the Colonies*, cmd. 3049 (London: HMSO, 1928), 16-23.

between the IDA and the ICTA, however, can be seen in Bridget Brereton's observation that one of the reasons for the "swift progress in founding the College", was that "the Principal, several professors, some administrative and clerical staff, and a fine specialised library, were all 'ready-made' in Barbados for transfer to the St Augustine site in Trinidad".[46] If a particular ideology of science for development was at the heart of the IDA, then there was certainly crossover with the ICTA.

This said, like its educational programme, the research conducted by staff at the ICTA was also afforded significance for its relevance to agriculture throughout the tropics more broadly, not just in the West Indies. Writing in 1927 for the Imperial Agricultural Research Conference which was to be held in London in October that year, the Principal of the ICTA (Geoffrey Evans), for instance, explained how "Research is a most important function of the College, and with the increasing importance of tropical products in the economic position of the world as a whole, and of the British Empire in particular, it is bound to receive greater and more detailed attention."[47] The idea that the ICTA would be a place with close proximity to research of global relevance was also reflected in the name of the institution's in-house journal, *Tropical Agriculture*, which was set up in 1924. Rather than referring to any regional West Indian affiliation, such as was the case with the former IDA's *West Indian Bulletin*, the journal's name implied a global outlook that would be relevant to the tropical world in its entirety.

The remit of the ICTA, as such, was both global and regional in character. Whilst it was afforded a great deal of significance as an imperial center within a global network of colonial agricultural departments and research stations, it also took on many of the functions of the IDA, which was rooted in problems specific to the West Indies. It also ran Diploma courses designed for students who would stay on in the West Indies. This said, Bridget Brereton argues that the "imperial remit" of the ICTA had come to dominate by the mid-1920s.[48] Efforts to draw funds toward the founding and maintenance of the ICTA, for instance, drew attention to the institution's relevance to the Colonial Empire as a whole, not just the West Indies.[49]

[46] Brereton, *From Imperial College to University of the West Indies*, 9.
[47] CO 323/988/10, "The Imperial College of Tropical Agriculture, B.W.I., by G. Evans, M.A., C.I.E.," p 19.
[48] Brereton, *From Imperial College to University of the West Indies*, 14.
[49] Ibid., 26.

3.3 The Hardy Approach: Physiological-Ecological Soil Survey

As Head of the Department of Chemistry and Soil Science, Hardy championed an approach to soil surveying that he called the "physiological-ecological soil survey". He published numerous articles describing the approach in journals such as *Tropical Agriculture* and the *Journal of Agricultural Science*.[50] The crux of the physiological-ecological soil survey approach was to determine and compare the soil profile characteristics of "good" and "bad" areas. What determined whether an area was good or bad was to be based upon farmers' or planters' knowledge of the yields and performance of crops on different parts of their land, or on data that could be collected about the yield of a crop in a particular area.[51] Hardy explained that such soil surveys should proceed through a combination of detailed field inspection of soil profiles, sampling of profile horizons, and analysis of those samples in a laboratory. The idea was that this would furnish numerical values for certain soil characteristics, such as mechanical composition, organic matter content, pH and more, depending on laboratory capacity. With the compilation of numerical data into tables, the characteristics of soils in supposedly good and bad areas could be directly compared with each other by examining differences in the numerical values obtained.[52] The appeal of this approach was that it could help elucidate the soil factors that were most affecting the performance of crops in particular areas.

This particular approach was not just spoken about as a potential way of approaching soil surveying in the tropics. It informed the approach to multiple soil surveys actually carried out in the British West Indies during the interwar period. Between 1922-36, some ten articles documenting soil survey studies in the West Indies were published. The first two, summarising research into soils on the Leeward islands of Dominica and Montserrat, appeared as supplements to the IDA's *West Indian Bulletin* in 1922. Research for these studies was carried out under the lead of Hardy during his time working as Soil Scientist to the IDA. The remainder were published as supplements to the ICTA's *Tropical Agriculture* between 1931-36 under the series "Studies in West Indian Soils". They covered research on the Leeward islands of Grenada, Antigua, Trinidad, Tobago and St Vincent, the Windward island of Jamaica, as well as British Honduras on the Central American mainland. All of the articles had Hardy as an author or co-author, and most of the studies underpinning the articles

[50] F. Hardy, "Tropical Soil Surveying: Part II," *Tropical Agriculture* 7, no. 10 (1930): 274-5; F. Hardy, "Some Aspects and Methods of Soil Survey Work," *Journal of Agricultural Science* 19, no. 4 (1929): 734-51.
[51] Hardy, "Tropical Soil Surveying: Part II", 275.
[52] Ibid., 274-7; Hardy, "Some Aspects and Methods of Soil Survey Work," 735-44.

had adopted approaches similar to, if not directly in accordance with, the principles and methodology of the physiological-ecological soil survey.[53]

Most of the studies were designed to survey the soil conditions affecting the growth of export crops. In Trinidad, Tobago and Grenada, this mostly concerned cacao, whilst in St Vincent a significant amount of attention was paid to arrowroot; then a profitable cash crop. In Jamaica, there was a focus on bananas and sugarcane.[54] Many of the published studies had titles which foregrounded the relationship between soils and these crops, such as *The Cacao Soils of Tobago* (1931) and *The Sugar-Cane Soils of Antigua* (1933).[55]

To illustrate how physiological-ecological soil surveying worked in practice, let us examine the seventh study of the series: *The Cacao Soils of Trinidad* (1933). The focus of this study was on the soils of the Ward of Montserrat in central Trinidad. The area under investigation was roughly 80 square miles or 52 thousand acres in size. There were many cacao estates in the Ward, as well as a forest reserve and hills reaching over 900 feet in some places.[56]

Work on the study was started in 1928 by ICTA postgraduate students, who conducted research on soils in the Ward as part of their dissertation projects. They were likely under the supervision of Hardy. One of these dissertation projects was conducted by two students (C.G. Akhurst and R.G. Wilshaw) and was entitled "A Study of Some Cacao and Forest Soil Profiles in Trinidad".[57] The aim of their dissertation, as outlined in its introduction, was "firstly, the presentation of soil profile data of Trinidad soils, and secondly, an attempt to correlate the data obtained with some of the problems of tropical soils." According to the two students, one of the main problems of tropical soils was the fallacy of their inherent fertility, particularly those in forests. As they went on to state in the introduction: "Owing to the luxurious growth of tropical forests, it is often presumed that these soils have a natural high fertility: yet when forest lands are opened up and planted, after a very few years the yields decrease rapidly and in many cases total failure of crops occurs."[58] A key focus of their

---

[53] F. Hardy, "Studies in West Indian Soils," *Tropical Agriculture* 13, no. 10 (1936): 268-73.
[54] Ibid., 268-73.
[55] F. Hardy et al., *Studies in West Indian Soils (III)—The Cacao Soils of Tobago* (Port-of-Spain: Government Printing Office, 1931); F. Hardy et al., *Studies in West Indian Soils (V)—The Sugar-Cane Soils of Antigua: Report on a Visit made during April, 1932, and on the Laboratory Examination of Representative Soil Samples* (Port-of-Spain: Government Printing Office, 1933).
[56] J.A. McDonald et al., *Studies in West Indian Soils (VII)—The Cacao Soils of Trinidad* (Port-of-Spain: Government Printing Office, 1933), 1.
[57] C.G. Akhurst and R.G.H. Wilshaw, "A Study of Some Cacao and Forest Soil Profiles in Trinidad," (A.I.C.T.A. thesis, ICTA, 1929).
[58] Ibid., 1.

dissertation, as such, was to compare soil profiles in forests of "good yielding" and "bad yielding" cacao areas.[59]

In 1930, work on the study was bolstered by the establishment of a five year Cocoa Research Scheme at the ICTA. The Scheme was funded by British cocoa-producing colonies such as the Gold Coast in West Africa and chocolate manufacturers in the United Kingdom with the intention of increasing cocoa yields in Trinidad and rehabilitating the country's cocoa industry.[60] A chemist, J.A. McDonald, was appointed under the Scheme. As chemist to the Scheme, McDonald was involved in organizing further survey efforts in Montserrat.[61]

Some of the research took place on the spot in Montserrat. Efforts were made to determine the main characteristics of the various soil types in the area through practices of field examination. Pits were dug at selected sites, in some instances six feet deep, so as to display soil profiles, and the horizons of these profiles were examined using a range of techniques. Some of these techniques were visual, such as the observation of changes in colour and structure. Others were probably based more upon touch, such as the examination of changes in texture.[62] Further still, examination of the presence of calcium carbonate involved quick experimentation on the spot in the form of an "acid test".[63] Standard practice involved testing a sample of soil with an acid and estimating the amount of carbonate present by the violence of the reaction (the degree of fizzing).[64]

Between 1928-30, the focus of much of the field work was on determining the range of soil types that existed within cacao estates in the Ward of Montserrat and differentiating the places where good and bad cacao soils occurred. Guidance as to where good and bad cacao soils occurred was provided by proprietors and managers of estates based upon yields obtained in different areas. In this particular study, a good soil was one in which a yield of over 8 bags of dry fermented cacao beans were obtained per 1,000 pickets, and a bad soil one in which 8 bags or under were obtained per 1,000 pickets.[65] More systematic traverses of the area were made later on. These later traverses involved the use of an auger to take borings, which sped up the process of identifying soil types as opposed to the more laborious process of observing soil profiles in dug pits. Some 2,300 borings were taken it total, to depths of two

---

[59] Ibid., 2.
[60] Jospeh M. Hodge, "Colonial Foresters versus Agriculturalists: The Debate over Climate Change and Cocoa Production in the Gold Coast," *Agricultural History* 83, no. 2 (2009): 206.
[61] McDonald et al., *Studies in West Indian Soils (VII)*, 1.
[62] Ibid., 6.
[63] Ibid., 6.
[64] For a description of this technique, see G.R. Clarke, *The Study of the Soil in the Field*, 3rd ed. (Oxford University Press, 1941), Appendix 1, 23.
[65] McDonald et al., *Studies in West Indian Soils (VII)*, 16.

or three feet. As the traverses progressed, the distribution of the different soil types were plotted onto a large-scale map, and the boundaries of the different types "approximately delineated".[66] In some cases, further profile pits were dug to enable the soil types to be more "accurately identified".[67]

Whilst field work was key to the study, the way in which the relationship between soil characteristics and cacao productivity was determined and much of the study's claims to useful and reliable knowledge made, were based upon the results of analytical work carried out in laboratories at the ICTA. For each soil profile that was examined, samples of each layer of the profile (horizons) were collected and transported to laboratory facilities at the ICTA, some several miles to the north of Montserrat, for analysis. Each sample was labelled with field details such as the location, yield of cacao obtained on the site, elevation above sea level, rainfall levels, and other species of vegetation present. In many instances, the samples were also labelled with local names for that type of soil, such as "Brasso Clay" and "Chocolate Soil".[68] By the end of the study, some 85 profiles had been examined, generating about 819 soil samples in total.

When the ICTA initially opened in the early-1920s, the main laboratory used by the Department of Chemistry and Soil Science was located in what had previously been the Old Yaws Hospital. This was a defunct hospital by the St Augustine Estate that had originally been established for treating patients with yaws disease. It was renovated in the early-1920s to house offices, laboratories, a library and classrooms.[69] One of Hardy's first jobs as Head of the Department was to install the equipment of the laboratories in the old hospital building.[70] The facilities available at the ICTA had likely improved by the time that the study of cacao soils in the Ward of Montserrat had commenced, though.

The work of analysing the soil samples collected from the various estates and places in the Ward of Montserrat was overseen by G. Rodrigues, who was employed as a chemical analyst in the Department of Chemistry and Soil Science. Rodrigues had been a runner up for the Trinidad island scholarship in 1923 to study for the Diploma at the ICTA and later took up a role as Froghopper Observer before moving to the ICTA in 1926. Rodrigues trained in chemistry through a correspondence course and then in London at the Chelsea Polytechnic,

---

[66] Ibid., 6.
[67] Ibid., 6.
[68] Ibid., 25-49.
[69] Brereton, *From Imperial College to University of the Wet Indies*, 10.
[70] F. Hardy, "A History of the Department of Soil Science of the Imperial College of Tropical Agriculture, Trinidad, Vol. I," n.d., St Augustine, West Indiana and Special Collections of the University of the West Indies, WI LE15 .W627 H37, p 5.

later obtaining the Associateship and Fellowship of the Institute of Chemistry.[71] Hardy later described Rodrigues as a "mainstay of the Department whose progress and accomplishments are largely owing to his particular contributions."[72]

Most of the laboratory analyses of the soil samples collected from Montserrat were not actually carried out by Rodrigues himself, however. Rather, Rodrigues organised and directed a team of junior laboratory assistants to do this work. Most of the routine laboratory analyses of soil samples conducted at the ICTA during the interwar period, in fact, were carried out by these assistants.[73] These staff were, in Hardy's words, mainly "youths of East Indian descent" (Indo-Trinidadians) with seventh standard elementary education from schools in Trinidad.[74] According to the accounts of Hardy and Rodrigues, six of these "junior staff", supervised by a "junior analyst" with higher certificate standard training, could deal with the routine analysis of 20 soil samples per day, over a five day working week.[75] Despite their key role in the production of knowledge of soils, these staff were not credited in the final published articles.

During the study of the cacao soils of Trinidad, ten different types of analysis were conducted on each soil sample. These analyses included: 1) Index of Texture, 2) Reaction Value (pH), 3) Calcium Carbonate Content, 4) Organic Matter Content, 5) Nitrogen Content, 6) Carbon/Nitrogen Ratio, 7) Available Phosphate Content, 8) Available Nutrients, 9) Rate of Solution of Potential Nutrients, and 10) Available Potash Content. Each sample was air-dried and sifted before the various analyses were carried out.[76]

Over the course of the study, classifications of the different soils started to be built up as statistics on the various chemical and physical properties of the soil profiles were accumulated. One of the key practices for comparing soil profiles was the use of coloured "soil profile charts".[77] These were charts that visually displayed variations in the values of various soil characteristics for each horizon of a soil profile. They were made by mixing finely sifted samples of soil from a soil profile with cellulose varnish (typically Necol) and

---

[71] F. Hardy, "A History of the Department of Soil Science of the Imperial College of Tropical Agriculture, Trinidad, Vol. II," n.d., St Augustine, West Indiana and Special Collections of the University of the West Indies, WI LE15 .W627 H37, p 502.
[72] Ibid., p 503.
[73] *Technical Communication No. 46—Proceedings of the First Commonwealth Conference on Tropical and Sub-Tropical Soils, 1948* (Harpenden: Commonwealth Bureau of Soil Science, 1949), 220.
[74] Hardy, "Studies in West Indian Soils," 269.
[75] *Technical Communication No. 46—Proceedings of the First Commonwealth Conference on Tropical and Sub-Tropical Soils*, 220.
[76] McDonald et al., *Studies in West Indian Soils (VII)*, 6-7.
[77] Ibid., 7.

painting the mixture onto a card, ruled to a scale of one inch to one foot, so as to represent the different horizons of the soil profile. Parallel to the columns, the values of various properties (in this case 1,2,4,7 and 9) for each soil profile were depicted, horizon layer by horizon layer, in watercolour washes based on an arbitrary scheme of standards. The idea was that these charts (sometimes termed "cards") could be grouped together according to relationships between the values obtained through laboratory analyses. By displaying these values as colours, rather than statistical figures, relationships between different soil profiles could be recognised at a glance. This helped with the classification and grading of soils, and was a key practice used at the ICTA.[78]

The statistics generated through the laboratory assistants' extensive analysis of soil samples from the Ward of Montserrat were also used to determine relationships between soil properties and the productivity of cacao trees. Once the values of the properties of different soil samples from good and bad sites were obtained, statistical analyses were conducted to find out the degree of significance of various soils' properties in determining whether a site was good or bad yielding. The method used was the "test of significance", based upon values for the mean and variance of various soil types' properties, together with Fisher's tables.[79] Through these statistical analyses, various relationships were able to be observed, such as that the difference between the pH of the surface six inches of clay soils in good and bad sites was "highly significant", and that the difference in the carbon-nitrogen ratio of Brasso Clay soils in good and bad sites was "very significant".[80] It was through these means that conclusions were able to be drawn about the key soil properties determining cacao productivity in the Ward. Indeed, the main conclusion of the study was that (given water and air relations, cultivation practices and genetic type of cacao tree are "satisfactory"), the "*chief controlling growth factor is the nutrient supply* provided by the soil."[81]

3.4 A Conservative Politics of Soil Science

The physiological-ecological soil survey approach was centred upon producing knowledge of soils in so far as they related to the productivity of specific crops. Questions driving the approach were less about what a soil was like and more about whether a particular soil was

[78] *Technical Communication No. 46—Proceedings of the First Commonwealth Conference on Tropical and Sub-Tropical Soils*, 225; Hardy "Tropical Soil Surveying: Part II," 275; Hardy, "Studies in West Indian Soils," 269.
[79] McDonald et al., *Studies in West Indian Soils (VII)*, 17-23.
[80] Ibid., 19.
[81] Ibid., 24.

any good, and if so, why and for what? It reflected a different ethos of soil science to that promoted by Milne in East Africa. The approach was "physiological" in the sense that it was concerned with the performance and growth of specific crops, and "ecological" in the sense that it elucidated the relationship between soil conditions and plant growth (and yield). As Anthony Young describes it, "the agricultural performance of the soils, with the respect to the specific crop, was associated with the soil characteristics right from the start."[82]

Hardy's decision to focus on soil-crop relations was, in part, a product of the wider political-economy of the British West Indies. Nearly all the crops that featured in the soil surveys carried out by Hardy and others during the interwar period were key export commodities for the West Indian colonies in question. Sugarcane and bananas in Jamaica, for instance, and cacao in Tobago, Trinidad and Grenada.[83] These crops constituted a key component of what Philip D. Curtin terms the "plantation complex"; a term used to describe the "economic and political order centering on slave plantations in the New World tropics."[84] Whilst the relevance of Curtin's concept of the plantation Complex to understanding the political, economic and social context of the interwar British West Indies could be debated, the plantation or estate scale production of crops for export markets was still understood by many as the backbone of social order in the region.[85] This was particularly so with regards to sugarcane. Take the following quote from a report of a commission appointed by the British Government in 1930 to investigate the state of the West Indian sugar industry. The report pointed out the dependency of the industry upon the tariff preference given to West Indian sugar in the British market.[86] Without such preference, it was warned in the report, many places in the region would risk social and political upheaval:

[82] Young, *Thin On the Ground*, 14.
[83] For statistics on commodity exports from Jamaica and Trinidad, see Havinden and Meredith, *Colonialism and Development*, 155.
[84] Philip D. Curtin, *The Rise and Fall of the Plantation Complex*, 2nd ed. (Cambridge University Press, 1998), xi.
[85] Slavery had been abolished in the British West Indies for close to a century by the time of Hardy's soil survey studies.
[86] Clarke, *Science at the End of Empire*, 25.

> there could hardly fail to be an immediate disastrous collapse in Barbados, St. Kitts, Antigua, and British Guiana, which would entail results which we do not think it possible for any British government to contemplate without taking measures to avert it. The same is true in a less degree in Trinidad and St. Lucia. The effects in Jamaica would be severe, but not crippling. The communities likely to be principally affected are themselves, indeed, small, but an economic and social collapse in any of these old-established British colonies would be an event which, we take it, the Government would not be prepared to risk.[87]

Without the sugar industry, which was itself largely reliant upon plantation agriculture, the report argued that there would be a collapse of social order in most British West Indian colonies.[88] Rather than seeking to help smallholder farmers improve the production of staple food crops such as yams and cassava, for example, the focus of Hardy's approach to soil surveying was upon sustaining the sort of monocultural, export oriented economic model upon which the 1930 report had argued that social order in the British West Indies was dependent. Of course, Hardy's studies did not focus only on sugarcane. He did, however, focus only on colonies' principal export crops. The politics of his approach to soil surveying can thus be seen as conservative in this regard. It was oriented toward preserving long established political economic structures in the region rather than challenging them.

Hardy presented the physiological-ecological soil survey approach as a mostly technical activity. In his written publications, Hardy rarely alluded to his vision of agricultural development that the approach was meant to support.[89] The rationale behind the approach that Hardy did express was related to it being a way of producing the sort of scientific knowledge that would be of use for farmers and planters who already possessed knowledge about the reputation of soils in their area. In areas that have "already been exploited by native inhabitants or by early settlers", Hardy wrote in an article on tropical soil surveying published in *Tropical Agriculture* in 1930, "much experience may already have been acquired, and the reputation of different soil-types and different localities will doubtless have been thoroughly established."[90] The goal of the soil surveyor in such areas, Hardy argued, was to characterise "both the soils and the environments, by methods which preferably give numerical expression

---

[87] *Report of the West Indian Sugar Commission*, cmd. 3517 (London: HMSO, 1930), 15.
[88] Not all sugarcane was produced on plantations. In Trinidad, in particular, a large quantity of sugarcane was grown by independent farmers who sold their cane to sugar factories. See Clarke, *Science at the End of Empire*, 27.
[89] The furthest Hardy went in this regard was to argue that the physiological-ecological soil survey approach was most suitable for "established agricultural areas". See Hardy, "Tropical Soil Surveying: Part I," 235.
[90] Hardy, "Tropical Soil Surveying: Part II," 274.

to the contributing factors controlling soil quality and plant growth."[91] This latter "characterisation" was essentially the physiological-ecological soil survey approach. The utility of the knowledge it provided was positioned by Hardy as based upon the fact that it would give "numerical expression" to factors affecting soil-crop relationships. This was the sort of knowledge that, supposedly, could not be acquired by farmers and planters through their usual activities of working the land or managing it.

In some ways, the areas under investigation by Hardy and others in their soil studies in the Caribbean had "already been exploited" and the reputation of different soil types within them "thoroughly established". To illustrate this, let us return to the case study of the Ward of Montserrat, the area under investigation in *The Cacao Soils of Trinidad*.

Montserrat had been a cacao frontier during the mid-nineteenth century, when small patches of forest were planted with cacao by squatters. During the 1860s, it was the site of an administrative experiment instigated by the then Governor of Trinidad, A.H. Gordon, to test a new policy for squatters' acquisition of Crown land.[92] Montserrat was made a Ward Union and a Warden and Commissioner of Crown Lands (Robert Mitchell) was appointed in 1867, who visited the "remote interior", in the words of Brereton, in which squatters lived and reported on the progress made in squatters' applications for Crown land.[93] Many of these squatters were, as the Professor of Economics at the ICTA Cecil Y. Shephard put it, "peons of Spanish extraction", and cultivated coffee and provision crops alongside cacao in plots between 3 and 120 acres in size.[94] Cacao was typically sold to merchants. As Brereton highlights, the squatters also included "Creoles, British West Indian Immigrants, Yoruba, Ashanti, Congo and Mandingo."[95] Gordon's experiment was largely a success, with most of the squatters either paying for their holdings or abandoning them. Very few new cases of squatting were reported by the end of 1872.[96] Experiences in Montserrat even prompted the Government to trial similar schemes in other parts of the island.[97]

Brereton explains how there were two main ways through which cacao estates were established in Trinidad. One was through peasants purchasing Crown land, planting it in cacao and then selling it on to planters. By accumulating multiple plots, planters built up

---

[91] Ibid., 274.
[92] Bridget Brereton, *A History of Modern Trinidad, 1783-1962* (Heinemann, 1981), 88-90.
[93] Ibid., 90.
[94] Cecil Y. Shephard, "The Cacao Industry of Trinidad. Some Economic Aspects. Part IV. Historical 1820-1920," *Tropical Agriculture* 9, no. 7 (1932): 200.
[95] Brereton, *A History of Modern Trinidad*, 90.
[96] Ibid., 90; Shephard, "The Cacao Industry of Trinidad," 200.
[97] Shephard, "The Cacao Industry of Trinidad," 200.

large estates. As Brereton describes it, peasants would often use the proceeds from selling their plots to buy "areas of fine virgin soil" in new districts, thus repeating the process.[98] Another way was through what was known as the "contract system":

> the capitalist would buy a large block of Crown land and fell the forest; he entered into an agreement with contractors who agreed to plant cocoa on a quarrée of land (3 1/5 acres). When the trees were bearing the owner took over the land, paying agreed sums for each tree according to the stage it had reached. The contractor was free to plant and use food crops and he often also gave wage labour to nearby cocoa estates. The contract usually lasted for five years, and the contractor could normally expect to make a reasonable sum.[99]

Brereton argues that most of Trinidad's cacao estates were probably built up by contractors. This would have included those in Montserrat. Many of the larger cacao estates were owned by French Creoles, who used the proceeds from selling small sugar estates during the latter half of the nineteenth century to buy up Crown lands.[100]

An example of a large estate in the Ward of Montserrat present at the time at which the study of the cacao soils of Trinidad was being conducted was La Vega Estate. La Vega was, in fact, one of numerous estates from which soil profiles were inspected, sampled and analysed as part of McDonald et al.'s study.[101] The Estate was owned by Carl de Verteuil, a French Creole planter. In 1887, de Verteuil had started to buy up cacao plots in Montserrat that were previously planted by squatters, followed by adjacent plots of Crown land which were then planted with cacao under the contract system.[102] Over time, this resulted in the building up of a large estate (Fig. 3.1). The size of the estate in 1927 was some 400 acres, of which 270 acres were planted with cacao, with an average of 250 trees per acre.[103]

---

[98] Brereton, *A History of Modern Trinidad*, 91-2.
[99] Ibid., 92.
[100] Ibid., 92-3.
[101] Namely a 121 inch deep soil profile on the "Sandalio Field". See McDonald et al., *Studies in West Indian Soils (VII)*, 39.
[102] Cecil Y. Shephard, "Economic Survey of the Cacao Industry of Trinidad, British West Indies," *Economic Geography* 3, no. 2 (1927): 251.
[103] Ibid., 251-2.

Figure 3.1. Map of La Vega Estate, showing the names of previous proprietors of consolidated plots, circa 1920s. The original legend reads, “Plan of La Vega showing the holdings of the former Spanish peasant proprietors. The area of each holding is given in acres, roods and poles. All the proprietors were of Spanish extraction but some possessed names of non-Spanish origin.” Source: Shephard, “Economic Survey of the Cacao Industry of Trinidad,” 251.

La Vega was seen as a success story for cacao estates in Trinidad during the late-1920s. Shephard pointed out in 1927 the significantly higher yields obtained at La Vega (11.6 to 20 bags per 1,000 trees) compared to the average in Trinidad (little more than 5 bags per 1,000 trees).[104] Writing in the journal *Economic Geography*, Shephard used La Vega as an example of how a cacao estate could be run successfully despite the precarity of global markets.[105] He attributed this success to the Estate's favourable natural conditions, such as its "deep rich sandy loam" soil, which was considered "among the finest cacao soils in Trinidad".[106] Shephard also argued that the system of cultivation had contributed to La Vega's success, with a regime of intensive weeding and pruning (and forking and manuring in some places), coupled with over 103 miles of drains.[107] He also highlighted the labour arrangements on the Estate, noting how labourers were grouped along ethnic lines into "West Indian negroes" and "East Indians". Some were "day labourers", who were paid a daily wage (45 cents for men and 30 cents for women in 1927), whilst others were "task" labourers, who were paid a fixed sum to carry out a specific task rather than according to time.[108]

Evidently, there was a complex history of land-use in the Ward of Montserrat by the interwar period. The account given above has focused mainly on cacao but indigenous peoples in Trinidad may well have cultivated crops in the area well before European colonisation. The "field" that Hardy and others involved in the the study of the soils of Montserrat approached as their area of study was one in which there was a legacy of cacao cultivation, be it on squatters' smallholdings, or on large estates such as La Vega. Some of the trees in the area could have been many decades old. It was also an area in which the reputation of different types of soil already existed. Shephard noted as early as 1927 how the soils of La Vega had a reputation of being some of the best for cacao in Trinidad. He made these comments a year before McDonald et al.'s study had formally commenced. It is not difficult to see how such an area might have been perceived by Hardy as "already exploited" and the reputation of its different soil types already "thoroughly established".

An interpretation of why such an approach to soil survey was taken at the ICTA that focuses solely on its connections with agricultural industries in the Caribbean, however, would fail to acknowledge the full institutional setting from which it emerged. Whilst the ICTA had a regional remit in terms of research, it was also an educational institution. As

[104] Ibid., 247.
[105] Ibid., 239.
[106] Ibid., 251.
[107] Ibid.
[108] Ibid., 252.

Head of the Department of Chemistry and Soil Science, Hardy was responsible for introducing whole cadres of students to soil science as practiced in "the tropics". Many of these students, as explained earlier, were intended to take up roles throughout the Colonial Empire as Agricultural Officers and technical staff. Their experiences of soil science in Trinidad had ramifications for the ways in which staff responsible for agricultural extension work in British colonial territories, and the development of colonial agricultural resources more broadly, understood the potential value of soil science for British colonial development in other regions of the world.

Hardy's physiological-ecological soil survey approach would have demonstrated to students the instrumental role that soil science could play in augmenting agricultural production. Involvement in soil survey studies formed an integral part of some students' experiences at the ICTA, such as Akhurst and Wilshaw, whose joint dissertation project formed contributory material to *The Cacao Soils of Trinidad*. This is not to suggest that postgraduate students would have left Trinidad with a conviction that they ought to replicate the physiological-ecological soil survey approach in other parts of the world. Hardy argued that methods known as "reconnaissance" and "plant-geographical" (elsewhere termed "broad ecological") soil survey were most appropriate in so-called "undeveloped tropical countries". The aims of both these methods, he argued, were not to determine the agricultural potentialities of an area, but to delineate the regions where different types of soil occur (in the case of reconnaissance soil survey), and where different growth conditions are found according chiefly to vegetation (as in plant-geographical or broad ecological soil survey).[109] Hardy argued that such information would be useful as a guide when planning future land development in such places. As he wrote in regards to broad ecological soil survey in 1930: "Its importance can hardly be overstressed in these days of rapid colonization and agricultural extension. Its thorough prosecution and appreciation by agricultural departments should prevent recurrences of wasteful procedures such as have figured only too largely in the history of soil exploitation."[110] These approaches can be seen as somewhat similar to the school of soil science created by Milne in East Africa. Indeed, Hardy used the term "reconnaissance" in the same way as Milne. Nevertheless, if postgraduate students left Trinidad with a particular *esprit de corps*, then their exposure to a soil research programme

[109] Hardy, "Tropical Soil Surveying: Part I," 235-6; Hardy, "Some Aspects and Methods of Soil Survey Work," 734-5.
[110] Hardy, "Tropical Soil Surveying: Part I," 236.

centred upon the augmentation of an export oriented agricultural economy would have been a key part of this.

There is some evidence which suggests that the teaching programme at the ICTA also exposed students to the potential connections that could exist between soil science and plantation agriculture in the Caribbean. In an account of his time teaching at the ICTA, Hardy reminisced on the way in which field excursions formed a key part of the training programme for postgraduate and third year Diploma students. These excursions, Hardy wrote, were held every Wednesday during term time and were usually attended by a member of the Department of Chemistry and Soil Science "in order to explain the soil aspects of the demonstration where necessary".[111] One such excursion, Hardy recalled, involved agricultural students visiting St Madeleine Sugar Estate and San Juan Cacao Estate in Trinidad to familiarise themselves with the inspection of soil profiles.[112] At least in this one instance recalled by Hardy, the training of students involved demonstrating the clear links that could exist between soil science and plantation agriculture. The excursion was not to the old growth forests of the Northern Range of Trinidad, for instance, but to heavily managed landscapes.

3.5 Analysis as a Way of Knowing Caribbean Soils

A key feature of the Trinidadian school of soil science created by Hardy was its analytical focus. In *Ways of Knowing* (2000), John V. Pickstone describes "analysis" as one of four historical typologies of science, technology and medicine. According to Pickstone, "analysis comes into play when objects can be viewed as compounds of 'elements', or when processes can be viewed as the 'flow' of an 'element' through a system." Rather than recording variety and change (as with natural history), Pickstone writes, analysis "seeks order by dissection".[113] Take analysis in chemistry, for instance. A significant shift toward analytical ways of knowing in chemistry, Pickstone argues, came during the late-eighteenth century through the work of the French chemist Antoine Lavoisier. Lavoisier's work was key to the emergence of what some historians term the "new chemistry" during the late-eighteenth century, when earlier concepts of "phlogiston" were rejected and a new language of chemistry introduced;

[111] F. Hardy, "A History of the Department of Soil Science of the Imperial College of Tropical Agriculture, Trinidad, Vol. II," n.d., St Augustine, West Indiana and Special Collections of the University of the West Indies, WI LE15 .W627 H37, p 497.
[112] Ibid., p 497.
[113] John V. Pickstone, *Ways of Knowing: A New History of Science, Technology and Medicine* (University of Chicago Press, 2001), 11.

made up, among other things, of "elements" and "compounds".[114] The "'operational' potential of this new paradigm", Pickstone writes, "was enormous: all the substances in the world waited to be analysed into the new elements, and all the chemical changes in the world awaited description as reactions between elements."[115]

The physiological-ecological soil survey approach shares similarities with the sort of analytical "way of knowing" described by Pickstone. This can be seen in how Hardy framed the approach as based first and foremost upon obtaining numerical figures for the various properties of soil profiles. Take the following description by Hardy of the methods in use at the ICTA in an article in *Tropical Agriculture* published in 1936:

> The methods differ fundamentally from those employed by other schools of pedology, in that the soil profile is described, not simply as a morphological unit on appearance and structure alone, but mainly in terms of determinable physical and chemical constants. Thus, the laboratory values enable one to describe the texture profile, the reaction profile, the organic matter and nitrogen profile, the soluble salt profile, and the available phosphate and potash profile, as separate, though related, entities. Such physical and chemical descriptions of the soil profile, […], provide much more reliable information regarding the nature and effects of the processes of soil formation than mere inspection alone. By their employment and application, soil profiles may the more accurately be compared and classified.[116]

Hardy's description demonstrates the highly analytical focus of the approach. Soils were viewed as objects to be understood through the obtainment and comparison of numerical figures for their various physical and chemical properties. This was different to other approaches in pedology, such as Milne's, which were based more upon the inspection of soil profiles and understanding the factors that had informed their formation over long periods of time. Hardy framed soils in the Caribbean as compounds constituted by elements rather than natural historical objects per se.

The arguments put forward by Hardy as to why an approach to soil surveying based upon the determination of the chemical and physical properties of soils was taken were often connected to the idea that such an approach would provide the sort of knowledge that would be of use for farmers and planters. This has been explained, in part, already. Let us take another example of Hardy's rationalisation, this time from an article in the *Journal of*

---

[114] Ibid., 89-90; William H. Brock, *The Fontana History of Chemistry* (Fontana Press, 1992), 87-127.
[115] Pickstone, *Ways of Knowing*, 91.
[116] Hardy, "Studies in West Indian Soils," 269.

Agricultural Science from 1929. In the article, Hardy criticised the approach to soil survey that had been taken within the United States Bureau of Soils; an agency under the USDA. As Director of the Bureau of Soils, the geologist and soil physicist Milton Whitney had held the view that physical soil texture was the main factor determining crop productivity. As David Moon points out, this focus on soil texture meant that Whitney "disregarded the significance for plant growth of mineral nutrients in the soil, which could be determined by chemical analysis, and ignored the role of chemical fertilizers in providing plant nutrition."[117] In line with Whitney's convictions, the typical practice within the Bureau of Soils up to the late-1920s was to distinguish soil types according to their texture and some morphological features, rather than their chemical properties.[118] Hardy commented upon this in his 1929 article, pointing out that many, including himself, thought that the soil maps produced by the Bureau of Soils in the US using this method were of little practical use to land practitioners. "It has frequently been maintained", Hardy wrote, "that such maps are of little value to the farmer or planter, in that they tell him no more than he can himself discover by 'walking the land', and by observing the behaviour of soils during the operation of ploughing and cultivation."[119] Hardy used this criticism to foreground the ways in which the physiological-ecological approach would be more relevant to farmers and planters. By analysing soils' chemical *and* physical properties, as well as paying closer attention to their relationship with the growth of specific crops, Hardy argued that the physiological-ecological soil survey approach would provide the sort of information that met the "practical needs" of farmers and planters.[120] It was an approach that took analysis a step further than had been the case in the US by determining not just the physical but also the chemical properties of soils. These latter properties, according to Hardy's logic, were those which remained largely invisible to farmers and planters, yet vital to any attempt at increasing productivity.

Chemical analyses carried out as part of physiological-ecological soil surveys had the appeal of providing insight into potential nutrient imbalances in soils that might be affecting crop performance. Since at least the mid-nineteenth century, there had been a wide circulation of scientific ideas about the mineral nutrition of plants. Much of this was due to the work of the German scientist Justus von Liebig . Liebig had introduced the thesis of the "Law of the Minimum", which contended that plant growth was directly proportional to the mineral

[117] Moon, *The American Steppes*, 188, 201-2.
[118] Ibid., 203-4; Gardner, "The National Cooperative Soil Survey of the United States," 26-9.
[119] Hardy, "Some Aspects and Methods of Soil Survey Work," 736.
[120] Ibid., 735.

substances of manure (fertilizer) added to the soil. Liebig argued that if there were a deficiency in just one essential mineral, even if all others were present in excess, plant growth would be limited. As such, the scarcest mineral affects plant growth.[121] In the British context, crop experiments started by John B. Lawes and Joseph H. Gilbert at Rothamsted Experimental Station in 1843 had demonstrated the importance of nitrogen for plant growth, particularly grain crop yields.[122]

An advantage of understanding nutrient imbalances in soils was the potential insight it could give into improving manuring practices. This was made clear in the final report of *The Cacao Soils of Trinidad*. In a section toward the end of the report, the authors stated how evidence was "being rapidly accumulated in support of the view that different species of crop plants require for maximum yield, nitrogen, phosphorous and potassium in very definite ratio […]" and how "Attempts to apply this rule to data obtained in studies of cacao soils might eventually lead to more definite conclusions regarding the nutrient requirements of the cacao tree, and to sounder systems of manuring."[123] Some tentative conclusions were drawn in the report, informed by pot and field experiments on coffee plants conducted elsewhere, as well as findings from the report itself. These results on coffee were used to speculate about the optimum nutrient ratios for cacao soils in Trinidad, with the justification being that "the Coffee and Cacao plant seem to thrive equally well in similar environments".[124] Phosphate, and potash to a lesser extent, the authors concluded, appeared to be deficient in the poor yielding cacao soils. Firmer conclusions were drawn in some of the other studies, such as that on the *Sugar-Cane Soils of Antigua*, in which it was recommended that the amelioration of the "less fertile sugar-cane soils" might include the application of specific mineral manures, such as soluble phosphates.[125] These sorts of recommendations had the appeal of providing information that could inform what manures were used on plantations in the British West Indies, with the overall goal of augmenting agricultural productivity and crop performance. They were recommendations that were made possible because of the inclusion of chemical analyses in soil surveys.

---

[121] Edward J. Russell, *Soil Conditions and Plant Growth* (Longmans, Green & Co., 1913), 10-12;
[122] Vaclav Smil, *Enriching the Earth: Fritz Haber, Carl Bosch, and the Transformation of World Food Production* (MIT Press, 2001), 11-2.
[123] McDonald et al., *Studies in West Indian Soils (VII)*, 20.
[124] Ibid., 20.
[125] Hardy et al., *Studies in West Indian Soils (V)*, 16.

3.6 Conclusion

This chapter has shown the vision of soil science promoted by Hardy at the ICTA during the interwar period. This was a vision that was very different to that of Milne in East Africa. Hardy's vision was politically conservative. He positioned soil science as a way of sustaining established forms of land-use and political economic structures in the Caribbean region. This was part of a legacy of efforts to align scientific research with plantation agriculture in the British West Indies that could be traced back to at least the IDA during the late-nineteenth century. The Trinidadian school of soil science created by Hardy was also underpinned by a methodology that centred upon determinations of the physical and chemical properties of soil profiles, giving them numerical expression and relating them to crop performance. This was different to the school of soil science promoted by Milne. The latter was based much more upon ideas about providing a foundation of knowledge for long-term development, and a conceptualisation of soils as natural historical objects to be classified and mapped.

The contrast between the Trinidadian and "East African" schools of soil science created by Hardy and Milne respectively tells us that soil science was still an emerging field in the Colonial Empire during the 1930s. There was not one unified discipline called British soil science. Rather, there were two potentially competing approaches. These approaches were the product of personal ambitions and institutional settings. Both Hardy and Milne were in the position to pursue soil science along their preferred lines. Whilst Hardy's institutional setting was connected closely with agricultural education, Milne's was much more about research. These approaches were also the product of their wider agricultural and economic environments. Regimes of agricultural production were very different in the British West Indies compared to East Africa. Whilst plantation agriculture occupied somewhat of a monopoly over imperial political imagination in the British West Indies, there was an arguably more mixed model of colonial agriculture in East Africa, spanning European settler farms and independent small-scale production. Soil science in the British West Indies was much more about sustaining forms of land-use that had existed for centuries, whereas in East Africa the focus was wider, about unlocking the region's supposedly untapped potential. Hardy was primarily concerned with plantations and estates whereas Milne was concerned with the whole of East Africa.[126]

[126] The fact that Hardy framed the physiological-ecological soil survey approach as providing knowledge that could augment production on estates in the Caribbean should not be taken as evidence that soil survey efforts were actually successful in increasing yields on said estates. To determine whether such a conclusion could be drawn would require paying attention to the sorts of primary source material that it has not been possible to consult during this Ph.D. project.

This said, there were similarities between the Trinidadian and East African schools of soil science. As with Milne in East Africa, soil science progressed through the labour of many people in the Caribbean, often of colour, whose contributions were essential for the success of the venture. Yet, the labour of these actors went largely unrecognised in scientific publications.

CHAPTER FOUR

Postwar Soil Survey in the British West Indies: Anglo-American Relations and Agricultural Diversification, 1938-58

4.1 Introduction

This chapter explores the place of soil surveys in ambitions for the development of agriculture in the British West Indies after 1945, and the challenge of implementing a programme of systematic soil survey in practice. In 1947, a Soils Research Scheme was launched at the ICTA, funded by a grant of £165,000 for a period of ten years.[1] The goal of the Scheme was to provide for systematic soil surveys of British territories in the Caribbean, as well as soil fertility studies with a focus on the chemistry and physics of the region's main soil types. It was one of numerous schemes launched at the ICTA that same year (others dealing with cacao and bananas) which were funded using money allocated for research under the British Government's Colonial Development and Welfare (CDW) Acts. By 1955, the Soils Research Scheme had become enveloped within a new Regional Research Centre (RRC) at the ICTA. Over a twelve-year period from 1958-70, some twenty-five soil and land-use survey reports were published, covering soil survey work carried out as part of the Soils Research Scheme and by the Regional Research Centre throughout the British West Indies. These included thirteen individual reports for each Parish of Jamaica, one report on Barbados, as well as two reports on the Rupununi Savannas of British Guiana (near the border with Brazil), and one report on a cacao area in central Trinidad, to name but a few. As publications of the RRC, each report included a folded soil map(s) in a pocket on the inside of the back cover.

Where soil surveying in the British West Indies during the interwar period had focused primarily on areas under estate agriculture, these postwar soil surveys took whole colonies (except in the cases of British Guiana and Trinidad) as their areas of study. Most of the soil maps produced collectively provided a view from above of whole islands rather than selective areas under the cultivation of a specific crop. This was a reflection of a different view of the relationship between soil science and Caribbean agriculture. Though not

[1] *Colonial Research 1947-8*, cmd. 7493 (London: HMSO, 1948), 29; F. Hardy, "Progress Report: West Indies Soils Research Scheme," 28/3/52, St Augustine, West Indiana and Special Collections of the University of the West Indies, S599.T 72 H3, p 1.

necessarily connected with a single agricultural policy, there was an understanding that soil science might be useful in supporting smallholder and peasant farmers in the region in a way that had not been the case beforehand. Such a shift in the politics of soil science was partly a result of events in the British West Indies during the late-1930s which revealed the widespread extent of economic and social deprivation in the region. Whilst soil science was linked with agricultural diversification in the form of support for smallholders and peasants, the view of the British West Indies as partly dependent upon estate agriculture had not vanished. The sort of agricultural economy that the soil surveys were intended to support varied between each colony.

The published soil and land-use survey reports, including soil maps, presented this postwar programme of soil survey as possessing a level of coherence which was not necessarily the case in reality. By paying attention to some of the more mundane aspects of organising and managing such big prestige projects, this chapter shows how the implementation of soil survey in practice was mired with difficulties. In particular, it draws attention to the challenges of recruiting qualified staff. There was a serious manpower problem, and Britain had to look toward the Food and Agriculture Organisation of the United Nations (FAO) and the USDA for technical assistance. This was despite a plethora of metropolitan initiatives set up around the late-1940s and early '50s aimed at increasing the numbers of qualified soil surveyors available to work in the Colonial Empire.

Existing scholarship has demonstrated the extent to which the impetus behind British development interventions and research efforts in the Caribbean after 1940 were shaped by US foreign policy. In *Science at the End of Empire* (2018), Sabine Clarke shows how British visions of industrial development in the Caribbean colonies after 1945, and the place of scientific research within these visions, emerged from a context of competing American ideas about Caribbean industrialisation; particularly in the US possession of Puerto Rico. Clarke's analysis shows that British postwar visions of economic development in the Caribbean cannot be understood without paying attention to such political tensions as American ambitions for greater influence in the region.[2] This chapter further demonstrates the ways in which British ambitions for the development of the Caribbean colonies after 1940 were driven by an awareness of US activity and foreign policy in the Caribbean region. It shows the significant extent to which the characteristics of the programme of soil survey that

[2] Clarke, *Science at the End of Empire*.

emerged in the British West Indies after the Second World War were a product of British technical experts' and officials' close interaction with and awareness of US soil science.

4.2 Tipping Point

Between 1934 and 1938 a series of labour revolts and violent unrest spread throughout the British Caribbean. Though specific to each country, much of this unrest started in the form of strikes in response to working class and peasant labour conditions. These ranged from strikes and riots on sugar plantations in British Guiana and St Kitts in 1935, to a dock workers strike in the capital of Jamaica, Kingston, in 1938, which later spiralled into rioting, resulting in the death of eight people and the arrest of some 170.[3] Historians have attributed this widespread discontent to factors such as the cumulative economic effects of the Great Depression, British imperial neglect, coupled with greater labour organization and unionization.[4] Some have also pointed out the acute anti-colonial sentiment behind the unrest. Kevin A. Yelvington, for instance, highlights the significance of Britain's ambivalence toward Italy's invasion of Ethiopia in 1935 to the labour strikes and rioting that took place in Trinidad in June-July 1937. For many Trinidadians, the nineteenth century-style invasion of Ethiopia by Mussolini's Italy, coupled with Britain's inaction, contributed to a heightened political sentiment of the injustice of colonial subordination and domination overseas and at home.[5]

Such unrest and violence in the British West Indies sparked the concern of officials in the Colonial Office in London. At a time of heightened awareness within the Colonial Office of the antagonistic imperial aims of Germany, Italy and Japan, as well as the unique place of the British West Indies as the empire's "show window" for the US, there was pressure for a comprehensive British response to the crisis.[6] On the request of the Colonial Secretary, Malcom MacDonald, a Royal Commission was appointed during the summer of 1938 to investigate social and economic conditions in the British West Indies. The Commission was made up of experts on topics ranging from education and economics to social reform and

---

[3] S.R. Ashton and David Killingray, ed., *British Documents on the End of Empire, Series B Volume 6: The West Indies* (HMSO, 1999), xlii.
[4] Ibid., xlii-xliii; Bridget Brereton and Kevin A. Yelvington, ed., *The Colonial Caribbean in Transition: Essays on Postemancipation Social and Cultural History* (The Press University of the West Indies, 1999), 19-20; Nigel O. Bolland, *On the March: Labour Rebellions in the British Caribbean, 1934-39* (James Curry, 1995).
[5] Kevin A. Yelvington, "The War in Ethiopia and Trinidad, 1935-1936," in *The Colonial Caribbean in Transition: Essays on Postemancipation Social and Cultural History*, ed. Bridget Brereton and Kevin A. Yelvington (The Press University of the West Indies, 1999), 189-225.
[6] Charlie Whitham, *Bitter Rehearsal: British and American Planning for a Post-War Indies* (Praeger, 2002), 4.

agriculture.[7] Under the chairmanship of the British peer Baron Moyne, the Commission left Liverpool in October 1938, arriving in Jamaica in early-November for a tour of the Caribbean region that lasted (for most of the Commission) until their return to England in April 1939.[8]

Although the findings of the Commission were ready by 1939 and a summary of their recommendations were soon presented to Parliament, the Moyne Report (so-called because of the Commission's Chairman, Baron Moyne) was not made publicly available until June 1945 due to fears that it might fuel anti-British propaganda during war time.[9] The Commission's findings revealed the widespread and severe extent of social and economic deprivation in the British West Indies.

When the Moyne Report was published in June 1945, a separate report on agricultural, veterinary, forestry and fishery matters was published as a supplement to the main report. It was prepared by the Cambridge-based agriculturist Frank L. Engledow, who had acted as an expert on agriculture on the Commission.[10] The conclusions reached by Engledow posed no explicit challenge to the dominant model of export oriented plantation agriculture in the Caribbean. Whilst he conceded that there ought to be greater support for domestic food production and peasant agriculture, he endorsed the need to increase production on estates growing cash and export crops, claiming that the West Indian colonies were dependent upon such crops, particularly sugarcane, for their external purchasing power.

> Oil and asphalt in Trinidad, timber and certain minerals in British Guiana, timber in British Honduras, very restricted fisheries and tourist trade, are the only exceptions to the fundamental circumstance that these Colonies are dependent on agriculture not only for sustenance but for their whole external purchasing power. To support their increasing populations, even at existing standards of life, they will therefore be compelled to make intensive development and use of land the basis of their agricultural policy.[11]

Engledow envisioned agriculture as the basis of the economic and social life in the Caribbean. Whilst he argued that domestic food production ought to be paid attention and supported, this was hardly at the expense of the power of estates and plantations.

---

[7] Clarke, *Science at the End of Empire*, 33.
[8] *West India Royal Commission Report*, cmd. 6607 (London: HMSO, 1945), xiii-xvi.
[9] Clarke, *Science at the End of Empire*, 34; Whitham, *Bitter Rehearsal*, 10-11.
[10] Heike Jöns, "The University of Cambridge, Academic Expertise and the British empire, 1885–1962," *Environment and Planning A* 48, no. 1 (2016): 107-8.
[11] Engledow, *West India Royal Commission Report on Agriculture, Fisheries, Forestry and Veterinary Matters*, 2.

Engledow's conclusions mirrored a wider view within the Commission of the future of the West Indian sugar industry. The state of the industry was a topic of major concern as it was understood to be a major cause of the deprivation and poverty experienced by many Caribbean peoples. Whilst the Commission offered a bleak view of the future of the industry, it also recommended a plethora of financial assistance measures which were a source of hope rather than complete pessimism.[12] As Charlie Whitham writes, "In all, the Moyne Commission was more concerned with initiating labor, health and welfare reforms than it was with rectifying the fundamental political and economic problems of the colonies. […] in absolute terms, it offered only palliatives; it was first aid, not major surgery."[13]

British official opinion on agricultural and land-use policy in the Caribbean contrasted with that of US officials, at least during the early-1940s. In 1941 as part of the Munoz-Tugwell Program, a policy of land redistribution had been introduced in the US Caribbean possession of Puerto Rico. This Program was aimed, very publicly, at converting portions of sugarcane land to food crop production. Whitham records that some sixty-thousand acres of sugarcane land in Puerto Rico was "earmarked" for food crops in 1942.[14] This reflected the views of US officials, such as Charles W. Taussig of the US Department of State, and Rexford G. Tugwell (Governor of Puerto Rico and previously of the USDA), that there ought to be a shift in US Caribbean possessions away from a dependency on imported foodstuffs. A reduction in the hegemony of the sugar industry was seen as key to this.[15]

American opinion on Caribbean agricultural policy extended to the British West Indies and was a source of tension and disagreement between US and British officials. This was especially so during the Caribbean food crisis of 1942, when German U-boat bombings of trade ships drastically reduced food imports. Tensions played out through the Anglo-American Caribbean Commission (AACC). This was an organisation founded in March 1942 as a "joint enterprise between the US and Britain".[16] It was established following the US Government's endorsement of the need for cooperation with Britain to ensure the security of the Caribbean region and to improve its social and economic conditions. Ambitions for the expansion of US commerce in the British West Indies were also a key motivator, yet notably

[12] Clarke, *Science at the End of Empire*, 35.
[13] Whitham, *Bitter Rehearsal*, 10.
[14] Ibid., 74.
[15] Ibid., 73.
[16] Clarke, *Science at the End of Empire*, 80.

against British interests.[17] Despite US members of the AACC pushing for greater British intervention to convert export and cash crop lands to food crops, British officials maintained a policy of maximising sugarcane production between 1942-3 to build up "stocks for relief purposes", according to Whitham, and made only limp promises to attempt to convert cane lands to food crops in some Caribbean colonies.[18] Even the latter concession was seen as a temporary, rather than a long term, measure.

As Governor of Puerto Rico, Tugwell was particularly critical of Britain's handling of its Caribbean colonies. In a memoir of his time spent in Puerto Rico, *The Stricken Land: The Story Of Puerto Rico* (1947), Tugwell reminisced on a trip he had taken with Taussig in 1937 from the island of St Thomas, through Martinique, Guadeloupe, St Kitts-Nevis and Barbados to Trinidad. Tugwell described the economic life of the British colonies as "held in a vise by a few merchants and planters."[19] His impression of the hold that estates had over people's lives was damning. "It is a sheer brutal economic monopoly which exists," Tugwell wrote, "long established and ruthlessly maintained, coming directly down, indeed, from the days of slavery, and not immensely improved in all respects since then. […] We had felt so strongly about what we had observed that we had informed the President and others in Washington."[20] Tugwell's is a particularly scathing assessment of the social and economic situation in the Caribbean during the 1930s. It illustrates the ways in which some US officials held strong public opinions on agricultural economies in the British West Indies.

There is reason to be skeptical, though, over the extent to which American discourse about supporting food production in Puerto Rico culminated in actual material support for the cultivation of food crops on the ground. Clarke shows that industrial development rather than agriculture occupied a central place in US visions of the organisation of Puerto Rico's economy from the 1940s. In what came to be known as Operation Bootstrap, a programme of government supported industrialisation was promoted in Puerto Rico from the early-1940s. This started with the establishment of government-run factories and by the mid-1940s a policy of outside investment was being promoted. As Clarke points out, by "creating conditions perceived favourable to private industrial capital, Puerto Rico saw twenty-four new industries established by 1948 and over 300 by 1955."[21] Taking into account the

---

[17] Whitham, *Bitter Rehearsal*, 37-63; Howard Johnson, "The Anglo-American Caribbean Commission and the Extension of American Influence in the British Caribbean, 1942–1945," *Journal of Commonwealth and Comparative Politics* 22, no. 2 (1984): 180-203.
[18] Whitham, *Bitter Rehearsal*, 74-5.
[19] Rexford G. Tugwell, *The Stricken Land: The Story of Puerto Rico* (Doubleday, 1947), 64.
[20] Ibid., 65.
[21] Clarke, *Science at the End of Empire*, 98.

emphasis that was placed on industrialisation in Puerto Rico calls into question the extent to which American discourse about supporting the cultivation of food crops in Puerto Rico was more rhetoric than reality. There is evidence to suggest that domestic food production was actually neglected in Puerto Rico after 1940 in comparison with manufacturing and other industries.[22]

One topic there was some agreement upon between the US and Britain was the need for a level of agricultural diversification in the region. Following on from the first West Indian Conference of the AACC held in Barbados in March 1944, both the UK and US governments released a joint statement endorsing, in principle, some of the recommendations made during the Conference. Emphasis was placed on the topic of agricultural diversification, with a particular focus on the need for increases in production for both local consumption and export. Complete self-sufficiency in foodstuffs, however, was seen as both impracticable and undesirable. There were also the suggestion that agricultural diversification should focus on converting "idle" land to the cultivation of food crops, which would have the double benefit of reducing unemployment.[23] The statement accommodated American calls for greater self-sufficiency in foodstuffs in the Caribbean, whilst also leaving British concerns about preserving the sugar industry unchallenged.

Discussions about agricultural diversification in the Caribbean by the early-1940s were also bound up with ideas about the role that soil surveys could play in land-utilization and agricultural planning. Engledow touched upon the topic of soil surveys in his Report for the Moyne Commission. He claimed that every British Caribbean colony was in "immediate need" of a soil survey as "a guide" to matters such as the "inherent manurial needs of various soils; suitability of areas to various crops and farming systems; prevention of soil erosion; sites for land settlement; alignment of roads; forest policy, land drainage; manufactures such as pottery, bricks, lime, etc.; and general agricultural development."[24] This exhaustive list reflected Engledow's conviction that soil was the "economic foundation" of the British West Indian colonial governments.[25]

A lack of knowledge of the principal types and distribution of soils in the British West Indies was seen as a serious drawback to the colonies' future economic prosperity. Whilst

---

[22] Emilio Pantojas-Garcia, "Strategies for Development and Ideological Contradictions in Puerto Rico: 1940-1978," (Ph.D. thesis, University of Liverpool, 1982), 154.
[23] CO 1042/25, "Agricultural Diversification. Notes for John Macpherson," n.d., no. 6, p 1.
[24] Engledow, *West India Royal Commission Report on Agriculture, Fisheries, Forestry and Veterinary Matters*, 19.
[25] Ibid., 19.

Hardy and his colleagues at the ICTA had surveyed soils on selected estates and sites in some colonies, there remained relatively little scientific knowledge of the different types of soil throughout much of the British West Indies by the late-1930s. Geoffrey Milne had commented on this following his tour of the Caribbean and the US in 1938.

> The existence of a strong school of activity and progressive thought in soil matters at the Imperial College of Tropical Agriculture has recently led to the important step of adding a soil surveyor to the establishment of the Department of Agriculture in that island, and the soils side of the sugar industry is well served; but there are other fields that could similarly be entered with profit. Until recently, at least, there has been a reluctance to be informed from the viewpoint of the soil specialist at a sufficiently early stage in dealing with problems in the use of land; fundamental soil knowledge has been, and perhaps is still, somewhat under-valued as the basic datum for the administration of rural territory.[26]

In Milne's view, the political vision for soil science in the British West Indies had been short-sighted. Focusing primarily on areas under plantation agriculture, British soil science in the Caribbean had, according to Milne, not taken the long range approach that had been the case in East Africa.

Engledow shared similar views on British Caribbean soil knowledge, stating in his report that "to speak in any but guarded general terms of soil types or condition or manurial requirements is impossible. In Trinidad, Barbados, and for the sugar estates of British Guiana knowledge of soils is sufficient to be of great practical value; elsewhere it is preliminary or insignificant."[27]

The shortcomings of soil science in the British West Indies were made all the more pertinent by the systematic approach to soil survey in Puerto Rico. Between 1928-36, staff from USDA's Division of Soil Survey, in collaboration with staff from the University of Puerto Rico, had carried out a detailed soil survey of the entire main island (some 3,435 square miles). Work had been carried out during the winter season (roughly January to June) each year from 1928-36, with an average party of one to eight "Federal men" (USDA-employed) and one to three "insular men" (employed by the University of Puerto Rico).[28] The methods used were intensive, involving long periods of time traversing the island by car

[26] Milne, *A Report on A Journey to parts of the West Indies and the United States for the Study of Soils,* 14.
[27] Engledow, *West India Royal Commission Report on Agriculture, Fisheries, Forestry and Veterinary Matters*, 18.
[28] R.C. Roberts, *Soil Survey of Puerto Rico* (Washington, D.C.: USDA Bureau of Plant Industry, 1942), 1.

or on foot, at intervals of a quarter of a mile or less. Aerial photographs of nearly half of the island taken by the US Navy in 1931 were used to help plot soil boundaries and other features in the field. Soils were examined to a depth of three to six feet, with detailed notes taken on the yields of crops grown on the different types of soil and the management practices used.[29]

The report of the soil survey appeared in 1942 (notably during the Caribbean food crisis) as a publication of the USDA. Over 500 pages in length, it included not just information on things such as the characteristics and genesis of the main types of soil in Puerto Rico, but also the agricultural practices used to grow certain crops, as well as the soils and land-forms best suited to the growth of those crops. Significantly, and in contrast with the efforts of Hardy and his colleagues, attention was paid to food crops such as corn, sweetpotatoes and cassava, in addition to Puerto Rico's principal export crops, such as sugarcane and coffee. Photographs were dotted throughout the report, illustrating aspects ranging from rural housing and food gardens to soil profiles, soil surveyors working in the field, aerial photographs and more.[30]

Perhaps the pièce de résistance of the report, however, were the soil maps and soil legend, which together displayed the wide variety (115 soil series and 352 soil "types" and "phases") and distribution of soils in Puerto Rico in intricate (1:50,000 scale) and colorful detail (Fig. 6). As stated in the soil survey report, the soil maps were intended to be a "guide for the purchase of land, establishment of fertilizer experiments," estimation of crop yields expected from the different types of soil, and "similar information." Yet, caution was placed on them not being used for the "purchase or sale of individual farm units" without further field inspection.[31]

[29] Ibid., 166-9.
[30] Ibid., 59-153.
[31] Ibid., 171.

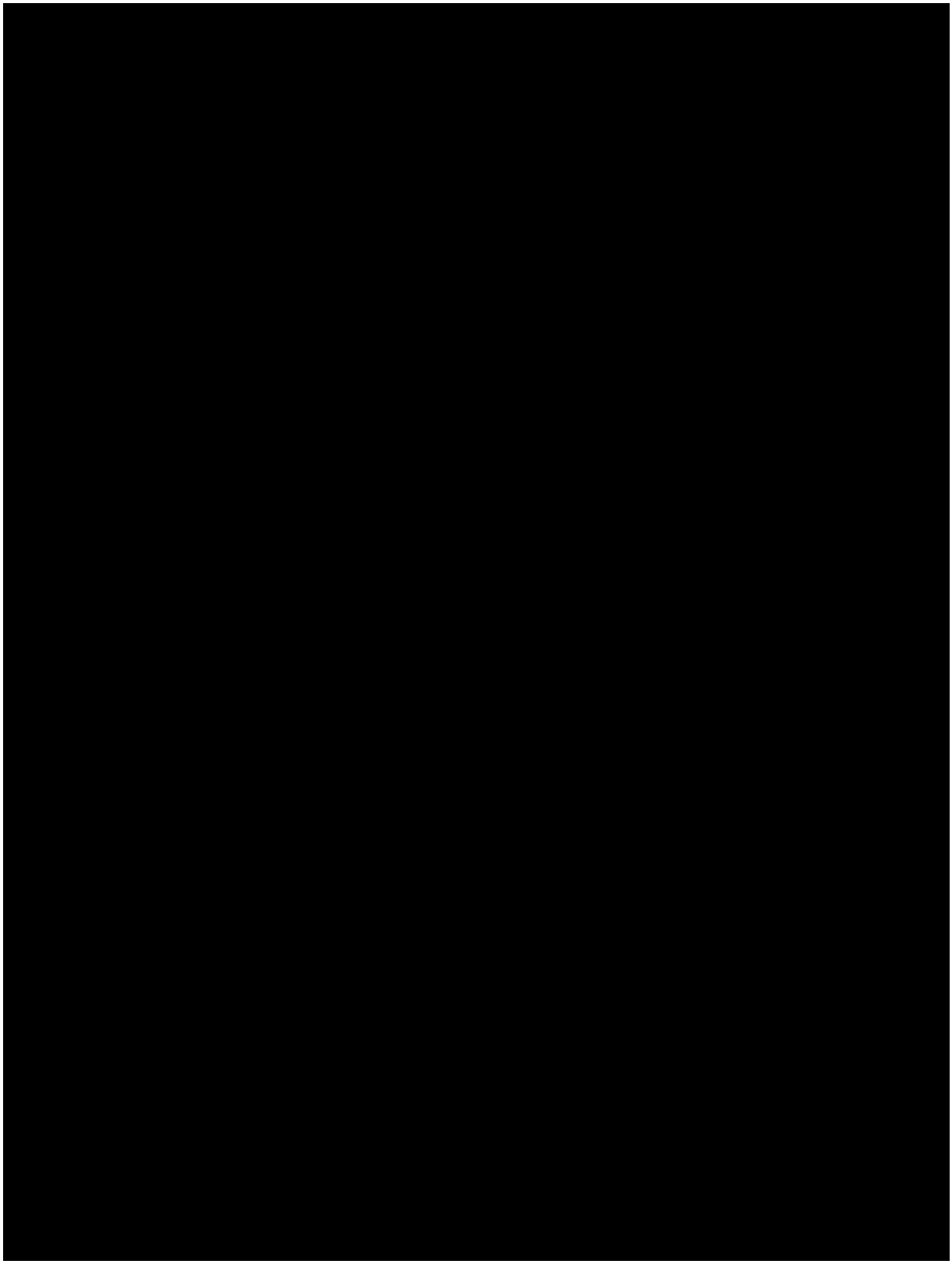

Figure 4.1. Roberts, R.C. *Soil Map of Puerto Rico Eastern Sheet*. Map. USDA Bureau of Chemistry and Soils, 1936. From WOSSAC, *item 45910*. https://www.wossac.com/search/wossac_detail.cfm?ID=45910 (accessed 1/8/25).

The ambition behind the project was more far-sighted than any attempts in the British West Indies. As detailed in the report:

> The purpose of the survey has been to take an inventory of all the land, determine the apparent productivity of the different soil types, and make a map of the island showing such cultural features as roads, trails, houses, schoolhouses, towns, railroads, bridges, canals, reservoirs, and cemeteries, and such natural features as soil types, streams, mountain peaks, lakes, and rock outcrops.
>
> It was thought that, with a careful study of the soil types, better procedures for soil and crop management could be worked out in relation to the many soil types, so that higher yields could be obtained or production costs reduced. […] By having a map showing the different soil types, the results of fertilizer experiments and the experiences of farmers can be classified, and the best crop and management can be found for each soil type.[32]

The project aimed at providing a comprehensive assessment of the agricultural resources of Puerto Rico. It was a more systematic and larger scale soil surveying effort than any attempt in the British West Indies.

As Principal of the ICTA, Odin T. Faulkner commented upon the more advanced state of US agricultural research compared to that in the British West Indies. In a letter to Sir Frank Stockdale on the prospects for collaboration between Britain and the US on research through the AACC in May 1942, Faulkner noted the close connections between staff at the ICTA and those in Puerto Rico. "as you know", Faulkner wrote, "we are informally in fairly close touch with the agricultural people at Puerto Rico, as a result of visits by various members of our staff to that colony and visits by their staff (which we wish occurred more frequently) to us."[33] "The USA side is so much better equipped in the way of Research and Experimental Stations than we are," Faulkner went on to write, "especially if the 'USA side' includes, as I think it should, such states as Florida, Louisiana and Texas. And so we should be much more receivers than givers in this matter."[34] In the letter, Faulkner even floated the idea of making the ICTA's journal *Tropical Agriculture* an "Anglo-American" journal so as to include published material from American research institutes, as well as the possibility of making the Imperial Bureaux "Anglo-American" so that American research workers might be up to date with work conducted in places such as Nigeria, Kenya and Malaya.[35]

---

[32] Roberts, *Soil Survey of Puerto Rico*, 2.
[33] CO 1042/63, Odin T. Faulkner to Sir Frank Stockdale, 22/5/42, no. 2, p 2.
[34] Ibid.
[35] Ibid.

In a political climate of competition and collaboration between the US and Britain on Caribbean affairs, soil surveying unsurprisingly came up as a topic of discussion during the second session of the West Indian Conference, held on the island of St Thomas in the US Virgin Islands during February to March 1946. By this point, the AACC had expanded its membership to include members from France and the Netherlands (both of which had territories in the Caribbean), thus changing name to the Caribbean Commission. On the agenda of the Conference at St Thomas was, again, the topic of agricultural diversification. This time, greater emphasis was placed on the need for land utilization planning.[36] In a paper circulated by the Caribbean Commission to the Conference, it was argued that more intensive use of the land would be needed if the main objective of agricultural diversification (the improvement of the "general well-being of the people") were to be achieved.[37] "In order to ensure that crops are grown only in those areas which are both ecologically and economically suitable," the paper went on to state, "a land utilization plan — including provision for equitable distribution of land appropriate to particular areas — is essential. A regional cropping program may ultimately be necessary. A soil survey is a most desirable aid in formulating such a plan."[38] For the Caribbean Commission, soil surveying was seen as a starting point for more targeted and careful soil improvement initiatives.

Evidently, there was shared ground in thinking about soil surveys in the Caribbean between the US, Britain and, to a certain extent, the Netherlands and France. Soil surveys were tied to ideas about agricultural diversification and land utilization planning, especially in the wake of widespread social and political unrest in the region. This said, there were differences in what was considered the best direction of land-use change and the manner in which agricultural economies ought to be diversified; particularly between the US and Britain. Furthermore, in comparison with the US, British arrangements for soil science in the Caribbean during this time were somewhat weak. If comprehensive soil surveys of British Caribbean colonies were to be carried out, then new arrangements were going to need to be in place.

[36] Frank Stockdale, "The Work of the Caribbean Commission," *International Affairs* 23, no. 2 (1947): 217-8.
[37] CO 1042/25, Extract from papers supplied by Caribbean Commission to 2nd session of the West Indian Conference, n.d., no. 7.
[38] Ibid.

4.3 A Colonial Development and Welfare Scheme

In addition to informing attitudes toward colonial agricultural policy and soil surveying in the British West Indies, the findings of the Royal Commission that was appointed in 1938 to look into social and economic conditions in the British West Indies contributed to the unsettling of metropolitan certainties about the efficacy of its governance of the Colonial Empire more broadly.

Unrest in the British West Indies during the late-1930s was part of a broader crisis of British imperial power and colonial control. Similar to the Caribbean, there was social and political unrest in other parts of the Colonial Empire during the mid- to late-1930s. Some notable examples are the strikes and rioting that took place in the Copperbelt in Northern Rhodesia in 1935 following the colonial government's changes in poll tax assessments; the deceleration of a state of emergency in Mauritius in September 1938 following strikes by sugar industry and dock workers; as well as strikes by dock and transport workers, coupled with cocoa farmers' protests in the Gold Coast and Nigeria.[39] There were also issues of imperial aggression. German calls for the return of its former colonies, together with the Italian invasion of Ethiopia in 1935 and the Japanese declaration of war with China in 1937, for instance, were events that, in the words of Michael Havinden and David Meredith, "posed a challenge to British imperialism which undermined confidence in Britain's ability and willingness to protect its colonies."[40] Such events, coupled with those in the Caribbean and the findings of the Moyne Commission, placed the question of the future of British colonial rule at the forefront of the minds of many, not least those in the Colonial Office.

In February 1940, following the initiative of the Colonial Office and the eventual support of the Treasury, the British Government announced the passing of the first CDW Act. This was the first of numerous CDW Acts passed up until the 1960s which committed the British Government to making available unprecedented funds for the explicit purposes of developing colonial resources and improving human wellbeing in the Colonial Empire. Included in the 1940 Act was "a fund for development of £5 million pa […], free grants rather than loans to the colonies, including grants for projects of social improvement, and the creation of an annual fund of £500,000 for scientific research."[41] The passing of the 1940 Act was a momentous occasion in British colonial development policy and for Britain's reputation as a colonial power. It was a break from previous metropolitan initiatives for funding colonial

[39] Havinden and Meredith, *Colonialism and Development*, 195-6.
[40] Ibid., 195.
[41] Clarke, *Science at the End of Empire*, 33.

development, such as the 1929 Colonial Development Act, which had largely come to be seen as a "failure" by the late-1930s.[42] It was also politically expedient as a gesture of the efficacy of Britain's handling of its Colonial Empire at a time of mounting international and domestic criticism of British colonial rule.[43]

Scientific research had a central place in the vision of colonial development behind the 1940 Act. As mentioned, the Act included a Research Fund of £500,000 per annum. This increased to £1 million per annum with the passing of the second CDW Act in 1945. Although there had been prior metropolitan initiatives aimed at aligning scientific research with colonial development, this new Research Fund marked a "technocratic" turn in British colonial policy.[44] New arrangements were introduced within the Colonial Office following the 1940 Act which gave metropolitan scientific advisers greater say over the direction of colonial research. In 1942, for instance, a Colonial Research Committee was created "to provide oversight of the full range of colonial research."[45] It was made up of some key members of Britain's scientific establishment and was part of a broader extension of Britain's domestic research council system to colonial affairs. The new arrangements in the Colonial Office included those for agricultural research. A new Committee for Colonial Agricultural, Animal Health and Forestry Research (CCAAHFR) was created in June 1945, for instance, to "oversee the expansion in research in agriculture, veterinary science and forestry."[46]

Sub-committees of the CCAAHFR on specific research areas were also created. This included a Soils Sub-Committee (SSC), whose first meeting took place at Rothamsted in April 1944, before the CCAAHFR had formally been created. Initial membership of the SSC was made up of William G. Ogg and G.V. Jacks, both of whom were soil scientists based at Rothamsted. Harold A. Tempany was also a member.[47] Tempany's career had spanned work in the British West Indies, Malaya and Mauritius. By the early-1940s, he had taken up the role of Agricultural Advisor to the Colonial Secretary. He also sat as a member on the CCAAHFR.[48] The SSC would go on to provide advice on the direction of soils research in

---

[42] Havinden and Meredith, *Colonialism and Development*, 199.
[43] Ibid., 202; Cain and Hopkins, *British Imperialism,* 589-90.
[44] Sabine Clarke, "A Technocratic Imperial State? The Colonial Office and Scientific Research, 1940-60," *Modern British History* 18, no. 4 (2007): 453-80.
[45] Clarke, "The Research Council System and the Politics of Medical and Agricultural Research for the British Colonial Empire," 343.
[46] Ibid., 343.
[47] CO 996/12, "Meeting of the Sub-Committee on Colonial Soils held at Rothamsted on April 17th, 1944," n.d., no. 16.
[48] Frank L. Engledow, "Sir Harold Tempany, C.M.G., C.B.E.," *Nature* 176 (1955): 283.

the Colonial Empire up until the late-1950s.[49] Membership over these years would also change and expand to include soil scientists such as A.B. Stewart (Aberdeen University), Herbert Greene (Rothamsted), E.M. Crowther (Rothamsted), and Gilbert W. Robinson (University of Wales), to name but a few. One of the reasons that the SSC had been formed in the first place was for its members to consider whether the soil nomenclature used in *Soil Survey of Puerto Rico* (1942) ought to be used uniformly throughout the British West Indies.[50]

Unique arrangements were put in place to oversee the spending of CDW funds in the Caribbean. In 1940, shortly following the announcement of the first CDW Act, a Colonial Development and Welfare Organisation (CDW Org) was established to assist with the allocation of British development funds to the Caribbean region.[51] The creation of specific arrangements to oversee development funding in the British West Indies had been a recommendation of the Moyne Commission.[52] The headquarters of the CDW Org were established in Barbados and it was headed by Sir Frank Stockdale as Comptroller.[53] Stockdale was an established colonial agricultural administrator. After working for the IDA during the early-1900s, he had served as Director of Agriculture in various colonies (British Guiana, Mauritius and Ceylon, for instance). He had also served as Agricultural Advisor to the Colonial Secretary from 1929 before the role was taken over by Tempany.[54]

Several expert advisers were appointed under Stockdale. This included the agriculturist A.J. Wakefield (previously Director of Agriculture, Tanganyika), who was assigned the role of Inspector General of Agriculture in the West Indies. Wakefield and Stockdale shared views on the types of land tenure and farming practices best suited to the West Indies. Both were convinced of the importance of fostering the closer integration of livestock with crop production amongst peasant farmers, typically through methods known as "mixed farming": the production of livestock manure, the application of manure to crop fields and the use of rotational grass leys to provide fodder for livestock, and other practices.[55] Mixed farming was

[49] CO 908/32-5.
[50] CO 996/12, Circular by Oliver Stanley on the Soils Sub-Committee, 22/2/45, no. 77.
[51] Clarke, *Science at the End of Empire*, 34; Ashton and Kilingray, *British Documents on the End of Empire, Series B Volume 6*, xliii.
[52] Engledow, *West India Royal Commission Report on Agriculture, Fisheries, Forestry and Veterinary Matters*, 427-31.
[53] Lawrence S. Grossman, "The Colonial Office and Soil Conservation in the British Caribbean, 1938–1950," in *Caribbean Land and Development Revisited*, ed. Jean Besson and Janet H. Momsen (Palgrave Macmillan, 2007), 31.
[54] Harold Tempany, "Sir Frank Stockdale, G.C.M.G., C.B.E," *Nature* 164 (1949): 397-8.
[55] Grossman, "The Colonial Office and Soil Conservation in the British Caribbean," 32.

seen as a way of promoting a more permanent form of agriculture by replacing shifting cultivation practices. Wakefield and Stockdale were also convinced of the importance of promoting leasehold rather than freehold tenure on land settlement schemes as a way of maintaining government control over peasants' farming practices once they had paid for their land. This was tied up with their concerns over the need to prevent soil erosion.[56]

Together with the Governing Body of the ICTA, these new arrangements for the provision and oversight of development funding formed the administrative backbone from which an invigorated scheme for soil surveys in the British West Indies was introduced during the early- to mid-1940s. A major concern of the CDW Org during its early years was the centralisation of agricultural research at the ICTA. Discussions on this topic took place between the Comptroller, his advisers, ICTA staff and local Departments of Agriculture during the early-1940s, culminating in two memoranda (July 1943 and April 1944) that were circulated to the Colonial Office in London and its various advisory committees.[57] These memoranda, prepared by Wakefield as the Inspector General of Agriculture and Faulkner as the Principal of the ICTA, made the case for an expansion in arrangements for agricultural research in the British West Indies. Their vision was to expand the functions of the ICTA so it could serve as a research station for the British West Indies. Agricultural research of a "fundamental character", they stated, could be focused at the ICTA, whilst the research activities of the Departments of Agriculture could be directed to "matters of immediate local need and application."[58]

Significantly, plans for the centralisation of agricultural research at the ICTA included those for soil surveys. For Wakefield and Faulkner, soil surveys held particular value as a way of providing the knowledge that was needed by local Departments of Agriculture for things such as land settlement schemes and the correlation of the results of manurial experiments. In places such as Barbados and Jamaica, where the subsidization of artificial manures was being considered, soil surveys were even seen as a requisite for justifying

[56] Ibid., 32.
[57] CO 318/455/20, Joint Memorandum by the Principal of the ICTA and the Inspector General of Agriculture in the West Indies entitled "Proposals for the Centralisation of Agricultural Research for the West Indies by the Imperial College of Tropical Agriculture,", 2/7/43, no. 2, pp 1-11; CO 318/471/4, Revised joint memorandum by the Principal of the ICTA and the Inspector General of Agriculture in the West Indies entitled "Proposals for the Centralisation of Agricultural Research for the West Indies by the Imperial College of Tropical Agriculture," 18/4/44, no. 22, pp 1-26.
[58] CO 318/455/20, Joint Memorandum by the Principal of the ICTA and the Inspector General of Agriculture in the West Indies entitled "Proposals for the Centralisation of Agricultural Research for the West Indies by the Imperial College of Tropical Agriculture,", 2/7/43, no. 2, p 1.

expenditure of public funds on "cheap manures".[59] In their 1943 memorandum, Wakefield and Faulkner argued that there was a particular need for surveys in Dominica, St Lucia, St Vincent, Grenada and the Grenadines, Nevis, Tobago and Jamaica. They stated that the Professor of Soil Science at the ICTA (Hardy) ought to direct the work and, somewhat optimistically, that it would take two soil surveyors two years to complete the Eastern Group of islands, and five years to complete Jamaica.[60] These staffing proposals were updated to include one senior and seven junior research workers in the second memorandum.[61] They also suggested that analytical assistants would need to be employed and new laboratory accommodation and equipment would be required.[62]

Some members of the Colonial Research Committee were skeptical of Wakefield's and Faulkner's proposals. Take Lord Hailey, for instance, chairman of the Colonial Research Committee and previously head of the African Research Survey. Upon reading Wakefield's and Faulkner's second memorandum of April 1944, Hailey commented on the capacity of the ICTA to take on new responsibilities for research at a time when the standard of teaching at the institution was under question.

> The Imperial College has come under considerable criticism lately in respect of its teaching work; and if I am correct, there has been some dissatisfaction on the subject among its more advanced students. This creates a further doubt as to the wisdom of the general "set up" which is now contemplated.[63]

Hailey questioned whether an expansion in research ought to be placed under the responsibility of the ICTA (which had an important imperial function as a educational institution), or whether a separate research institute for the West Indies ought to be set up, albeit with close links to the ICTA. His principal concern was whether lumping together an expanded program of research with teaching at the ICTA might have an adverse effect on both activities.

---

[59] Ibid., p 4.
[60] Ibid., pp 3-4.
[61] CO 318/471/4, Revised joint memorandum by the Principal of the ICTA and the Inspector General of Agriculture in the West Indies entitled "Proposals for the Centralisation of Agricultural Research for the West Indies by the Imperial College of Tropical Agriculture," 18/4/44, no. 22, p 5.
[62] Ibid; CO 318/455/20, Joint Memorandum by the Principal of the ICTA and the Inspector General of Agriculture in the West Indies entitled "Proposals for the Centralisation of Agricultural Research for the West Indies by the Imperial College of Tropical Agriculture,", 2/7/43, no. 2, p 4.
[63] CO 318/471/4, Note by the chairman, Hailey, on papers circulated under the Colonial Research Committee, 24/11/44, no. 55.

Some staff at the ICTA were already raising alarm bells about being overworked and understaffed. This was particularly the case in the College's Department of Agriculture. On learning about Wakefield's and Faulkner's proposals, the Head of the Department of Agriculture at the ICTA, D.D. Paterson, noted his frustration at the idea that the "full value" of the ICTA for both teaching and research could be realised without "some substantial amendment of present proposals in regard to staffing, land, equipment and facilities suggested for the College Agricultural Department"[64]. Paterson drew attention to the disparate ratio of staff numbers to teaching hours between the various departments at the College. The Department of Agriculture was responsible for the highest number of class hours (800 hours per academic year) yet, under the proposals, would have only six staff members (compared to the chemistry department's twelve). As Paterson remarked somewhat snidely: "Is this situation to be tolerated ad infinitum or is the above a fair allocation of staff between Departments at the Imperial College of Tropical Agriculture?"[65]

All this said, the view of the Colonial Research Committee eventually swayed toward supporting Wakefield's and Faulkner's proposals, albeit with some modifications, such as the appointment of a "senior scientist" with experience of both research and "academic administration" as "academic head" of the College; a role intended to be similar to that of a Vice-Chancellor in British Universities. The Colonial Research Committee argued that this latter role would best serve "the cause" of fundamental agricultural research in the British West Indies.[66] Hailey's original concerns about the capacity of the ICTA to expand its functions transpired into a conviction that an expansion in research would help raise the "academic standing" of the College.[67] Care was taken by the Colonial Research Committee to distinguish the research that ought to be carried out at the ICTA with that of local Departments of Agriculture and commodity research institutes. In the Colonial Research Committee's view, the College was a place for "academic" research, not "applied" work.

[64] CO 318/471/4, "Abridged Notes by Professor of Agriculture on Memorandum of 18th April 1944," July 1944, pp 1-4.
[65] Ibid., p 3.
[66] CO 318/471/4, "Agricultural Research in the West Indies. Report by the Colonial Research Committee," 30/1/45, no. 61, p 2.
[67] Ibid.

> we do not consider that the research workers at the College should not on occasion concern themselves with the application of their work; nor that workers at the "applied" institutes should be precluded from following up fundamental implications of their applied studies. We are, however, here concerned to emphasise our view that, however close the necessary relationship is between College and Institute the work of the latter should be organisationally distinct from academic research.[68]

In sum, the Colonial Research Committee sought to create a distinction between the sort of research that the ICTA would conduct and that which Departments of Agriculture and commodity research institutes would conduct. The former were to be concerned primarily with "applied" research, and the latter more with "fundamental" agricultural research.

With the support of the Colonial Research Committee, plans to organise soil surveys in the British West Indies really started to get under way. Based on Wakefield's and Faulkner's proposals, the CCAAHFR recommended that regional research on cocoa, bananas, sugar and soils (including soil surveys) be organised at the ICTA. This recommendation was then approved by the Colonial Secretary and the College was asked to put together a more detailed plan and financial estimates.[69]

By October 1946, a plan for a Soils Research Scheme had been put together by the ICTA. Hardy most likely had significant say over its content. As outlined in the introduction to the plan, the Scheme was to provide for "the undertaking of systematic soil surveys, together with related researches into the chemistry and physics of the main soil-types, including an investigation of the possible role of trace elements in West Indies agriculture."[70] The initial plan suggested the Scheme be divided into two sections: i) a soil survey section made up of "field staff, laboratory staff […] and office staff for mapping", and ii) a soils research section made up of a "soil chemist, soil physicist and one additional chemist for investigation of trace elements".[71] The soil survey section was to have three field surveyors, three local assistants, and one senior officer responsible for coordinating the work of the field surveyors with analytical staff at the College.[72] "Subordinate staff" were also required; namely, a "junior analyst, senior and junior cartographers, clerical and technical assistants, laboratory

[68] Ibid.
[69] CO 927/98/5, Circular by L. Lord, Colonial Office, to the CCAAHFR, 13/11/46, no. 9.
[70] CO 927/98/5, "The Imperial College of Tropical Agriculture. Research Scheme III. Soils Research," 22/10/46, no. 3, p 1.
[71] Ibid., 1.
[72] Ibid., 1-2.

attendants, messengers and cleaners and field labour for digging pits."[73] This was in addition to new residences (£8,500) and equipment, such as a spectrograph, petrological microscope and x-ray apparatus (£14,500 in total).[74]

The pretence behind these discussions was that the Soils Research Scheme would be financed using money from the CDW Research Fund. Yet, before this could happen, it had to gain the final approval of the CCAAHFR. In an effort to obtain the views of soil specialists before making a decision, the CCAAHFR circulated the plans with the SSC in November 1946. As a member of the SSC, Harold Tempany argued that at least double the figures given in the ICTA's estimate for travel would be necessary, highlighting how the soil surveyors and their assistants would "have to be travelling almost continuously and must have motor transport; while the senior soil officer as well as the specialist will have to travel fairly extensively from time to time if their work is to be effective."[75] Some of the other comments from SSC members included the question of whether aerial photography would be used for soil surveys and the need for a greater allocation toward the publishing of memoirs and maps, which, based on their understanding of experiences in the US, was "an extremely heavy item of expenditure."[76] Concerns were also raised about whether the purchasing of expensive laboratory equipment ought to be held off until staff capable of using the equipment had been hired.[77]

The opinions of SSC members are insightful for what they tell us about how plans for soil surveying in the British West Indies were situated within a global context of ambitions for soil surveys in Colonial Empire during the postwar period. In addition to those already mentioned, another key concern raised by the SSC was whether the Scheme might unfairly concentrate resources and personnel in the Caribbean at the expense of other parts of the Colonial Empire. Five members of the SSC expressed their concerns in a joint statement.

[73] Ibid., p 2.
[74] CO 927/98/5, "Capital Expenditure under the Soils Research I.C.T.A. Scheme III," n.d., no. 3.
[75] CO 927/98/5, "Comments on the I.C.T.A. Soils Research Scheme," enclosed in circular by L. Lord, Colonial Office, to the CCAAHFR, 27/11/46, no. 10.
[76] Ibid.
[77] Ibid.

> Does the scheme, particularly as regards numbers of staff proposed, represent a fair share for the West Indies of the resources likely to be available to the three major regions, the Caribbean, East Africa and West Africa? We doubt whether, under the circumstances ruling at present and the immediate future, so large a qualified staff could be found without depriving the other colonial regions of their share of the available personnel.[78]

For SSC members, at least, the flurry of interest in soil surveys in the British West Indies had to be considered against a backdrop of plans for soil science in other parts of the Colonial Empire.

Suggestions were made by the Soils Sub Committee as to how staffing could be economized. Members indicated that a soil chemist could be shared between the Soils and Cocoa Research Schemes. In the eyes of SSC members, this would "permit of some reduction in the staff of the Soils Research Scheme."[79] Yet, they still thought that the staffing situation would have to be considered further. One member, J.W. Robinson, drew attention to the importance of hiring "adequately trained men" for work under the Scheme, claiming he would have rather seen the scheme start in "skeleton form" than it "incur the burden of a number of third rate men."[80] The availability of qualified staff was a major concern for the SSC.

Around the same time at which SSC members were sharing their views on the College's plan, the Comptroller of the CDW Org (then Kenneth Blackburne, later Governor of Jamaica) was being pressed by some British West Indian colonial governments for the provision of funds for soil surveys in their respective territories. The Governor of British Honduras, for instance, wrote to the Comptroller asking whether funds outside the colony's allocation of £600,000 from the CDW Act might be found for a more extensive soil survey in line with the recommendations of the second session of the West Indian Conference. A similar request for funds for the "early execution" of soil surveys came from the Governor of the Windward Islands.[81] The Comptroller's response to these requests was to not provide any ad hoc grants for soil surveys given that plans were being devised for a Soils Research Scheme at the ICTA. This decision was influenced by the opinion of his economic adviser (Professor Beasley), who the Comptroller contacted given the absence of the Inspector General of

[78] Ibid.
[79] Ibid.
[80] Ibid.
[81] CO 927/98/5, Kenneth W. Blackburne to George H. Hall, 19/9/46, no. 11, pp 1-2.

Agriculture.[82] Beasley had also advised the Comptroller that soil surveys were "undoubtedly necessary for long term planning in the West Indian colonies, and should be encouraged as scientific research," but that they were "most unlikely to yield immediate economic results."[83] For Beasley, soils were only one part (a somewhat insignificant part) of a bigger picture of the environmental knowledge needed to underpin land-use planning.

Despite the uncertainties about staffing and other issues raised by SSC, the Soils Research Scheme received the approval of the CCAAHFR. All that was left was for the Colonial Office to confirm with the Treasury that funds for the scheme could not be found from any other organisation or industry, and to agree pension contribution rates. This was soon sorted out. No alternative funding sources could be confirmed and a pension rate of seventeen percent was agreed.[84] By the end of April 1947, the Treasury had agreed to provide a free grant of £165,000 (roughly £15,000 per annum and £14,500 capital expenditure) for the Scheme for a period of ten years. The money was to come from the Research Fund of the CDW Acts.[85]

4.4 "Much More Receivers than Givers": Getting the Resources and Expertise

The agreement of the Treasury to fund the Soils Research Scheme at the ICTA marked a turning point for soil surveys in the British West Indies. There was now a significant amount of money available from external sources for the explicit purpose of soil surveying in the region. This included funds for the employment of staff to work on soil surveys full-time. Previous arrangements in most places in the British West Indies had meant that soil surveys had to be done by staff who were balancing survey work alongside other duties, such as teaching at the ICTA. Hardy, for instance, could only visit field sites to conduct soil surveys during the interwar period in the Christmas and Easter holidays, when he was not teaching.[86] The appointment of E.M. Chenery as a soil surveyor to the Trinidad Department of Agriculture in 1936 was an exception to this.[87]

---

[82] Ibid., pp 2-3.
[83] Ibid., 2.
[84] CO 927/98/5, "Extract from note of discussion with the Treasury," 24/4/47, no. 17A.
[85] *Colonial Research 1947-48*, 29; F. Hardy, "Progress Report: West Indies Soils Research Scheme," 28/3/52, St Augustine, West Indiana and Special Collections of the University of the West Indies, S599.T 72 H3, p 1.
[86] F. Hardy, "A History of the Department of Soil Science of the Imperial College of Tropical Agriculture, Trinidad, Vol. II," n.d., St Augustine, West Indiana and Special Collections of the University of the West Indies, WI LE15 .W627 H37, p 291.
[87] Ibid., p 287.

As early as September 1947, arrangements were put in place for the recruitment of staff and the construction of houses and laboratory facilities at the ICTA in Trinidad.[88] A letter was sent from the ICTA to the Colonial Office to request the employment of a colonial agricultural scholar as a soil chemist under the Scheme. Soon after, advertisements were put out to fill some of the other posts covered by the Scheme.[89]

During the Scheme's early years, actually getting soil surveys done proved to be a challenge. By 1949, signs of the difficulty of recruiting staff were really starting to show. In a letter to the Colonial Office in November 1949, the Principal of the ICTA admitted that no progress report on the Scheme had been submitted for that year "owing to the most regrettably very slow start which this scheme has made as a result of difficulty of obtaining Staff."[90] This looked particularly bad given that the other Research Schemes that had received CDW funds (those for Cocoa, Banana and Sugar) had prepared progress reports or papers. Why was this the case?

The setup of the Soils Research Scheme at the ICTA created recruitment issues that were somewhat unique to the Caribbean. For those administering the Scheme, there was an understanding that the ICTA itself might function as a centre from which staff recruited for work under the soil survey section would undergo training. What this meant in practice was that staff with relatively little experience of soil survey in the tropics were appointed and an initial period of training created a gap until they were ready to start work.

Take the first two soil surveyors recruited to the Scheme from the United Kingdom in 1948 (Kenneth C. Vernon and F.C. Darcel). Far from jumping straight into organising soil surveys, both underwent a period of training that lasted some two years. Their training started at the ICTA in October 1948. During this initial period, at least one of the soil surveyors (Vernon) carried out a soil survey of an estate in Trinidad, as well as of an experiment station on the neighbouring island of St Vincent. Both tasks were initiated at the request of Hardy.[91] Later on, both Darcel and Vernon were seconded on a trip to the US from April to August 1950, where they shadowed soil surveyors and scientists working for the USDA in Washington D.C., Tennessee and Mississippi.[92] Part of the purpose of their visit to the US was to gain personal experience of soil surveys in the field and to observe American methods

[88] CO 927/98/5, Imperial College of Tropical Agriculture to Humphrey Smith, 2/9/47, no. 24.
[89] Ibid.
[90] CO 927/192/3, H.J. Page to J.G. Hibbert, 3/11/49, no. 4, p 2.
[91] Kenneth C. Vernon, "Report on a Study Visit to the United States. Soil Survey Report of River Estate, Trinidad. Soil Survey Report of Camden Park Experiment Station, St Vincent," (A.I.C.T.A. thesis, ICTA, 1951).
[92] Namely, the Soil Conservation Service, and the soil survey teams of the Bureau of Plant Industry, Soils and Agricultural Engineering. See Ibid., 4-16.

with an eye to replicating such methods in their own future work in the Caribbean. Vernon kept a diary of his visit, which he later submitted as part of a thesis for the acquirement of the Associateship of the ICTA qualification. He documented a range of things, from insights on public perceptions of the utility of USDA soil surveys, to the tools used by surveyors in the field.[93] It was not until November 1950 that both recruits were appointed for soil survey work under the Soils Research Scheme. Vernon was posted to Jamaica, and Darcel to British Honduras for work with the Colonial Development Corporation.[94] This was 25 months from when they first started training at the ICTA.

There was a somewhat similar experience with the second batch of recruits. Three more soil surveyors (T. Finch, J.P. Watson and E.L. Birse) were recruited in the United Kingdom in 1950 and started training at the ICTA that same year. Whilst one of the recruits (Finch) had previous training and was appointed to Jamaica in June the following year, the other two surveyors (Watson and Birse) finished later on. Watson was posted to St Vincent in November 1952, whilst Birse ended up resigning, leaving Trinidad in April 1953.[95]

The difficulties of recruiting staff for work on the Soils Research Scheme were also symptomatic of a more global issue concerning the availability of trained soil surveyors for work in British Overseas Territories during the postwar period. This was not a problem unique to the British West Indies. Several initiatives were implemented by the Colonial Office after 1945, in fact, in recognition of the barrier that a lack of qualified staff was placing on the ability to initiate soil survey projects throughout the Colonial Empire. Looking briefly at these initiatives shows how the lack of trained soil scientists available to carry out research work in the Colonial Empire was an issue that prompted a considerable response from the Colonial Office and its advisory committees.

Take the soil science studentships scheme, for instance. Launched in 1949 following a recommendation from the SSC to the Colonial Secretary, the studentships scheme was aimed at training young graduates in the United Kingdom to undertake soil research in colonial territories.[96] Six studentships were offered in the first year but responses to the advertisement of the awards were "somewhat disappointing" according to the Colonial Office's report on

---

[93] Ibid.
[94] F. Hardy, "Progress Report: West Indies Soils Research Scheme," 28/3/52, St Augustine, West Indiana and Special Collections of the University of the West Indies, S599.T 72 H3, p 2.
[95] Ibid.; F. Hardy, "A History of the Department of Soil Science of the Imperial College of Tropical Agriculture, Trinidad, Vol. II," n.d., St Augustine, West Indiana and Special Collections of the University of the West Indies, WI LE15 .W627 H37, p 305.
[96] *Colonial Research 1948-49*, cmd. 7739 (London: HMSO, 1949), 98.

Colonial Research for the year 1949-50.[97] Things picked up in 1950, when five students were awarded places and soon started training at research centres in the United Kingdom, such as Aberdeen University, the Oxford School of Rural Economy and Rothamsted Experimental Station.[98] By December 1950, there were conversations within the Colonial Office about these students being appointed to work in Northern Rhodesia, Nigeria and various other British overseas territories.[99]

Another example is the Colonial Office's appointment of a Tropical Soils Adviser at Rothamsted in 1949, also using CDW funds. The role was taken up by Herbert Greene, who had previously worked as Chief Chemist in the Department of Agriculture and Forests in the Anglo-Egyptian Sudan and as a soils specialist in the Land Use Branch of the FAO. Greene had also been a member of the SSC. Greene's functions as Tropical Soils Adviser were numerous. He was expected to "advise on tropical and sub-tropical soil problems" as they were referred to Rothamsted "from time to time"; to make "periodical visits to the Colonies for discussion on the spot with Colonial soil workers"; and to act as a "liason" for tropical soil workers and soil workers based in the United Kingdom.[100] Another key function of the Tropical Soils Adviser was to assist in the recruitment and training of officers for soil research work in the Colonial Empire. This included recruits for the soil science studentships.[101] At a meeting of the SSC in 1950, Greene noted how he had been on a "recruiting drive" at Scottish universities. Whilst he reported "no tangible evidence of success" he told members that he was "encouraged by the interest shown by undergraduates."[102]

The Colonial Office also started a scheme for a Pool of Colonial Soil Surveyors in 1953, financed using CDW funds (£13,525).[103] The scheme was aimed at creating a group of trained and experienced soil surveyors in the United Kingdom who could be called upon to work temporarily on soil survey projects overseas. The idea was that the Pool would help territories that were unable to support a permanent team of soil scientists.[104] Colonial

---

[97] *Colonial Research 1949-50*, cmd. 8063 (London: HMSO, 1950), 122.
[98] *Colonial Research 1950-51*, cmd. 8303 (London: HMSO, 1951), 169; CO 877/48/10, William G. Ogg to G.G. Grimwood, 12/6/50, no. 17.
[99] CO 877/48/10, "Interim notes on Colonial Research Students in soil sciences (C.D.W. scheme R 292)," enclosed in letter to P.J. Kitcatt from Herbert Greene, 19/12/50, no. 35.
[100] CO 908/32, "Appointment of an Adviser on Tropical Soils at Rothamsted Experimental Station," circular by W.S. Bates to the CCAAHFR, 12/12/49, no. 9.
[101] Ibid.
[102] CO 908/33, Minutes of the Fourth Meeting of the Soils Sub-Committee, 2/2/50, no. 9.
[103] *Colonial Research 1953-54*, cmd. 9303 (London: HMSO, 1954), 10.
[104] Ibid., 192.

governments could make requests for soil surveyors from the Pool for specific projects. In 1954, for instance, requests for "immediate assistance" were made from governments in the Windward Islands of Dominica and Grenada, and those of Aden and Somaliland, Northern Rhodesia and Swaziland.[105] Not all countries received help, though. Those overseeing the Pool were keen to see if technical assistance could be acquired from other sources first.

The Soils Research Scheme at the ICTA benefited from these metropolitan initiatives only to a limited degree. There was a reluctance on the part of Hardy at times to recruit people who had gone through the soil science studentships scheme. At the start of 1950, for instance, a previous student of Hardy's from the Caribbean who was then studying at Aberdeen University was being considered for the award of a studentship by the Colonial Office and the Tropical Soils Adviser. In order to be awarded a place, the student needed a piece of research "in sight" for which he would be "prima facie suitable".[106] With this in mind, the Colonial Office contacted Hardy to see if the student might be considered for a post on the Soils Research Scheme once he had completed his studies. In support of the student's application, a staff member from Aberdeen University even wrote a reference for the student, noting how he had found the student (E.A. Fitzpatrick) "intelligent, capable in the laboratory and hard-working". He also noted that "In the field, he shows a good eye for country and he takes great pains in producing a meticulous description of a soil profile."[107] On receiving this request, Hardy had the following response, which was directed to the Tropical Soils Adviser:

> I regret however that I cannot definitely promise Fitzpatrick a post in our soil survey division neither can I hold out definite prospects of his obtaining a post in the Soils Research Scheme in the College, but I should be very willing to consider him seriously when he has passed his examinations and done himself credit.[108]

Hardy's response was such that the Colonial Office could not offer Fitzpatrick a studentship place on the basis of him working at the ICTA in the future. They had to look toward potential research projects elsewhere. Looking at the records of the Soils Research Scheme, it is noticeable that not one member of staff was recruited from the Colonial Office's postwar soil science technical assistance and training schemes during its initial seven years.

---

[105] CO 908/34, "Summary of requests received from Colonial Governments for assistance from the Pool of Soil Surveyors," enclosed in circular from K.D. Law to the CCAAHFR, 22/6/54, no. 8.
[106] CO 877/48/10, G.G. Grimwood to I.M. Campbell, 7/2/50.
[107] Ibid.
[108] Ibid.

If the impact of the Colonial Office's schemes aimed at training and recruiting soil scientists for work in the Colonial Empire on the Soils Research Scheme was weak, then the opposite was the case with regards to the impact of American expertise and resources on the trajectory of the Scheme. As mentioned already, some of the Scheme's first recruits were sent to the US for training. But the impact of American expertise and resources on the Scheme went well beyond this. Following failures to recruit a senior soil surveyor in the United Kingdom in 1950, arrangements were made between the ICTA and the FAO for a senior soil surveyor from the US to visit the British West Indies in 1953 to assist with the training of the soil surveyors that had already been recruited under the Scheme. As a result of these arrangements, an experienced soil scientist, Mark Baldwin (later described by Hardy as a "world authority on pedology"), formerly of the USDA, visited Jamaica during May to June 1953 to run special field classes on soil surveying.[109] These classes were attended by soil surveyors already stationed in Jamaica, as well as surveyors undergoing training at the ICTA in Trinidad. When Baldwin left Jamaica in July 1953, another experienced American soil scientist, J.G. Steele, also from the USDA, was soon appointed to supervise the soil survey of Jamaica which had been started by Vernon in 1950.[110] Odin T. Faulkner's comments as Principal of the ICTA in May 1942 that the British West Indies ought to be "much more receivers than givers" with the US on the matter of agricultural research was ringing true, at least with regards to soil science.[111]

The transfer of soil survey experts from the US to the British West Indies to work or help on the Scheme, as well as the sending of soil surveyors to the US to undergo training, took place within a political atmosphere of collaboration with regards to soil science in the Caribbean region. The Caribbean Commission, in particular, formed a platform upon which greater collaboration and knowledge-exchange in soil science was fostered between governments in the region. Following the second session of the West Indian Conference held in St Thomas in 1946, a sub-committee of scientists from British, Dutch, French and US Caribbean territories was appointed to advise on the recommendation that had been made for soil surveys.[112] The sub-committee proposed that a conference of soil scientists be held in Puerto Rico in 1948. Such a conference, as they put it, would be "for the purpose of studying

[109] F. Hardy, "A History of the Department of Soil Science of the Imperial College of Tropical Agriculture, Trinidad, Vol. II," n.d., St Augustine, West Indiana and Special Collections of the University of the West Indies, WI LE15 .W627 H37, p 305.
[110] Ibid.
[111] CO 1042/63, Odin T. Faulkner to Sir Frank Stockdale, 22/5/42, no. 2, p 2.
[112] "Soil Surveys in the Caribbean," *Nature* 160 (1947): 634-5.

systems and methods of classification and mapping of tropical soils, with special reference to the standardization of such systems and methods for use in soil surveys throughout the Caribbean region, and to carrying out such surveys as soon as possible."[113]

Spearheaded by the Caribbean Commission, the Puerto Rico soils conference marked a commitment to collaboration in soil science between governments in the Caribbean, as well as some Latin American governments. Due to a clash with another soils conference held in England in 1948, the Puerto Rico conference was delayed until 1950.[114] Arrangements for the conference were made by the Committee on Agriculture, Nutrition, Fisheries and Forestry of the Caribbean Research Council; a body linked to the Caribbean Commission.[115]

Between 30 March and 8 April 1950, delegates, observers and other attendees congregated in Río Pedras in San Juan, the capital of Puerto Rico, for the conference. Opening addresses were given by the Chancellor of the University of Puerto Rico and Eric Williams as Deputy Chairman of the Caribbean Research Council.[116] In attendance as delegates were scientists from European and US Caribbean territories; namely, Barbados, French Guiana, Guadeloupe, Trinidad and Tobago, Jamaica, Martinique, the Netherlands West Indies, Puerto Rico, Suriname, and the US Virgin Islands. Present as "observers" were individuals from the "British Commonwealth" (Vernon and G. Rodrigues, for instance), Puerto Rico (over twenty six people), the FAO (A.D. Lewis), the US, Colombia, the Dominican Republic, Haiti and Venezuela. There were also a plethora of people present as "visitors".[117] This diverse array of attendees from across the Caribbean and Latin America was, in part, a product of the conference organisers' conviction that invitations should not just be limited to soil scientists from the Dutch, French, US and British Caribbean territories but should be broadened out to soil scientists from elsewhere with an interest in tropical soils, particularly those based in the republics of Cuba, Haiti and the Dominican Republic.[118]

The conference was split into three committees dealing separately with soil surveys, soil conservation and land classification. Hardy, as well as the two soil surveyors employed on the Soils Research Scheme at the time (Vernon and Darcel), sat on the soil survey committee, which was itself chaired by American soil scientist Roy Simonson.[119] The structure of the

---

[113] Ibid., 634.
[114] CO 927/100/5, J.A. Bonnet to G.V. Jacks, 16/1/48.
[115] "Soil Surveys in the Caribbean," 634.
[116] *Soil Science in the Caribbean: Report of the Soils Conference held in Puerto Rico, March 30—April 8, 1950* (Port-of-Spain: Caribbean Commission Central Secretariat, 1950), 14.
[117] Ibid., 5-13.
[118] "Soil Surveys in the Caribbean," 634-5.
[119] *Soil Science in the Caribbean*, 14.

conference was such that field trips were held each day. Some of the places visited on these trips included the Luquillo Mountains, the University of Puerto Rico's Agricultural Experiment Station, as well as various rural areas between towns and cities in Puerto Rico.[120] Seminars were then held in the evenings. One such seminar held on the evening of Monday 3 April was chaired by Hardy, with Simonson as a speaker on the topic of soil research and classification in a "Caribbean Land Improvement Programme".[121]

The Puerto Rico conference was, in part, a product of the Caribbean Commission's desire to promote collaboration in research between the US and European colonial governments in the Caribbean. One of the hot topics of discussion during the conference was the setting up of a Land Improvement Programme for the Caribbean area, as in the title of Simonson's paper. Such a programme, as documented in the conference report, was about "preventing the misuse of land resources, developing the potentialities of various kinds of land, and thus safeguarding and improving the livelihood of the people." It was emphasised in the report of the conference that the success of such a programme would be reliant upon "basic information of a scientific nature", such as that acquired through a soil survey with accompanying research, as well as land capability maps.[122] There was an awareness of the shortage of personnel in the Caribbean available to actually carry out this improvement programme. With this problem in mind, the report recommended that

> the territorial governments, with the aid of the Caribbean Commission, seek to obtain such technical assistance, through the existing Technical Assistance Programme of the United Nations, the projected Expanded Technical Assistance Programme of the United Nations, technical assistance programmes of governments, and other sources, as they may require in initiating and conducting the Land Improvement Programme.[123]

Such recommendations to seek the help of UN technical assistance would have likely been foregrounded by A.D. Lewis, who was present at the conference as a representative of the FAO. Discussions at the Puerto Rico conference also likely influenced the recruitment of American soil scientists (Baldwin and Steele) in the early-1950s to help with the Soils

[120] Ibid., 222-30.
[121] Ibid., 19.
[122] Ibid., 37-9.
[123] Ibid., 38.

Research Scheme. Indeed, the recruitment of Baldwin to help with training in Jamaica in 1953 was arranged between the ICTA and the FAO.[124]

4.5 The Regional Research Centre and Reforms to the Soils Research Scheme

Many of the shortcomings of the Soils Research Scheme were brought to the fore in the mid-1950s when plans for the establishment of a new Regional Research Centre (RRC) at the ICTA were being implemented. The vision behind the RRC was to combine the pre-existing Research Schemes on Cocoa, Bananas and Soils, as well as some new areas of research, under a separate research organisation at the ICTA. As put in a 1951 Colonial Office memorandum, such a research centre would thus constitute "the main focus for basic and long-range agricultural research in the West Indies."[125]

The establishment of the RRC had been a topic of conversation between the Colonial Office, the Comptroller and the British Caribbean Advisory Council on Agriculture, Animal Health, Forestry and Fisheries (British Caribbean Advisory Council) as early as 1951.[126] Some of the recommendations that emerged from these conversations were the need for the RRC to be separate from the teaching activities of the ICTA ("though geographically and socially closely related to them"), as well as to have its own director, who could also be Principal of the ICTA, and who "would have complete control of the research done at the Centre."[127]

As Principal of the ICTA and later Director of the RRC when it was established in September 1955, the botanist and ornithologist Geoffrey A.C. Herklots (formerly based in Hong Kong and London) was critical of the progress that had been made on soil surveys

[124] F. Hardy, "Progress Report: West Indies Soils Research Scheme," 28/3/52, St Augustine, West Indiana and Special Collections of the University of the West Indies, S599.T 72 H3, p 2.
[125] CO 1031/791, "Appendix II. Regional Agricultural Research in the West Indies. (Revised Memorandum Prepared in the Colonial Office)," in Report of the First Meeting of the British Caribbean Advisory Council, 17-20 December, 1951, no. 13, p 1.
[126] The latter was established in 1951 essentially to coordinate regional agricultural research in the British West Indies. Emphasis was placed on it being a body which could deal with the oversight of both "basic" and "applied" research. Its members included the Inspector General of Agriculture as chairman, Directors of Agriculture, the Principal of the ICTA, and various senior veterinary and forestry officers. The Council held their first meeting at Hastings House, the headquarters of the CDW Org, in Barbados in December 1951. See CO 1031/791, Report of the First Meeting of the British Caribbean Advisory Council, 17-20 December, 1951, no. 13, pp 1-10.
[127] CO 1031/791, "Appendix II. Regional Agricultural Research in the West Indies. (Revised Memorandum Prepared in the Colonial Office)," in Report of the First Meeting of the British Caribbean Advisory Council, 17-20 December, 1951, no. 13, p 1.

under the Soils Research Scheme.[128] In a memorandum on research policy in the Caribbean circulated to the CCAAHFR in February 1955 in the build up to the establishment of the RRC, Herklots foregrounded his disappointment with the Scheme's soil survey section.

> It is a little disappointing that although the Soils Research Scheme is now in its seventh year no papers, reports or maps prepared by the survey section have yet been published. The reason is not far to seek; workers in the field have been too few and scattered. Recruitment of the right type of men has been difficult, training at ICTA has taken too long, wastage has been severe and it has not been possible to concentrate effort on a chosen objective.[129]

This was a scathing appraisal. It was made all the more pertinent by Herklots' vision of the RRC as a place at which "men of outstanding worth" would be concentrated. "Men with vision", Herklots wrote, "men with fire in their bellies must not be wasted."[130] The state of soil surveys seemed not to live up to Herklots' heady ambitions for the RRC. Something had to change.

For Herklots, as the future Director of the RRC, the question of what happened next was key. Should soil surveying cease or should a "new viewpoint" be adopted?[131] If continued at their current rate, Herklots estimated that it would take "very many years" to complete surveys of the British Caribbean territories; something that "can never have been intended", in Herklots' words.[132] The solution he proposed was to reform the ways in which the surveys were organised. Rather than working in a scattered way, he proposed that surveyors ought to work together in the field as a "single team". This team, "under one leader", would carry out both the soil surveys, as well as the interpretation of the results in terms of land usage and land capability.[133] Herklots saw the existence of separate teams devoted to land capability assessments as an uneconomical use of time and resources.

---

[128] Karen Barretto, "Geoffrey Alton Craig Herklots: A Biographical Essay," *Journal of the Royal Asiatic Society Hong Kong Branch* 64 (2024): 269-97.
[129] CO 927/327, "Research Policy," extract of memorandum on the establishment of a Regional Research Organisation in the West Indies by Geoffrey A.C. Herklots, circulated by K.D. Law to CCAAHFR, 17/2/55, no. 18/19.
[130] Ibid.
[131] Ibid.
[132] Ibid.
[133] Ibid.

> Anyone who is carrying out a soils survey in the field — trampling over the ground, talking with farmers, seeing the crops grown and judging their condition, not only with access to the results of chemical and physical analyses of soil samples but deciding what analyses should be done — must inevitably obtain a real understanding of the capabilities of the land and of its correct usage. Especially must this be true in Jamaica where there is little land capable of growing food-crops that has never been cultivated.[134]

Herklots also proposed several staffing adjustments. He proposed that a senior soil scientist already teaching at the ICTA (T.A. Jones) could be appointed head of the Soils Research Scheme, spending at least three months a year in the field. Hardy left the ICTA in 1956 to work for the Inter-American Institute of Agricultural Sciences at Turriallba, Costa Rica.[135] Furthermore, in Jamaica, in particular, where there had been a concentration of soil survey efforts, Herklots thought that a cartographer could be sent over from the ICTA, and the Jamaica Department of Agriculture could assist by attaching some four junior Agricultural Officers to the soil survey team. These junior officers, Herklots proposed, could be trained as "land-use officers" and "assist in the work of detailed mapping." Herklots also proposed that the Director of Agriculture in Jamaica could provide laboratory facilities for the field chemist, as well as "such subordinate staff as is necessary."[136] Rather than scrapping soil survey efforts, Herklots' response was to reform the way in which they were internally organized and to integrate the work with local Departments of Agriculture.

By the mid-1950s, despite the limited progress that had been made, there was a renewed commitment to the goal of conducting soil surveys of British Caribbean territories. The formation of the RRC was announced in September 1955 as a new CDW research scheme, with a total of £362,000 worth of funding. The previous Research Schemes for Cocoa, Banana and Soils were amalgamated under the RRC, in addition to some new areas of research.[137]

In the Colonial Office's report on Colonial Research for 1955-6, it was stated that roughly twenty-five percent coverage had been achieved by the soil survey team stationed in Jamaica, that the final soil map for St Vincent was complete and its report was being prepared for

---

[134] Ibid.
[135] F. Hardy, "A History of the Department of Soil Science of the Imperial College of Tropical Agriculture, Trinidad, Vol. II," n.d., St Augustine, West Indiana and Special Collections of the University of the West Indies, WI LE15 .W627 H37, p 502.
[136] CO 927/327, "Research Policy," extract of memorandum on the establishment of a Regional Research Organisation in the West Indies by Geoffrey A.C. Herklots, circulated by K.D. Law to CCAAHFR, 17/2/55, no. 18/19.
[137] *Colonial Research 1955-56*, cmnd. 52 (London: HMSO, 1956), 16, 30.

publication, and that some 1,200 square miles of the Rupununi Savannas in southwestern British Guiana near the border with Brazil had been "mapped in the field" and the final soil maps were "under compilation".[138] Soil surveys were now well under way.

Alongside the founding of the RRC, new arrangements for reviewing and coordinating agricultural research in the British West Indies were also introduced. During the fourth meeting of the British Caribbean Advisory Council in St Vincent in April 1956, members had under discussion a paper prepared by the Colonial Office's Secretary for Colonial Agricultural Research (Donald Rhind) on the organisation of regional research. Rhind had prepared the paper a month earlier, following a tour of the Caribbean. In the paper, Rhind commented on the ethos behind the regional organisation of research throughout the Colonial Empire.

> The general aim is to coordinate research being done by territorial departments, non-government institutes such as University Colleges and private companies and by regional research organisations supported by C.D. & W. Research funds with or without local contributions. With this it is also hoped to link overseas research with that being done in the United Kingdom and possibly foreign countries. The tendency has been growing recently to make increasing use of research facilities in Europe and to borrow research workers from eminent institutions for work overseas.[139]

Rhind went on to comment on the RRC, noting how it was a place from which "research of a somewhat more specialised or long-term character for which territorial departments are less well equipped" could be carried out. He also went through pains to note that the research carried out by the RRC ought to not "substitute" or "interfere" in the work of the Departments of Agriculture.[140] With all of this in mind, Rhind proposed that a Technical Coordinating Committee (TCC) be set up "As a first step in drawing together those concerned with agricultural research in the region". Membership of such a Committee, he proposed, could be made up of those "within the region", as well as one or two scientists from the CCAAHFR who, "apart from their purely scientific contributions," would "form a link with research institutes in the United Kingdom."[141] Rhind drew parallels between these proposed arrangements for the Caribbean and those already in place in East Africa, where a somewhat similar research organisation was established after 1945.

---

[138] Ibid., 54.
[139] CO 927/517, "Organisation of Regional Research (Note by Mr. Rhind)," 10/3/56, no. E/1/3, p 1.
[140] Ibid.
[141] Ibid.

Rhind's paper and the possibilities of establishing the TCC dominated discussions at a meeting of the British Caribbean Advisory Council on the island of St Vincent in 1956. Attendees generally agreed with the proposals. By the end of the meeting, they had put together a list of who they thought should be included in the TCC's membership. This list included Herklots as Director of Research at the ICTA, two Directors of Agriculture, "two scientists with wide research interests in the agricultural field within the region, at least one of whom should not be in government service", a private agriculturist from the within the Caribbean, and an independent chairman, to name but a few.[142]

Part of the rationale of those in the British Caribbean Advisory Council behind establishing the TCC was that it might be better placed to keep under review research needs in the Caribbean. This included soil surveys. When a paper by Herklots on a five year programme for research at the RRC was discussed at the Council's 1956 St Vincent meeting, for instance, some members of the Council were concerned with the absence of provision for soil surveys in their territories. Conversations on this matter at the meeting soon shifted toward a discussion of the difficulty of recruiting soil scientists. It was proposed that the TCC would play an important role in the future in providing advice on the priorities of the Soils Research Scheme.[143]

Rhind's proposals were a success. The first meeting of the TCC took place in May 1957 at Hastings House, Barbados. In addition to the British Caribbean Advisory Council's recommendations, membership included two scientists from the CCAAHFR. These were W.I.B. Beveridge and G.D.H. Bell; both based at Cambridge University. H.D. Huggins, Director of the Institute of Social and Economic Research at the newly established University College of the West Indies was also a member.[144] The aims of the TCC were to advise on research plans proposed by Herklots as Director of the RRC; to propose new lines of research in consultation with the British Caribbean Advisory Council; to make recommendations for the "fullest coordination of research" between the RRC, Departments of Agriculture and other research organisations in the Caribbean area, including commercial interests; and to consider the finances necessary for its own meetings.[145]

---

[142] CO 1031/1883, Report of the Fourth Meeting of the British Caribbean Advisory Council, enclosed in letter from the Comptroller to the Colonial Secretary, 2/5/56, no. 24, pp 13-4.
[143] Ibid., 11-2.
[144] CO 927/712, Report of the First Meeting of the Technical Coordinating Committee, enclosed in letter from the Comptroller to the Colonial Secretary, 21/5/57, no. 9.
[145] Ibid., foreword.

Among the numerous topics discussed at the inaugural meeting of the TCC in 1957 was soil surveys. Attendees noted the absence of reconnaissance soil surveys of the islands of Dominica, Montserrat, Nevis and St Lucia, and recommended that, when adequate staff were available, surveys of these islands should be carried out as soon as possible with the help of aerial photographs. They also discussed the vacancies in the Soils Research Scheme, noting that, if needs be, one of the posts could be filled by someone from the Pool of Colonial Soil Surveyors. Much appreciation was expressed when Herklots presented specimens of the soil maps that had been put together so far by the Soils Research Scheme staff.[146] The general takeaway from the first meeting of the TCC was that soil surveying was, on the whole, progressing well. Members' ambitions for the future included an expansion of survey efforts and greater integration of work between the soil survey teams of the RRC and personnel within the Departments of Agriculture.[147]

Soil surveys were yet again a major topic of discussion during the second meeting of the TCC in April 1958 in Trinidad. Attendees noted the progress that had been made filling vacancies in the Soils Research Scheme. One officer would be coming over from Fiji, with another from British Guiana. There were also plans to secure someone from the Pool of Colonial Soil Surveyors. Attendees discussed how this experienced surveyor (D.M. Lang) should be stationed with the team in Jamaica before proceeding to Dominica and other Leeward and Windward islands.[148] The Director of Agriculture in British Guiana (A.F. MacKenzie) and a representative from Bookers Sugar Estates in British Guiana (H. Evans) were both present at the meeting and a point was made how, in British Guiana, arrangements had been made for soil surveys to be followed up with experimental work by agronomists. It was suggested that the soil maps would be "of little value, and indeed a waste of money" without this follow up experimental work, such as field trials, and the TCC agreed on the desirability of appointing an agronomist within the RRC.[149]

[146] Ibid., pp 3-4.
[147] Ibid.
[148] CO 927/713, Report of the Second Meeting of the Technical Coordinating Committee, enclosed in letter to Donald Rhind from the Ministry of Natural Resources and Agriculture, Trinidad, 28/6/58, no. 43, pp 2-3.
[149] Ibid., p 3.

4.6 Land Capability Appraisal and a Pragmatic Approach

As head of the Soil Survey and Research Department of the RRC, T.A. Jones was very clear on the fact that the approach to soil surveying taken by the RRC was intended to relate the soils under study to their supposed best use.[150] Jones presented these views in a paper circulated to the TCC in advance of their 1958 Trinidad meeting. In the paper, Jones cast doubt on the utility of pedological soil surveys in the Caribbean. Being "strongly flavoured of the inert soil mass", Jones wrote, pedological studies "often seriously delay the practical applications of soil survey."[151] As Jones went on to argue:

> At the present stage of its development the West Indies does not require that too much of its scientific potential be spent on plain pedology. It does however require as a region a systematic mapping of its different soils and some appreciation of the methods whereby their potentialities may be enhanced and their possible limitations corrected.[152]

The way in which the RRC's soil surveys would be of practical agricultural use, Jones asserted, was through the use of land capability appraisal. This involved grading land according to its suitability for agriculture. Land graded as class one, for instance, might not show any serious limitations toward agriculture, whereas land given higher number classes might be less suitable to agriculture, or unsuitable altogether. Appraisals could be made in "the field", observing the angle of slopes, stoniness, the degree of erosion and other factors. Land-use recommendations could then be made, such as which crops might be suitable or which ameliorative measures (swamp drainage, for instance) might make the site more productive in an agricultural sense. As Jones wrote in his paper to the TCC: "Land capability appraisal is the real means of putting systematic soil surveys into practical agricultural use and helps to avoid misuses of soil maps — particularly that popular misuse of hanging them on the office wall."[153]

Land capability appraisal had been practiced within the Soils Research Scheme since its inception and was, in part, a consequence of the influence of American soil scientists on the Scheme. Kenneth C. Vernon had observed its deployment by USDA staff during his study

---

[150] T.A. Jones, "Soil Classification—A Destructive Criticism," *Journal of Soil Science* 10, no. 2 (1959): 196-200.
[151] CO 927/713, Account of the work of the Soils Research Department of the RRC by T.A. Jones, enclosed in letter to Donald Rhind from the Ministry of Natural Resources and Agriculture, Trinidad, 28/6/58, no. 43, p 1.
[152] Ibid., 2.
[153] Ibid., p 4.

visit to the US in 1950.[154] Before he left the ICTA, Hardy had held somewhat similar views on the efficacy of land capability appraisal to that of Jones. Hardy endorsed it as an example of the application of ecological principles to soil surveying in an article published in the *Malayan Journal of Tropical Geography* in 1954, noting how the approach had been first applied by the USDA's Soil Conservation Service in 1939.[155] Jones' stance on land capability appraisal by 1958 was that it was part of a wider trend toward a pragmatic soil survey approach. Jones downplayed the importance of extensive chemical and physical analyses of soils in the laboratory, claiming that a method of moving quickly from a study of soil profile morphology in the field to "appraisals of the growing qualities of the site" was an efficient use of limited time and resources in the Caribbean. "A deliberate attempt is made in my department", Jones wrote, "at checking dissipation of energy and research material on unintelligent uncritical analyses undertaken solely for record purposes and for that infamous replacer of good precise scientific thinking and logical deduction couched in the phrase 'for the sake of scientific experimental continuity'".[156] There was an implicit criticism of Jones' predecessor, Hardy, in these comments. Hardy had been a key advocate of extensive laboratory analysis of soils. Whether this view was still present when Hardy was overseeing the Soils Research Scheme after 1945 is difficult to tell. Either way, it is clear from these comments that Jones presented himself as someone who was overseeing an efficient, expedient and pragmatic soil survey apparatus, and an acknowledgment of the skill of field observation was key to these claims.

The land capability approach to soil survey in the British West Indies was sometimes couched in moralistic terms. Take Jamaica, for instance, where capability appraisal was seen as part of a solution to not just the country's agricultural problems but also its supposed social problems. Such sentiment can be seen in the Tropical Soils Adviser's (Herbert Greene) report of a visit to the Caribbean from February to April 1956, which was circulated to the SSC. Greene recalled the practice used by the soil survey team in Jamaica of grouping soils according to their capability and making recommendations on land-use; a practice which Greene noted had been set up with the help of the USDA's J.G. Steele.[157] For Greene, the real benefit of this approach came not from what it could do for the plantations of sugarcane and

[154] Vernon, "Report on a Study Visit to the United States," 7.
[155] F. Hardy, "Ecological Aspects of Tropical Pedology," *Malayan Journal of Tropical Geography* 2 (1954): 1-8.
[156] CO 927/713, Account of the work of the Soils Research Department of the RRC by T.A. Jones, enclosed in letter to Donald Rhind from the Ministry of Natural Resources and Agriculture, Trinidad, 28/6/58, no. 43, p 3.
[157] CO 908/35, "Report by Dr. H. Greene, Adviser on Tropical Soils, on his visit to the British West Indies February-April, 1956," enclosed in circular from R. Mowforth to the CCAAHFR, 9/7/56, p 18.

bananas on Jamaica's coastal areas, which were, according to Greene, "for the most part under highly skilled management", but from what it meant for peasant farmers, particularly in the island's upland areas.

> Agricultural problems and some social problems are however more acute in rugged upland areas and it is these that offer the most severe challenge to the soil surveyors and to the administration. How effective is the approach to the problems of impoverished peasants and their small impoverished holdings? It is greatly to the credit of all concerned that these problems are being tackled with enthusiasm and energy.[158]

Greene saw the land capability approach more as a way of intervening in and improving peasant farming in Jamaica than plantation agriculture. This was a very different politics of soil science to that promoted by Hardy during the 1920s and '30s.

This said, there was no single regional agricultural economic policy which soil surveying was intended to support during the 1950s. Conversations within the British Caribbean Advisory Council since its inception in 1951 had shown a plurality of ambitions for the future direction of the agricultural economies of the Caribbean colonies. In 1953, the Director of Agriculture in British Guiana (H.H. Croucher) had emphasized the importance of local food production as a means of meeting the food requirements of Caribbean populations. He argued that local food production was good in regards to the "employment problem", in the event of war, and as a cushion against price fluctuations in world markets.[159] For Croucher, the only way local food production could be placed on a "competitive basis" with export crop production and imported food was by "intensified research into methods to increase the efficiency of production."

> The production of the majority of export crops has been brought to the present state of efficiency as a result of the expenditure of vast amounts of thought, energy and money on research. [...] The energy and money expended on investigations in production of food-stuffs for home consumption in the tropics is relatively negligible. The methods and production of, for example, yams and rice are little in advance of the methods of fifty years ago.[160]

---

[158] Ibid., p 20.
[159] CO 1042/129, "Appendix III. Memorandum by the Director of Agriculture, British Guiana. Competitive Food Production in the British Caribbean Area," in Report of the Second Meeting of the British Caribbean Advisory Council, 1/4/53, p 1.
[160] Ibid., p 2.

One of the recommendations of the third meeting of the Council in 1955 was that there should be an "expansion of production of foodstuffs consumed within the area, and the development of a regional approach to the problem."[161] Local food production was evidently a priority for some.

Local food production was not always prioritized, though. During the first Council meeting in 1951, the Comptroller (Sir George Seel) suggested the importance of increasing the production of export crops on small holdings. Whilst Seel acknowledged the importance of production for "local internal needs" (reducing dependence on costly imported foods), he nonetheless thought that export production must also be increased, to essentially augment colonies' purchasing powers.

> On the question of output, we know that this is steadily improving on the highly organised and developed plantation. But what of the small holdings, which are so numerous in every territory? This important question calls for very serious consideration. In many territories plantations are highly capitalised and fully developed. For any outstanding increase in production we must therefore look mainly to the small holder.[162]

There was a lack of consensus within the British Caribbean Advisory Council on the necessary balance between export oriented and local or regional oriented agricultural production. Whilst there was an interest in smallholder production at a high policy level, priorities differed between territories.

Despite these uncertainties, it was clear that most of the surveys were intended to derive their value from their practical relevance to agriculture and farming. In addition to land capability appraisal, there were other ways in which those involved in the surveys sought to achieve this.

The production of large scale soil maps, which showed relatively small areas of land in great detail, was one way those involved in the soil surveys sought to align their work with the needs of Agricultural Officers and, ultimately, agriculturists and farmers on the ground. Staff went through pains to ensure that the soil maps showed as much granular detail as possible. Aerial photographs were a significant help to this end. In contrast with printed

---

[161] CO 1031/1882, Report of the Third Meeting of the British Caribbean Advisory Council, enclosed in letter from the Comptroller to the Colonial Secretary, 18/4/57, no. 17.
[162] CO 1031/791, Speech made by Sir George Seel at the inaugural meeting of the British Caribbean Advisory Council, Appendix I, in Report of the First Meeting of the British Caribbean Advisory Council, 17-20 December, 1951, no. 13.

topographic maps, the use of aerial photographs, with their higher resolution, made it easier to demarcate soil boundaries. In the US, soil boundaries were marked directly on to aerial photograph prints but the advice of the Directorate of Colonial Surveys for the RRC was to use overlays to the prints so as to maintain their archival value in case they started to fade.[163] As Tropical Soils Adviser, Herbert Greene stressed the efficacy of using aerial photographs. Greene corresponded with the Secretary for Colonial Agricultural Research (Rhind) in June 1956 about a set of recent aerial photographs of Jamaica that had been taken by Hunting Aerosurveys at the request of the Jamaica Government. These photographs showed more detail than any prior photographs or topographic base maps, and Greene was keen to see them used by the soil survey team in Jamaica. As Greene explained to Rhind:

> the Hunting air photos make it possible to place the soil survey data on record in unequivocal fashion whereas if the printed map alone is used there is likely to be doubt as to the precise location of soil boundaries and the data will not be readily available to the ordinary user. In short, the printed map does not have enough local detail to permit easy and accurate location of a farmer's field or a soil boundary. On the other hand, it is difficult to go wrong when using an air photograph in which so much local detail is shown.[164]

The use of aerial photography was tied up with ideas about providing a more detailed picture of soils, and thus the sort of knowledge that would enable more targeted interventions into Caribbean agriculture.

Not all of the soil maps created were of the same scale. The maps of Jamaica, Barbados, and St Vincent, for instance, which covered entire islands, were of scales 1:20,000 to 1:25,000, whilst those of specific areas of British Guiana on the South American mainland were of a scale of 1:50,000. This difference in mapping scale was a product of the difficulty of mapping larger areas, differences in the distribution of soil types, as well as perceptions of the agricultural needs of different territories. During a meeting of the SSC in July 1956, Greene was asked whether general reconnaissance surveys might be carried out in the Caribbean rather than more time consuming detailed surveys. Greene's response was that the type of survey carried out should be varied so as to "suit the soils of the territory concerned."[165] "in British Honduras", Green argued, "with soils of similar types covering

[163] CO 927/327, W.D.C. Wiggins to Herbert Greene, 12/6/56, no. E/65/1; Herbert Greene to Donald Rhind, 13/6/56, no. 65.
[164] CO 927/327, Herbert Greene to Donald Rhind, 11/6/56, no. 63.
[165] CO 927/327, Extract from the minutes of the 11th meeting of the Soils Sub-Committee held 16/7/56, no. 74.

large areas and with a small population it would not be necessary to carry out the more detailed survey of the whole territory". On the other hand, he continued, "in Jamaica with a large population and with many different types of soil the more detailed survey was essential."[166] According to Greene, the mapping scale had to be adjusted according to the characteristics of the area under investigation. Being able to use a soil map to determine things such as farm boundaries did not matter as much to colonial administrations in places such as the remote Rupununi Savannas of British Guiana as it did in more densely populated territories such as Barbados, Jamaica and other islands.

Effort was also made to ensure the findings of the soil surveys were intelligible to staff within the Departments of Agriculture. After all, it was these staff, not the soil surveyors per se, who were, as the TCC put it, ultimately responsible "to pass on the findings of the surveys to the farmers who would use the land."[167]

The integration of Agricultural Officers into the soil survey teams was one of the ways that this was meant to be achieved. In Jamaica, there was an arrangement where junior staff from the Department of Agriculture, particularly those with a Diploma qualification from the ICTA, were attached to the soil survey team. The TCC "welcomed" this arrangement, noting how it was a way of giving departmental staff experience of soil survey work and ensuring continuity after the soil survey team left.[168] Herklots noted that a similar endorsement of these arrangements had been made by members of the RRC and staff from the Jamaica Ministry of Agriculture and Lands during a discussion on soils in January 1955.[169] The fact that these arrangements were effective in Jamaica is illustrated by the fact that the Ministry of Agriculture and Lands put together the first "soil technical guide sheets" between 1955 and 1956. Each sheet gave recommendations on the soil and water conservation practices, crops, and fertiliser treatments suited to each land class of a soil type. They were distributed to extension staff.[170] In theory, this meant that extension staff would be able to identify the specific soil types in their area of work based on the descriptions in the sheets, as well as, if available, the RRC's published soil maps. They could then make specific recommendations to farmers about which crops they ought to grow, the fertilizer treatments they ought to use,

---

[166] Ibid.
[167] CO 927/713, Report of the Second Meeting of the Technical Coordinating Committee, enclosed in letter to Donald Rhind from the Ministry of Natural Resources and Agriculture, Trinidad, 28/6/58, no. 43, p 4.
[168] CO 927/712, Report of the First Meeting of the Technical Coordinating Committee, enclosed in letter from the Comptroller to the Colonial Secretary, 21/5/57, no. 9, p 3.
[169] CO 927/327, "Visit to Jamaica 10th-13th January 1955", minutes of a discussion on soils by Geoffrey A.C. Herklots, 17/1/55.
[170] *Soil Technical Guide Sheets* (Kingston: Government Printer, 1964); R.K. Cunningham, "Applied Soil Science Research in the Caribbean," *Caribbean Quarterly* 12, no. 1 (1966): 36.

and other things. The creation of these sheets was made possible by departmental staff's familiarity with the technical content of the soil surveys.

The published soil and land-use survey reports were also crafted in a way that was intended to make them intelligible to people who were not necessarily soil specialists.[171] The reports neatly summarised the key findings of the soil surveys, with folded soil maps included as an insert in a pocket inside the back cover of each report. The idea was that these reports would serve as a background for future work by Departments of Agriculture and others interested. The first report was on the Parish of St Catherine, Jamaica, published in March 1958. The last report, on the Parish of Trelawney in Jamaica, was published in 1970.[172]

4.7 Conclusion

This chapter has focused on a soil survey programme executed in the British West Indies after 1945. It has shown how the ambitions behind soil surveying were tied to ideas about land utilisation planning and the diversification of agriculture in the region that came to prominence in the postwar period. This was a different politics of soil science to that which had been present in the British West Indies during the interwar period. The programme was made possible partly due to new sources of funding for scientific research in the Colonial Empire after 1940. Despite this availability of new funds, however, the actual implementation of soil surveys in practice proved to be a serious challenge. A lack of qualified personnel, in particular, meant that progress was curtailed during the initial years of the Soils Research Scheme. In response to the limited progress that had been made by the mid-1950s, a new organisational structure was introduced at the ICTA in 1955 in the form of the RRC. This was accompanied by changes in staff and reforms to the ethos of soil survey work. This chapter has indicated a gradual marginalisation of Hardy after 1945. With the establishment of the RRC in 1955, soil science was no longer within Hardy's direct sphere of influence and a new approach was promoted in full force.

Changes in the approach to soil science after 1945 reflected other issues, apart from a shift in colonial policy towards land-use in the Caribbean. A key feature of the postwar soil

[171] "Report on Soil Research, 1962 (Trinidad: ICTA)", St Augustine, West Indiana and Special Collections of the University of the West Indies, S590.A2 R4/B, p 2.
[172] Kenneth C. Vernon, *Soil and Land-Use Surveys No. 1: Jamaica, Parish of St. Catherine* (Trinidad: ICTA, 1958); G.H. Barker, *Soil and Land-Use Surveys No. 25: Jamaica, Parish of Trelawny* (Trinidad: University of the West Indies, 1970).

survey programme was its close proximity to US soil science. Much of the impetus for soil surveys in the British West Indies came from an awareness of American accomplishments in Puerto Rico, which showcased the ways in which soil surveying could hold the potential of supporting a more rational form of soil management across a whole country. With the Caribbean Commission providing a platform for the circulation of such ideas between American and British personnel, the Soils Research Scheme was largely the product of US-induced anxiety in the British West Indies. Reports of Britain's poor handling of its Caribbean colonies during the late-1930s made this all the more politically pertinent. British Caribbean soil science was also connected with American scientific networks in a very practical way. The Soils Research Programme was reliant upon the secondment of soil scientists from the USDA to the British West Indies to help with the training of soil surveyors in the field. The soil surveys themselves also incorporated methodological approaches that had their origins in the work of the USDA, such as land capability appraisal. Overall, British Caribbean soil science was weak in comparison with that of the US.

CHAPTER FIVE

The Politics of Tropical Soils Research at the East African Agriculture and Forestry Research Organisation, 1945-53

5.1 Introduction

In the postwar period new visions of the role of soil science for African development were promoted. This chapter will examine both the reasons for renewed interest in soil science and the factors that worked to limit the realisation of large-scale projects of soil surveying in practice. This is important for showing that while science in Africa after 1945 saw unprecedented levels of support from London, grand plans could be undermined by seemingly mundane issues such as staffing constraints, and a lack of coordination across institutions in British colonies.

The geographical focus of this chapter is East Africa, and the East African Agriculture and Forestry Research Organisation (EAAFRO), in particular. Established on the outskirts of Nairobi, Kenya after the Second World War, EAAFRO was one of numerous research institutions set up in the Colonial Empire after 1945 using CDW funds. It was one of the largest and most expensive of such institutions.[1] The vision behind EAAFRO was that it would function as a regional research organisation for East Africa, facilitating the sort of fundamental research that would be of long-term value for agricultural development in Africa. It replaced the former Amani Station in Tanganyika. Yet, it was different to Amani in that it embodied a uniquely postwar assemblage of ideas about the relationship between state sponsored scientific research and colonial development. Similar to other research institutions set up after 1945 using CDW funds, EAAFRO was administered to attract personnel from some of Britain's most prestigious universities and domestic research institutions. The promise of relative freedom from direction of local colonial administrations was seen as a key way to attract such personnel.[2]

EAAFRO was a part of widespread recognition during the postwar period that "tropical soils" needed far greater study. Experiences during the 1930s had demonstrated the limits to European understanding of African environments. This was particularly so with regards to

[1] Clarke, *Science at the End of Empire*, 60-1; *Colonial Research 1947-48*, 19-31.
[2] Clarke, "The Research Council System and the Politics of Medical and Agricultural Research for the British Colonial Empire,": 338-58.

tropical soils. From the writings of Edgar B. Worthington in *Science in Africa* (1938) to that of G.V. Jacks in *The Rape of the Earth* (1939), tropical soils had come to be seen as fundamental to the future of European colonial rule on the African continent. Yet, they were also seen as something with which Europeans were largely out of touch.[3] In the postwar period the study of tropical soils was presented as a way of securing the knowledge upon which colonial development and renewed agricultural exploitation could be based. By the late-1940s, tropical soil science had emerged as a scientific specialty in its own right. There were international gatherings of soil scientists focused on the formation of consensus on the study and classification of tropical (and sub-tropical) soils in a way that had not been the case beforehand.[4] As Director of EAAFRO, the British soil physicist Bernard A. Keen positioned EAAFRO as a place from which contributions would be made to the advancement of this scientific specialty. In fact, Keen framed the study of tropical soils as a top priority on the research programme of EAAFRO.

Keen's ambitions for soil science at EAAFRO were two-fold. He positioned soil science as serving the practical function of providing the knowledge that would underpin the future development of East Africa's agricultural resources. This was particularly the case with regards to soil surveys. Classifying East Africa's tropical soils, Keen argued, would enable future experimental work, such as fertilizer trials, to be coordinated over large areas so that the results could be compared according to soil types and later put into practice with African and European settler farmers. This was a similar vision of soil science for development to that which had underpinned arrangements for soil studies at the Amani Station in Tanganyika during the 1930s and that had been promoted by Milne. Keen, though, made the links between soil science and development clearer than Milne had during the 1930s, at least in rhetoric.

The rhetoric that claimed EAAFRO would contribute to the advancement of knowledge of tropical soils was also symbolic. Keen used tropical soil surveying as an example to demonstrate what he meant by fundamental research. This was the sort of research that he argued EAAFRO would be carrying out. It presented EAAFRO as a world leading research institution, demonstrating the power of British science and thus the supposed efficacy of new programmes of colonial development and agricultural exploitation.

---

[3] Worthington, *Science in Africa*, 124; Jacks and Whyte, *The Rape of the Earth*, 263.

[4] Literature on the emergence of scientific disciplines tells us that the creation of internationally agreed standards is part of the process. See, for instance, Joseph O'Connell, "Metrology: The Creation of Universality by the Circulation of Particulars," *Social Studies of Science* 23, no. 1 (1993): 129-173; Gerard Lemaine et al., ed., *Perspectives on the Emergence of Scientific Disciplines* (Mouton, 1976).

The extent to which the ambitions for soil science in East Africa were realised, however, was limited. Administrative tensions between EAAFRO and the East African Departments of Agriculture undermined the sort of coordination that was key to the flow of knowledge from EAAFRO to the Agricultural Officers responsible for putting results into practice with farmers on the spot. Furthermore, local political and social events in Kenya related to the Mau Mau rebellion during the early-1950s, as well as staffing and financial issues, placed material barriers on the capacity to carry out soil surveys in the first place. By mid-1952, Keen was arguing that the scope of soil surveys at EAAFRO would have to be limited to areas of immediate interest for Departments of Agriculture for specific development or settlement projects, rather than the initial ambition of providing complete coverage of East Africa. Whilst there were factors which worked to promote soil science in East Africa, there were also those which undermined its success.

5.2 A Regional Research Organisation for East Africa

After decades of having very few research centres in the Colonial Empire (only the Amani Station and the ICTA were available for agricultural research beforehand), the postwar period saw a substantial expansion in brand new institutes.[5] EAAFRO was one of the biggest, most expensive and longest lasting of them all, and soil science was one of its key areas of research. EAAFRO was hugely important; as a statement about British intentions to develop East Africa, to attract scientific researchers to the colonies and to provide a space for longer term fundamental studies.

The establishment of EAAFRO was a product of a confluence of developments in both East Africa and the United Kingdom. Far from being just a replacement for the Amani Station, it embodied fresh aspirations within the Colonial Office for the regional organisation of research throughout the Colonial Empire.

Around June 1945, discontent among Directors of Agriculture in East Africa and the Director of the Amani Station (Alexander G.C. Hill) with the capacity of Amani to act as a centre of technical expertise for the benefit of agriculture and colonial development in British East African territories had started to gain greater attention within the Colonial Office. Complaints had been raised much earlier on but they had been shelved due to war conditions. With the price of land in and around Nairobi rising (where it was proposed the new institution

[5] Clarke, *Science at the End of Empire*, 61.

ought to be re-sited) and a recognition of "a feeling of discontent among research workers", members of the Colonial Office, particularly those within the CCAAHFR, thought it more urgent to take action.[6]

Some of the complaints raised against the Amani Station were related to its geographical location. Being high up in the Usambara Mountains of northern Tanganyika, it was argued that the station was unrepresentative of East African conditions.[7] The extreme remoteness of the station also presented issues for research workers. The Colonial Office suggested in December 1945 that the station suffered from "almost complete social and scientific isolation".[8] As the Director of Amani, Hill argued that this remoteness had contributed to the deterioration of the morale of his staff during the War, which was also severely depleted. During a meeting with members of the Colonial Office in December 1945, Hill suggested that Amani was a place "better suited for a monastery than an agricultural research institution."[9] There was an understanding among many officials that moving the headquarters of the station to within the neighbourhood of Nairobi in central Kenya would be a better situation for a central agricultural research institution of the calibre desired for East Africa during the mid-1940s.

These desires for a high calibre research institution in East Africa were related to wider ambitions for colonial research within the Colonial Office. Plans to re-site the Amani Station to Kenya during the mid-1940s became enveloped within the aspirations of those in charge of British colonial research policy (such as the CCAAHFR) of establishing "regional research organisations" throughout the Colonial Empire. The idea, as expressed by the CCAAHFR, was to create new research organisations in British colonies that would serve the needs of whole regions rather than single colonies or territories. It was also argued that they would operate with relative autonomy from existing Departments of Agriculture.[10] The CCAAHFR argued that this regional coordination of research through relatively autonomous organisations would address the issues that had previously hindered the efficiency of research throughout the Colonial Empire, such as researchers' scientific isolation and their lack of freedom to determine their own lines of work.[11]

---

[6] CO 927/12/3, Extract from the first minutes of the CCAAHFR, 25/6/45, no. 13.
[7] Ibid.
[8] CO 927/12/3, "Resiting of East African Agricultural Research Institute," note by Colonial Office, 14/12/45, no. 34.
[9] CO 927/12/3, Extract from minutes of a meeting of the CCAAHFR, 11/12/45, no. 33.
[10] Clarke, "The Research Council System and the Politics of Medical and Agricultural Research for the British Colonial Empire," 344-5.
[11] Ibid., 345-6; CO 927/92/1, "Draft Report on the Organisation of Colonial Agricultural Research," by the CCAAHFR, 30/10/47, no. 15.

In early-1946, the CCAAHFR arranged for a delegation made up of Frank L. Engledow (Cambridge University), Harold Tempany (Agricultural Adviser to the Colonial Secretary) and James W. Munro (Imperial College) to tour East Africa and advise on the future of the Amani Station. Their tour lasted from mid-February until April and involved visits to Kenya, Zanzibar, Tanganyika and Uganda, speaking with Directors of Agriculture, veterinary and forestry services, as well as officers engaged in research work. The delegation's findings were ready by May 1946. In their report, they endorsed relocating the headquarters of the Amani Station as a new organisation near Nairobi and suggested that its functions ought to expand, with an augmented research staff and an improvement of their "status and prospects".[12]

Such ideas about establishing regional research organisations gained the support of colonial authorities in East Africa. By 1948, it was agreed that EAAFRO would be established in Kenya, replacing the Amani Station. This was alongside a sister organisation specialising in veterinary research: the East African Veterinary Research Organisation (EAVRO).[13] In line with the premise of regional research organisations, EAAFRO was intended to be afforded a level of autonomy from the East African Departments of Agriculture. The Director of EAAFRO, Sir Bernard Keen, together with the CCAAHFR were ultimately responsible for the lines of research that would be pursued at the organisation.[14]

EAAFRO was not meant to be completely autonomous from local bodies in East Africa, however. Mechanisms were set up to ensure some level of coordination between the Departments of Agriculture, EAAFRO and other institutions, albeit with an advisory rather than an executive function. The East African Advisory Council on Agriculture, Animal Health and Forestry (East African Advisory Council) was one of these mechanisms. Sitting on this Council were an array of official and unofficial representatives from across East Africa, including members of the East Africa High Commission, the Directors of EAAFRO and EAVRO, Directors of Agriculture, Directors of Veterinary Services, Conservators of Forests, representatives from the Overseas Food Corporation and the Empire Cotton Growing

[12] CO 927/12/4, "A Note on the Tour of Sir F. Engledow, Professor J.W. Munro and Sir H. Tempany," enclosed in circular from C.Y. Carstairs to the CCAAHFR, 16/5/46, no. 40, p 7.
[13] *Colonial Research 1947-48*, 80-1.
[14] Clarke, "The Research Council System and the Politics of Medical and Agricultural Research for the British Colonial Empire," 346-7.

Corporation, and others. The first meeting of this Council was held in Kabete, a neighbourhood of Nairobi, in January 1949.[15]

The site at which the headquarters of EAAFRO was established sat a few miles northwest of Nairobi, in an area called Muguga. Administratively, the site was in the District of Kiambu, within Central Province. It was in an area of central Kenya recognised as Kikuyuland, a name which reflected the main ethnic group living in the area: the Kikuyu (or "Gikuyu").[16] The Director of EAAFRO, Keen, together with Edgar B. Worthington, who was then a member of the East Africa High Commission, and Ferdinand Cavendish-Bentnick, a settler and Member for Agriculture and Natural Resources in Kenya, visited the site in late-1947 and supported the headquarters being based in Muguga. Reporting on their visit, they noted how much of the area was forest, with a neighbouring farm belonging to a "Lady McMillan"; presumably a European settler.[17] African farmers or herders may well have been using the land but were not mentioned. The reasons that Keen, Worthington and Ferdinand-Bentnick gave for siting the headquarters in Muguga included the existence of "room for expansion"; the fact that much of the site was "wattle land" which, when cut out, would revert to good grass land for experimental purposes; the existence of "untouched indigenous forest" for control purposes in forestry experiments; and sufficient rainfall levels.[18] Muguga also sat along the railway line connecting the port city of Mombasa in the east with the interior of Uganda to the west and so had good transport connections.

Building at the site commenced in 1948, taking three years until the opening ceremony of the headquarters in May 1951. The East African Railways and Harbours Corporation acted as consultants and architects, overseeing much of the construction work, with finances coming in the form of a capital grant from the British Government.[19]

The intention was for the headquarters at Muguga to have the facilities that would facilitate cutting edge agricultural and forestry research work. Arrangements were made for the resident clerk of works to make visits to laboratories and institutions throughout the United Kingdom for advice and inspiration before leaving for East Africa. The clerk of works made visits to places such as Rothamsted, the Cambridge School of Agriculture, Lever

---

[15] *Colonial Research 1948-49*, 94; CO 927/95/5, Report of the First Meeting of the East African Advisory Council, held in Nairobi on 25-7 January 1949, enclosed in circular by the East Africa High Commission, January 1949, no. 17.
[16] Jomo Kenyatta, *Facing Mount Kenya: The Tribal Life of the Gikuyu* (Secker & Warburg, 1938).
[17] CO 927/94/3, Record of a meeting held by the EAAFRO and EAVRO siting committee on 5/12/47, no. 17.
[18] Ibid.
[19] CO 927/187/2, "The East African Agriculture and Forestry Research Organisation: Its Origins and Objects," by Bernard A. Keen, n.d., pp 4-6.

Brothers in Merseyside, and the Imperial Chemical Industries Research Station in Bracknell. A range of advice was given, such as the importance of cavity walls for laboratories in tropical climates, with ventilation at both high and low levels protected with mosquito gauze.[20] Much attention was also paid to the library at Muguga. The extensive library that had been built up at Amani (which included material from the days of German colonial rule) was transferred to Muguga. Keen later claimed that a grant from the Carnegie Corporation of New York had enabled the library to become "one of the most comprehensive agricultural and scientific collections in Africa."[21] All of these facilities and more were put on display at the opening ceremony in May 1951. The ceremony was led by the Colonial Secretary and was attended by some 400 guests.[22] These arrangements reinforced the symbolic role that EAAFRO was intended to take on as a leading centre for British agricultural research.

5.3 Bernard Keen, Tropical Soils and EAAFRO

Before becoming Director of EAAFRO, Keen was not someone with any experience of working in Africa. Between 1929 and 1931, Keen had directed the Imperial Institute of Agricultural Research at Pusa, India.[23] He had also taken on various overseas advisory roles over the years, such as with the Foreign Office and British Council in Bulgaria toward the start of the Second World War, and as Scientific Adviser to the Middle East Supply Centre in Cairo between 1943-5[24]. This made Keen rather different to Milne. Keen was chosen for the role of Director of EAAFRO for other reasons. His experiences as a researcher himself, as well as advising on and directing research work overseas aligned with the Colonial Office's emphasis on the need for a "man of science" with high "standing" to direct a regional research organisation.[25] The CCAAHFR argued that, in principle, only an individual with experience of research themselves would understand the conditions needed to secure the success of other researchers' work and be able to "command the respect of those who work

[20] CO 927/95/1, "Note by Mr L.C. Martin, MBE, on visits paid by him to various research stations etc in the United Kingdom prior to proceeding to East Africa,", 27/4/48, no. 18, pp 1-10.
[21] CO 927/187/2, "The East African Agriculture and Forestry Research Organisation: Its Origins and Objects," by Bernard A. Keen, n.d., p 6.
[22] Newspaper clipping entitled "Sir Bernard Keen Retires," n.d., Keen (Sir Bernard Augustus) Papers, MSS ADD 297/3, UCL Special Collections, London.
[23] Herbert C. Pereira, "Bernard Augustus Keen, 5 September 1890 - 5 August 1981," *Biographical Memoirs of Fellows of the Royal Society* 28 (1982): 210-1.
[24] Ibid., 212-6.
[25] CO 927/92/1, "Draft Report on the Organisation of Colonial Agricultural Research," by the CCAAHFR, 30/10/47, no. 15., p 6.

under him."[26] Before moving to East Africa to direct EAAFRO, much of Keen's time had also been spent at Rothamsted as a soil physicist, where he had become well known for his field experiments with Edward W. Russell on soil tillage practices. The results of Keen's and Russell's work at Rothamsted were later remarked upon as having called into question received wisdom on the mechanisms through which customary tillage practices (at least in the United Kingdom), such as ploughing and harrowing affected crop growth.[27]

As Director of EAAFRO, Keen repeatedly presented the study of tropical soils in East Africa as the central research problem facing his organisation. At the first meeting of the East African Advisory Council in 1949, for instance, Keen asserted that the "primary problem" before EAAFRO was the "fertility status of tropical and sub-tropical soils".[28] Later on, in a paper circulated to the same Council in 1951 on the broad programme of research at EAAFRO until 1957, Keen elaborated further on the central importance of soil studies.

> Just as the Herbarium is of essential value to the economic botanist, so is the soil survey to the agriculturist. It should be noted that basic research of classical value on soil was done at Amani by the late Dr. Milne […]. This was an early step towards a system of classification for tropical soils, which should be the main basic research problem for EAAFRO.[29]

According to Keen, soil studies, and soil surveying in particular, embodied the type of research activity that would provide the knowledge base upon which more applied research could be planned, and ultimately interventions made into agricultural practice in East Africa. This resonated with the SSC, who had been interested in tropical soil classification in the Colonial Empire since their inception in 1944.[30]

The way in which the research conducted by EAAFRO staff would be made relevant to other groups in East Africa was explained by Keen using a three stage model of research. He reiterated this model in many different settings as Director of EAAFRO. The crux of the model was that research would be split into the following stages: 1) "basic" or "fundamental" research, 2) "technological" research and 3) application to practice. The first stage (basic or

---

[26] Ibid., p 6.
[27] Pereira, "Bernard Augustus Keen," 208-9.
[28] CO 927/95/5, Report of the First Meeting of the East African Advisory Council, held in Nairobi on 25-7 January 1949, enclosed in circular by the East Africa High Commission, January 1949, no. 17, p 13.
[29] CO 927/187/2, "Broad programme of EAAFRO for the remainder of the first ten-year period, up to 1957," enclosed in letter from Bernard A. Keen to Geoffrey A.C. Herklots, 6/3/51, no. 2, p 4.
[30] CO 996/12, "Meeting of the Sub-Committee on Colonial Soils held at Rothamsted on April 17th, 1944," n.d., no. 16.

fundamental research), Keen explained, primarily involved research into the unknown. The idea was that this type of research might "bring light to a new fact" or uncover general principles that would inform the later stages of work.[31] This was the research that Keen saw as one of the primary functions of EAAFRO as a regional research organisation, and he argued that it required a level of freedom for a research organisation to "go off at a tangent if the results make this course desirable."[32] It was the type of research, Keen argued, that could only be carried out by specialists such as physicists, chemists and plant physiologists, rather than agriculturists, for instance.[33] Tropical soil classification, in particular, fitted within this category.

When Keen was speaking about fundamental research in this way, he was building upon a discourse that was prevalent within the Colonial Office and other officials responsible for overseeing British colonial research policy at the time. Sabine Clarke highlights the multiple meanings of the term "fundamental research"; a term that was increasingly used to describe the research work that would be carried out in British colonies after 1940 using money from the CDW Research Fund. The term had rhetorical intent, connoting research of a supposedly high status and prestige, and emphasizing the necessity of freedom for researchers from external direction (from government, for instance) engaged in such work.[34] The term "basic research" carried with it somewhat different connotations.[35]

The second stage in Keen's model (technological research) was meant to build upon the first, taking one of the findings and testing it in varying conditions. An example of activities that were meant to fit into this second stage were fertilizer trials. The way in which soil surveys would inform such technological research was explained by Keen using the example of government experiment stations. Keen suggested that future soil surveyors employed by EAAFRO could assist the Departments of Agriculture in choosing the most suitable sites to set up new experiment stations, as well as assisting in the interpretation of the results of the experiments according to soil type.[36]

---

[31] CO 927/187/2, "The East African Agriculture and Forestry Research Organisation: Its Origins and Objects," by Bernard A. Keen, n.d., p 7.
[32] CO 927/95/5, Report of the First Meeting of the East African Advisory Council, held in Nairobi on 25-7 January 1949, enclosed in circular by the East Africa High Commission, January 1949, no. 17, p 12.
[33] CO 927/187/2, "The East African Agriculture and Forestry Research Organisation: Its Origins and Objects," by Bernard A. Keen, n.d., p 7.
[34] Clarke, *Science at the End of Empire*, 49-50; Clarke, "Fundamental Research and New Scientific Arrangements for the Development of Britain's Colonies after 1940".
[35] Jane Calvert, "What's Special About Basic Research?" *Science, Technology & Human Values* 31, no. 2 (2006): 199-220; Clarke, "Experts, Empire and Development," 70-81.
[36] CO 927/187/2, "Broad programme of EAAFRO for the remainder of the first ten-year period, up to 1957," enclosed in letter from Bernard A. Keen to Geoffrey A.C. Herklots, 6/3/51, no. 2, p 8.

According to Keen, these prior two stages of research would then provide the knowledge needed for the final stage: the application of results to agricultural practice.[37] In theory, this would form a three stage process, with knowledge moving from the first stage, gradually resulting in changes to agricultural practice.

Keen's ordering of research activity in this way was aimed at establishing the difference but also the connections between the role of EAAFRO and that of the Departments of Agriculture and commodity research stations in East Africa. In Keen's view, the final stage (application to practice) was the function of the Departments of Agriculture, with their teams of Agricultural Officers and others stationed throughout East Africa, not EAAFRO. These officers were more likely to have a broad training in agriculture (perhaps from the ICTA) than specialist training in a single discipline. Keen argued that overlap between EAAFRO and Departments of Agriculture would only occur in the second stage, technological research.[38] In theory, this model worked to justify the relative autonomy afforded to EAAFRO research staff whose specialist lines of research might not have appeared as of immediate practical relevance in East Africa. It suggested that the freedom afforded to scientists at EAAFRO would pay off as it would result in the production of knowledge that would flow between the different stages, ultimately informing practice.

The idea that soil surveying was valuable for the development of agriculture in East Africa was neither novel nor confined only to Keen. Similar ideas had been key to the appointment of Geoffrey Milne to the Amani Station during the interwar period. During the postwar period, others with influence over scientific research in East Africa were also convinced of the necessity of systematic soil surveys. Engledow is a case in point. Following his tour of East Africa in early-1946 with Munro and Tempany on behalf of the CCAAHFR, Engledow had raised concerns that knowledge of the "nature, composition and distribution of East African soils" was "seriously lacking".[39] In Engledow's view, this was the type of "systematic basic knowledge" necessary for the formulation of agricultural policy in the region.[40] Worthington, in his report on the state of scientific research in Africa*,* similarly commented upon the importance of basic knowledge acquired through surveys for the

---

[37] CO 927/187/2, "The East African Agriculture and Forestry Research Organisation: Its Origins and Objects," by Bernard A. Keen, n.d.*,* p 7.
[38] CO 927/187/2, "The East African Agriculture and Forestry Research Organisation: Its Origins and Objects," by Bernard A. Keen, n.d.*,* p 8; CO 927/95/5, Report of the First Meeting of the East African Advisory Council, held in Nairobi on 25-7 January 1949, enclosed in circular by the East Africa High Commission, January 1949, no. 17, p 12.
[39] CO 927/12/4, "Note of a meeting held at 2.30 p.m. in Mr Creech Jones' room on Friday, 3rd May, 1946," by C.Y. Carstairs, 8/5/46, no. 36.
[40] Ibid.

planning of African development. Worthington included soil surveys within the category of research work required to provide the "raw material" upon which a "planned system of land utilisation" could be based.[41] For Worthington, the value of soil surveys was not necessarily in their "immediate practical application", but in the data which could be obtained from them on "the fundamental qualities of the soil". Writing in 1938, Worthington argued that such data would become increasingly important in Africa as changes take place "under the influence of agricultural development."[42]

5.4 From Local Utility to International Soil Science

Whilst the rationale behind fundamental soil studies at EAAFRO was often explained by Keen in terms of its ultimate practical relevance to agriculture, Keen's ambitions for this research were tied as much to EAAFRO's role in the advancement of international soil science as it was the specific development of East Africa. This intent can be seen in how Keen spoke about EAAFRO as a place of tropical soils expertise. From a British Broadcasting Corporation programme to statements on the direction of research at EAAFRO circulated to the Colonial Office and various bodies in East Africa, Keen regularly presented EAAFRO as a place that would contribute to the advancement of international scientific knowledge of tropical soils. This ranged from research on the microbiology of tropical soils, which was often juxtaposed with that of soils in the temperate zone, to the development of systems of tropical soil classification.[43]

The term "tropical soils" had been in circulation well before the late-1940s but it had not been used as a specific category of specialist research at international gatherings of soil scientists in the way it was after 1945. In 1948, the first conference on tropical and sub-tropical soils was held at Rothamsted under the auspices of the Commonwealth Bureau of Soil Science.[44] The conference was convened following a recommendation by the SSC for an international gathering of soil scientists to build consensus on the classification of tropical and sub-tropical soils.[45] In attendance were delegates from across the world, including

[41] Worthington, *Science in Africa*, 16.
[42] Ibid., 127.
[43] CO 927/187/2, "Broad programme of EAAFRO for the remainder of the first ten-year period, up to 1957," enclosed in letter from Bernard A. Keen to Geoffrey A.C. Herklots, 6/3/51, no. 2, pp 3-5; CO 927/187/3, "Regional Agricultural Research in East Africa," notes for BBC broadcast by Bernard A. Keen, broadcast 15/7/51, no. 63; CO 927/95/5, Report of the First Meeting of the East African Advisory Council, held in Nairobi on 25-7 January 1949, enclosed in circular by the East Africa High Commission, January 1949, no. 17, p 13.
[44] Formerly the Imperial Bureau of Soil Science.
[45] CO 927/100/4-5.

experts from the United Kingdom and British colonies, as well as observers from the US, Holland, France, Belgium and others.[46] Furthermore, in 1950, at the Fourth International Congress of Soil Science held in Amsterdam, a whole section of the Congress was devoted to tropical and sub-tropical soils.[47] This had not been the case at any of the previous Congresses held in Washington, Leningrad and Oxford. After attempts to forge tropical soils research as a field before the Second World War, the postwar period saw the discipline gaining new recognition and support, and EAAFRO was a part of this.

In the case of Britain, the period between 1947-51 was characterised by a reversion to an economic policy of using colonial territories to support the immediate interests of the British national economy. This doctrine was put in place during the postwar economic crisis, precipitated by the ending of the US Lend Lease system in 1945 and the ensuing balance of payments crisis in Britain. In addition to the long-term development and welfare projects supported using CDW funds, the British Government saw it necessary to create measures for immediate increases in the production of colonial commodities so as to relieve shortages of food stuffs and raw materials in Britain and earn dollars.[48] It was out of these circumstances that bodies such as the Overseas Food Corporation and the Colonial Development Corporation were established, with the ostensible goals, as Hodge writes, of "both improving the general standard of living and welfare of colonial peoples and increasing the supply of colonial products abroad."[49] The Overseas Food Corporation became responsible for implementing the infamous East African Groundnut Scheme; a highly mechanised and costly project aimed at converting over 3 million acres of land in central Tanganyika to the cultivation of groundnuts for export to Britain to meet domestic nutritional needs.[50]

Knowledge of tropical soils was presented as a foundation upon which postwar programmes of development and also renewed exploitation would be based. Take the remarks made by the British Member for Parliament, David Rees-Williams, during his opening address at the tropical and sub-tropical soils conference at Rothamsted in 1948:

---

[46] *Report of the Conference on Tropical and Sub-Tropical Soils, June, 1948* (Harpenden: Commonwealth Bureau of Soil Science, 1949), 5-6; *Technical Communication No. 46—Proceedings of the First Commonwealth Conference on Tropical and Sub-Tropical Soils*.
[47] *Transactions of the Fourth International Congress of Soil Science, Amsterdam, July 24-August 1, 1950, Volume I: General and Sectional Papers* (Groningen: Hoitsema Brothers, 1950), 266-313.
[48] Havinden and Meredith, *Colonialism and Development*, 227-8; Hodge, *Triumph of the Expert*, 207-9.
[49] Hodge, *Triumph of the Expert*, 208.
[50] Nicholas Westcott, *Imperialism and Development: The East African Groundnut Scheme and its Legacy* (James Currey, 2020).

> The seriousness of the relative neglect hitherto of the study of tropical and sub-tropical soils is becoming increasingly apparent as the world, and Europe in particular, comes to rely more and more on tropical lands as sources of essential food and raw materials. Soil science has helped temperate countries greatly to increase the productivity of their soils, but no such increase has been possible in the warmer regions of the world. […] One of the most fruitful—and the most certain—methods of improving the welfare of the inhabitants of the tropics, and at the same time of helping the over-populated countries of Europe to maintain their standards of living, would be to increase the fertility of tropical soils.[51]

Tropical soils were now represented as essentially different from those found in the temperate zone and as though it was only through the deployment of soil science in the tropics that their productivity could be increased.

Tropical soils were a key feature of postwar discourse about the essential difference between "the tropical" and "the temperate". Take the French Geographer Pierre Gourou's *Les Pays Tropicaux*, which was first published in French in 1947 and later in English as *The Tropical World* (1953). Gourou, a Professor at the Collège de France in Paris and the Université Libre de Bruxelles, included in his book a whole chapter on tropical soils. He remarked about the inherent challenges that tropical soils placed upon agricultural development, noting their essential difference to soils formed in the temperate zone. As one line from an English translation reads: "As a whole, tropical soils are poorer and more fragile than those of temperate lands. To harness them for a stable agriculture, capable of regular harvests, thus requires careful and refined techniques which have more respect for the soil and for its enrichment than is the case in the temperate zone."[52] In the case of Gourou, whilst his work was popular with some audiences (four English editions of *The Tropical World* had been published by 1966), it was also heavily criticised. The Martinican writer Aimé Césaire labelled Gourou's work that of an "impure and worldly geography", calling into question Gourou's assumption that it would be cultural elements from non-tropical regions that would ensure the progress of tropical regions.

---

[51] *Report of the Conference on Tropical and Sub-Tropical Soils,* 7-8.
[52] Pierre Gourou, *The Tropical World: Its Social and Economic Conditions and its Future Status*, 4th ed., trans. S.H. Beaver and E.D. Laborde (Longmans, 1966), 29.

> Need I say that it is from a lofty height that the eminent scholar surveys the native populations, which "have taken no part" in the development of modern science? And that it is not from the effort of these populations, from their liberating struggle, from their concrete fight for life, freedom, and culture that he expects the salvation of the tropical countries to come, but from the good colonizer […].[53]

Postwar representations of tropical soils were connected to a wider discourse about the future of the "tropical world". Whilst often presented as an apolitical and technical matter by the likes of Gourou, it was politicised by anti-colonial writers like Césaire, who made connections between such discourse and European perceptions and ideas about the capacity to intervene in colonial territories.[54]

There *were* reasons for Europeans to be cautious about intervening in environments in colonial territories without sufficient prior knowledge, particularly in Africa. Experiences during the 1930s had revealed the paucity of European knowledge and understanding of environments in the tropics. The gaps in 1935 East African soil map were but just one example. By the late '30s, much of the hubristic imperial optimism about the inherent agricultural potentialities of tropical environments had given way to a sense of caution and an understanding of soils in the tropics, in particular, as a fragile resource. In addition to Gourou's later writing, such sentiment was given expression in Worthington's *Science in Africa*, in which he professed that "As knowledge concerning tropical soils progresses, it becomes more and more evident that to judge them from a European standpoint is entirely misleading."[55] It was also expressed, perhaps most vividly, in G.V. Jacks' and R.O. Whyte's *The Rape of the Earth*. G.V. Jacks' chapter on tropical Africa, in particular, represented soils in Africa as something with which Europeans were out of touch compared to Africans, and the control of which would determine the future of white colonial rule on the continent.[56]

In East Africa, rhetoric about tropical soils during the late-1940s was particularly connected to an understanding of the limits of European environmental knowledge. Take the following quote from an article in the *East African Agricultural Journal* in 1949, reporting on the conference on tropical and sub-tropical soils held the year before:

---

[53] Aimé Césaire, *Discourse on Colonialism*, 2nd ed., trans. Joan Pinkham (Monthly Review Press, 2000), 56-7.
[54] For more, see Gavin Bowd and Daniel Clayton, *Impure and Worldly Geography: Pierre Gourou and Tropicality* (Routledge, 2019).
[55] Worthington, *Science in Africa*, 124.
[56] Jacks and Whyte, *The Rape of the Earth*, 263.

> The plans for colonial development which are now being put into effect are intended to increase the productivity of the dependencies in minerals, industries and agriculture. Development of minerals and industry should lead directly to a higher standard of living for the native populations, but this cannot easily be attained without a substantial increase in agricultural productivity. More efficient use of the soil is therefore a vital part of the development plans, and in order to reach this objective it may be necessary to revolutionise the methods of production, as is now being attempted in the East African Groundnut Scheme. But our knowledge of tropical soils is far from sufficient to permit drastic interference with the present native methods of cultivation, inefficient though they are, and the study of tropical soils is therefore of immediate and essential importance.[57]

These reappraisals did not emerge out of a vacuum but were, in part, a product of the ecological and economic realities of prior colonial interventions, as well as the work of researchers such as Geoffrey Milne and technical officers based in British African territories during the 1930s which called into question European assumptions about environments and peoples in the tropics.[58]

5.5 "A Complete Rift"?

This chapter will now move from discussion of the factors that worked to promote soil science to those which undermined its success. If the fundamental research carried out by EAAFRO staff, such as soil surveys, was to have any practical relevance for agriculture, farming or other types of land-use in East Africa, then cooperation between EAAFRO and those responsible for the implementation of agricultural policy was essential. It required mutual understanding and respect between EAAFRO and the East African Departments of Agriculture regarding each other's functions and the value of each other's work. After all, it was the responsibility of the Departments Agriculture to use the results of research to implement changes in agricultural practice and land-use in East Africa. In reality, though, the relationship between EAAFRO and other institutions in East Africa was fraught with tensions and, at times, a lack of respect and understanding. The crux of the issues that emerged was the conviction held by Keen and others that EAAFRO, if it was to be a regional research organisation of high calibre and prestige, required freedom for its researchers from external direction and control. This did not sit well with many within the Departments of Agriculture

[57] "Conference on Tropical and Sub-Tropical Soils," *East African Agricultural Journal* 14, no. 3 (1949): 111.
[58] Tilley, *Africa as a Living Laboratory*, 153-9; Hodge, *Triumph of the Expert*, 146-66.

and the tensions that emerged had the potential to undermine the power of fundamental soil studies to impact agriculture in East Africa.

Keen was open with his view that the various councils and committees set up in East Africa to coordinate work between regional research organisations such as EAAFRO and EAVRO, and the territorial departments, commodity research stations and other bodies, could restrict EAAFRO from reaching its full scientific potential. Keen commented on such points in a *Nature* journal article in 1951. Whilst noting the desirability of coordination and the prevention of overlapping research in East Africa between these various bodies, Keen wrote that "there is much danger of elaborating the administrative organisation at the expense of flexibility and freedom of the scientific work."[59] As Keen put it: "it may lead, for example, to a particular scientific committee being three or four times larger than necessary or, alternatively, to the formation of three committees where one would serve, plus yet a fourth committee to 'co-ordinate' the other three."[60] Keen was writing hypothetically, yet there was an implicit suggestion that such circumstances were the reality in East Africa. Indeed, by June 1951, numerous councils and committees had been set up to coordinate agricultural, forestry and veterinary policy and research in East Africa. These included: the East African Advisory Council; specialist sub-committees of the latter; the Research Organizations Committee; and three Technical Coordinating Committees, on agriculture, forestry and animal health.[61]

Keen had elaborated on a similar point during his presidential address to the annual meeting of the Nairobi Scientific and Philosophical Society in January 1949. This Society was set up in 1947 to provide a platform for general "scientific discussion" between scientific and technical officers in Kenya.[62] Speaking to a crowd which ranged from employees of the various technical departments in Kenya to Worthington, who was then Scientific Secretary in the East Africa High Commission, and the Head of the Anti-Locust Research Centre, entomologist Boris Uvarov, Keen highlighted the ways in which the customary councils and committees devised by governments to advise on and sometimes direct state funded research could hinder the progress of that very research. These bodies, Keen argued, whilst not "wholly dangerous", possessed "dangerous potentialities" given the fact that they were often

---

[59] Bernard A. Keen, "The East African Agriculture and Forestry Research Organization," *Nature* 168, no. 4277 (1951): 676.
[60] Ibid.
[61] CO 927/187/2, Extract from minutes of the 37th meeting of the CCAAHFR held 11/6/51, no. 47, pp 6-8.
[62] "Editorial Foreword," *Proceedings of the Nairobi Scientific and Philosophical Society* 1 (1947); "Nairobi Scientific and Philosophical Society," *Nature* 162, no. 4121 (1948): 647.

made up of eminent scientists and administrators, whose "high level of authority" means that their "advice" often becomes synonymous with "orders".[63] The problem, according to Keen, was that if a researcher wanted to deviate from the advice of a council, they would need to present their case to a committee. This process, whilst often resulting in a "sympathetic reception" by said committee, could delay research and "contribute a sense of frustration which is bad for the research spirit […]". "at the worst", Keen continued, noting how "scientists are still human beings, with all their frailties", "it means acting against one's judgment, and a tendency to avoid anything suggesting that one is possessed of a difficult and obstinate personality." Keen's conclusion was that whilst councils and committees had an essential function in helping with coordination, "the best committee is sometimes a committee of one."[64]

Keen's reservations were also directed toward the supposed pointlessness of trying to plan fundamental research in detail. He elaborated on these points during the same address to the Nairobi Scientific and Philosophical Society. Reiterating the notion that fundamental research was essentially research into the "unknown", Keen argued that organization and planning, except in the "very broadest general terms", were "quite useless" in that they imply "the possession of an intellectual omnipotence that just does not exist among us."[65] Keen even invoked his own prior experiences as a physicist to explain this, recalling how he had to take a detour to research the basic properties of "moist porous material" before he could apply himself to the study of soil physics.[66]

The point of Keen's personal anecdote was to illustrate how the successful prosecution of fundamental research required freedom and flexibility for researchers to choose and adapt their own lines of work. In Keen's view, the freedom that had been afforded to himself ought to be afforded to others working at research organizations such as EAAFRO.

This emphasis on freedom and flexibility created issues when it came to coordinating research at EAAFRO with the activities of Departments of Agriculture and other institutions in East Africa. Directors of Agriculture complained that Keen was not clear enough on the programme of research at EAAFRO and that this lack of information made it difficult, nigh on impossible, to coordinate EAAFRO research work with the activities of their own departments. Many of these issues were aired at a meeting of a Standing Research Committee

---

[63] Bernard A. Keen, "The Guessers and the Accumulators," *Proceedings of the Nairobi Scientific and Philosophical Society* 3 (1949): 26-7.
[64] Ibid., 27.
[65] Ibid., 28.
[66] Ibid.

held in Nairobi in May 1950. This was a subsidiary committee of the East African Advisory Council, devised to coordinate research policy in East Africa.[67] Those present at the meeting had under discussion an offer of US technical assistance under the Economic Cooperation Administration for numerous agricultural research schemes in East Africa, including a scheme for systematic soil surveys. When the chairman of the meeting asked for general comments, the Director of Agriculture in Uganda (A.B. Killick) asserted that he found it difficult to comment on the offer, even in "general terms", without information on the programme of research at EAAFRO.[68] The only information on the programme of research that would have been available to Directors of Agriculture at the time was the rough outline circulated at the first meeting of the East African Advisory Council in 1949. As H.H. Storey stated as Acting Director of EAAFRO at the meeting (Keen was away at the time), even this had been "a very rough framework" and the programme had anyways been severely curtailed owing to staffing difficulties.[69] The lack of clarity about the research work that EAAFRO was going to be undertaking placed barriers on the ability to decide which schemes of US technical assistance ought to be accepted. Such decisions were dependent on shared knowledge of the resources, personnel and activities that would be in place at EAAFRO in the years to come.

Complaints were also raised by European settlers and unofficial members of the East High Commission that EAAFRO might disrupt the existing arrangements for research and agricultural work within the territorial departments. Cavendish-Bentnick, who was present at the meeting of the Standing Research Committee in May 1950 as Member for Agriculture and Natural Resources in Kenya, drew attention to European settlers' discontent with EAAFRO. He suggested there was "a feeling of apprehension" among many Kenya unofficial members and settlers that EAAFRO was growing into "a vast organisation" which would be "superimposed" onto other institutions in East Africa, and that in order to "combat this feeling" EAAFRO ought to keep in closer touch with the Departments of Agriculture and Veterinary Services.[70] These criticisms were likely spurred on by the political power gained by many settlers in East Africa during and after the Second World War. In Kenya, many settlers over middle age remained in East Africa during the War, where, in the absence of

[67] It later became the Research Organizations Committee. General agricultural policy was the remit of the East African Advisory Council. See CO 927/187/2, Extract from minutes of the 37th meeting of the CCAAHFR held 11/6/51, no. 47, p 7.
[68] CO 927/187/1, Paper III, minutes of the meeting of the Standing Research Committee held in Nairobi, 31/5/50, no. 15, p 1.
[69] Ibid.
[70] Ibid., pp 2-3.

physical fighting, their main wartime service centred on the project of increasing agricultural production.[71] David Anderson writes that the War saw more of the "White Highlands" (an area in central Kenya where many settlers lived) than ever before coming "under the plough" and the flooding in of capital to pay for mechanization on settler farms.[72] This had implications for African Kenyans, particularly those who were tenants on European owned farms — known as "squatters". It was at this time that settlers started to place restrictions on squatters' livestock holdings and their areas of cultivable land through new contracts. In some districts, squatters were even evicted. Anderson notes that more than 100,000 Kikuyu squatters were "forcibly 'repatriated'" between 1946 and 1952.[73] The settler community in Kenya also came to have a greater role in influencing government policy. Ian Spencer notes that the Settlement and Production Board that was established in 1939 to "coordinate economic activity" in Kenya was headed by a settler and was "dominated by their views." Furthermore, on the Kenya Supply Board, which "dealt with all questions of import and export control", Spencer notes that there was a clear "unofficial majority" (meaning individuals, most likely Europeans, not officially employed by government).[74] Efforts to reassert metropolitan authority over settler politicians in Kenya toward the end of the War, such as through the appointment of Philip Mitchell as Governor, were met with a "feeling of emasculation" among many settlers; many of whom had a sense of pride and self-importance given their role as agricultural producers during the War.[75] This sense of settler opposition to metropolitan authority would have easily translated to opposition to EAAFRO, especially given Keen's strident rhetoric about freedom, flexibility and fundamental research.

The deterioration of relations between EAAFRO and the Departments of Agriculture soon became a source of concern for the Colonial Office. Upon reading the minutes of the meeting of the Standing Research Committee of May 1950, the Colonial Secretary's Agricultural Adviser (Geoffrey F. Clay), convened a one-on-one meeting in August that same year with Keen. In addition to reading the comments made by the likes of Cavendish-Bentnick and Killick during the Standing Research Committee meeting, Clay had recently visited East Africa himself, confirming his view that relations between EAAFRO and the Directors of

---

[71] Ian Spencer, "Settler Dominance, Agricultural Production and the Second World War in Kenya," *Journal of African History* 21, no. 4 (1980): 498; Joanna Lewis, *Empire State-Building: War & Welfare in Kenya 1925-52* (James Currey, 2000), 245.
[72] David Anderson, *Histories of the Hanged: Britain's Dirty War in Kenya and the End of Empire*, 2nd ed. (Phoenix, 2006), 82.
[73] Ibid., 25-6.
[74] Spencer, "Settler Dominance, Agricultural Production and the Second World War in Kenya," 500-1.
[75] Lewis, *Empire State-Building*, 246.

Agriculture in East Africa were not what they were supposed to be and were, in fact, getting worse. Summarizing his discussion with Keen, Clay documented how he had expressed that it would be "difficult to recover the lost ground and get those relations on the harmonious basis which is obviously necessary for the development of regional research vis-a-vis the territorial Departments and their Specialist workers."[76] The outlook on the situation from the metropole was bleak.

The fact that the Colonial Office was increasingly worried about relations between EAAFRO and other institutions in East Africa is further illustrated by the discussion that took place at a meeting of Colonial Office officials, including some members of the CCAAHFR, in London on in May 1951. The meeting was convened to discuss the future of EAAFRO and there was a feeling of urgency between those present. Early in the meeting, Engledow shifted the discussion toward the relationship between EAAFRO and the territorial departments. Speaking on the apparent feeling "in some quarters" that the former system whereby research was primarily undertaken by territorial departments might be revived if EAAFRO were reduced in size, Engledow suggested that such feeling might be, in part, a result of Keen's supposed disregard of the views of the Directors of Agriculture.[77] At another point in the meeting, a Colonial Office official (a "Mr Rogers") implied that Keen had only recently come to accept the need for cooperation with Directors of Agriculture. Later on, the point was even raised that the territorial departments had not fully accepted the idea of the regional organisation of research and, in some cases, had been operating without regard to the needs of EAAFRO.[78] The content of discussion at this meeting is insightful not just as evidence that members of the Colonial Office were worried about what was happening in East Africa but, also, for what it tells us about how the Colonial Office thought these tensions had arisen. It suggests that they saw the manner in which Keen had tried to position EAAFRO as a centre of fundamental research as partly responsible for the strained relations that had ensued. They were not dismissive of fundamental research, many at the meeting just thought Keen had approached the situation stubbornly. It also shows that not all of the blame was placed on Keen. In the view of those present at the meeting, tensions had also emerged due to the reluctance of territorial departments to engage with the new arrangements for regional research in East Africa.

---

[76] CO 927/187/1, Geoffrey F. Clay to Hibbert, 21/8/50, no. 16.
[77] CO 927/187/2, Draft note of a meeting held in the Colonial Office to discuss the future of the East African Agriculture and Forestry Research Organisation on 23/5/51, no. 25, p 2.
[78] CO 927/187/2, Draft note of a meeting held in the Colonial Office to discuss the future of the East African Agriculture and Forestry Research Organisation on 23/5/51, no. 25, pp 2-3.

The Colonial Office's outlook on the situation in East Africa was pessimistic but not hopeless. Members of the Colonial Office saw the CCAAHFR as a key player in resolving relations. This had been a key rationale behind the Colonial Office meeting in London in May 1951. As proclaimed in a note circulated to attendees over a week before the meeting:

> An important point in the history of EAAFRO has been reached. Unless effective steps can be taken by the CARC [CCAAHFR], a complete rift between EAAFRO and the Territorial Department[s] may now begin. If the situation can be handled effectively, not only will the rift be prevented, but relations between the two partners — Science and Agriculture in E.Africa — will be set on a firmer footing than they have ever had up to now.[79]

Rather than giving up hope, the Colonial Office saw the CCAAHFR as playing a key role in resolving relations between EAAFRO and other institutions in East Africa.[80]

Solutions prescribed by the CCAAHFR to mend these relations centred on Keen providing more clarity on the direction of research at EAAFRO. Following Clay's and Keen's discussion in August 1950, it was agreed that Keen, on his return to East Africa, would prepare "long considered memorandum" on the lines of research that EAAFRO would be pursuing in the years to come.[81] The idea was that this would form a guide for territorial departments to plan their technological investigations and enable some lines of EAAFRO research to be "farmed out". Keen's preparation of this memorandum was considered by Clay as a matter of priority. Clay wanted it prepared in time to be circulated at a meeting of the East African Advisory Council which was due to be held in early-1951.[82] Keen, alongside the Director of EAVRO (E.G. White), went on to prepare this memorandum, which was presented and "accepted" at the meeting of the Council at Muguga in January 1951.[83] Similar recommendations were made during the Colonial Office meeting in May 1951. It was proposed that Keen ought to prepare another statement on the direction of research at EAAFRO that would be suitable for others in East Africa, such as the Members for Agriculture, Directors of Agriculture, Central Legislative Assembly, directors of commodity

[79] CO 927/187/2, Notes for Meeting at the Colonial Office on Wednesday, 23 May 1951, 8/5/51, p 2.
[80] See also Clarke, "The Research Council System and the Politics of Medical and Agricultural Research for the British Colonial Empire, 1940-52," 358.
[81] CO 927/187/1, Record of a discussion between Bernard A. Keen and Geoffrey F. Clay regarding the relations between EAAFRO and the territorial Departments of Agriculture on 21/8/50, no. 16.
[82] Ibid.
[83] CO 927/188/5, Minutes and Conclusions of the Second Meeting of the East African Advisory Council held on 20 January 1951, enclosed in circular by the East Africa High Commission, 8/3/51, p 4.

research stations, and "the farming community".[84] The CCAAHFR also, in general, wanted closer contact with developments in East Africa.[85]

There is some evidence to suggest that relations had started to improve by mid-1951. During a meeting of the CCAAHFR in June 1951, Keen (then on a visit to the UK) painted a positive picture of the situation in East Africa. "in the past", Keen told the CCAAHFR, "the absence of a formal headquarters had introduced difficulties in regional research work." But with the formal opening of EAAFRO by the Colonial Secretary, Keen suggested, there had been an undoubted "beneficial effect on its prestige." Keen went on to argue that this "good impression had now to be followed up and the importance of the work which EAAFRO was undertaking explained even more fully than in the past to those who were inclined to be critical."[86] Keen's comments suggest that EAAFRO was starting to be regarded in a more positive light. Yet, the fact that he still thought it pertinent to explain "even more fully" the importance of the work of his organisation suggests that there were still tensions and that criticism was still rife. Moreover, the fact that Keen's comments were made to the CCAAHFR in London should also be taken into consideration. It would have been expedient for Keen to represent the situation in East Africa as improving given the high level of concern at the Colonial Office over relations between EAAFRO and other institutions in East Africa.

An illustration of the fact that tensions persisted can be seen in the complaints raised by the Director of Agriculture in Kenya (Gilbert M. Roddan) at a meeting of the Research Organizations Committee (previously the Standing Research Committee) in September 1952, two years after Keen's original meeting with Clay. Roddan raised the now perennial complaint that arrangements for the coordination of research in East Africa were unsatisfactory. The specifics of the complaint were related to the complex bureaucratic mechanisms set up to coordinate research between EAAFRO and EAVRO, and other institutions in East Africa. By this point, the Research Organizations Committee was meant to act as a governing body for EAAFRO and EAVRO. It was responsible for considering the estimates of both organisations and submitting them to the Central Legislative Assembly. Roddan's issue was that he thought the estimates were being submitted to the Research Organizations Committee without due regard being paid to whether they fitted within the research programmes of the Departments of Agriculture and other institutions. Roddan

[84] CO 927/187/2, Draft note of a meeting held in the Colonial Office to discuss the future of the East African Agriculture and Forestry Research Organisation on 23/5/51, no. 25, pp 2-3.
[85] CO 927/187/2, Extract from minutes of the 37th meeting of the CCAAHFR held 11/6/51, no. 47, p 9.
[86] CO 927/187/2, Extract from minutes of the 37th meeting of the CCAAHFR held 11/6/51, no. 47, p 1.

suggested that whilst this machinery might be adequate in theory, it did not appear to be working satisfactorily in practice.[87] This was a view shared by the Member for Agriculture and Natural Resources in Tanganyika (A.E. Trotman), who was also present at the meeting. Roddan wanted an "authoritative statement" from the various Technical Coordinating Committees that such consideration had taken place and was endorsed by their members before the estimates were sent to the Research Organizations Committee.[88] These Technical Coordinating Committees contained a greater representation of Directors of Agriculture than the Research Organizations Committee and so would have been a means of giving voice to the priorities of the Departments of Agriculture. As the minutes of the meeting document, Roddan thought that "This would enable the Research Organizations Committee to satisfy themselves that the estimates represented the most effective deployment of the resources of the two Research Organizations, and they would thus be in a position to examine and endorse the estimates with confidence."[89] Far from being resolved, tensions between EAAFRO and other institutions in East Africa over the coordination of research persisted. Directors of Agriculture repeatedly sought to make sure their own interests and priorities received recognition alongside, and sometimes over, those of EAAFRO.

The fact that these tensions persisted until at least 1952 shows the stark contrast between Keen's initial visions for research in East Africa and the realities of implementing those visions in practice. Metropolitan backed research initiatives such as EAAFRO had to come to terms with local social and bureaucratic circumstances.

5.6 Manpower and Money

The barriers to cooperation between EAAFRO and other institutions in East Africa had the potential to undermine the ultimate practical relevance of soil surveys according to Keen's three stage model of research. Yet, there were also a range of other issues which hindered the prosecution of soil surveys in the first place. One of the main issues hindering soil survey work in East Africa was the difficulty of recruiting qualified personnel.

The lack of personnel available for soil survey work in East Africa had been recognized as an issue by Milne's replacement as soil chemist at Amani, D.W. Duthie, around the time in

[87] CO 927/256, Minutes of the meeting of the Research Organizations Committee held in the conference room of the East Africa High Commission on 19 September 1952, enclosed in letter from the East Africa High Commission to the Colonial Secretary, 20/12/52, no. 2, p 2.
[88] Ibid.
[89] Ibid.

which ideas about establishing a new regional agricultural research organization in Kenya were first being aired. Duthie documented his views on the matter in a memorandum on future soil work in East Africa that was sent to Hill as the Director of Amani in June 1944. The memorandum was later circulated within the Colonial Office and between its various scientific advisers for soils such as Ogg and Crowther for their consideration in 1945.[90] Duthie's memorandum laid forth, among other things, his views on the programme of soil survey work required for the successful development of agriculture in East Africa. What was needed, in Duthie's view, were "detailed surveys", particularly in connection with development schemes. In order to carry out this work, or even extend existing reconnaissance surveys, he thought that each East African territory (except Zanzibar) would require two "whole-time" soil surveyors accompanied by a "qualified topographical surveyor" and the occasional assistance of an ecological botanist. He also thought that a permanent organisation ought to be set up for the purpose of overseeing the work. Even with this manpower, Duthie estimated that only districts of "considerable agricultural importance" could be "dealt with" in the first ten to fifteen years.[91] In total, he estimated that a soil team consisting of twenty three "European specialist staff" would be needed to meet his proposed lines of investigation, including activities other than soil surveys. "While a soil team of this size cannot even be visualized," Duthie wrote, "the figure is not an exaggeration, and it shows the necessity for placing the problems in their order of importance."[92] Duthie drew attention to the great numbers of staff required to carry out soil surveys in East Africa several years before EAAFRO was even established.

Up until early-1952, Keen's description of the type of soil surveys that EAAFRO staff would carry out centred on the prosecution of fundamental pedological studies. In the programme of research for EAAFRO that Keen shared with the East African Advisory Council in 1951, for instance, he stated that the "main basic research problem" for EAAFRO would be the establishment of a "system of classification for tropical soils".[93] Similarly, in a revised EAAFRO research programme circulated to the CCAAHFR in January 1952, Keen suggested that soil surveys would have broad classificatory aims.

---

[90] CO 927/12/3, "Suggestions for Future Soil Work in East Africa," by D.W. Duthie, 6/11/44, no. 2, pp 1-9; William G. Ogg to Harold Tempany, 27/3/45, no. 3.
[91] CO 927/12/3, "Suggestions for Future Soil Work in East Africa," by D.W. Duthie, 6/11/44, no. 2, p 3.
[92] Ibid., p 9.
[93] CO 927/187/2, "Broad programme of EAAFRO for the remainder of the first ten-year period, up to 1957," enclosed in letter from Bernard A. Keen to Geoffrey A.C. Herklots, 6/3/51, no. 2, p 4.

> The specialist soil survey portion of this programme will be directed to building up a general body of soil data by studying the genesis, the constitution and the general field characteristics of natural soil types, so that a systematic method of classification of East African soils may be comprehensively established. Representative regions will have to be studied in detail, the natural soil condition being described with precision and sorted into an arbitrary number of soil types. In these regions, or parts of them, the soil types will have to be mapped, while at the same time the best system of classification is developed. In the process workers will be trained in the technique of soil survey and mapping for the later general survey. The detailed experimental survey areas will be mainly based on aerial photographs and will probably take the form of long traverse strips across areas of various rainfalls and altitudes, and a series of blocks in regions of more uniform climate.[94]

This was fundamental research aimed at gaining an understanding of the characteristics, properties and natural history of the region's main soil types. Keen did not describe these surveys as completely disconnected from agricultural practice, though. He suggested that the detailed experimental survey areas would be in places where agricultural development projects were planned, or in places where it was proposed to "replace an existing agricultural system with another system of land use."[95] This appeased the Departments of Agriculture. Keen's framing nonetheless implied that the larger goal was one of building up a knowledge base of the basic properties of East African soils, not addressing local development problems.

By mid-1952, however, Keen had come to reappraise the type of soil surveys EAAFRO would be carrying out, and their aims. Take the following comments made by Keen in another document circulated to the CCAAHFR, in October 1952, on the research programme of EAAFRO, six months after the previous programme:

[94] CO 927/187/4, "Revised research programme of the East African Agricultural and Forestry Research Organisation up to 1957," by Barnard A. Keen, enclosed in letter from R. Scott, East Africa High Commission, to Hibbert, Colonial Office, 25/1/52, no. 8, p 4.
[95] Ibid.

> In these circumstances, and remembering the impossibility of providing enough surveyors to make even a reasonable impression on this great mass of unknowns, the task of the soil survey section of a Research Organisation is clear. It is to pay especial attention to those areas of land in the territories where some kind of soil survey is essential for their development or preservation. Thus, in Kenya, there are the lands at higher altitudes farmed under European systems of agriculture; in Tanganyika there are large areas in Sukumaland that must be settled to African cultivation to relieve pressure elsewhere. In short, there are certain special areas where, for reasons of territorial policy, it is important to be as sure as possible about the right methods of land use and development.[96]

This was a change in rhetoric about the direction of soil survey work at EAAFRO. Keen was no longer alluding to fundamental pedological studies as the larger goal of EAAFRO soil surveys. The aims of soil surveying were now being spoken about by Keen as connected to immediate land-use policy and development projects. Keen's rationale for this change in direction was, in part, the supposed difficulties of recruiting surveyors.[97] What, then, were these difficulties, and why did they exist?

Between 1949-52, offers of US financial and technical assistance had held the potential of helping EAAFRO meet its staffing needs for soil survey work. In 1949, under the terms of the Economic Cooperation Act, a special mission made up of three American agriculturists from the Agricultural Research Administration visited East Africa to observe the arrangements in place for agricultural and veterinary research in the region and to make recommendations to the Colonial Secretary in London on future lines of work and the ways in which US assistance could be provided. Their visit was part of broader postwar US foreign policy aimed at providing economic assistance to Western European countries. One of the projects (no. 17) the mission recommended was for soil surveys. The Lambert Report produced by the mission claimed that soil surveys were needed in the whole of "British Colonial Africa", not just East Africa, and their function was explained as follows:

---

[96] CO 927/187/5, "The Background of Tropical Agricultural Research," by Bernard A. Keen, enclosed in circular from Geoffrey A.C. Herklots to the CCAAHFR, 20/10/52, no. 71/72, p 3.

[97] Keen also suggested it was due to the lack of international scientific consensus on the classification of tropical soils. See ibid. Also A.P.G. Michelmore, "A Note on Soil Classification by a Naturalist," *East African Agricultural Journal* 16, no. 1 (1950): 47.

> The problem is essentially one of determining what kinds of soils exist, where they occur, and how large an area they occupy. Without this kind of knowledge, every development scheme, every resettlement program, every experiment station, and every advisory service that involves the use and management of the soil is subject to possible waste of manpower and money as a result of blind choice of soils with which to work.[98]

The rationale behind soil survey expressed in the Lambert Report had a striking similarity with Keen's vision of soil science as the cornerstone of agricultural development. Indeed, Keen had raised the need for studies of the genesis, classification and surveying of tropical and sub-tropical soils with the mission during their time in East Africa.[99] The mission also reported that they had been made aware of the demand for "an inventory of soil resources" through conversations with various Agricultural Officers.[100]

The initial offer of US assistance for soil survey work in East Africa was generous. The Lambert Report suggested that American personnel could be provided to fill the posts of a principal soil scientist, a soil chemist and a soil mineralogist at EAAFRO, as well as four soil surveyors who would be stationed at specific field sites across East Africa.[101] In the Report, it was estimated that the programme of work would commence with a broad inventory of soil resources, gradually moving toward more detailed surveys.[102]

For the most part, the offer was received well by the Colonial Office. Following discussion between members of the CCAAHFR and the SSC, the Colonial Secretary endorsed the proposals, albeit with some small modifications. One of the changes recommended was for the role of the principal soil scientist at EAAFRO to be taken up by a British officer rather than an American. This was a role that involved supervising and correlating soil survey activities under the direction of Keen at EAAFRO. It was suggested that the soil chemist G.H. Gethin-Jones, who was already employed in the Kenya Department of Agriculture, could take up this role if it were possible for the Governor of Kenya to release him earlier than mid-1951. The Colonial Secretary did not explain why this conclusion had been reached other than it was "preferable" to have a British officer take up the role rather

[98] CO 852/1294/5, Extract on Project 17 of the Lambert Report, n.d., no. 1, p 23.
[99] CO 908/33, Note by the Colonial Office on projects other than those put forward in the Lambert Report which it is suggested may be considered for submission to the Economic Cooperation Administration, enclosed in circular from W.S. Bates to the SSC, 5/1/50, no. 2.
[100] CO 852/1294/5, Extract on Project 17 of the Lambert Report, n.d., no. 1, p 23.
[101] Ibid., pp 25-6.
[102] Ibid., pp 24-5.

than an American.[103] Another change recommended by the Colonial Secretary was that only two American soil surveyors would be necessary, rather than the four that had originally been proposed. It was forecasted that, if the assistance were accepted, then the other two soil surveyor roles could be obtained independently of the US. The idea was that the latter two soil surveyors would be "British replacements", learning from the two American soil surveyors in the field in preparation for continuing the work when the Americans' contracts had terminated after about two years.[104]

Reception of the offer by those based in East Africa was more tentative than the Colonial Office. There were practical issues that needed to be considered. Accepting the offer would have meant an immediate expansion in research staff at EAAFRO beyond that which had been accounted for in plans for the first phase of the organisation. The soil survey project would have been particularly demanding of building space at a time in which the EAAFRO headquarters at Muguga had not officially opened and some staff were still based at Amani in Tanganyika. Whilst the four soil surveyors would mainly be working the field and thus would not need laboratory space at Muguga, and arrangements were already in place for accommodating Gethin-Jones under plans for phase 1 of EAAFRO, the project would have required a total of four laboratories, four ancillaries, two houses and five rooms in the hostel at Muguga. This was one of the most demanding of facilities of all the Economic Cooperation Administration projects on offer.[105]

There were also financial implications to consider. Whilst the salaries of American personnel would have been covered by the Economic Cooperation Administration and the sterling expenditure involved in carrying out the project (such as foreign service allowances, local transport and contingencies) would have been covered by CDW funds, it would have been the responsibility of colonial governments in East Africa to finance accommodation, laboratories and other facilities. If it were found necessary to provide a car for one of the American workers, for instance (a likely circumstance for soil survey work), then the cost would need to have come from East African governments given the "residual value" of the car to East Africa once the worker had left.[106] Acceptance of the soil survey project would have placed a financial burden on East African governments. Indeed, knowledge that such

[103] CO 852/1294/5, Circular from the Colonial Secretary to the East Africa High Commission and others, 24/2/50.
[104] CO 852/1294/5, M.V. Spurway to Malcom R. Crawford, 16/5/50; CO 927/187/1, Memorandum on offers of American assistance under ECA, for meeting of the Standing Research Committee on 31/5/50, no. 15, pp 2-4.
[105] Ibid., pp 5-8.
[106] Ibid., p 12.

projects were under consideration might have contributed to the deterioration of relations between Keen and the Directors of Agriculture.

The American proposals for soil survey work were never put into practice. The reasons for this are not clear. It could have been due to a reluctance on the part of East African governments to commit themselves financially to the project. It could also have been due to timing issues. The Economic Cooperation Administration came to an end in mid-1952, with US assistance continuing under the Point Four Programme.[107] Worthington's comments at a meeting of the Nairobi Scientific and Philosophical Society in April 1951 suggest that offers of Economic Cooperation Administration assistance, in general, often failed to materialise on the ground.

> Up to now there has been rather more talk than action on this, but the intention is clear — to bring to bear on African problems the particular skills and knowledge of the USA by seconding scientists and technicians. Since the days of ECA are numbered — it ends in 1952 — and the time taken to arrange each case is considerable — there has been some feeling that the assistance under ECA to Africa might not be very large […].[108]

As Scientific Secretary to the East Africa High Commission, Worthington would have known first hand the processes involved in getting US assistance into operation on the ground. The Colonial Secretary corresponded directly with the East Africa High Commission on Project 17 and the Lambert Report.[109] Regardless of what the causes of this failure were, it highlights the ways in which the recruitment of staff at EAAFRO for the prosecution of soil surveys was obstructed by numerous financial and practical barriers.

This is not to suggest that there was completely no staff available at EAAFRO for soil survey work during the early-1950s. Keen reported to the CCAAHFR in June 1951 that Gethin-Jones had been brought over to EAAFRO from the Kenya Department of Agriculture as a research officer in the soil survey section. Keen reported that "it had been agreed that Dr. Gethin-Jones should co-ordinate his work with the territories and at present undertake surveys only of immediate land-use value."[110] Another research officer for the soil survey

---

[107] Edgar B. Worthington, "Organisation of Research in Africa," *Nairobi Scientific and Philosophical Society* 5 (1951): 75.
[108] Ibid., 75.
[109] CO 852/1294/5, Circular from the Colonial Secretary to the East Africa High Commission and others, 24/2/50.
[110] CO 927/187/2, Extract from minutes of the 37th meeting of the CCAAHFR held 11/6/51, no. 47, p 5.

section at EAAFRO, R.M. Scott (previously of the Gold Coast Department of Agriculture), was recruited by 1952.[111]

There were also some staff at EAAFRO with less direct connections to soil survey work. By November 1950, Colin G. Trapnell, formerly an ecologist in the Agricultural Department in Northern Rhodesia, had moved to EAAFRO to work as the officer in charge of a new Ecological Training Unit. Financed using CDW funds, this unit was intended to address the shortage of trained ecologists in British colonies capable of undertaking surveys of land resources.[112] The training was meant to build upon Trapnell's expertise as an ecological surveyor in Northern Rhodesia. As described by the Colonial Office: "Emphasis in the training course will be placed on large-scale vegetation survey coupled with soil reconnaissance, on air photograph investigation and type-mapping and on the study of land categories in relation to present and potential land usage."[113] The number of trainees at the unit was relatively small. Only two students and one probationer were enrolled on the 1952-3 course. Students typically underwent a year of postgraduate training in the United Kingdom beforehand.[114]

Some researchers were also brought in to EAAFRO to work on specific soil microbiology research projects. This included George Salt, for instance; a scientist from Cambridge University who visited East Africa during 1948-9 under the "general scientific direction" of Keen to carry out research into the numbers and kinds of arthropods in East African soils.[115] Another researcher, Jane Meiklejohn, was seconded to EAAFRO during 1952-3 from Rothamsted to carry out soil microbiological studies, focusing on the role of microflora in soil nitrogen cycling.[116]

The soil survey section at EAAFRO also collaborated with B. Anderson during the early-1950s; an employee of the Overseas Food Corporation. Anderson was involved in carrying

---

[111] CO 927/427, Annual Report of the East African Agriculture and Forestry Research Organisation for 1952, p 80.
[112] *Colonial Research 1949-50*, 113.
[113] *Colonial Research 1950-51*, 151.
[114] *Colonial Research 1952-53*, cmd. 8971 (London: HMSO, 1953), 177.
[115] CO 927/193/3, "Investigations of the Arthropod Fauna of the Soil in East Africa (with entomological and other observations)," by George Salt, n.d., pp 3-4.
[116] CO 927/269, Copy of Jane Meiklejohn's report on secondment to EAAFRO to initiate work on soil microbiology, enclosed in letter from Donald Rhind to Bernard A. Keen, 15/12/53, no. 2, pp 1-4; Jane Meiklejohn, "The Effect of Bush Burning on the Microflora of a Kenya Upland Soil," *European Journal of Soil Science* 6, no. 1 (1955): 111-8.

out soil surveys and soil fertility research work at Nachingwea in Tanganyika.[117] This was an area formerly connected with the East African Groundnut Scheme.

Whilst there were some personnel available at EAAFRO for soil survey work, these staffing arrangements were far less coherent than those which had been proposed by the Economic Cooperation Administration. By 1952, Gethin-Jones and Scott were the only full time soil survey staff employed at EAAFRO. With the soils of Kenya, Tanganyika, Zanzibar and Uganda to survey, is it surprising that Keen came to stress the need to align soil surveys with immediate land-use policy and development projects rather than the broader goal of building a system of classification for tropical soils?

5.7 Mau Mau

There is more to be said about why Keen came to reappraise the types and aims of soil survey work carried out by EAAFRO staff. In connection with staffing and financial issues, the political situation in central Kenya during the early-1950s had a profound impact on the capacity of EAAFRO staff to carry out research.

During the early-1950s, central Kenya was in the midst of a political crisis. African led political struggle against British colonial rule in central Kenya had been prominent since at least the interwar period. For many Kikuyu (the main ethnic group resident in central Kenya at the time), this struggle had centred on issues such as their lack of political representation and missionary-led campaigns against clitoridectomy practices. One the most significant loci of Kikuyu political struggle was also the question of land. By 1926, multiple pieces of legislation had been passed by the Kenya colonial government dividing up land according to ethnic and racial categorisations. In central Kenya, land was portioned into "African Reserves", leaving other areas, known collectively as the "White Highlands", for European settlers.[118] Various organizations aimed at giving African Kenyans greater political representation had been established by the end of the Second World War. By the early-1950s, the current of political struggle in central Kenya had taken a much more violent turn. In what came to be known as the Mau Mau rebellion, there were outbursts of violent attacks by militants on people (initially mostly African Kenyans and later Europeans) seen to be loyal to the colonial government. Violence spread quickly, partly because of the forceful

[117] CO 927/187/4, "Programme of Work, 1952', n.d., no. 27, pp 7-8; CO 927/427, Annual Report of the East African Agriculture and Forestry Research Organisation for 1953, p 64.
[118] Anderson, *Histories of the Hanged*, 21.

administering of oathing ceremonies which committed participants to the militants' cause. In October 1952, the Governor of Kenya announced a State of Emergency, ushering in a wave of measures aimed at quelling Mau Mau activity. A British battalion, the Lancashire Fusiliers, was brought into Kenya, for example, and a range of collective punishments were carried out by government officers.[119] It was not until 1960, three years before Kenya gained independence from Britain, that the Emergency formally ended.[120]

Being located in Muguga in central Kenya, the headquarters of EAAFRO were in close geographical proximity to Mau Mau activity. Herbert C. Pereira, a soil physicist at EAAFRO who was later made Deputy Director, recalled his sense of isolation and danger when stationed at the headquarters during the early-1950s in an obituary for Keen published in 1982.

> The declaration of a State of Emergency in Kenya, to overcome the atavistic excesses of the 'Mau Mau' movement, emphasized the somewhat isolated site of the new research complex. Although only some 14 miles from Nairobi, the EAAFRO/EAVRO campus at Muguga was built in a forested enclave in a densely populated area of the Kikuyu Reservation. With six square miles of thick forest on the northern boundary, the wild and uninhabited Rift Valley to the west and a very large concentration of population on the eastern boundary of the estate, the security problems of some fifty expatriate families were well beyond the capacity of the small police post at Kikuyu railway station, some five miles away by road.[121]

Whilst many African Kenyans were murdered by Mau Mau militants, it was the murder of certain settlers which really ignited a feeling of danger and anger amongst Europeans in central Kenya. The murder of the Ruck family and their farm worker (Muthura Nagahu) in northern Kinangop in January 1953 is one case in point. The Ruck's and Muthura were hacked to death on the family farm by assailants using pangas; a machete like farming tool.[122] Though the murder of the Ruck family occurred numerous miles to the north of the EAAFRO headquarters, it would have resonated with the organisation's European staff. The Ruck's were seen as an idealistic, young settler family and their deaths triggered a wave of European led protest in Nairobi.

---

[119] Ibid., 390. For more on collective punishments in connection with Mau Mau, see Thomas J. Wright, "'Constituencies of Control': Collective Punishments in Kenya's Mau Mau Emergency, 1952–55," *Journal of Imperial and Commonwealth History* 51, no. 2 (2023): 323-50.
[120] Anderson, *Histories of the Hanged*, 393.
[121] Pereira, "Bernard Augustus Keen," 219.
[122] Anderson, *Histories of the Hanged*, 93-7.

Many of the staff at EAAFRO took up roles connected to the Emergency. In the EAAFRO annual report for 1952, Keen noted how, since the declaration of a State of Emergency in October that year, "the greater proportion" of his male staff had joined the Kenya Police Reserve, while the remainder had joined the Special Police and "several of the women staff" were "giving useful assistance in office and telephone duties."[123] The Kenya Police Reserve was a gendarmerie whose membership expanded significantly following the declaration of a State of Emergency. Most of its new full and part time officers were settlers. Its members had a reputation in Kenya for their extreme political views and tendency to use physical force in their treatment of African Kenyans.[124] Pereira later recalled his experiences as commandant of the Kenya Police Reserve unit at the EAAFRO headquarters. According to Pereira, all those in the unit "took turns in active 24-hour patrolling of the area."[125] Somewhat facetiously, Pereira also recalled the unit's collective surprise at finding that "the best pistol shot on the Station proved to be Dr Haydon Storey, F.R.S." who, then aged 60, had previously been a pilot on the Western Front during the First World War.[126]

Unsurprisingly, research work at EAAFRO was obstructed due to staff commitments to Emergency measures. Writing in the EAAFRO annual report for 1952, Keen highlighted how the "routine and short-notice night patrols and other duties" constituted a "handicap to the day-time research work," and how "further inconveniences" had been caused by the "necessity to postpone some journeys to, and work at, outside centres, because of the pressure of local duties."[127] Keen reported a similar situation in the EAAFRO annual report for 1953.

[123] CO 927/427, Annual Report of the East African Agriculture and Forestry Research Organisation for 1952, p 5.
[124] Anderson, *Histories of the Hanged*, 85.
[125] Pereira, "Bernard Augustus Keen," 219.
[126] Ibid.
[127] CO 927/427, Annual Report of the East African Agriculture and Forestry Research Organisation for 1952, p 5.

> The State of Emergency declared by the Kenya Government in October 1952 lasted throughout 1953. The whole of the male European staff, except for two members who are in the Special Police, has continued its service in the Kenya Police Service. These conditions have adversely affected the research output at the Muguga headquarters, because the calls of the Authorities on the services of the Muguga KPR [Kenya Police Reserve] Section have increased. In addition, work at outside centres has been affected, either because of difficulties in making the journey or because time could not be spared. At the end of 1953 there were, unfortunately, no indications of an early return to normal research and administrative conditions.[128]

Keen's reports suggest his staff's commitments to serving in the various police units in Muguga significantly curtailed research work. It appears that research was sometimes less of a priority than these other duties.

As alluded to in the quote above from Keen's report for 1953, it was not just research work in the laboratories and facilities on site at Muguga which were hindered by Emergency conditions but also research that took place on various field sites away from the EAAFRO headquarters. Time could often not be spared away from policing and other duties on site at Muguga. Political realities outside Muguga also presented unique barriers to field work. In Embu (to the northeast of Nairobi near the foothills of Mount Kenya), an Agricultural Officer responsible for carrying out fertilizer field trials initiated under an EAAFRO Native Fertilizer Scheme reported in October 1953, for instance, that only one trial plot was able to be harvested because "Mau Mau destroyed one" and the Kenya Police Reserve was "feeling hungry" with the other.[129]

The political situation also affected soil survey work. The soil survey section at EAAFRO reported in 1953 that, due to "unsettled conditions", survey work involving the mapping of soil associations had been confined to a relatively small area immediately to the east of Nairobi.[130] What was meant by the term "unsettled conditions" is not immediately clear but given the tone of the rest of the annual report in which it was included, it could very well have been a reference to the political situation concerning the Emergency. Many field sites in central Kenya may have been virtually inaccessible or too dangerous for Gethin-Jones and Scott to spend prolonged periods of time doing soil survey work during the heights of the

[128] CO 927/427, Annual Report of the East African Agriculture and Forestry Research Organisation for 1953, p 5.
[129] District Agricultural Officer, Kiambu, to The Agricultural Officer (Experiments), Embu, 13/10/53, Kenya National Archives (KNA), DAO/KBU/1/239.
[130] CO 927/427, Annual Report of the East African Agriculture and Forestry Research Organisation for 1953, p 60.

Emergency. Even before the Emergency, difficulty in obtaining the cooperation of some farmers in central Kenya in soil studies had been raised. V.A. Beckley (then Senior Agricultural Chemist in Kenya) had pointed out during the 1932 soil chemists conference at Amani how research workers in Kenya had to resort to taking "snatch" samples of soil in areas of shifting cultivation in Kikuyu Reserves due to farmers' supposed suspicions of holes being dug on their land.[131] "The field" for soil surveyors in central Kenya was far from a politically neutral space.

5.8 Conclusion

When EAAFRO was established in Kenya after 1945, it seemed to present an opportunity to implement a new programme of soil surveys in the East African region. As with the 1930s, soil science was given a role in visions of East African development. Such ideas were crystallised by Keen in a rhetoric that claimed the study of tropical soils would form the first "fundamental" or "basic" research stage of a three stage process through which research undertaken by staff at EAAFRO would inform agricultural practice in East Africa. Where Milne had been operating in a global context in which tropical soils had received relatively little scientific attention during the 1930s, the postwar period was characterised by greater interest in, and arrangements for, the study of tropical soils. Keen presented EAAFRO as a place from which British contributions to this field would be made. This was a rhetoric that carried symbolic connotations of the efficacy of Britain's plans for colonial development and agricultural intervention in Africa.

Up to 1953, the trajectory of soil survey work at EAAFRO had been marked by a stark contrast between ambition and implementation. Keen's initial claims about soil surveys being both of practical use for agricultural development, as well as contributing to international soil science had failed to materialise on the ground. The causes were numerous. There was a disconnect between EAAFRO and the Departments of Agriculture and other institutions in East Africa responsible for putting the results of research into practice; staffing and financial issues made it difficult to obtain the personnel and resources necessary to carry out soil surveys in the first place; and the political situation in central Kenya with the Mau Mau rebellion during the early-1950s absorbed the time and efforts of research staff at the EAAFRO headquarters in Muguga. By 1952, Keen had come to champion a different rhetoric

[131] *Proceedings of a Conference of East African Soil Chemists Held at the Agricultural Research Station, Amani, … 1932*, 14.

about soil survey at EAAFRO. He now focused on the immediate practical relevance of soil surveys, pushing to the background his earlier notion that EAAFRO soil survey work would make profound contributions to international soil science. Though EAAFRO received much support from London, the trajectory of research at the organisation was influenced by developments in East Africa itself. Grand plans for the relationship between soil science and East African development had to come to terms with realities on the ground. The trajectory of soil science at EAAFRO up until 1953 suggests that failed aspirations were the norm rather than the exception.

CHAPTER SIX

Between Colony and Continent: The Inter-African Pedological Service and the Tensions of Integrated Soils Research, 1948-65

6.1 Introduction

This chapter will explore the tensions between visions of integrated soils research activities across Africa, and the expectation that soil science would serve the needs for development at the level of individual colony or nation. It focuses on the Inter-African Pedological Service; a high profile inter-territorial collaborative scheme set up during the postwar period aimed, broadly speaking, at promoting cooperation and collaboration in pedological research between various European colonial governments in Sub-Saharan Africa.

The Pedological Service was part of broader developments in arrangements for scientific research during the late-1940s that focused on cooperation between African nations and European colonial powers. Two new organisations were formed in 1949 and 1950, both functioning in different ways to facilitate such cooperation. These were the Scientific Council for Africa South of the Sahara (CSA) and the Commission for Technical Cooperation in Africa South of the Sahara (CCTA). They were established in 1949 and 1950 respectively and united under a joint secretariat in 1958. Initial membership of both organizations included the United Kingdom, France, Belgium, Portugal, South Africa and Southern Rhodesia.[1] The Pedological Service was one of numerous organisations established under the auspices of the CCTA. The function of the CCTA was, in the words of Edgar B. Worthington, to act as an "inter-governmental organization for discussion and executive decision."[2] It was recognised for its ability to enable "things to happen" in the technical sphere on a continental scale without recourse to long diplomatic procedure.[3] A key function of the CSA, on the other hand, in addition to the organization of its own collaborative schemes, was to act as the scientific advisor to the CCTA.[4] Together, the CCTA and CSA formed a novel international system that worked to promote technical and scientific cooperation between colonial powers,

[1] Isebill V. Gruhn, "The Commission for Technical Cooperation in Africa, 1950-65," *Journal of Modern African Studies* 9, no. 3 (1971): 459.
[2] Edgar B. Worthington, "Science in African International Relations," *International Affairs* 29, no. 1 (1953): 56.
[3] Ibid.
[4] Ibid.

and later independent states, throughout the African continent. The Pedological Service was one of the major schemes that came to fruition under this system.

The idea that there ought to be scientific cooperation, as opposed to competition, between colonial powers in Africa in their dealing with various problems in fields such as the environment, health and others, had been a conviction of some imperial statesmen since at least the late-1930s. It had been one of the key arguments laid out by Lord Hailey in his *An African Survey* (1938).[5] Helen Tilley notes that Hailey's recommendation for the establishment of a "permanent African Research Bureau" was an important strand in the origin of the CSA.[6] Isebill V. Gruhn similarly points out the significance of the Royal Society's Empire Scientific Conference held at Senate House in London in 1946 in providing a platform for scientists working in Africa to express the need for a "framework for cooperation".[7] Calls for inter-African scientific cooperation had been made well before the establishment of the CCTA and CSA.

Though the first calls for a scheme for integrated pedological research in Africa were made in 1948, progress in getting the Pedological Service into operation was slow. It was not until October 1953 that the first meeting of the Council of the Service, which was the body responsible for overseeing its functioning, was held. This marked the starting point of the inauguration of the Service. The meeting took place between 20-1 October 1953 at the headquarters of the Service; the Institut Nationale pour l'Etude Agronomique du Congo Belge (INEAC). This was an agronomic research institute located in Yangambi in the Belgian Congo, just west of the city of Stanleyville along the northern bank of the Congo River.[8] Gethin-Jones, the senior research officer for soil survey at EAAFRO, was one of only a handful of "experts" present at this meeting as a member of the Council.[9] He likely made the journey to Yangambi from the EAAFRO headquarters at Muguga, Kenya.

By the mid-1950s, one of the main activities of the Pedological Service was the preparation of a new soil map of Africa. The rationale behind the project was that such a map could be used as a tool for land-use and agricultural planning on a continental scale. It was pedological research on a large scale aimed at providing a view from above of the soils of the entire African continent. The map(s) was to be built by utilising a network of regional hubs

---

[5] Hailey, *An African Survey*.
[6] Helen Tilley, *Africa as a Living Laboratory*, 380.
[7] Gruhn, "The Commission for Technical Cooperation in Africa," 459.
[8] For more on INEAC, see Wemo Menge, *Le Transfert du Savoir Agricole au Congo-Zaïre: Héritage Colonial et Recherche Agronomique* (L'Harmattan, 2001).
[9] CO 1029/185, Report of the First Meeting of the Council of the Inter-African Pedological Service (Yangambi 20-21 October 1953), enclosed in circular by P.M. Henry, 13/5/54, no. 25, p 1.

and research centres in Africa itself. This said, the vision of large-scale development planning and diplomacy which permeated the project were not shared by all. Focusing on Kenya, this chapter shows how those responsible for the implementation of agricultural development on a national scale, such as staff within the Kenya Department of Agriculture and even EAAFRO at times, held views that were extremely critical of the Service's activities. In the case of Kenya, scepticism towards the Service was consistent from its inception right through until at least the early-1960s, by which point the political landscape of inter-African scientific cooperation was rapidly changing with the increasing number of independent African states. This chapter shows the tensions that could exist between internationalism in soil science which conferred status, and "the local" which spoke to utility but lacked the same prestige.

6.2 Reception of the Inter-African Pedological Service in East Africa and London

When the Pedological Service was in its initial stages, the value of East African colonial governments committing to the scheme was perceived differently between those in the Colonial Office in London and those in the East African governments themselves. Disagreements emerged and these were largely due to differences in metropolitan and local East African priorities. There were a range of factors operating at an international scale which might not have appeared as relevant for those concerned with governance or development at the level of the individual colony.

The origins of the Pedological Service lay in a recommendation made at a soils conference held in Goma in the Belgian Congo in November 1948. Attended by representatives of France, the United Kingdom, Portugal, the FAO, Belgium and others, the conference culminated in numerous recommendations being made for the advancement of inter-territorial collaboration in soil science across Africa. This included the setting up of a "Pedological Service" charged with the duty of formulating a common soil terminology.[10] The plan was for this Service to be based at INEAC in the Belgian Congo. Soil studies had been carried out through INEAC since the interwar period. The Belgian pedologist and Professor at the University of Louvain in Belgium, J. Baeyens, for instance, worked as a Chargé de Mission at INEAC during part of the 1930s, publishing research on soils in the Bas-Congo in 1938.[11]

[10] CO 852/1010/1, General recommendations of the Goma soils conference as stated in the Secretary-General's report, n.d., no. 2.
[11] J. Baeyens, *Les Sols de l'Afrique Centrale, Spécialment du Congo Belge: Tome I, Le Bas-Congo* (J. Duculot, 1938).

Historians have pointed out the political and diplomatic motivations behind inter-territorial scientific cooperation in Africa after 1945. Damiano Matasci argues that whilst the shared existence of problems such as soil erosion, human pandemics and more drove a desire for inter-African scientific cooperation, such cooperation took place against a political backdrop that included the rise of anti-colonial movements, pressure from international organizations providing development aid in Africa, as well as the weakening of colonial powers from "world conflict".[12] Matasci writes that it was within this context that "colonial science became a crucial instrument in supporting a vast project to economically and socially modernise the African territories, with the ultimate aim of relegitimising the 'civilising mission' of colonialism on the national and international stage."[13] Writing in relation to the field of medicine, Jessica Pearson-Patel draws attention to the ways in which scientific cooperation in Africa could be tied more specifically to the goal of countering criticism of European colonialism within UN agencies, many of which were coming to have greater involvement in the African continent after 1945.[14] Existing scholarship suggests that inter-territorial scientific cooperation in Africa through bodies such as the CSA and CCTA was tied as much to practical ambitions of dealing with environmental, health related and other problems as it was with the more political and diplomatic goals of reasserting the legitimacy of European colonial rule in Africa at a time of imperial crisis, or looking toward maintaining a relationship with independent nations as part of the commonwealth.[15] It is also worth noting that such cooperation took place within the context of the Cold War, with greater interest on the part of the US and the USSR in African affairs.[16] As Secretary General of the CSA, Worthington positioned the forging of closer ties between African colonies as important for the planning and execution of development, as well as global peace. In an article in the journal *International Affairs* in 1953, Worthington claimed that integration of development effort was seen as a way of bringing the "vast and diverse" African continent "into some form of cohesion whereby it might become a bulwark for peace."[17] Exactly what this was a

[12] Damiano Matasci, "Internationalising Colonial Knowledge. Edgar Barton Worthington and the Scientific Council for Africa, 1949–1956," *Journal of Imperial and Commonwealth History* 48, no. 5 (2020): 894-5.
[13] Ibid., 895.
[14] Jessica Pearson-Patel, "Promoting Health, Protecting Empire: Inter-Colonial Medical Cooperation in Postwar Africa," *Monde(s)* 7, no. 1 (2015): 213-30.
[15] See also Miguel B. Jerónimo and Hugo G. Dores, "Enlightened Developments? Inter-imperial Organizations and the Issue of Colonial Education in Africa (1945–1957)," in *Education and Development in Colonial and Postcolonial Africa: Policies, Paradigms, and Entanglements, 1890s–1980s*, ed. Damiano Matasci, Miguel B. Jerónimo and Hugo G. Dores (Palgrave Macmillan, 2020), 237-62.
[16] Elizabeth Schmidt, "Africa," in *The Oxford Handbook of the Cold War*, ed. Richard H. Immerman and Petra Goedde (Oxford University Press, 2013), 265-85.
[17] Worthington, "Science in African International Relations," 52.

bulwark against was not made explicit. It may well have been a reference to countering the influence of the USSR in Africa but this is not clear. Nevertheless, Worthington was clear in his view that a key way of forging alliances was through scientific collaboration and cooperation.[18]

The crux of the issues that emerged between the Colonial Office and East African colonial governments was that the Colonial Office was more eager to see East African governments commit to the Pedological Service than the East African governments were themselves. Evidence of East African governments' hesitancy about committing to the Pedological Service during the latter's initial years can be seen in the concerns raised by the Kenya Director of Agriculture (Gilbert M. Roddan) in November 1952. Writing to the Member for Agriculture and Natural Resources in Nairobi, Roddan expressed his scepticism about the value of the Service for Kenya. "I am becoming quite bewildered", Roddan wrote,

> by the number of committees and services and conventions which I hear of daily. A very large number of Commissions and Committees have been concerned with the foundation and function of this particular service – the Pedological Service. It has taken them four years (since the Goma Conference) of contortions to arrive at the present position in a matter which is relatively simple. I feel sure that international cooperation in technical matters would be better achieved through neighbourliness between territories and personal contact and friendship between scientific workers studying them.[19]

Roddan reported that the soil chemist working in his Department also had reservations about the Service; namely, that much of its work in the initial years would be biased toward Congo soils, meaning the "direct benefit to Kenya will be small", as well as the potential for overlap with other committees organized by the International Society of Soil Science, such as those for the standardization of pedological methods and soil nomenclature.[20] Evidently, the value of the Service was not necessarily apparent to senior staff within the Kenya Department of Agriculture. For Roddan, technical collaboration could be better organized through other less formal and time consuming avenues. For Roddan's soil chemist, furthermore, the technical content of the Service was disconnected from Kenya and was at risk of overlapping with existing arrangements in international soil science.

---

[18] Ibid.
[19] Director of Agriculture, Kenya, to the Member for Agriculture & Natural Resources, Nairobi, on "Inter-African Pedological Service," 17/11/52, KNA, BV/3/1672, no. 42.
[20] Ibid.

East African colonial governments and even EAAFRO also expressed reservations toward committing to the formation of an Eastern African Regional Committee in connection with the Pedological Service. This committee was one of four regional committees the Service intended to establish to help coordinate its work, such as through the holding of conferences and acting as hubs for the collection of data.[21] The prospects of British East African territories committing themselves to such a committee was a topic of discussion at the third meeting of the East African Advisory Council in January 1952. A paper was circulated to members of the Council before the meeting detailing how the governments of Uganda, Zanzibar and Kenya wished *not* to be represented officially on such a committee, and how only the Government of Tanganyika expressed interest in joining, albeit with the proviso that most of the transaction of the business of the committee be done by correspondence given the distances that its members would have to travel to meet specialists in other territories.[22] The paper also had details on Keen's view on the matter. This was sceptical to say the least. Some of Keen's reservations included his view that formal regional conferences on matters such as pedology were needed only at "relatively lengthy intervals", as well as the fact that the head of INEAC had not yet visited East Africa for a discussion on the matter of coordinating soil types throughout Africa. Keen had been present at the Goma soils conference, where it had been suggested that such a visit by the head of INEAC was a necessary precursor to the formation of any regional committee.[23] The overall conclusion of the East African Advisory Council was that it was "premature" to establish the Eastern African Regional Committee.[24] This said, they welcomed "contact at the technical level" between scientists working on similar problems across the region, albeit through the "interchange of visits and correspondence than by the establishment of a permanent organisation operating through the medium of large-scale periodic conferences."[25] There was a sense that committing to an Eastern African Regional Committee in line with the original proposals at the Goma soils conference might take up too much of the time of the limited numbers of soil scientists in East Africa; particularly if they were expected to regularly attend conferences.

---

[21] CO 927/188/6, "Proposed Establishment of an Eastern Regional Committee for Soil Conservation and Land Utilization," 20/12/51, item 6, pp 1-4.
[22] Ibid., p 1.
[23] Ibid., pp 3-4.
[24] CO 927/188/5, Conclusions of the Third Meeting of the East African Advisory Council held 25-6 January 1952 at Muguga, Kenya, enclosed in letter from the East Africa High Commission to the Under Secretary of State for the Colonies, 5/3/52, no. 14, p 3.
[25] Ibid.

In contrast with the reservations of some in East Africa, the Colonial Office was eager to see British East African involvement in the Pedological Service. In 1952, the East Africa High Commission reported that the Colonial Secretary was "reluctant to accept the view expressed by the East African Governments" regarding the establishment of the Eastern African Regional Committee.[26] One of the key concerns for the Colonial Secretary, as reported by the East Africa High Commission, was that an "unwillingness" on behalf of British territories in East Africa to join the Committee might be perceived as a "failure to cooperate internationally for the promotion of scientific ends in Africa."[27] This was especially so given the Colonial Secretary's knowledge that the establishment of the committee had been favoured by the majority of the non-British territories in Eastern Africa.[28] There was political pressure for the Colonial Office to be ensuring that British territories in East Africa were not seen to be falling behind the latest developments in inter-African collaboration in soil science. For the Colonial Office, this was a concern about the image of Britain as a colonial power on the international stage.

The Colonial Office was particularly concerned with the case of Kenya. By December 1952, the view of the Kenya Government was not just that Kenya ought not to join the Eastern African Regional Committee, but that Kenya also ought not to cooperate in the Pedological Service itself. R.O. Hennings, a government official in Kenya, wrote a letter to the Colonial Office expressing his government's stance on the Service on 18 December 1952. One of the key reasons voiced by Hennings was financial. Whilst the Belgian Government had agreed to cover the entire costs of staffing the Pedological Service for the first four years, it was planned that the contributing governments would be expected to cover some of the costs after this period. Hennings feared that such future financial contribution would fail to get legislative approval in Kenya when the time came. He referenced similar experiences of legislative rejection of Kenyan contribution to a "Soils Bureau" and "Locust controls", and argued that Kenya ought not to join the Pedological Service now so as to avoid future embarrassment.[29] Writing in response to Hennings, P. Rogers in the Colonial Office agreed that future Kenyan withdrawal would be embarrassing. Nevertheless, Rogers thought that

[26] CO 927/256, Item 9, "Eastern African Regional Committee for Soil Conservation and Land Utilization," paper for the Fourth Meeting of the East African Advisory Council, 25/11/52, enclosed in circular from the East Africa High Commission to the Colonial Secretary, 20/12/52, no. 2, p 2.
[27] Ibid.
[28] Ibid.
[29] R.O. Hennings to P. Rogers, Colonial Office, 18/12/52, KNA, BV/3/1672, no. 55.

participation in the Pedological Service would also be "in Kenya's own interest".[30] Rogers pointed out that, if the Pedological Service lived up to its plans of seeking common standards for pedological research and soil analysis in Africa, it would be "performing a very real and much needed service to the world of soil science which is not duplicated anywhere else."[31] Indeed, this was the original aim of the Pedological Service. Among other things, Rogers also alluded to the political expediency of Kenya joining the Service, although he wrote about this rather cryptically.

> I will not burden you by reiterating the more general political arguments for the establishment of these Inter-African services which provide for cooperation at the technical level between the various African powers. The arguments are, no doubt, over-familiar to you. In any case, our view is that the proposed Pedological Service will be filling a sufficiently genuine and strongly felt need to stand or fall on its own merits.[32]

Later in the letter, writing in regard to the Belgian Government's financial contribution to the scheme during its initial years, Rogers even stated that it would be "churlish, to say the least of it, for H.M.G. [Her Majesty's Government] to refuse so generous an offer."[33] Similar to the way in which the Colonial Secretary was concerned about East African governments' stances on the Eastern African Regional Committee, the Colonial Office was also concerned about the political implications of Kenya not contributing to the Pedological Service itself. Exactly how these "political arguments" were in Kenya's interests was not made clear by Rogers, though. The arguments he put forward reflected the priorities of those in the Colonial Office rather than that of Kenya Government.

The Colonial Office's correspondence with East African governments about their involvement in the Pedological Service suggests that political and diplomatic considerations were one of the key reasons they were keen to see East African governments contribute to the Service. The Service carried with it an image that it was helping bring modernity and welfare to Africa. Take the remarks made by the Belgian Inspector Royal of the Colonies (P. Staner) at the first meeting of the Council of the Service held at Yangambi in October 1953:

---

[30] P. Rogers, Colonial Office, to R.O. Hennings, Office of the Member for Agriculture & Natural Resources, Nairobi, 19/1/53, KNA, BV/3/1672, no. 60.
[31] Ibid.
[32] Ibid.
[33] Ibid.

> The interest of nations responsible for territories in Africa is not restricted to mineral wealth. We have reason to be more concerned with the potential agronomic possibilities that can contribute to an increase of economic and social welfare. And that is an urgent matter.
>
> Making this wealth available raises some difficult problems and if we are to solve them, we must have some sound basic knowledge. Collecting and coordinating such information calls for close cooperation between the various research workers, and between their respective research Centres.[34]

Staner invoked the idea that the Service would be working to unlock the potential, both economic and social, of Africa. Whilst these comments were made after the Colonial Office first started corresponding with East African governments about their commitment to the Service, they demonstrate the ways in which the latter held paternalistic connotations of providing economic and social welfare to African territories. Being concerned with the reputation of Britain as a colonial power on the international stage, British East African contribution to the Service would have been politically expedient for the Colonial Office.

Whether the political arguments for the establishment of inter-African services alluded to by Rogers in his letter to Hennings reflected a broader aim within the Colonial Office of "relegitmising the 'civilising mission' of colonialism", as described by Matasci, is not clear.[35] Nevertheless, Matasci and others historians' work supports the idea that political and diplomatic considerations were a key factor behind the desire within the Colonial Office for East African governments to contribute to the Pedological Service.

The Colonial Office's desire for East African involvement with the Pedological Service paid off to a certain extent. Gethin-Jones attended the first meeting of the Council of the Service at Yangambi in October 1953. Following his visit, he prepared a report of events at the meeting which was later sent to the Colonial Office. The report included summaries of discussions that took place, as well as Gethin-Jones' personal views on the scheme.[36] Gethin Jones also attended the second meeting of the Council, held at Yangambi from 8-10

---

[34] CO 1029/185, Annexe I, "Address of Welcome by Mr. P. Staner," in Report of the First Meeting of the Council of the Inter-African Pedological Service (Yangambi 20-21 October 1953), enclosed in circular by P.M. Henry, 13/5/54, no. 25, p 1.
[35] Matasci, "Internationalising Colonial Knowledge," 895.
[36] Personal report by Gethin-Jones on the technical business of the meeting of the Council of the Inter-African Pedological Service on 20-1 October 1953, n.d., KNA, BV/3/1672, no. 103/1; CO 1029/185, Chairman of the East Africa High Commission to the Colonial Secretary, 2/2/54.

November 1955. Similar to the first meeting, he prepared a report on this second meeting that was later sent to the Colonial Office.[37]

By 1955, the stance of some East African governments on the Eastern African Regional Committee had also changed. The first meeting of this committee was held at Muguga, Kenya from 15-16 March 1955. In attendance were delegates from Uganda, Tanganyika, the Belgian Congo (also representing Ruanda-Urundi), Madagascar, Reunion, and the East Africa High Commission. Kenya was notably absent, even though the meeting itself was held at Muguga, near (if not at) the EAAFRO headquarters.[38] The Kenya Government's absence was remedied somewhat by the provision of trips for delegates to visit soil conservation measures in the Machakos and Limuru areas of Kenya during the two days following the meeting. A prefatory note to the report of the meeting stressed how these trips had been afforded "by courtesy of the Department of Agriculture of the Government of Kenya".[39]

The reluctance of some governments to contribute to the East African Regional Committee was noted by the Administrator of the East Africa High Commission in his opening speech to the meeting.

> The establishment of this Committee has, as you know, not been attained without difficulty, and even now its membership is not as complete as we would desire, and as we hope may one day be the case. The important thing however is that we have made a start, and it is my earnest hope that the Committee, by its useful labours, will gain the confidence of the Governments and the peoples of this area in ever-increasing measure, with the result that those Governments which at the present time have not yet become participants in the Committee will ultimately do so.[40]

Kenya would have been in mind when the Administrator expressed his hopes that the committee might gain the confidence of governments and peoples in Eastern Africa in the future. Whilst Kenya's absence from the meeting was not ideal, the fact that the meeting actually took place and was attended by representatives from some British East African governments was an improvement since 1952 when the East African Advisory Council had essentially forestalled any British contribution to the committee.

---

[37] Report by Gethin-Jones on second meeting of the Council of the Inter-African Pedological Service on 8-10 November 1955, 30/11/55, enclosed in circular by the Colonial Office, 20/2/56, KNA, BV/3/1672, no. 163/2.
[38] "Eastern African Regional Committee for the Conservation and Utilization of the Soil. 1st Meeting: Muguga, 15th and 16th March, 1955," n.d., KNA, BV/3/1672, no. 149.
[39] Ibid.
[40] Ibid.

Initial opinion about British East African membership of the Pedological Service was split between officials in London and those in East Africa. For the Colonial Office in London, diplomatic and political considerations were central. There was pressure for Britain not to be seen to be falling behind developments in scientific cooperation in Africa. For most of the East African colonial governments, on the other hand, the diplomatic and political considerations that were so important for the Colonial Office were not regarded with the same sense of urgency. By 1955, the situation had changed somewhat, with Colonial Office pressure likely encouraging the formation of the Eastern African Regional Committee and Gethin-Jones' attendance of Council meetings. Yet, Kenya's absence from the Eastern African Regional Committee shows that the Pedological Service was still not seen as a priority by all governments in East Africa. Not all disagreements had been resolved. It is possible that Kenya was reluctant to get involved because agricultural research was relatively well funded in Kenya with the existence of EAAFRO and EAVRO. In other places, existing arrangements for scientific research were different and research on a coordinated basis might have appeared as extremely useful.

6.3 Toward a Soil Map of Africa … and the World

The years 1954 and 1955 marked a turning point in the activities of the Pedological Service. Between 9-15 August 1954, a second inter-African soils conference was held in Leopoldville in the Belgian Congo as a successor to the Goma soils conference of 1948. Arranged under the auspices of the CCTA and with the support of the Belgian Government, the conference was convened as an opportunity to review the progress that had been made by the permanent soils related organizations formed under the CCTA, including the Pedological Service. It was a major gathering of technical soils experts in Africa, organized so as to align with the Fifth International Congress of Soil Science which was held in Leopoldville directly afterwards. A short news piece in the journal *Africa* in July 1954 reported that every member country of the CCTA was invited to send as delegates "a maximum of eighty experts on agronomy, soil science, and soil conservation", and that invitations were also extended to other interested organizations.[41] During the conference, a recommendation was made that would come to have a lasting impact on the direction of the Pedological Service. In addition to things such as the need for the Service to facilitate the interchange of laboratory procedures and for the

[41] "Inter-African Soils Conference," *Africa* 24, no. 3 (1954): 272.

Director (the Belgian soil scientist Jules D'Hoore) to provide data and material to specialists interested in pedological studies, a recommendation was made for the Service to oversee the compilation of a new soil map of Africa south of the Sahara.[42] This later became one of the main goals of the Pedological Service. It was endorsed by the Council of the Service during their second meeting in Yangambi in November the following year.[43]

Members of the Council of the Pedological Service saw the compilation of a new soil map of Africa as an activity that would be of practical utility for development planning on the continent. Take the following excerpt from a report of the second meeting of the Council:

> The Council […] NOTED that there was a tendency in some quarters to minimise the value of small scale continental soil maps and to assume that large scale maps of small areas for development schemes were alone of practical importance. The latter were undoubtedly of great value for agriculture and for scientific research, but they did not provide the fundamental information needed to permit results and experience gained in one region to be applied to others where similar soil conditions prevailed. Small scale, continental soil maps were essential to ensure that every possible advantage was taken of utilizing the results of a relatively small number of workers, investigating problems of great complexity extending over vast areas […].[44]

For the Council, the value of producing a soil map of Africa was tied to its potential to enable the planning of agricultural development on a continental scale. It reflected the ethos of inter-territorial cooperation (as opposed to competition) that was at the heart of schemes organized under the CCTA and CSA. Yet, the Council's comments also suggest that not all were convinced of the practical utility of small-scale, continental soil maps. Although the report was not clear on exactly which "quarters" were minimizing their value, it is evident that the Council was aware that some thought a different approach to soil mapping was needed in Africa; an approach that focused on small areas in minute detail rather than more general coverage of the entire continent.

The precedent for soil mapping on a continental scale in Africa went back to at least the 1920s, with Curtis F. Marbut's 1923 soil map of Africa (Fig. 2.1).[45] This map underwent

---

[42] Report by Gethin-Jones on second meeting of the Council of the Inter-African Pedological Service on 8-10 November 1955, 30/11/55, enclosed in circular by the Colonial Office, 20/2/56, KNA, BV/3/1672, no. 163/2.
[43] CO 1029/186, Report of the Second Meeting of the Council of the Inter-African Pedological Service held in Yangambi, Belgian Congo, 8-10 November 1955, 23/11/55, no. 117, p 7.
[44] Ibid., p 4.
[45] Some general soil maps of the world created by Russian scientists during the nineteenth century had included the African continent. See Alfred E. Hartemink, Pavel Krasilnikov and James G. Bockheim, "Soil Maps of the World," *Geoderma* 207-8 (2013): 256-67.

heavy criticism by Geoffrey Milne and others in the build up to the Third International Congress of Soil Science in 1935. Critiques of Marbut's map had centred on the fact that it had been produced with little first-hand experience of African soils in the field. The Pedological Service's map was to be different in this regard. The Council claimed that the map would be built by utilising the knowledge accumulated by pedologists working in different territories across Africa. Their idea was to use the four regional committees (those for eastern, central, western, and southern Africa) as hubs that would assemble regional soil maps based upon maps of individual territories sent in by their respective pedologists. These regional maps would then be sent to the Director of the Service, Jules L. D'Hoore, at INEAC in Yangambi, Belgian Congo, where they would be collated to form the final overall map.[46] It was a somewhat similar method to that taken by Milne and his colleagues in their effort to build a soil map of East Africa during the 1930s in that it adopted a "view from everywhere", in Perrin Selcer's use of the phrase; an "epistemological strategy of coordinating diverse national perspectives to produce credible knowledge".[47] The scale of the area under investigation and the diversity of contributing territories was much larger than Milne's attempt, however.

The Pedological Service's approach to soil mapping was recognized as extremely difficult, especially for D'Hoore and other staff in Yangambi charged with synthesising a large diversity of soil information sent in from the regional committees. The Council of the Service was reported as having "realized" during their second meeting "the considerable difficulties that the Director of the Service might encounter in the carrying out of this part of his programme [pedological mapping of Africa], particularly as regards collecting and collating a large amount of data of very unequal value".[48] Gethin-Jones expanded on these difficulties in his report on the second Council meeting for the Colonial Office. He remarked how D'Hoore would have to collate material "submitted by specialists holding somewhat different views on soil classification, and also that the data procured would be of unequal merit and accuracy."[49] Pedologists working in Africa at the time adopted a variety of techniques, approaches and terminology, all of which would need to be correlated if the soil

[46] CO 1029/186, Report of the Second Meeting of the Council of the Inter-African Pedological Service held in Yangambi, Belgian Congo, 8-10 November 1955, 23/11/55, no. 117, p 7.
[47] Perrin Selcer, "Fabricating Unity: the FAO-UNESCO Soil Map of the World," *Historical Social Research* 40, no. 2 (2015): 178.
[48] CO 1029/186, Report of the Second Meeting of the Council of the Inter-African Pedological Service held in Yangambi, Belgian Congo, 8-10 November 1955, 23/11/55, no. 117, p 7.
[49] Report by Gethin-Jones on second meeting of the Council of the Inter-African Pedological Service on 8-10 November 1955, 30/11/55, enclosed in circular by the Colonial Office, 20/2/56, KNA, BV/3/1672, no. 163/2, p 5.

map was to be built. Disagreements over the characteristics and nature of tropical soils showing characteristics associated with a process known as "laterization" are just one illustration of the lack of scientific consensus on soils in Africa at the time. These soils featured heavily in the Inter-African Soils Bureau's (an adjacent body to the Pedological Service also organised under the auspices of the CCTA) bulletin *African Soils*, with regular articles summarizing recent developments in their classification emanating from international soil science gatherings over the early-1950s.[50]

There were certain measures that the Council of the Service thought might help with the project. One was the distribution of circulars dealing with expressions at risk of causing confusion between pedologists in different territories. Inspiration for this came from Jean Lozet's "Dictionnaire de Pedologie".[51] The first edition of the *Multilingual Vocabulary of Soil Science* had also been published in 1954, containing translations of key soil science expressions between nine languages.[52] This publication was a product of collaboration between the International Society of Soil Science and the FAO. It was meant to help with the translation of terms between different languages. The term "loam" in English, for instance, used to describe soil of a particular texture, had a different definition in the UK compared to the USA. "Limon", the French translation of "loam", furthermore, could also be translated to the English word "silt", which had a different meaning in a British context to that of "loam".[53] Clarifying the meaning of terms between languages and national contexts was a complex and important task if information was to be correlated between pedologists working in different territories.

Another measure that the Council envisioned helping with the project was the building up of soil monoliths or, failing these, soil samples of representative soil types at the headquarters at INEAC, Yangambi. It was proposed that this would "facilitate the comparison of data obtained from observation and analysis, with the profiles described, and thus lay the foundation of a correlation service".[54] Having soil monoliths at INEAC would enable D'Hoore and other staff there to observe the morphology of different soils themselves, essentially bringing aspects of "the field" indoors.

---

[50] See, for instance, Jules L. D'Hoore, "Proposed Classification of the Accumulation Zones of Free Sesquioxides on a Genetic Basis," *African Soils* 3, no. 1 (1954): 67-81.
[51] Report by Gethin-Jones on second meeting of the Council of the Inter-African Pedological Service on 8-10 November 1955, 30/11/55, enclosed in circular by the Colonial Office, 20/2/56, KNA, BV/3/1672, no. 163/2, p 4.
[52] G.V. Jacks, R. Tavernier and D.H. Boalch, ed., *Multilingual Vocabulary of Soil Science*, 2nd ed. (FAO, 1960).
[53] Ibid., 19-20.
[54] CO 1029/186, Report of the Second Meeting of the Council of the Inter-African Pedological Service held in Yangambi, Belgian Congo, 8-10 November 1955, 23/11/55, no. 117, p 7.

Progress was made in constructing the soil map of Africa over the latter half of the 1950s. By 1959, two successive "drawings" of the map had been prepared, based upon information sent to D'Hoore in Yangambi from the various regional committees, as well as other sources. The second drawing was discussed at a third inter-African soils conference held in Dalaba, a town in Guinea, West Africa between 2-11 November 1959.[55] Here, technical debate between pedologists and soil scientists from across the African continent over the course of several days (four sessions) culminated in the updating of the legend of the map from 35 mapping units to 45. From mid-November 1959 to mid-February 1960, the map was then completely redrawn, incorporating the new legend developed at the Dalaba soils conference, new regional documentation, as well as new observations shared at Dalaba.[56] The preparation of this third drawing marked a milestone for the project. It was the first time that a drawing of the map had been created which did not contain any gaps due to lack of knowledge.[57] It was later showcased by D'Hoore at the Seventh International Congress of Soil Science in the city of Madison, USA in August 1960.[58]

The project did face unforeseen difficulties, though. Starting in July 1960 with a mutiny of the armed forces, the Republic of the Congo (formerly the Belgian Congo) entered, in the words of the Georges Nzongola-Ntalaja, "a period of political instability and civil war" that came to be known as the first "Congo crisis", lasting until November 1965 with a military coup.[59] In July 1960, the month of the initial mutiny of the armed forces, European personnel at INEAC in Yangambi were evacuated due to violent disturbances. The Assistant Director of the Pedological Service, T. Paton, was later described as having been "seriously harmed" during the disturbances and his house looted.[60] Paton was evacuated to England, where he took leave and planned to leave the Service altogether the following year.[61] As Director of the Service, D'Hoore happened to be on leave in Europe during July, carrying with him a copy of the third map drawing that he intended to show at the Congress in Madison in August. Apart from this map and the explanatory text on West Africa which had already been sent out to

[55] "Third Inter-African Soils Conference (Dalaba, 2-11 November 1959). Reports, Recommendations and Conclusions," 16/12/59, enclosed in circular by the Colonial Secretary, 27/1/60, KNA, BV/1/2165, no. 26.
[56] "Meeting on Joint Project 11 - Soils Map (Paris, 18-21 September 1961). Progress Report on the Project by Dr. J. D'Hoore, SPI, 8/8/61, KNA, BV/1/2166, no. 40, p 1.
[57] "Third Inter-African Soils Conference (Dalaba, 2-11 November 1959). Reports, Recommendations and Conclusions," 16/12/59, enclosed in circular by the Colonial Secretary, 27/1/60, KNA, BV/1/2165, no. 26, p 13.
[58] Jules L. D'Hoore, *Soil Map of Africa Scale 1 to 5000000: Explanatory Monograph* (Lagos: CCTA, 1964), 13.
[59] Georges Nzongola-Ntalaja, *The Congo from Leopold to Kabila: A People's History* (Zed Books, 2002): 95-6.
[60] Circular by CCTA/CSA on Inter-African Pedology Service, Yangambi, 13/8/60, KNA, BV/3/1672, no. 208.
[61] "Report of the Secretary-General to the Sixteenth Session of CCTA. Lagos; 3, 6-11 February 1961," 12/12/60, KNA, BV/1/2166, no. 1A, p 30.

addressees, all of the basic documentation of the project, such as the reports and maps sent in from the regional committees, became virtually inaccessible to the Service.[62]

The evacuation from Yangambi was a severe obstacle to the progress of the project. Most of the activities of the Service were temporarily moved to the State Institute of Agriculture in Ghent, Belgium, where a professor of pedology (L. de Leenheer) lent space in his laboratory.[63] It was from Ghent that D'Hoore sent requests to the participating regional committees and pedologists for them to resend copies of the documentation that had been abandoned at Yangambi, as well as for new documents.[64] The Secretariat of the CCTA and CSA made an effort to contact the Government in Leopoldville, asking them to put measures in place to safeguard the building, equipment and archives of the Service at Yangambi but it is not clear to what extent this was ensured.[65] For all intents and purposes, the project continued from Belgium. The work of compiling a fourth approximation of the map was started by D'Hoore in February 1961, some six months after events in Yangambi. This took place at the Centre de Cartogrtaphie de Sols (IRSIA) in Belgium, with the help of the Centre's Director, R. Tavernier.[66]

As the process of constructing the final soil map of Africa neared its end during the early-1960s, an adjacent soil mapping project led by the FAO and the United Nations Educational, Scientific and Cultural Organization (UNESCO) aimed at building a soil map of the world was starting to get under way. The latter scheme emerged from discussions that took place during the Congress at Madison in August 1960. Just weeks before the Congress, FAO had launched their Freedom from Hunger Campaign; a high profile educational and information campaign set up with the goal of helping to alleviate the world from hunger.[67] FAO's new Director General, B.R. Sen, who had been influential in setting up the Campaign, attended the Congress in Madison. Sen used the Congress as an opportunity to endorse the role that soil science could play in helping FAO's goal of alleviating the world from hunger by providing the knowledge that would enable increases in agricultural production to be

[62] "Meeting on Joint Project 11 - Soils Map (Paris, 18-21 September 1961). Progress Report on the Project by Dr. J. D'Hoore, SPI, 8/8/61, KNA, BV/1/2166, no. 40, p 1.
[63] Ibid.
[64] Ibid., p 2.
[65] Circular by CCTA/CSA on Inter-African Pedology Service, Yangambi, 13/8/60, KNA, BV/3/1672, no. 208.
[66] "Meeting on Joint Project 11 - Soils Map (Paris, 18-21 September 1961). Progress Report on the Project by Dr. J. D'Hoore, SPI, 8/8/61, KNA, BV/1/2166, no. 40, p 3.
[67] Anna Bocking-Welch, "Imperial Legacies and Internationalist Discourses: British Involvement in the United Nations Freedom from Hunger Campaign, 1960–70," *Journal of Imperial and Commonwealth History* 40, no. 5 (2012): 879-896.

achieved, particularly in supposedly "underdeveloped" countries.[68] Speaking to hundreds of soil scientists from across the world, Sen invoked ideas about the fundamental role of soil in agricultural production to make an emotive case for the role that soil scientists could play in helping tackle world hunger. Sen's endorsement of the work of soil scientists at the Congress led to a resolution being made for FAO to publish seven small-scale (showing larger areas in lesser detail) soil maps that had been showcased at the Congress. This likely included D'Hoore's third drawing of Africa. It was from this resolution that the soil map of the world project was initiated.[69]

Connections had been established between FAO and the Pedological Service since the inception of the latter. An FAO official was present at the Goma soils conference of 1948 when the recommendation for an inter-African Pedological Service was first made.[70] The sending of FAO personnel to meetings in Africa connected with the work of the Service continued throughout the 1950s. In 1959, for instance, arrangements were made for FAO's soil survey expert in Brazil, Jacob Bennema, to attend the third inter-African soils conference in Dalaba, as well as a meeting of the Service's West African Regional Committee in Conakry, Guinea.[71] As Director-General of FAO, B.R. Sen had received an invitation from the CCTA in January 1959 asking whether FAO wished to send an observer to the Dalaba conference, emphasizing that their "technical participation" would be welcome.[72] With Luis Bramao (Senior Soil Scientist in FAO's Soil Survey and Fertility Branch) unable to attend, the invitation was extended to Bennema, then working from the Ministry of Agriculture in Rio de Janeiro, Brazil. The relevance of Bennema (who was based in Brazil) to these conferences focused on soils in Africa was explained by senior FAO personnel by referring to Bennema's knowledge of tropical soils.[73] Being an expert on tropical soils, even if they were those of Brazil, was seen by Bramao as a qualifier to contribute to technical debate on soils in Africa. Bennema later shared his general comments on the legend of the soil map of Africa with Bramao, noting the difficulties of correlating terms with those used in Brazil.[74]

---

[68] *Transactions of 7th International Congress of Soil Science, Madison, Wisc., USA, 1960 Volume I: Official Communications* (International Society of Soil Science, 1961), xvi.
[69] The origins and trajectory of the FAO/UNESCO soil map of the world project is examined in much greater detail in Selcer, "Fabricating Unity," 174-201.
[70] CO 852/1010/1, "African Conference on Soils, Goma (Kivu) - 8th - 16th November, 1948. Memorandum on the Meeting of the Co-ordinating Committee at Brussels, the 31st August, 1948," n.d., p 3.
[71] B.R. Sen to J. Bennema, 28/9/59, FAO Archive, IL-11/56.
[72] G.M. Greenwood to Director-General of FAO, 16/1/59, FAO Archives, IL-11/56.
[73] D. Luis Bramao to Rainer Schickele on subject "Third Inter-African Soils Conference," 18/6/59, FAO Archives, IL-11/56.
[74] J. Bennema to D. Luis Bramao, 17/7/59, FAO Archives, IL-11/50.

There were also connections between the FAO/UNESCO soil map of the world project, more specifically, and that of the Pedological Service. Following the Congress at Madison in August 1960, D'Hoore was made a member of an advisory committee established to advise both FAO and UNESCO on their soil map of the world project. D'Hoore sat on this committee as a representative of the CCTA, though he was still working as Director of the Service.[75] One of the resolutions of the committee was that the FAO/UNESCO project ought to make use of existing material in addition to field correlation work.[76] Agreements were made for data that had been accumulated by the CCTA in Africa, including through the Service, to be put at the disposal of both FAO and UNESCO in their effort to construct a soil map of the world.[77]

What this meant in practice was that the data accumulated by the Service in connection with building their soil map of Africa would be made available to those building the soil map of the world. This was to be facilitated, in part, by specialist meetings organized under the auspices of CCTA and FAO. One such meeting was planned to be held at the University of Lovanium in Leopoldville, Republic of the Congo in August 1961. The meeting was seen as a potential knowledge sharing opportunity for specialists linked to the CCTA in Africa and those linked to FAO working in different areas in the tropics. One particular goal of the meeting was to compare the Service's soil map of Africa with those of other "inter-tropical regions", particularly Latin America.[78] Bramao called upon Bennema in Brazil again to contribute to the meeting, arguing that it would "provide a further opportunity to advance soil correlation work between African and South American soils" and that "the Brazilian program will certainly benefit from your [Bennema's] mission."[79] As of March 1961, FAO had also ensured the participation of a specialist from Southeast Asia in the meeting.[80] Due to "obvious reasons", in the words of D'Hoore, however, Lovanium could no longer be used as the venue for the meeting.[81] Lourenço Marques in Mozambique was later considered as an

[75] "Soil Map of the World," *Bulletin of the International Society of Soil Science* 19 (1961): 2; "Report of the Secretary-General to the Sixteenth Session of CCTA. Lagos; 3, 6-11 February 1961," 12/12/60, KNA, BV/1/2166, no. 1A, p 30.
[76] "Soil Map of the World," 2.
[77] "Report of the Secretary-General to the Sixteenth Session of CCTA. Lagos; 3, 6-11 February 1961," 12/12/60, KNA, BV/1/2166, no. 1A, p 30.
[78] "CCTA/FAO Symposium on the Classification of Soils in Inter-Tropical Regions," 10/3/61, FAO Archives, IL-11/50.
[79] D. Luis Bramao to J. Bennema, 7/6/61, FAO Archives, IL-11/50.
[80] "CCTA/FAO Symposium on the Classification of Soils in Inter-Tropical Regions," 10/3/61, FAO Archives, IL-11/50.
[81] These reasons were likely a reference to events connected with the Congo crisis.

alternative location but similarly did not prove possible.[82] In the end, the meeting was postponed until 1962, when the Government of the Republic of the Congo agreed for the meeting to be held at Lovanium, with a technical adviser from the Congolese Ministry of Agriculture (M. Van Pee) acting as liason officer for the meeting, booking accommodation and welcoming delegates.[83]

When the final soil map of Africa was published in 1963-4, it was presented as a symbol of international scientific cooperation. The final map was spread over seven separate sheets, covering different regions of the continent, including northern Africa and Madagascar, at the scale of 1:5,000,000 (Fig. 6.1). It was accompanied with an explanatory monograph (published by CCTA in 1964) over 200 pages long, containing an overview of "the African environment", as well as descriptions and explanations of the different soils that had been classified and mapped.[84] In the preface to the monograph, the Assistant Secretary General of the CCTA, Richelieu Morris, suggested that the agreements that had been reached between the pedologists who contributed to the project (there were over one hundred authors mentioned in the monograph) were testimony to the ways in which difference could be overcome in the search for a positive future for the African continent.

> This agreement deserves special emphasis in that, several years ago, few people believed that agreement would ever be reached by pedologists from opposed schools of thought. Thus we have yet another pillar of support for the theory that African governments must agree to act in concert if they are to surmount the many obstacles on the way to attaining their goal: a better Africa for all.[85]

Morris' comments had particular resonance given the establishment of the Organization of African Unity (OAU) roughly a year earlier (May 1963) following a conference of heads of African states in Addis Ababa, Ethiopia. CCTA was incorporated into the OAU in August 1963 as one of its seven commissions; the Scientific, Technical and Research Commission (STRC).[86] The activities of the CCTA were then formally absorbed by the OAU in January 1965, with European governments' budgetary contributions to the CCTA having ceased a year earlier.[87] This transfer of the activities of the CCTA from colonial powers to independent

[82] J. D'Hoore to D. Luis Bramao, 8/6/61, FAO Archives, IL-11/50.
[83] "CCTA/FAO Symposium on the Classification of Soils in Inter-Tropical Regions. Lovanium, summer 1962," 14/6/61, FAO Archives IL-11/50.
[84] D'Hoore, *Soil Map of Africa Scale 1 to 5000000*.
[85] Ibid., 3.
[86] Gruhn, "The Commission for Technical Cooperation in Africa," 467.
[87] Ibid.

African states had been an intention of senior CCTA personnel. In 1961, for instance, the Secretary General of the CCTA (M. Cheysson) had stated in a conversation with senior Kenya Government officials that, whilst the CCTA had started life as "an African exercise between Colonial powers", in the future, it was hoped to convert CCTA into "an African exercise between independent States" and that "It was necessary to give the feeling to these States that they had invented the whole idea."[88] At a time in which independent African states were taking on and adapting some of the infrastructures of technical cooperation started during the colonial period, Morris' comments were not just an abstract call for African cooperation but resonated with the shifts in institutional frameworks taking place alongside the end of empire in many parts of the African continent. These shifts included the transfer of the responsibilities of the CCTA to the newly established OAU.

This said, the value of the final soil map of Africa was also presented in terms of its practical utility. In the explanatory monograph, D'Hoore argued that soil maps with a single legend covering entire continents or sub-continents "make it possible to assess the land resources of large regions and allow extrapolation of the results of agronomic research carried out in technologically advanced territories into other, less developed areas with comparable soils and climates."[89] Whilst the final soil map of Africa was presented as a major scientific accomplishment in and of itself, D'Hoore also presented it as a tool for continent-wide planning. D'Hoore's reference to soil maps of entire continents or sub-continents rather than the soil map of Africa per se, furthermore, also created space to potentially accommodate the FAO/UNESCO soil map of the world project within this argument about practical utility.[90]

[88] Note of a meeting held in the office of the Minister for Finance & Development at 3pm on 18 January 1961, 23/1/61, KNA, BV/1/2166, no. 2.
[89] D'Hoore, *Soil Map of Africa Scale 1 to 5000000*, 14.
[90] Ibid., 14.

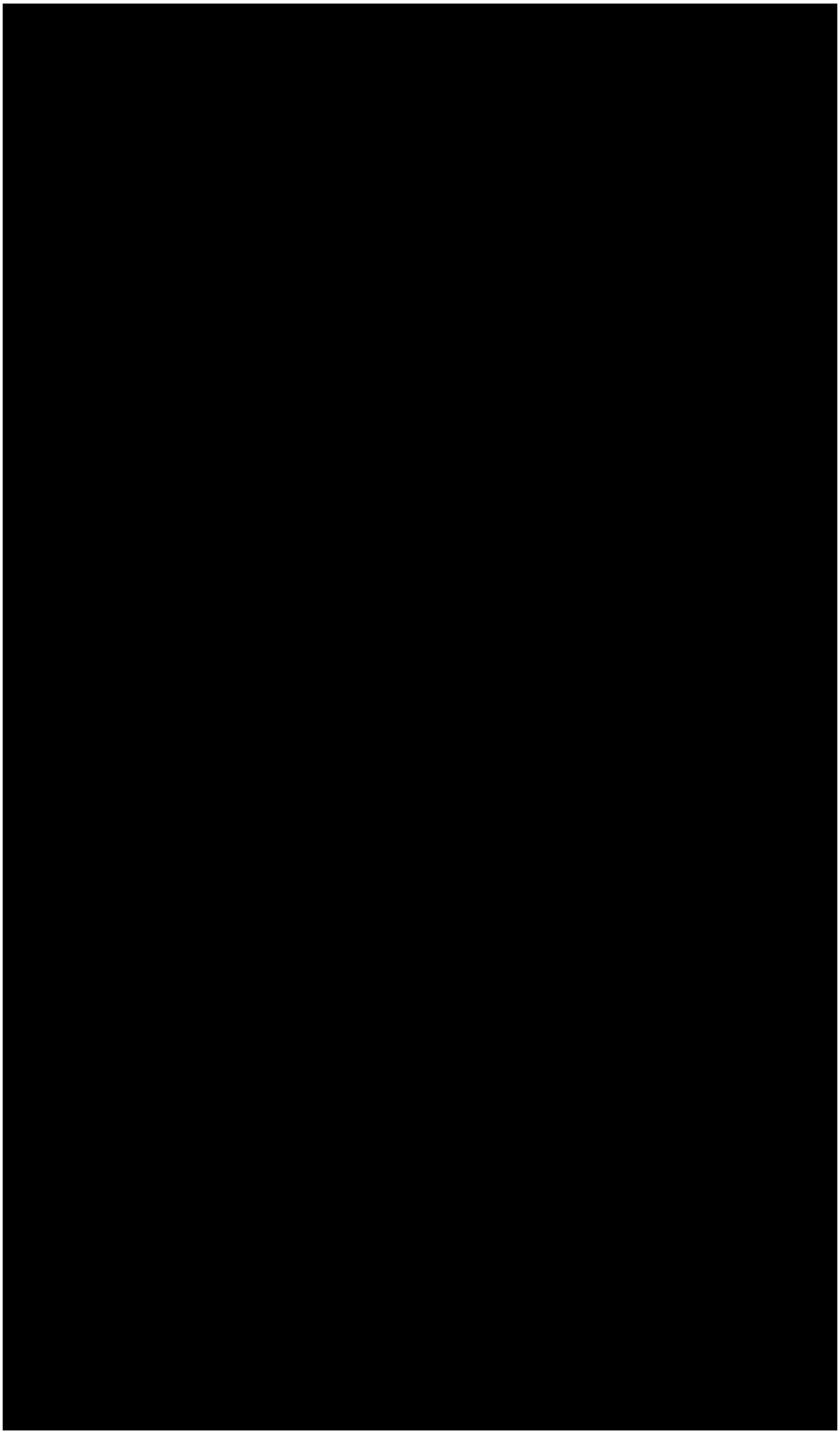

Figure 6.1. D'Hoore, Jules, L. *Soils Map of Africa Sheet 3*. Map. Bruxelles: Institut Géographique Militaire, 1963. From European Commission, *European Soil Data Centre (ESDAC)*. https://esdac.jrc.ec.europa.eu/content/soils-map-africa-sheet-3-carte-des-sols-dafrique-feuille-3 (accessed 24/7/25).

6.4 "A Cultural Exercise"

A key argument of those in support of the Pedological Service's soil map of Africa project was that the map would be a tool for agricultural or land-use planning on a continental scale. Yet, the idea that the value of the project lay in its ultimate relevance to agricultural practice in Africa was not shared by all.

Scepticism about the practical value of continental soil mapping had permeated discussions at the second meeting of the Council of the Pedological Service in November 1955. During the meeting, Gethin-Jones told attendees that a separate soil map of East Africa at a larger scale of 1:2,000,000 would be produced and "adjusted later" so as to fit within the Service's final continental map at the scale of 1:5,000,000.[91] Gethin-Jones' rationale for this was that any soil map covering East Africa at the scale of 1:5,000,000 would "be of little use to East Africa".[92] Being of smaller scale, he argued, such a map would not show the distribution of soils in enough detail to be of practical use. Such a statement at a meeting of the Council of the Service would have sat in direct opposition to claims about the map being a tool for development planning throughout the continent in the future. Indeed, Gethin Jones may have been one of the "quarters" from which the report of the meeting suggested that minimizations of "the value of small scale continental soil maps" and assumptions "that large scale maps of small areas for development schemes were alone of practical importance" were emerging.[93]

Despite these criticisms of the map's practical utility, Gethin-Jones contributed to the Service's project. Together with his EAAFRO colleague, R.M. Scott, he worked toward building a new provisional soil map of East Africa with the intention that a version of it would eventually be submitted as a contribution toward the Service's final continental map. The sources of information that went into building this new East African soil map were diverse. They included data collected by Milne and others during the late-1920s and '30s, and an experimental pedological map of Tanganyika created by the Tanganyika Government Chemist in Dar-es-Salaam (W.E. Calton, formerly Milne's assistant at Amani) based upon

[91] Report by Gethin-Jones on second meeting of the Council of the Inter-African Pedological Service on 8-10 November 1955, 30/11/55, enclosed in circular by the Colonial Office, 20/2/56, KNA, BV/3/1672, no. 163/2, p 5.
[92] Ibid.
[93] CO 1029/186, Report of the Second Meeting of the Council of the Inter-African Pedological Service held in Yangambi, Belgian Congo, 8-10 November 1955, 23/11/55, no. 117, p 4.

soil clay properties.[94] It also included information collected by Gethin-Jones and Scott themselves during soil reconnaissance journeys. One such journey took place over six weeks, involving some 4,200 miles of travel via motor vehicle across parts of Tanganyika with the assistance of Agricultural Officers along the way. The areas covered included Korogwe, Morogoro, Lindi, Songea, the shores of Lake Nyasa, Njombe, Mbeya, Singida and Arusha.[95] As of 1955, Gethin-Jones' and Scott's plan was to create this new East African soil map by combining a soil map they had built of Kenya and Tanganyika with a separate soil map of Uganda at 1:250,000 scale that was being built independently of EAAFRO by a departmental soil survey team led by E.M. Chenery.[96] A summary report by Gethin-Jones and Scott on their East African mapping project was printed internally within EAAFRO in 1955, laying forth both soil surveyors' intentions. As an excerpt from the introduction reads:

> It is fully appreciated that this second map is also a provisional one: with increasing information about the kinds of soil present and more complete surveys it is destined to be superseded. However, it is considered worth while to put on record a sorting out of the data that has accumulated to date and to offer a revised system of soil classification and cartography.
>
> It happens that one of the duties allotted to the Inter-African Pedological Service is the preparation, in collaboration with regional specialists, of a Pedological Map of Africa, South of the Sahara, and it is opportune that a revised soil map of East Africa be prepared as a basis for the synthesis of such a map for this portion of the continent.[97]

Even though Gethin-Jones and Scott recognized that their East African soil map was provisional in the sense that it was based upon incomplete data, they still saw it as a valuable contribution to the Pedological Service's larger project of constructing a continental soil map of Africa. The language used in their summary report suggests that their East African map was more about showcasing existing scientific knowledge (putting "on record") than it was creating a tool that would be of use for planning purposes. Their motivation for showcasing such knowledge may have come from a desire to demonstrate that EAAFRO had a functioning soil survey team. Grand plans for tropical soils research at EAAFRO had been

---

[94] G.H. Gethin-Jones and R.M. Scott, "A Second Provisional Soil Map of Kenya and Tanganyika," 1955, Kenya Agricultural and Livestock Research Organisation (KALRO) Library, Muguga, MUG015236, pp 2-3.
[95] G.H. Gethin-Jones and R.M. Scott, "A Soil Reconnaissance Journey Through Parts of Tanganyike," 1955, KALRO Library, Muguga, MUG015060 (631.47).
[96] G.H. Gethin-Jones and R.M. Scott, "A Second Provisional Soil Map of Kenya and Tanganyika," 1955, KALRO Library, Muguga, MUG015236, p 3.
[97] Ibid., p 2.

scuppered by numerous barriers by the mid-1950s. The production of a new East African soil map would have been a way of showing that soil surveys were actually being prosecuted by EAAFRO staff, even if it was not to the extent that had originally been envisioned by Keen.

The fact that Gethin-Jones and Scott thought it worthwhile compiling a new provisional soil map of East Africa with the understanding that it would ultimately go toward a project of which the relevance to agricultural practice in East Africa was not apparent (the Service's soil map of Africa), at least to Gethin-Jones, is all the more surprising given Agricultural Departments' demands for soil surveys in East Africa; particularly in Kenya. In October 1953, the Director of Agriculture in Kenya, Roddan, wrote to the Member for Agriculture and Natural Resources in Nairobi recommending that a request be made for the appointment of a soil surveyor from the Pool of Colonial Soil Surveyors. The rationale behind the Roddan's request was that other commitments were limiting the time that the existing field staff of his department and soil surveyors from EAAFRO could devote to soil classification. As Roddan wrote in October 1953:

> The absence of objective soil surveys is a major source of weakness in the planning of our research activities and in the transmission of our findings to the farmer. In collaboration with the Soil Survey Division of EAAFRO and with Departmental field staff, we are attempting in some measure at least to remedy this weakness but other commitments limit the time we can devote to establishing a soil classification in each area.[98]

For Roddan, the need for soil surveys in Kenya stemmed not from gaps in knowledge in international soil science but from a lack of information required to coordinate research activities and guide extension work. Roddan's comment about the need for "objective" soil surveys might have been a reference to the sort of soil surveys that would have immediate practical importance. Maybe he thought that they were produced by actual observation of soils on the spot in a way that was not the case with more large-scale soil survey, classification and mapping projects? The specific request made by Roddan was for a full-time soil surveyor who could initiate and supervise soil surveys carried out by departmental field officers, and who would be employed for a period of three years.[99]

---

[98] Gilbert M. Roddan to Member for Agriculture and Natural Resources, Nairobi, 14/10/53, KNA, BV/16/422, no. 8.
[99] Ibid.

By mid-1954, the Kenya Department of Agriculture was still in correspondence with senior government officials in Nairobi about the recruitment of a soil surveyor. A vacancy form had been sent to the Colonial Office for the appointment of a soil surveyor to the Department but there was an acknowledgment that it was not likely to be received well and so the directorship was persistent that a request for assistance also be made to the Pool.[100] By this point, the Department's rationale behind the appointment of a soil surveyor was tied to ambitions for agricultural development in Kenya related to the Swynnerton Plan. The latter was a scheme for the intensification of African agriculture in Kenya devised by Roger J.M. Swynnerton (Assistant Director of Agriculture for Field Services) together with Leslie Brown and Sandy Storrar (both Agricultural Officers in the Department of Agriculture). The Plan, published in 1954, set out a vision of African agricultural development in Kenya based upon the consolidation of land units and the establishment of different classes of rural peasants.[101] The Kenya Department of Agriculture's directorship argued that an additional soil surveyor was required to assist with the assessment of fertiliser requirements in "African areas", as well as with the establishment of numerous irrigation schemes; the second of which, at least, was an activity proposed explicitly under the Plan.[102] The Plan proposed several areas where irrigation schemes could be set up (the largest proportion being in Nyanza) and suggested that investigations into "cultural and watering techniques suited to different soil types" would be required beforehand.[103]

The specifics of how this soil surveyor would support agricultural initiatives in Kenya were made even more explicit by the Kenya Department of Agriculture in August 1954. As described in a letter from the Acting Director of Agriculture in Kenya to the Secretary for Agriculture in Nairobi:

[100] Director of Agriculture, Kenya, to the Minister for Agriculture, Animal Husbandry and Water Resources, Nairobi, 4/6/54, KNA, BV/16/422, no. 17.
[101] Hodge, *Triumph of the Expert*, 248-9; Anne Thurston, *Smallholder Agriculture in Colonial Kenya: The Official Mind and the Swynnerton Plan* (Cambridge Centre of African Studies, 1987); Judith Heyer, "Agricultural Development Policy in Kenya from the Colonial Period to 1975," in *Rural Development in Tropical Africa*, ed. Judith Heyer, Pepe Roberts and Gavin Williams (Palgrave Macmillan, 1981), 101-7.
[102] Director of Agriculture, Kenya, to the Minister for Agriculture, Animal Husbandry and Water Resources, Nairobi, 4/6/54, KNA, BV/16/422, no. 17; Roger J.M. Swynnerton, *A Plan to Intensify the Development of African Agriculture in Kenya* (Nairobi: Government Printer, 1954), 39-40.
[103] Swynnerton, *A Plan to Intensify the Development of African Agriculture in Kenya*, 39-40.

> It has now become apparent that the need for soil survey in connection with irrigation schemes, particularly those at Marigat, Wewe, Mwea, Yatta and the Tana River, is very urgent as the development of these schemes is required to proceed with the greatest possible rapidity in view of the need for accommodating persons detained in connection with the Emergency.[104]

The setting up of detention camps was one of the key responses by the British to the Mau Mau rebellion. David Anderson estimates that at least 70,000 Kikuyu supporters of Mau Mau were held in such camps during the peak of the Emergency; many without trial, "simply on the order of the administration, on the basis of accusation or mere suspicion."[105] This large number of detainees would have required logistical arrangements that included the provision of foodstuffs. Whether the irrigation schemes mentioned by the Acting Director of Agriculture were related to the production of foodstuffs for detainees, or to "accommodating" detainees in different ways, was not made clear in his correspondence, however. The development of these irrigation schemes could also have been related to the imposition of forced labour upon detainees, for instance. The colonial state capitalised on the Emergency by using detainees as a source of labour for projects that included irrigation schemes such as the thirty-seven mile long South Yatta irrigation furrow.[106]

Exactly why Gethin-Jones thought it worthwhile to contribute information to the Pedological Service's map, even when he thought it would be "of little use to East Africa" and there was a demand for soil surveys in connection with various local colonial imperatives in Kenya, may have been related to his own personal career trajectory. Before joining EAAFRO in 1952, Gethin-Jones had worked as a soil chemist within the Kenya Department of Agriculture. Some of the high profile moments in his career had been his involvement, together with his colleague at the time, V.A. Beckley, in the compilation of the Kenya portion of the 1935 provisional soil map of East Africa. Gethin-Jones had also attended some international soil science conferences, such as the conference on tropical and sub-tropical soils at Rothamsted in 1948 and the Goma soils conference in the Belgian Congo that same year.[107] Much of his time and research work, however, had been devoted to matters of local

---

[104] Acting Director of Agriculture, Kenya, to the Secretary for Agriculture, Nairobi, 6/8/54, KNA, BV/16/422, no. 22.
[105] Anderson, *Histories of the Hanged*, 5. See also Josiah M. Kariuki, *'Mau Mau' Detainee: The Account by a Kenya African of his Experiences in Detention Camps 1953-1960* (Oxford University Press, 1963).
[106] Caroline Elkins, *Britain's Gulag: The Brutal End of Empire in Kenya* (Pimlico, 2005), 167-8; James Parker, "A Wasted Eden: Colonial Water Management and Ecological Change in Kitui, Kenya 1948–63," *East African Review* 55 (2020): 10.
[107] *Report of the Conference on Tropical and Sub-Tropical Soils*, 5; "Communication No. 93 présentée à la conference africaines des sols," n.d., KNA, BV/1/358.

agricultural development and land-use in Kenya rather than contributions to international soil science. An example of the type of routine work Gethin-Jones was responsible for undertaking before his move to EAAFRO were soil surveys for settlement schemes. In December 1944, for instance, a Senior Agricultural Officer requested the services of Gethin-Jones for soil survey work in connection with five settlement schemes in Coast Province in eastern Kenya.[108] Gethin-Jones' senior colleague, V.A. Beckley, postponed this work, claiming that much more time than that which had originally been planned would be needed to do an adequate survey of the areas, and that Gethin-Jones and the Senior Agricultural Officer were "not in a fit state of health to do such a full survey."[109] The recruitment of Gethin-Jones to EAAFRO in 1952 marked somewhat of a career turning point in this regard. At EAAFRO, he would have been freer to pursue the lines of research that he desired compared to his time in the Kenya Department of Agriculture, even despite Keen's later rhetoric about the need for a more applied approach to soil surveys. Gethin-Jones' contribution to the Service's mapping project represented a further reorientation of his career toward international soil science. Contributing material, and even attending Council meetings, would have been an opportunity to advance his professional status as a soil scientist by being part of a major international collaborative project.

If Gethin-Jones' scepticism about the practical relevance of the Service's mapping project demonstrates that not all thought that the project was relevant to agricultural practice in Africa, then the views of staff within the Kenya Department of Agriculture toward the turn of the decade further foreground some of the potential contradictions of the project in its claims to practical utility.

Take E. Bellis in 1960, for instance, then Senior Soil Chemist within the Kenya Department Agriculture. Much of Bellis' work in Kenya up to this point had sat within the category of research that Keen would have labelled "technological" investigation. During the early- to mid-1950s, Bellis had led the Highlands Fertilizer Scheme. This was a CDW funded scheme organised under the auspices of EAAFRO in collaboration with the Kenya Department of Agriculture aimed at testing crop responses to fertilizer treatments on European farms in the highlands of central Kenya.[110] This included crops such as wheat, barley and oats.[111] Bellis had also been involved in soil mapping endeavours, albeit on a

[108] G.H. Gethin-Jones to Senior Agricultural Officer, Mombasa, 15/12/44, KNA, BV/7/44, no. 7.
[109] V.A. Beckley to Senior Agricultural Officer, Mombasa, 29/12/44, KNA, BV/7/118, no. 21.
[110] Bernard A. Keen et al., "Crop Responses to Fertilizers and Manures in East Africa," *East African Agricultural Journal* 19, no. 1 (1953): 19.
[111] Ibid., 34-5.

much more local scale than the Service's project. He was a co-author on a paper on the soils of the Kenya Highlands which was submitted to the Seventh International Congress of Soil Science at Madison in 1960, for instance, which included a generalised soil map of the central Kenya Highlands.[112]

In early-1960, Bellis had a telephone conversation with Swynnerton about the third inter-African soils conference held at Dalaba in November the year before. Following up on this conversation, Bellis prepared a summary of the views he had expressed to Swynnerton which was then circulated to the Director of Agriculture in Kenya in February. Bellis' summary of the conversation focused, in particular, on his opinion of D'Hoore's third approximation of the continental soil map of Africa, which had just been finished. It began with some backhanded compliments.

> Dr. D'Hoore has completed the mission given to S.P.I. [the Pedological Service], to prepare a soil map of Africa on a scale of 1/5,000,000. The map he has prepared will be of distinctly greater authority and use for Education Institutions, chair-bound policy makers and world planners than any earlier effort. Furthermore, his work has particular value in that the classification structure on which he has based his map units has its inspiration in the concepts of people actually working in Africa and does not constitute an attempt arbitrarily to impose alien ideas on the classification of African soils.[113]

Bellis clearly had some positive things to say about the project. His comments about the classification structure representing the views of those actually working in Africa were, indeed, a fact which separated the project from that of Marbut's attempt following the First World War. Furthermore, Bellis also clearly thought that the map would have authority and utility in some quarters. He did not make explicit who these bodies for whom the map would have "greater authority and use" exactly were, though. It may have been a reference to UN agencies such as FAO and UNESCO. Yet, there was a tone of sarcasm is Bellis' praise for the map. His comments about the map being of use for "chair-bound policy makers" resonated with an underlying criticism of the relevance of the map to agricultural practice that permeated much of the rest of his summary of the conversation.

---

[112] Notes representing the views of the Kenya Government on the future of the Inter-African Pedological Service, enclosed in letter from A.R. Melville, Director of Agriculture, to the Permanent Secretary to the Ministry, Nairobi, 23/8/61, KNA, BV/3/1673, no. 26, p 2.
[113] E. Bellis to the Director of Agriculture, Nairobi, 23/2/60, KNA, BV/1/2165, no. 31.

Criticisms of the relevance of D'Hoore's map to agricultural practice in Kenya were voiced more vociferously in the remainder of Bellis' summary. Part of this criticism was about a supposed bias in the authority of the map toward parts of West Africa. As Bellis wrote, "the distribution of soil surveyors in Africa and the greater pre-occupation of the Gallic than the Saxon mind with the classification of natural objects inevitably biases the authority of the map in favour of the humid and sub-humid areas of tropical western Africa."[114] His views on this may have been shaped by the fact that much of the deliberation that had gone into building the third approximation had taken place at Dalaba in Guinea, which had been a French colony until 1958. Many specialists from both France and Francophone Africa were present at the Dalaba conference, including the pedologist Georges Aubert; founder of the pedology section of France's Office de la Recherche Scientifique et Technique d'Outre-mer (ORSTOM).[115]

Bellis expanded further on the limited extent to which he thought the map could be used as a tool for planning in Kenya, invoking an anecdote of the tea agriculturist T. Eden's attempt to use the 1935 provisional soil map of East Africa to determine soil types in Kericho in western Kenya.

> The value of the map to field workers in Kenya who are faced with a diversity of environmental factors which must be unique in Africa is quite small and the classification structure, dealing as it does purely with the higher orders of classification is of no more than academic interest to us in our dealings with the detail of land-use. The pitiful attempt I once saw even Dr. Eden make after some years at Kericho to squeeze detail of local soil distribution out of the sketch outline of the first official soils map of East Africa makes me fear for the harm which can come from similar misinterpretation of the S.P.I. map or even from simple attempts to read more into it than Dr. D'Hoore intends.[116]

For Bellis, D'Hoore's map was part of a lineage of soil mapping attempts that had very limited local utility for land-use planning in Kenya; a lineage that included the 1935 provisional soil map of East Africa. Bellis thought that D'Hoore's classification system, whilst academically rigorous, was too generalised; a symptom of the practical realities of

---

[114] Ibid.
[115] "Third Inter-African Soils Conference (Dalaba, 2-11 November 1959). Reports, Recommendations and Conclusions," 16/12/59, enclosed in circular by the Colonial Secretary, 27/1/60, KNA, BV/1/2165, no. 26; Christian Feller et al., "The Importance of French Tropical Research in the Development of Pedology," *Soil Science Society of America Journal* 72, no. 5 (2008): 1375-1381.
[116] E. Bellis to the Director of Agriculture, Nairobi, 23/2/60, KNA, BV/1/2165, no. 31.

mapping soils over such a large, continental scale at the time. Bellis' comments also suggest that he was not convinced that knowledge of soils alone would be enough for field workers to plan land-use in Kenya. In Bellis' view, this was partly due to the large diversity of environmental factors in Kenya, which he thought made Kenya a unique case compared to other places in Africa. Bellis held on to a type of Kenyan environmental exceptionalism.

Bellis further voiced his scepticism of the local utility of the Pedological Service's mapping project in a letter to the Kenya Director of Agriculture in August 1961. This time, the letter was in response to correspondence that had been sent by the Colonial Secretary to East African governments about the upcoming fifth meeting of the Council of the Service. The Colonial Secretary's correspondence had stated that the British Government was entitled to send two delegates to the meeting. It had already been decided that Herbert Greene (Tropical Soils Adviser) would be one of them and the Colonial Office suggested that someone from East Africa, preferably Edward W. Russell (Keen's replacement as Director of EAAFRO), also attend so as to "represent the views of the East African territories".[117] The Colonial Secretary's correspondence had also highlighted how item 4 on the agenda of the upcoming Council meeting concerned the future of the Pedological Service, and that the Colonial Office was eager to get East African governments' views on this matter.[118] By this point, independent African states made up the majority of the CCTA's membership and the Colonial Secretary had been told by his advisers that the future of the Service was likely to be decided more by these states than colonial powers.[119]

As Senior Soil Chemist within the Kenya Department of Agriculture, Bellis thought it necessary to meet the Colonial Office's demand and voice his opinion on the matter. The letter Bellis wrote to the Director of Agriculture reiterated many of the criticisms of D'Hoore's map that Bellis had raised over a year earlier. He complimented the "perspicacity" with which D'Hoore had "discerned a pedologically acceptable classification framework […] reconciling the diversity of divergent strongly held parochial concepts which exist in individual territories."[120] Bellis "even" considered the map, once again, of value to "educational institutions", "metropolitan centres" and "international circles" where "broad policy" was considered.[121] According to Bellis' logic, the map was useful as a view from

[117] Circular by the Colonial Secretary on the Inter-African Pedological Service, 4/5/61, KNA, BV/3/16723, no. 1/A.
[118] Ibid.
[119] B.C. Wills, Director Agriculture to the Senior Soil Chemist, Kenya, 9/8/61, KNA, BV/3/1673, no. 21.
[120] E. Bellis to the Director of Agriculture, Nairobi, 4/8/61, KNA, BV/3/1673, 4/8/61, no. 20.
[121] Ibid.

above, allowing one to see overall patterns and think of broader issues of resource allocation and funding throughout the continent. Yet, criticisms concerning the severe limitations of the map as a tool for more local scale planning remained in Bellis' thoughts:

> in dealing with local land-use problems which are our concern as departmental officers, our view is that the broad generalizations which must go into the preparation of a soil map on continental scale and which inevitably are present in D'Hoore's are positively dangerous. The information which it is possible to put on such a map is too easily misinterpreted by non technical users in authoritative situations. Furthermore the information cannot be relied upon even by technical officers as an indication of the soil actually occurring in a given locality whose utilization is under examination, or of its fertility characteristics.[122]

In some ways, this new wave of criticism went further than that which Bellis had raised the year before. Rather than just suggesting that the map was limited in its local utility, Bellis was now suggesting that it was "positively dangerous" in that it gave authorities the illusion of an accurate view from above which, in practice, did not reflect realities on the ground. His comments were infused with a sense of frustration and fear.

Further on in the letter Bellis alluded to his thoughts on the project's actual function. "In our view", Bellis wrote ("we" likely referring to the Kenya Department of Agriculture), "the preparation of this map and its integration with a world map under FAO/UNESCO is a cultural exercise towards the cost of which it is not the function of our department to contribute."[123] Bellis' use of the phrase "cultural exercise" resonated with the idea that the project was more about the promotion of international scientific cooperation in and of itself than it was producing knowledge that would be of use for those responsible for overseeing agricultural development on the ground, at least in Kenya. It also resonated with the idea that the project could act as a demonstration of the strength of technical expertise in Africa at a time in which the future of the Pedological Service was moving away from colonial governments and towards newly independent African states. Indeed, Richelieu Morris' preface to the explanatory monograph later positioned the project in this way.[124]

Bellis' comments were later incorporated into an official statement on behalf of the Kenya Government on the future of the Pedological Service. This statement was then given

---

[122] Ibid.
[123] Ibid.
[124] D'Hoore, *Soil Map of Africa Scale 1 to 5000000*, 3.

to the Tropical Soils Adviser, Herbert Greene, as a brief in respect of Kenya for his trip to Paris to attend the fifth meeting of the Council of the Service in September 1961.[125] The brief contained all the main criticisms that Bellis had raised earlier that year, such as how the information in the map could not be relied upon by technical officers, and "As far as land use studies in Kenya are concerned" the map had "little or no relevance".[126] Nevertheless, the stance of the Kenya Government was that the work of the Pedological Service ought to continue "on the grounds that it will tend towards the maintenance of satisfactory standards in soils research at the present time."[127] This latter comment was informed by correspondence from Bellis to the Director of Agriculture earlier that year in which Bellis had endorsed the continuation of the Pedological Service so as to enable the "maintenance of satisfactory standards in soils research at a time when circumstances tend to a lowering of these standards."[128] Perhaps Bellis was worried that some sloppy work was being done? Whilst the Kenya Government saw the main activity of the Pedological Service (the construction of a continental soil map of Africa) as disconnected from agricultural practice and land-use in Kenya, they nonetheless held onto ideas about it being a valuable way of maintaining standards of scientific research.

6.5 Conclusion

From its inception, the Inter-African Pedological Service was perceived with scepticism from people in East Africa. Staff within the Kenya Department of Agriculture and even EAAFRO raised concerns about the utility of the scheme before it was officially inaugurated and proposed alternative means through which scientific cooperation between soil specialists in different territories could be arranged. Nevertheless, in the eyes of the Colonial Office, East African governments' contribution to the scheme was desirable along numerous fronts, not least for the political and diplomatic expediency of British East African territories being seen to be keeping up with the latest developments in international scientific cooperation.

The activities of the Service accelerated during the mid-1950s, with the building of a soil map of Africa becoming one of its main functions. Yet, tensions over the value of the work of the Service remained. Whilst the mapping project was seen by some as a valuable

[125] Notes representing the views of the Kenya Government on the future of the Inter-African Pedological Service, enclosed in letter from A.R. Melville, Director of Agriculture, to the Permanent Secretary to the Ministry, Nairobi, 23/8/61, KNA, BV/3/1673, no. 26.
[126] Ibid., p 1.
[127] Ibid.
[128] E. Bellis to Director of Agriculture, Nairobi, 10/8/61, KNA, BV/3/1673, no. 23.

contribution to scientific knowledge and even a symbol of international cooperation during a period of decolonisation, there was a view among those responsible for the implementation of agricultural development and land-use planning, at least in Kenya, that the project represented little more than a wasteful expense of technical resources on high profile international science rather than the production of authoritative knowledge of use for development planning on the ground.

Whether or not the Service's final map was successfully used for development planning is not the concern of this chapter. Answering such a question would require further research. Rather, this chapter shows the different perspectives from which soil science could be attributed value in Africa during the late colonial period. It shows a disconnect between those who saw soil science as serving political and diplomatic functions, whether it be the Colonial Office with their concerns about British East African territories keeping up with international scientific developments or Richelieu Morris positioning the final soil map(s) of Africa as a lesson of international cooperation for independent African states, and those for whom soil science was meant to be a tool for implementing changes in agricultural production and land-use in practice, such as Bellis within the Kenya Department of Agriculture. This disconnect was partly related to the scale at which soil science was operating. Larger projects could be more prestigious and powerful symbolically than smaller projects, but it seems that smaller projects and the production of large-scale maps (showing smaller areas in greater detail) could be more useful. The tensions between the different functions given to soil mapping explored in this chapter illustrate the ways in which soil maps were not just scientific objects but also had political, cultural and diplomatic functions.

Conclusion

This thesis has argued that attempts to produce nuanced and in-depth knowledge of soils in the tropics were undertaken in the British Colonial Empire during the early- to mid-twentieth century. This complicates narratives about the history of soil science in the tropics which have tended to portray the history of the discipline as one of linear scientific progress, moving from past generalisations about lateritic soils toward a contemporary appreciation of the diversity of soils in the tropics. Well before the 1970s, empire provided impetus to programmes of soil survey, classification and mapping that took account of the variety of soil types in the tropics rather than representing tropical soils as ubiquitously fertile or fragile. Understanding of the differences between soils was a central technical goal of these various ventures.

By examining these attempts to produce knowledge of soil, this thesis has expanded our understanding of the historical connections between soil science and the aims and objectives of empire. Soil science was shaped by economic imperatives such as visions of agricultural development, but also shifting political contexts, such as increasing demands for independence. This thesis, however, shows that there was no single type of British soil science that emerged in response to wider imperial factors. The imagined relationship between soil science, agricultural futures and development differed between the Caribbean and East Africa. During the interwar period, the study of tropical soils was still a scientific specialty in its infancy and there were two main schools of soil science in the Colonial Empire; the Trinidadian and East African schools. In the British West Indies, Hardy promoted a vision in which soil science would support long established political and economic structures in the region centred upon monocultural export oriented production, primarily on estates. Milne's vision of soil science in East Africa was reflective of a wider discourse of fundamental research in which soil mapping was seen as a way of providing the foundation of knowledge needed to plan the long-term development of the region.

These two schools were characterised by epistemological difference. Hardy emphasised the systematic analysis of soil samples in the laboratory in his physiological-ecological survey approach, whilst Milne emphasised the importance of seeing things for himself, on the spot. Whilst Hardy's scientific ideas were disseminated largely through his students, Milne's circulated primarily through publications.

These differences in soil science between East Africa and the Caribbean during the interwar period were due to a confluence of factors. Hardy's and Milne's personal ambitions and institutional settings were significant. The Trinidadian school of soil science created by Hardy reflected Hardy's proximal relationship to agricultural education at the ICTA. It demonstrated to whole cadres of colonial agricultural recruits, at least in theory, the instrumental role that soil science could play in augmenting production. Milne, on the other hand, was located at the Amani Station which was explicitly a centre for research in the Empire and an institution whose fate was connected to anxieties about whether Britain was taking research as seriously as other European colonial powers and Germany. Milne's choice of how to disseminate soil knowledge reflected his awareness of the politics of research at the Amani Station. Milne and his colleagues intentionally included blank spaces in the provisional soil map of East Africa, for instance, with the understanding that they would resonate symbolically with audiences elsewhere. This reflected, in part, an understanding of the significance of the Amani Station for Britain. The blank spaces were symbolic because they illustrated the rather limited extent to which Britain's primary centre for agricultural research in Africa was able to oversee the production of knowledge of East African soils. The map illustrated this whilst also indicating the accuracy, empirical focus and reliability of the school of soil science promoted by Milne.

These two schools were also products of their wider agricultural and economic environment, and ideas about what Britain ought to be doing with its colonies. The Trinidadian school created by Hardy was part of a legacy of efforts to align scientific research with the needs of estates in the British West Indies. These had emerged out of a recognition that estate agriculture, particularly sugarcane production, was an industry in decline. The field sites of soil science in the British West Indies were conceptualised less as "the environment" and more as "land". Their economic significance and agricultural function were foregrounded from the start of the methodological approach. Soil science in East Africa operated under different conditions. The remit of colonial agriculture in East Africa was arguably more mixed, covering an agricultural population that spanned European settler farms to independent small-scale production. Though efforts were thwarted in East Africa during the interwar period by a paucity of resources and the sheer size of the area under investigation, the East African school can be seen as connected to optimistic visions of the role that scientific research could play in unlocking tropical Africa's supposedly untapped potential.

Soil science in the Colonial Empire underwent significant changes during the 1940s. There were more funds for soil studies in the colonies during the 1940s than the 1930s because of the Research Fund of the CDW Acts. Numerous schemes, committees and advisory roles were introduced by the Colonial Office to help oversee an expansion of colonial soils research ventures. Whilst there was interest in soil fertility studies and fertilizer experiments, there was particular emphasis on soil surveys, at least in the major research institutions and schemes launched in East Africa and the Caribbean. The type of soil survey work generally promoted in the Empire after 1940 was more akin to the school of soil science created by Milne than it was that of Hardy. This reflected the prominent place of fundamental research in visions of colonial development after 1940. Soil surveying, classification and mapping were seen in various ways as means of acquiring the basic knowledge that would underpin agricultural and land-use planning.

Postwar developments in soil science in the Colonial Empire were generally the product of previous experience and a changing political landscape. These political changes comprised three main things: organised resistance to colonial rule and growing demands for independence, the growing importance of US experts and projects in the field of overseas technical assistance, and new forms of international cooperation after 1945 focused on African issues. The new soil survey venture launched at the ICTA in 1947 had its origins in concerns about the neglect of the peasant sector of the Caribbean agricultural population made clear during the civil unrest of the mid- to late-1930s. Yet, British soil science in the Caribbean in the postwar period was also driven forward by its proximity to US soil science. American accomplishments in Puerto Rico showcased the potential links that could exist between soil survey and land utilisation planning in the Caribbean region. Soil surveys organised under the auspices of the Soils Research Scheme at the ICTA, and later the Regional Research Centre, were also dependent upon the technical assistance of experts from the USDA and their methods. In East Africa, Keen's vision for soil science at EAAFRO was partly an attempt to build upon the work of Milne from the 1930s. Keen's ambitions for EAAFRO to be a centre of tropical soils expertise also reflected a wider recognition during the postwar period that tropical soils needed far greater study. This recognition was itself informed by experiences during the 1930s, which had revealed the rather limited extent of European knowledge of tropical environments, particularly in Africa. The rhetoric that claimed EAAFRO would contribute to international scientific knowledge of "tropical soils" had geopolitical cachet, suggesting the efficacy of future programmes of African

development and agricultural exploitation. Soil science had both practical and symbolic functions in Keen's ambitions for EAAFRO.

A common thread running through the account of soil science given in this thesis is a contrast between ambition and implementation. Attempts to carry out soil surveys were persistently undermined. There were many barriers. These included lack of funds and resources as well as, perhaps most significantly, shortages of qualified personnel. The problem of manpower was prevalent during the interwar and postwar periods. It seriously undermined the extent to which Milne and his colleagues were able to build a complete picture of East African soils in their soil mapping project during the 1930s. Whilst a variety of schemes were introduced by the Colonial Office after 1940 to help increase the availability of qualified soil surveyors for work in the Colonial Empire, demand often outstripped supply. It would be interesting to see whether similar problems were faced with the recruitment of specialists for other fields of scientific research, such as in entomology or statistics. Was there something about the unique nature of soil survey work in the colonies that made it a less attractive career option for potential recruits? It could certainly involve extensive periods of time travelling, involving quite repetitive tasks such as observing soil profiles and sampling. Yet, for some, this could have been quite appealing.

Implementation was also often undermined by a lack of coordination between institutions. This was true, at times, for the relationship between institutions in the metropole, particularly the Colonial Office, and those in the colonies. During the initial years of the Soils Research Scheme at the ICTA, for instance, Hardy was hesitant to secure the future employment of students going through the Colonial Office's soil science studentships scheme. Furthermore, during the interwar period, Milne was keen on establishing autonomy for soil specialists in East Africa from the demands of the Imperial Bureau of Soil Science at Rothamsted. Metropolitan officials' visions for soil science were rarely implemented in the colonies in the way they had originally been imagined. There was also often a lack of coordination between institutions located in the colonies. Take the situation in postwar East Africa, for instance, where Keen's ambitions for EAAFRO ran into opposition with the demands of Departments of Agriculture. Implementation was constrained by a lack of institutional coordination at both global and regional scales.

The fact that such grand plans to survey and map the soils of areas as large as East Africa and the British West Indies were conceived at times in which there was such a paucity of available resources and personnel points toward a certain hubris characteristic of the ambitions for soil science in the Colonial Empire. Many colonial soil scientists were not

necessarily arrogant in the ways described by John McCracken in regards to experts in colonial Malawi.[1] They often paid attention to local nuances and complexity, and developed methods that took into account local knowledge, such as Hardy's principle of listening to estate managers' views on "good" and "bad" areas and Milne's use of Sukuma soil classifications as a lens through which to distinguish soil types in the field. The hubris of British colonial soil science was located more in peoples' attitude toward the scientific capacity of Britain than in individual experts' methodological approaches or short-sightedness. There was often a gross overestimation of the capacity of the technical and research infrastructure in the Empire to oversee the completion of programmes of soil surveying. This reflected, perhaps, an overzealous confidence in the place of Britain as a scientific powerhouse. At times, it seems also to have reflected an underestimation of the sheer size of "the field" under investigation. Britain's power to implement programmes of soil surveying in the colonies often failed to live up to expectations, despite the availability of new sources of funding after 1940. Paying attention to some of the more mundane aspects of scientific research, such as the recruitment of qualified personnel, can expand understanding of the contrast between historical ambitions for, and realities of, large-scale scientific projects in the colonies.

Acknowledging soil scientists' sensitivity to local conditions does not mean that soil surveys in the colonies ought to be generally seen as having "liberalizing effects, relieving rather than concentrating inappropriate colonial interventions" because of their "detailed and empirical basis" as suggested by Helen Tilley in regards to environmental sciences in interwar British Africa.[2] Such an argument would ignore the way in which soil science in the British West Indies during the interwar period, for instance, was framed as a way of preserving a tradition of arguably extractive plantation agriculture in an instrumental way. The connections between soil science and agricultural exploitation might not have been as immediately apparent in the more fundamental research ventures undertaken in East Africa or during the postwar period, but they were certainly present in the interwar Caribbean. Using Africa as a default for understanding the historical relationship between science and development in the late colonial period can obscure the full variety of connections that existed between scientific knowledge and ideas about governance, development and empire on a global scale. Soil science offered many things to a lot of different people during this

[1] McCracken, "Experts and Expertise in Colonial Malawi".
[2] Tilley, *Africa as a Living Laboratory*, 168.

period. It was part of personal ambitions and was shaped by wider political and economic conditions in the Empire. It was also related to symbolic concerns, such as those regarding British prestige and international cooperation.

By the late-1950s, soil science in Africa had become increasingly organised as part of an integrated research effort between colonial governments. Soil survey, classification and mapping, as expressed through the Inter-African Pedological Service, was tied to ideas about continent-wide development planning. The fact that these arrangements and ambitions for soil science existed at a time in which many African countries were about to gain independence from European colonial rule raises questions about the trajectory of soil science during the postcolonial period. Was soil science still seen as important for development by independent African states during the 1960s and '70s, or within the OAU? If so, what sorts of differences and similarities can be seen between the colonial and postcolonial periods in terms of the ambitions for soil science? Were these centred upon integration, similar to the Inter-African Pedological Service, or specific national projects? Similar questions are also important for the Caribbean. In Trinidad and Tobago, for instance, a major soil survey venture was launched in the early-1960s called the "Land Capability Survey of Trinidad and Tobago" under the independent government of Eric Williams.[3] To what extent were there differences or similarities between the place of soil science in visions of development in the postcolonial period between Africa and the Caribbean?

[3] "Land Capability Survey of Trinidad and Tobago: Brochure," n.d., St Augustine, West Indiana and Special Collections of the University of the West Indies, S599.25.T7L367/B.

Abbreviations

AACC	Anglo-American Caribbean Commission
CAC	Colonial Advisory Council on Agriculture and Animal Health
CCAAHFR	Committee for Colonial Agricultural, Animal Health and Forestry Research
CCTA	Commission for Technical Cooperation in Africa South of the Sahara
CDW	Colonial Development and Welfare
CSA	Scientific Council for Africa South of the Sahara
EAAFRO	East African Agriculture and Forestry Research Organisation
EAARS	East African Agricultural Research Station (Amani Station)
ESDAC	European Soil Data Centre
FAO	Food and Agriculture Organisation of the United Nations
HMSO	His/Her Majesty's Stationery Office
IBSS	Imperial Bureau of Soil Science
ICTA	Imperial College of Tropical Agriculture
IDA	Imperial Department of Agriculture for the West Indies
INEAC	Institut National pour l'Etude Agronomique du Congo Belge
KALRO	Kenya Agricultural and Livestock Research Organisation
KNA	Kenya National Archives
RRC	Regional Research Centre
SSC	Soils Sub-Committee
TCC	Technical Coordinating Committee
UNESCO	United Nations Educational, Scientific and Cultural Organisation
USDA	United States Department of Agriculture
WOSSAC	World Soil Survey Archive and Catalogue

Bibliography

Manuscript Collections

WEST INDIANA AND SPECIAL COLLECTIONS, ALMA JORDAN LIBRARY OF THE UNIVERSITY OF THE WEST INDIES, TRINIDAD AND TOBAGO

LIBRARY OF THE KENYA AGRICULTURAL AND LIVESTOCK RESEARCH ORGANISATION, MUGUGA

THE NATIONAL ARCHIVES, LONDON

CO 295 Trinidad Original Correspondence
CO 318 West Indies Original Correspondence
CO 323 Colonies, General: Original Correspondence
CO 554 West Africa Original Correspondence
CO 852 Economic General Department and predecessors: Registered Files
CO 877 Appointments Department: Registered Files
CO 908 Colonial Agricultural, Animal Health and Forestry Research Committee: Minutes and Papers
CO 927 Research Department: Original Correspondence
CO 996 Colonial Advisory Council of Agriculture, Animal Health and Forestry: Minutes and Papers
CO 1029 Production and Marketing Department: Registered Files
CO 1031 West Indian Department: Registered Files
CO 1042 West Indies Development and Welfare Organisation: Registered Files

FAO ARCHIVES, ROME

IL Land and Water Development Division: Liaison with International, National Organizations and Groups

BODLEIAN LIBRARIES, UNIVERSITY OF OXFORD

MSS.Brit.Emp.s.457 Papers of Geoffrey Milne

UCL SPECIAL COLLECTIONS, LONDON

MS ADD 297 Keen (Sir Bernard Augustus) Papers

KENYA NATIONAL ARCHIVES, NAIROBI

BV Ministry of Agriculture

DAO/KBU District Agricultural Officer: Kiambu

Reports, Conference Proceedings and HMSO Publications

Agricultural Research and Administration in the Non-Self-Governing Colonies: Report of a Committee Appointed by the Secretary of State for the Colonies. Cmd. 2825. London: HMSO, 1927.

Agricultural Research Council. *Soil Survey Research Board Report No. 1: Soil Survey of Great* Britain. London: HMSO, 1950.

Akhurst, C.G., and R.G.H. Wilshaw. "A Study of Some Cacao and Forest Soil Profiles in Trinidad." A.I.C.T.A. thesis, ICTA, 1929.

Barker, G.H. *Soil and Land-Use Surveys No. 25: Jamaica, Parish of Trelawny.* Trinidad: University of the West Indies, 1970.

Colonial Agricultural Service: Report of a Committee Appointed by the Secretary of State for the Colonies. Cmd. 3049. London: HMSO, 1928.

Colonial Development and Welfare Acts 1929-70: A Brief Review. Cmnd. 4677. London: HMSO, 1971.

Colonial Research 1947-8. Cmd. 7493. London: HMSO, 1948.

Colonial Research 1948-49. Cmd. 7739. London: HMSO, 1949.

Colonial Research 1949-50. Cmd. 8063. London: HMSO, 1950.

Colonial Research 1950-51. Cmd. 8303. London: HMSO, 1951.

Colonial Research 1952-53. Cmd. 8971. London: HMSO, 1953.

Colonial Research 1953-54. Cmd. 9303. London: HMSO, 1954.

Colonial Research 1955-56. Cmnd. 52. London: HMSO, 1956.

D'Hoore, Jules L. *Soil Map of Africa Scale 1 to 5000000: Explanatory Monograph*. Lagos: CCTA, 1964.

Engledow, Frank L. *West India Royal Commission Report on Agriculture, Fisheries, Forestry and Veterinary Matters*. Cmd. 6608. London: HMSO, 1945.

Fraser, R.H., and F.R. Sanders. "The Labour Supply of Sugar and Cocoa Estates, Trinidad." Diploma thesis, ICTA, 1928-9.

Hardy, F., Akhurst, C.G., and G. Griffith. *Studies in West Indian Soils (III)—The Cacao Soils of Tobago.* Port-of-Spain: Government Printing Office, 1931.

Hardy, F., McDonald, J.A., and G. Rodriguez. *Studies in West Indian Soils (V)—The Sugar-Cane Soils of Antigua: Report on a Visit made during April, 1932, and on the Laboratory Examination of Representative Soil Samples*. Port-of-Spain: Government Printing Office, 1933.

McDonald, J.A., Hardy, F., and G. Rodriguez. *Studies in West Indian Soils (VII)—The Cacao Soils of Trinidad.* Port-of-Spain: Government Printing Office, 1933.

Milne, Geoffrey, Beckley, V.A, Gethin-Jones, G.H. *et al*. *A Provisional Soil Map of East Africa (Kenya, Uganda, Tanganyika, and Zanzibar) with Explanatory* Memoir. Amani: EAARS, 1936.

Milne, Geoffrey. *A Report on A Journey to parts of the West Indies and the United States for the Study of Soils, February to August 1938*. Dar-es-Salaam: Government Press, 1940.

Proceedings and Papers of the First International Congress of Soil Science, *June 13-22, 1927, Washington, D.C., U.S.A.: Transcontinental Excursion and Impressions of the Congress and of America.* Washington, D.C.: American Organizing Committee of the First ICSS, 1928.

Proceedings of a Conference of East African Soil Chemists Held at the Agricultural Research Station, Amani, Tanganyika Territory, May 21st to 26th, 1932. Nairobi: Government Printer, 1932.

Proceedings of Agricultural Research Conference Held at Amani Research Station, February 2nd to 6th, 1931. Nairobi: Government Printer, 1931.

Proceedings of the Second Conference of East African Agricultural and Soil Chemists held at Zanzibar, August 3rd to 9th, 1934. Nairobi: Government Printer, 1935.

Report of the Committee on the Staffing of the Agricultural Departments in the Colonies. Cmd. 730. London: HMSO, 1920.

Report of the Conference on Tropical and Sub-Tropical Soils, June, 1948. Harpenden: Commonwealth Bureau of Soil Science, 1949.

Report of the East Africa Commission. Cmd. 2387. London: HMSO, 1925.

Report of the West Indian Sugar Commission. Cmd. 3517. London: HMSO, 1930.

Roberts, R.C. *Soil Survey of Puerto Rico*. Washington, D.C.: USDA Bureau of Plant Industry, 1942.

Soil Science in the Caribbean: Report of the Soils Conference held in Puerto Rico, March 30—April 8, 1950. Port-of-Spain: Caribbean Commission Central Secretariat, 1950.

Soil Technical Guide Sheets. Kingston: Government Printer, 1964.

Swynnerton, Roger J.M. *A Plan to Intensify the Development of African Agriculture in Kenya.* Nairobi: Government Printer, 1954.

Technical Communication No. 46—Proceedings of the First Commonwealth Conference on Tropical and Sub-Tropical Soils, 1948. Harpenden: Commonwealth Bureau of Soil Science, 1949.

Transactions of 7th International Congress of Soil Science, Madison, Wisc., USA, 1960 Volume I: Official Communications. International Society of Soil Science, 1961.

Transactions of the Fourth International Congress of Soil Science, Amsterdam, July 24-August 1, 1950, Volume I: General and Sectional Papers. Groningen: Hoitsema Brothers, 1950.

Transactions of the Third International Congress of Soil Science, Oxford, England, 1935, Vol. III. London: Thomas Murby & Co., 1936.

Transactions of the Third International Congress of Soil Science, Oxford, England, 1935, Vol. I. London: Thomas Murby & Co., 1935.

Vernon, Kenneth C. "Report on a Study Visit to the United States. Soil Survey Report of River Estate, Trinidad. Soil Survey Report of Camden Park Experiment Station, St Vincent." A.I.C.T.A. thesis, ICTA, 1951.

———. *Soil and Land-Use Surveys No. 1: Jamaica, Parish of St. Catherine.* Trinidad: ICTA, 1958.

West India Royal Commission Report. Cmd. 6607. London: HMSO, 1945.

Primary and Secondary Sources

"A Soil Map of East Africa." *Geographical Review* 26, no. 3 (1936): 522-3.

"Conference on Tropical and Sub-Tropical Soils." *East African Agricultural Journal* 14, no. 3 (1949): 111-3.

"Editorial Foreword." *Proceedings of the Nairobi Scientific and Philosophical Society* 1 (1947).

"Inter-African Soils Conference." *Africa* 24, no. 3 (1954): 272.

"Land Usage and Soil Erosion in Africa." *Journal of the Royal African Society* 37, no. 146 (1938): 3-19.

"Nairobi Scientific and Philosophical Society." *Nature* 162, no. 4121 (1948): 647.

"Soil Map of the World." *Bulletin of the International Society of Soil Science* 19 (1961): 2-4.

"Soil Surveys in the Caribbean." *Nature* 160, no. 4071 (1947): 634-5.

Ahmad, Nazeer. "In Memoriam: Emeritus Professor F. Hardy - Honorary Member I.S.S.S. (1889-1977)." *Bulletin of the International Society of Soil Science* 52 (1977): 30-1.

Alter, Peter. *The Reluctant Patron: Science and the State in Britain, 1850-1920.* Berg, 1987.

Anderson, David. "Depression, Dust Bowl, Demography, and Drought: The Colonial State and Soil Conservation in East Africa during the 1930s." *African Affairs* 83, no. 332 (1984): 321-43.

———. *Histories of the Hanged: Britain's Dirty War in Kenya and the End of Empire*, 2nd ed. Phoenix, 2006.

Anker, Pedr. *Imperial Ecology: Environmental Order in the British Empire, 1895-1945.* Harvard University Press, 2001.

Arendt, Hannah. *On Violence*. Harcourt, 1969.

Ashton, S.R., and David Killingray, ed. *British Documents on the End of Empire, Series B Volume 6: The West Indies.* HMSO, 1999.

Baeyens, J. *Les Sols de l'Afrique Centrale, Spécialment du Congo Belge: Tome I, Le Bas-Congo.* J. Duculot, 1938.

Barretto, Karen. "Geoffrey Alton Craig Herklots: A Biographical Essay." *Journal of the Royal Asiatic Society Hong Kong Branch* 64 (2024): 269-97.

Beinart, William, Brown, Karen, and Daniel Gilfoyle. “Experts and Expertise in Colonial Africa Reconsidered: Science and the Interpenetration of Knowledge.” *African Affairs* 108, no. 432 (2009): 413-33.

Bell, George D.H. “Frank Leonard Engledow, 20 August 1890 - 3 July 1985.” *Biographical Memoirs of Fellows of the Royal Society* 32 (1986): 187-219.

Bennett, George, ed. *The Concept of Empire: Burke to Attlee, 1744-1947*, 2nd ed. Adam & Charles Black, 1962.

Bocking-Welch, Anna. “Imperial Legacies and Internationalist Discourses: British Involvement in the United Nations Freedom from Hunger Campaign, 1960–70.” *Journal of Imperial and Commonwealth History* 40, no. 5 (2012): 879-896.

Bolland, Nigel O. *On the March: Labour Rebellions in the British Caribbean, 1934-39.* James Curry, 1995.

Bonneuil, Christophe. “Crafting and Disciplining the Tropics: Plant Science in the French Colonies.” In *Science in the Twentieth Century*, edited by John Krige and Dominique Pestre, 77-96. Harwood Academic Publishers, 1997.

———. “Development as Experiment: Science and State Building in Late Colonial and Postcolonial Africa, 1930-1970.” *Osiris* 15, no. 1 (2000): 258-81.

Borden, R. Wayne, Baillie, Ian C., and Stephen H. Hallett. “The East African Contribution to the Formalisation of the Soil Catena Concept.” *Catena* 185 (2020), 1-7.

Bowd, Gavin, and Daniel Clayton. *Impure and Worldly Geography: Pierre Gourou and Tropicality.* Routledge, 2019.

Bowker, Geoffrey C. *Memory Practices in the Sciences.* MIT Press, 2006.

Bowker, Geoffrey C., and Susan Leigh Star. *Sorting Things Out*: *Classification and its Consequences.* MIT Press, 2000.

Brereton, Bridget, and Kevin A. Yelvington, ed. *The Colonial Caribbean in Transition: Essays on Postemancipation Social and Cultural History.* The Press University of the West Indies, 1999.

Brereton, Bridget. *A History of Modern Trinidad, 1783-1962*. Heinemann, 1989.

———. *From Imperial College to University of the West Indies: A History of the St Augustine Campus, Trinidad & Tobago.* Ian Randle, 2011.

Brinitzer, Cameron, and Etienne Benson. “Introduction: What Is a Field? Transformations in Fields, Fieldwork, and Field Sciences since the Mid-Twentieth Century.” *Isis* 113, no. 1 (2022): 108-13.

Brock, William H. *The Fontana History of Chemistry.* Fontana Press, 1992.

Brockway, Lucile H. *Science and Colonial Expansion: The Role of the British Royal Botanic Gardens.* Academic Press, 1979.

Burnett, D. Graham. *Masters of All They Surveyed: Exploration, Geography, and a British El Dorado.* University of Chicago Press, 2000.

C.G. "A Provisional Soil Map of East Africa by G. Milne." *Geographical Journal* 88, no. 5 (1936): 465-6.

Cain, P.J., and A.G. Hopkins. *British Imperialism, 1688-2000*, 2nd ed. Pearson Education, 2002.

Calvert, Jane. "What's Special About Basic Research?" *Science, Technology & Human Values* 31, no. 2 (2006): 199-220.

Cameron, Laura. "Histories of Disturbance." *Radical History Review* 1999, no. 74 (1999): 5-24.

Césaire, Aimé. *Discourse on Colonialism*, 2nd ed. Translated by Joan Pinkham. Monthly Review Press, 2000.

Chakrabati, Pratik, and Michael Worboys. "Science and Imperialism since 1870." In *The Cambridge History of Science Volume 8: Modern Science in National, Transnational, and Global Context*, edited by Hugh Slotten, Ronald Numbers and David N. Livingstone, 9-31. Cambridge University Press, 2020.

Church, Archibald G. *East Africa, a New Dominion: A Crucial Experiment in Tropical Development and its Significance to the British Empire.* H.F. & G. Witherby, 1927.

Clarke, G.R. *The Study of the Soil in the Field,* 3rd ed. Oxford University Press, 1941.

Clarke, Sabine. "'The Chance to Send Their First Class Men Out to the Colonies': The Making of the Colonial Research Service." In *Science and Empire: Knowledge and Networks of Science across the British Empire, 1800-1970*, edited by Brett M. Bennett and Joseph M. Hodge, 187-208. Springer, 2011.

———. "A Technocratic Imperial State? The Colonial Office and Scientific Research, 1940-60." *Modern British History* 18, no. 4 (2007): 453-80.

———. "Fundamental Research and New Scientific Arrangements for the Development of Britain's Colonies after 1940." In *Basic and Applied Research: The Language of Science Policy in the Twentieth Century*, edited by David Kaldewey and Désirée Schauz, 143-62. Berghahn Books, 2018.

———. “The Research Council System and the Politics of Medical and Agricultural Research for the British Colonial Empire, 1940–52.” *Medical History* 57, no. 3 (2013): 338-58.

———. *Science at the End of Empire: Experts and the Development of the British Caribbean, 1940-62.* Manchester University Press, 2018.

Collins, Harry. *Tacit and Explicit Knowledge.* University of Chicago Press, 2010.

Constantine, Stephen. *The Making of British Colonial Development Policy 1914-40.* Frank Cass, 1984.

Conte, Christopher A. *Highland Sanctuary: Environmental History in Tanzania’s Usambara Mountains.* Ohio University Press, 2004.

Cooper, Caren. *Citizen Science: How Ordinary People Are Changing the Face of Discovery.* The Overlook Press, 2016.

Cunningham, R.K. *“*Applied Soil Science Research in the Caribbean.” *Caribbean Quarterly* 12, no. 1 (1966): 35-40.

Curtin, Philip D. *The Rise and Fall of the Plantation Complex,* 2nd ed. Cambridge University Press, 1998.

D’Hoore, Jules L. “Proposed Classification of the Accumulation Zones of Free Sesquioxides on a Genetic Basis.” *African Soils* 3, no. 1 (1954): 67-81.

Daston, Lorraine, and Peter L. Galison. *Objectivity*. Zone Books, 2007.

de Bont, Raf, and Jens Lachmund, ed. *Spatializing the History of Ecology: Sites, Journeys, Mappings.* Routledge, 2017.

Drayton, Richard. *Nature’s Government: Science, Imperial Britain, and the ’Improvement’ of the World.* Yale University Press, 2000.

Elkins, Caroline. *Britain’s Gulag: The Brutal End of Empire in Kenya.* Pimlico, 2005.

Engledow, Frank L. “Sir Harold Tempany, C.M.G., C.B.E.” *Nature* 176, no. 4476 (1955): 283.

Fairhead, James, and Melissa Leach. *Misreading the African Landscape: Society and Ecology in a Forest-Savanna Mosaic.* Cambridge University Press, 1996.

Feller, Christian, Blanchart, Eric, and Adrien Herbillon. “The Importance of French Tropical Research in the Development of Pedology.” *Soil Science Society of America Journal* 72, no. 5 (2008): 1375-1381.

Gelfand, Lawrence E. *The Inquiry: American Preparations for Peace, 1917-1919.* Yale University Press, 1963.

Gilbert, S.M. "The History of a Herd at the Coffee Research Station, Lyamungu, Moshi, 1935–1944." *East African Agricultural Journal* 10, no. 3 (1945): 164-7.

Golinski, Jan. *Making Natural Knowledge: Constructivism and the History of Science.* University of Chicago Press, 2005.

Goss, Andrew. "Introduction: An Imperial Turn in the History of Science." In *The Routledge Handbook of Science and Empire*, edited by Andrew Goss, 1-9. Routledge, 2021.

Gourou, Pierre. *The Tropical World: Its Social and Economic Conditions and its Future Status*, 4th ed. Translated by S.H. Beaver and E.D. Laborde. Longmans, 1966.

Gregory, J.W. "Science and Administration in East Africa." *Nature* 115, no. 2898 (1925): 753-5.

Grossman, Lawrence S. "The Colonial Office and Soil Conservation in the British Caribbean, 1938-1950." In *Caribbean Land and Development Revisited*, edited by Jean Besson and Janet H. Momsen, 29-40. Palgrave Macmillan, 2007.

Gruhn, Isebill V. "The Commission for Technical Cooperation in Africa, 1950-65." *Journal of Modern African Studies* 9, no. 3 (1971): 459-69.

Haguet, Lucile. "Specifying Ignorance in Eighteenth-Century Cartography, a Powerful Way to Promote the Geographer's Work: The Example of Jean-Baptiste d'Anville." In *The Dark Side of Knowledge: Histories of Ignorance, 1400-1800*, edited by Cornel Zwierlein, 358-81. Brill, 2016.

Hailey, Lord. *An African Survey: A Study of Problems Arising in Africa South of the Sahara.* Oxford University Press, 1938.

Hardy, F. "Ecological Aspects of Tropical Pedology." *Malayan Journal of Tropical Geography* 2 (1954): 1-8.

———. "Some Aspects and Methods of Soil Survey Work." *Journal of Agricultural Science* 19, no. 4 (1929): 734-51.

———. "Studies in West Indian Soils." *Tropical Agriculture* 13, no. 10 (1936): 268-73.

———. "Tropical Soil Surveying: Part I." *Tropical Agriculture* 7, no. 9 (1930): 235-6.

———. "Tropical Soil Surveying: Part II." *Tropical Agriculture* 7, no. 10 (1930): 274-7.

Harrison, Mark. "Science and the British Empire." *Isis* 96, no. 1 (2005): 55-63.

Hartemink, Alfred E. “Soil Science in Tropical and Temperate Regions: Some Differences and Similarities.” *Advances in Agronomy* 77 (2002): 269-92.

———. *Soil Science Americana*: *Chronicles and Progressions, 1860─1960.* Springer, 2021.

Hartemink, Alfred E., Krasilnikov, Pavel, and James G. Bockheim. “Soil Maps of the World.” *Geoderma* 207-8 (2013): 256-67.

Havinden, Michael, and David Meredith. *Colonialism and Development: Britain and its Tropical Colonies, 1850-1960.* Routledge, 1993.

Headrick, Daniel. *Tools of Empire: Technology and European Imperialism in the Nineteenth Century.* Oxford University Press, 1981.

Hennessey, Elizabeth. “The Politics of a Natural Laboratory: Claiming Territory and Governing Life in the Galápagos Islands.” *Social Studies of Science* 48, no. 4 (2018): 483-506.

Hodge, Joseph M. “Science and Empire: An Overview of the Historical Scholarship.” In *Science and Empire: Knowledge and Networks of Science Across the British Empire, 1800-1970*, edited by Brett M. Bennett and Joseph M. Hodge, 3-29. Springer, 2011.

———. *Triumph of the Expert: Agrarian Doctrines of Development and the Legacies of British Colonialism.* Ohio University Press, 2007.

———. “Colonial Foresters versus Agriculturalists: The Debate over Climate Change and Cocoa Production in the Gold Coast.” *Agricultural History* 83, no. 2 (2009): 201-20.

Huxley, Elspeth. “The Menace of Soil Erosion.” *Journal of the Royal African Society* 36, no. 144 (1937): 357–70.

Jacks, G.V., and R.O. Whyte. *The Rape of the Earth: A World Survey of Soil Erosion.* Faber and Faber, 1939.

Jacks, G.V., Tavernier, R., and D.H. Boalch, ed. *Multilingual Vocabulary of Soil Science,* 2nd ed. FAO, 1960.

Jasanoff, Sheila, and Sang-Hyun Kim, ed. *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power.* University of Chicago Press, 2015.

Jerónimo, Miguel B., and Hugo G. Dores. “Enlightened Developments? Inter-imperial Organizations and the Issue of Colonial Education in Africa (1945–1957).” In *Education and Development in Colonial and Postcolonial Africa: Policies, Paradigms, and Entanglements, 1890s–1980s*, edited by Damiano Matasci, Miguel B. Jerónimo and Hugo G. Dores, 237-62. Palgrave Macmillan, 2020.

Johnson, Howard. “The Anglo-American Caribbean Commission and the Extension of American Influence in the British Caribbean, 1942–1945.” *Journal of Commonwealth and Comparative Politics* 22, no. 2 (1984): 180-203.

Jones, T.A. “Soil Classification—A Destructive Criticism.” *Journal of Soil Science* 10, no. 2 (1959): 196-200.

Jöns, Heike. “The University of Cambridge, Academic Expertise and the British empire, 1885–1962.” *Environment and Planning A* 48, no. 1 (2016): 94-114.

Kariuki, Josiah M. ‘*Mau Mau’ Detainee: The Account by a Kenya African of his Experiences in Detention Camps 1953-1960.* Oxford University Press, 1963.

Keen, Bernard A. “The East African Agriculture and Forestry Research Organization.” *Nature* 168, no. 4277 (1951): 674-6.

———. “The Guessers and the Accumulators.” *Proceedings of the Nairobi Scientific and Philosophical Society* 3 (1949): 22-9.

Kenyatta, Jomo. *Facing Mount Kenya: The Tribal Life of the Gikuyu.* Secker & Warburg, 1938.

Kohler, Robert E. *Landscapes and Labscapes: Exploring the Lab-Field Border in Biology.* University of Chicago Press, 2002.

Latour, Bruno, and Steve Woolgar. *Laboratory Life: The Construction of Scientific Facts.* Princeton University Press, 1986.

Latour, Bruno. “Circulating Reference: Sampling the Soil in the Amazon Forest.” In *Pandora’s Hope: Essays on the Reality of Science Studies*, 24-79. Harvard University Press, 1999.

Lemaine, Gerard, MacLeod, Roy, Mulkay, Michael, and Peter Weingart, ed. *Perspectives on the Emergence of Scientific Disciplines.* Mouton, 1976.

Lewis, Joanna. *Empire State-Building: War & Welfare in Kenya 1925-52*. James Currey, 2000.

Li, Tania Murray. “What is Land? Assembling a Resource for Global Investment.” *Transactions of the Institute of British Geographers* 39, no. 4 (2014): 589-602.

Livingstone, David N. *Putting Science in its Place: Geographies of Scientific Knowledge.* University of Chicago Press, 2003.

Low, D.A., and John Lonsdale. “Introduction: Towards the New Order, 1945-1963.” In *History of East Africa: Volume Three*, edited by D.A. Low and Alison Smith, 1-63. Clarendon Press, 1976.

MacLeod, Roy. “Introduction, *Nature and Empire: Science and the Colonial Enterprise*.” *Osiris* 15 (2000): 1-13.

Martin, Peter J. “The Zanzibar Clove Industry.” *Economic Botany* 45, no. 4 (1991): 450-9.

Masefield, Geoffrey B. *A History of the Colonial Agricultural Service.* Clarendon Press, 1972.

Matasci, Damiano. “Internationalising Colonial Knowledge. Edgar Barton Worthington and the Scientific Council for Africa, 1949–1956.” *Journal of Imperial and Commonwealth History* 48, no. 5 (2020): 892-913.

McCracken, John. “Experts and Expertise in Colonial Malawi.” *African Affairs* 81, no. 322 (1982): 101-16.

Meiklejohn, Jane. “The Effect of Bush Burning on the Microflora of a Kenya Upland Soil.” *European Journal of Soil Science* 6, no. 1 (1955): 111-8.

Menge, Wemo. *Le Transfert du Savoir Agricole au Congo-Zaïre: Héritage Colonial et Recherche Agronomique.* L’Harmattan, 2001.

Michelmore, A.P.G. “A Note on Soil Classification by a Naturalist.” *East African Agricultural Journal* 16, no. 1 (1950): 47-9.

Milam, Erika Lorraine “Making Place in the Field.” *Isis* 113, no. 1 (2022): 121-7.

Milne, Geoffrey. “A Soil Reconnaissance Journey Through Parts of Tanganyika Territory December 1935 to February 1936.” *Journal of Ecology* 35, no. 1/2 (1947): 192-265.

———. “Normal Erosion as a Factor in Soil Profile Development.” *Nature* 138 (1936): 548-9.

Moon, David. *The American Steppes: The Unexpected Russian Roots of Great Plains Agriculture, 1870s–1930s.* Cambridge University Press, 2020.

Morgan, D.J. *The Official History of Colonial Development Vol. 1: The Origins of British Aid Policy, 1924*-45. Clarendon Press, 1976.

Mukumbuta, Ikabongo, Chabala, Lydia M., Sichinga, Stalin, and Murray R. Lark. “Accessing and Assessing Legacy Soil Information: An Example from Two Provinces of Zambia.” *Geoderma* 420 (2022): 1-15.

Nowell, William. “The Agricultural Research Station at Amani.” *Journal of the Royal African Society* 33, no. 131 (1934): 1-20.

Nzongola-Ntalaja, Georges. *The Congo from Leopold to Kabila: A People’s History.* Zed Books, 2002.

O'Connell, Joseph. "Metrology: The Creation of Universality by the Circulation of Particulars." *Social Studies of Science* 23, no. 1 (1993): 129-173.

O'Connor, Thomas F. "Library Service to the American Commission to Negotiate Peace and to the Preparatory Inquiry, 1917-1919." *Libraries and Culture* 24, no. 2 (1989): 144-57.

Pearson-Patel, Jessica. "Promoting Health, Protecting Empire: Inter-Colonial Medical Cooperation in Postwar Africa." *Monde(s)* 7, no. 1 (2015): 213-30.

Pereira, Herbert C. "Bernard Augustus Keen, 5 September 1890 - 5 August 1981." *Biographical Memoirs of Fellows of the Royal Society* 28 (1982): 204-24.

Pickstone, John V. *Ways of Knowing: A New History of Science, Technology and Medicine.* University of Chicago Press, 2001.

Pritchard, Sarah B., Wolf, Steven A., and Wendy Wolford. "Knowledge and the Politics of Land." *Environment and Planning A: Economy and Space* 48, no. 4 (2015): 616-25.

Raby, Megan. '"Slash-and-Burn Ecology': Field Science as Land-Use." *History of Science* 57, no. 4 (2019): 441-68.

Richter, Daniel, and Liana Babbar. "Soil Diversity in the Tropics." *Advances in Ecological Research* 21 (1991): 315-89.

Ross, Corey. *Ecology and Power in the Age of Empire: Europe and the Transformation of the Tropical World.* Oxford University Press, 2017.

Russell, Edward J. *Soil Conditions and Plant Growth.* Longmans, Green & Co, 1913.

Russell, Edward W. "Fred Hardy." *Nature* 269 (1977): 93-4.

Sanchez, Pedro A. *Properties and Management of Soils in the Tropics*, 2nd ed. Cambridge University Press, 2019.

Sanchez, Pedro A., and Rattan Lal, ed. *Myths and Science of Soils of the Tropics.* Soil Science Society of America, 1992.

Schmidt, Elizabeth. "Africa." In *The Oxford Handbook of the Cold War*, edited by Richard H. Immerman and Petra Goedde, 265-85. Oxford University Press, 2013.

Scott, James C. *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed.* Yale University Press, 1998.

Secord, James A. "Knowledge in Transit." *Isis* 95, no. 4 (2004): 654-72.

Selcer, Perrin. "Fabricating Unity: the FAO-UNESCO Soil Map of the World." *Historical Social Research* 40, no. 2 (2015): 174-201.

Shantz, Homer L., and Curtis F. Marbut. *The Vegetation and Soils of Africa.* American Geographical Society, 1923.

Shephard, Cecil Y. "Economic Survey of the Cacao Industry of Trinidad, British West Indies." *Economic Geography* 3, no. 2 (1927): 239-58.

———. "The Cacao Industry of Trinidad. Some Economic Aspects. Part IV. Historical 1820-1920." *Tropical Agriculture* 9, no. 7 (1932): 200-5.

Showers, Kate B. *Imperial Gullies: Soil Erosion and Conservation in Lesotho.* Ohio University Press, 2005.

Smil, Vaclav. *Enriching the Earth: Fritz Haber, Carl Bosch, and the Transformation of World Food Production.* MIT Press, 2001.

Spencer, Ian. "Settler Dominance, Agricultural Production and the Second World War in Kenya." *Journal of African History* 21, no. 4 (1980): 497-514.

Stafford, Robert A. "Geological Surveys, Mineral Discoveries, and British Expansion, 1835–71." *Journal of Imperial and Commonwealth History* 12, no. 3 (1984): 5-32.

Staples, Amy. *The Birth of Development: How the World Bank, Food and Agriculture Organization and World Health Organization Changed the World, 1945-65.* Kent State University Press, 2006.

Stepan, Nancy Leys. *Picturing Tropical Nature.* Reaktion Books, 2002.

Stockdale, Frank. "The Work of the Caribbean Commission." *International Affairs* 23, no. 2 (1947): 213-20.

Storey, William K. "Plants, Power and Development: Founding the Imperial Department of Agriculture for the West Indies, 1880-1914." In *States of Knowledge: The Co-Production of Science and the Social Order*, edited by Sheila Jasanoff, 109-30. Routledge, 2004.

Sutter, Paul S. "The Tropics: A Brief History of an Environmental Imaginary*."* In *The Oxford Handbook of Environmental History*, edited by Andrew C. Isenberg, 184-204. Oxford University Press, 2014.

Tempany, Harold. "Sir Frank Stockdale, G.C.M.G., C.B.E." *Nature* 164, no. 4166 (1949): 397-8.

Thurston, Anne. *Smallholder Agriculture in Colonial Kenya: The Official Mind and the Swynnerton Plan*. Cambridge Centre of African Studies, 1987.

Tilley, Helen. "African Environments and Environmental Sciences: The African Research Survey, Ecological Paradigms, and British Colonial Development, 1920-1940." In *Social*

History and African Environments, edited by William Beinart and Joann McGregor, 109-30. James Currey, 2003.

———. *Africa as a Living Laboratory: Empire, Development, and the Problem of Scientific Knowledge, 1870-1950.* University of Chicago Press, 2011.

Tugwell, Rexford G. *The Stricken Land: The Story of Puerto Rico.* Doubleday, 1947.

Vageler, Paul. *An Introduction to Tropical Soils*. Translated by Herbert Greene. Macmillan and Co., 1933.

Vetter, Jeremy, ed. *Knowing Global Environments: New Historical Perspectives on the Field Sciences.* Rutgers University Press, 2010.

Wagner, Florian. "Inventing Colonial Agronomy: Buitenzorg and the Transition from the Western to the Eastern Model of Colonial Agriculture, 1880s–1930s." In *Environments of Empire: Networks and Agents of Ecological Change*, edited by Ulrike Kirchberger and Brett M. Bennett, 103-28. University of North Carolina Press, 2020.

Welte, E. "Professor Dr. Paul Vageler, 30.10.1882- 3.12.1963." *Journal of Plant Nutrition and Soil Science* 105, no. 3 (1964): 193.

Westcott, Nicholas. *Imperialism and Development: The East African Groundnut Scheme and its Legacy.* James Currey, 2020.

Whitham, Charlie. *Bitter Rehearsal: British and American Planning for a Post-War Indies.* Praeger, 2002.

Williams, Eric. *Capitalism and Slavery*, 3rd ed. Penguin Classics, 2022.

Worthington, Edgar B. "Organisation of Research in Africa." *Nairobi Scientific and Philosophical Society* 5 (1951): 68-80.

———. "Science in African International Relations." *International Affairs* 29, no. 1 (1953): 52-8.

———. *Science in Africa: A Review of Scientific Research Relating to Tropical and Southern Africa.* Oxford University Press, 1938.

Wright, Thomas J. "'Constituencies of Control': Collective Punishments in Kenya's Mau Mau Emergency, 1952–55." *Journal of Imperial and Commonwealth History* 51, no. 2 (2023): 323-50.

Yelvington, Kevin A. "The War in Ethiopia and Trinidad, 1935-1936." In *The Colonial Caribbean in Transition: Essays on Postemancipation Social and Cultural History*, edited by Bridget Brereton and Kevin A. Yelvington. The Press University of the West Indies, 1999.

Young, Anthony. *Thin On the Ground: Land Resource Survey in British Overseas Territories.* Memoir Club, 2007.