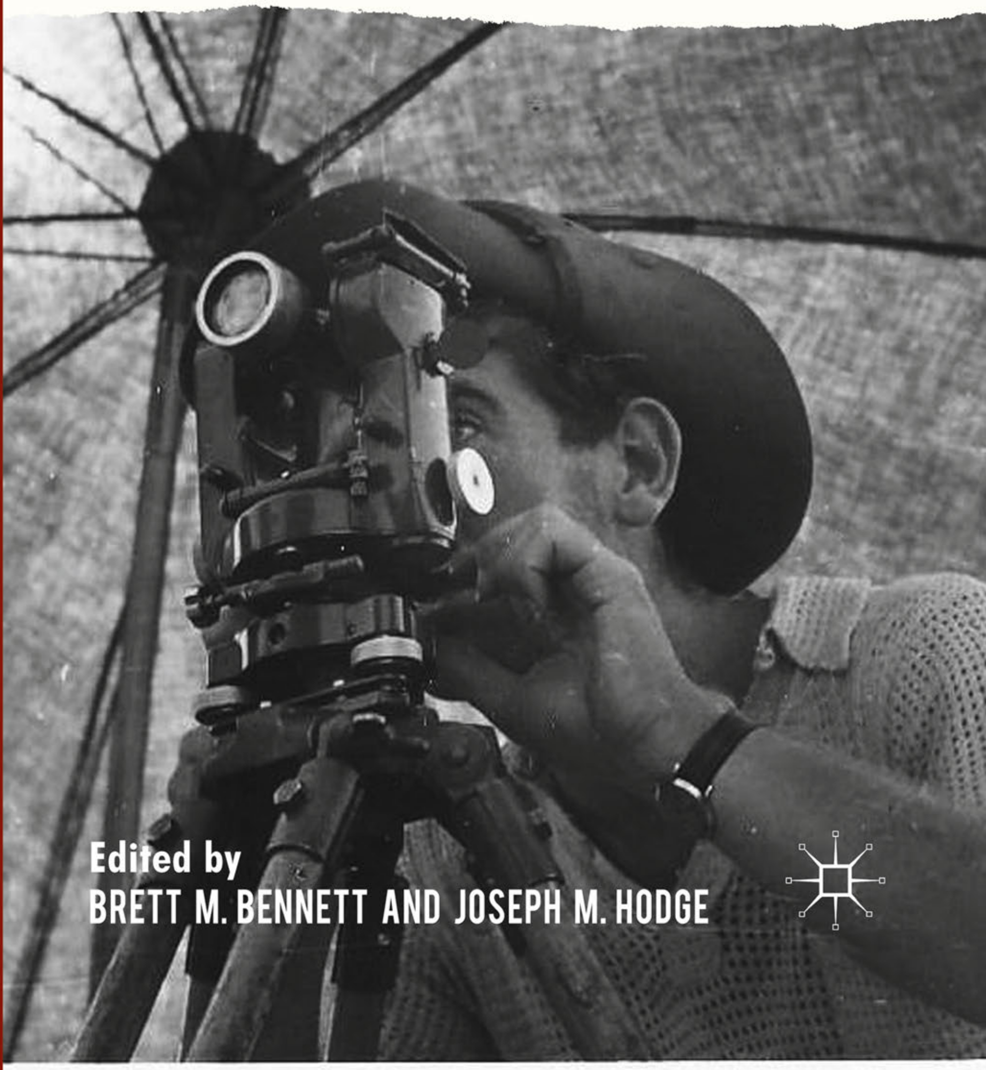
BRITAIN AND THE WORLD

SCIENCE AND EMPIRE

Knowledge and Networks of Science Across the British Empire, 1800–1970



Edited by
BRETT M. BENNETT AND JOSEPH M. HODGE

Britain and the World

Editors

Science and Empire: Knowledge and Networks of Science Across the British Empire, 1800–1970 is the second book in the *Britain and the World* series, edited by The British Scholar Society and published by Palgrave Macmillan. From the sixteenth century onward, Britain's influence on the world became more progressively profound and far-reaching, in time touching every continent and subject, from Africa to South America and archaeology to zoology. Although the histories of Britain and the world became increasingly intertwined, mainstream British history still neglects the world's influence upon domestic developments and British overseas history remains largely confined to the study of the British Empire. This series takes a broader approach to British history, seeking to investigate the full extent of the world's influence on Britain and Britain's influence on the world.

Joseph Hodge and Brett Bennett's book is the most wide-ranging survey of scientific endeavour within the British Empire yet published. It examines the interconnections between science, the British Empire, and the emergence of a globalized world. It identifies and analyzes the web of scientific networks crisscrossing the British Empire through which scientific knowledge and authority were produced, circulated and legitimated. It engages critically with new ways of thinking about networked connections across space, and about the relationality of multiple colonial, metropolitan, and even extra-imperial sites. Finally, it offers a comparative perspective that surveys a variety of scientific initiatives and circuits, and that charts the movement of various agendas, ideas, people, and practices across Africa, Australia, Britain, India and elsewhere. Each chapter combines rigorous research with theoretical reflection based on the latest literature, as well as serving as a useful introduction to that literature. We believe *Science and Empire* will become a standard reference for years to come.

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Science and Empire

Knowledge and Networks of Science across the British Empire, 1800–1970

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To Wm. Roger Louis

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List of Abbreviations

AAS	Australian Academy of Science
ARC	Agricultural Research Council
CAC	Colonial Advisory Council on Agricultural & Animal Health
CDC	Colonial Development Corporation
CD&W	Colonial Development and Welfare
CFAC	Colonial Fisheries Advisory Committee
CFS	Colonial Forestry Service
CGIAR	Consultative Group for International Agricultural Research
CO	Colonial Office
CRC	Colonial Research Committee
CMRC	Colonial Medical Research Council
CRC	Colonial Research Council
CRS	Colonial Research Service
DSIR	Department of Scientific and Industrial Research
EAHC	East Africa High Commission
EAMFRO	East African Marine Fisheries Research Organization
EIC	East India Company
FAO	UN's Food and Agriculture Organization
FSSU	Federated Superannuation Scheme for Universities
GTS	Great Trigonometric Survey of India
HMOCS	Her Majesty's Overseas Civil Service
IARS	Imperial Agricultural Research Institute, Pusa
ICTA	Imperial College of Tropical Agriculture, Trinidad
IFS	Indian Forest Service
INC	Indian National Congress
IPSS	International Pilot Study of Schizophrenia
IRRI	International Rice Research Institute, Philippines
IGY	International Geophysical Year
IWC	International Whaling Commission
MRC	Medical Research Council
OFC	Overseas Food Corporation
RGS	Royal Geographic Society
SPRI	Scott Polar Research Institute
WHO	World Health Organization

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Preface

The history of science and empire is a burgeoning field that continues to expand yearly. Yet, to date, there is little scholarly overview that explores how scientists and scientific ideas and institutions functioned and changed across the entire British Empire in the nineteenth and twentieth centuries. This volume helps to fill the growing demand for books on science and empire that cover multiple chronologies, geographies, and specialisms. It offers one of the first analyses of how networks of science interacted within the British Empire during the past two centuries. We analyze the rise and reconfiguration of various individuals and scientific networks, including academic scientists, agronomists, botanists, comparative anatomists, doctors, foresters, marine biologists, physicists and many others. This book shows how the rise of formalized state networks of science in the mid nineteenth century led to a constant tension between administrators and scientists who sought to centralize powers and networks into rationalized systems of science against the forces of globalization, colonial nationalism, and internal bureaucratic and professional resistance.

The book is divided into three sections, each of which explores an important period or theme in the history of science and empire. The first two chapters review the historiography of science and empire, and chart out an outline and argument for the book. The second section begins by providing a background of the early history of scientific networks in the British Empire up to 1850, and then examines the period from the 1850s to the 1940s. These were years of rapid bureaucratic expansion that witnessed the creation of new departments of science, new schools to train scientists and technical experts, new metropolitan research bureaus and regional research institutes, and the growth of scientific jobs in the colonies and Britain. This is the period that witnessed the rise of the expert. The 1940s and after, as the final section of the book details, witnessed both the 'triumph' and decolonization of the expert, when colonial scientists in India left owing to decolonization, while others in Africa received increased funding and support from Britain during the 'Second Colonial Occupation' of the 1940s and 1950s. By the late 1950s and 1960s the writing was on the wall: decolonization could not be stopped, but many former colonial scientists were able to reconfigure their career networks by joining the staff of the new international development organizations like the UN's specialized agencies. The epilogue by Michael Worboys offers some reflection as well as thoughts on the future of histories of science and empire.

A number of people have inspired this volume and deserve credit. Wm. Roger Louis has played a central role in making the University of Texas at Austin into a pre-eminent world institution for the study of the British Empire. UT's large history graduate program in British Studies has been called an empire itself. Brett Bennett, Adrian Howkins, Matt Heaton, and Christian Jennings all pursued their PhDs at Texas and Joseph Hodge and Gregory Barton have played an important part in the life of the larger culture of British Studies. A number of other important current and former faculty members at Texas have helped to shape this book as well, including Bruce Hunt, Toyin Falola, Antony Hopkins, Gail Minault, Diana Davis, and James Vaughn. Bruce Hunt, more than anyone at UT, has helped to build what Peter Hoffenberg describes as the 'Texas Gang' of historians of science and empire. In addition to the contributors in this book, Hunt has also shaped the careers of other UT doctoral students studying the history of science in and outside of the British Empire. Without Bruce it is doubtful that this book would have ever existed.

In England, the British Society for the History of Science offered the authors the opportunity to present their work at the Sixth Joint Meeting of the Three Societies (BSHS, CSHPS, HSS), held at Keble College, Oxford, from July 4th to July 6th, 2008. We debated and discussed the book's focus within the gothic grey walls and intimate wood-floored pubs of Oxford. Simon Pooley provided excellent thoughts and comments on the project and was a gracious host in Oxford. Hannah Gay, Patrick Petijean, and Michael Worboys acted as commentators and discussants for the papers. We would also like to thank Jürgen G. Nagel, Perrin Selcer, Andreas Weber, Hamilton Cravens, and Akihito Suzuki for presenting papers at the three panels. The Imperial College History of Science Programme has supported this project from its inception. Andrew Warwick, Andy Mendelsohn, Abigail Woods, and David Munns provided excellent criticism and comments at Brett's seminar in the summer of 2009. Imperial College has provided a history of science home away from home. Finally, we warmly thank James Onley for offering us his house and showing us around Exeter.

In the United States and throughout the world many people and institutions also shaped this book. Wm. Roger Louis and the National History Center's International Seminar on Decolonization at the Library of Congress in Washington, DC, gave Joe Hodge the time and financial support to work on his chapter and current project that examines how colonial

scientists handled the transition to independence by working for international agencies and national governments. In addition to Roger, special thanks goes to Dane Kennedy, Christopher Lee, Philippa Levine, Mauri MacDonald, Brandon Marsh, Jason Parker and Pillarisetti Sudhir, for their helpful suggestions and advice during the seminar. Joe Hodge would also like to give much deserving thanks to West Virginia University for its continuing financial support for his research, and to Corinna Unger and David Engerman for inviting him to participate and share his ideas at a stimulating workshop on 'Modernization as a Global Project', held at the German Historical Institute in Washington, DC.

In Australia, Tom Griffiths, Libby Robin, Roy MacLeod, James Beattie, and John Dargavel offered support and thoughtful comments about imperialism and science both in Australia and in the wider world. James Beattie read drafts of Brett's chapter and offered advice on how networks functioned across the Antipodes and Asia in Melbourne in 2009. MacLeod helped by first suggesting the title of Brett's introductory chapter, and then by encouraging us to think about the relationship between the structures of empire – constitutions, economies, ecologies – and scientific networks. It is only because of conflicting schedules that MacLeod could not contribute to this book; his spirit and prodigious writings on science and empire are obvious within its pages.

At Palgrave, we wish to thank Michael Strang for working with us on the book. From our first meeting in the British Library to submission, Strang and Ruth Ireland answered questions and patiently guided us through every stage of the process. This book is part of the larger series, Britain and the World. We would like to thank the series editors Bryan Glass, Greg Barton and James Onley for their support for the project and advice.

Notes on Contributors

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Brett M. Bennett received his PhD in history from the University of Texas at Austin. Since January 2011, he has been a Lecturer in Modern History at the University of Western Sydney. He specializes in the environmental and scientific histories of British imperialism in the Indian Ocean region in the nineteenth and twentieth centuries. He has been the recipient of fellowships from the National Science Foundation, the Social Science Research Council, the American Council of Learned Societies, the Forest History Society, the J.B. Harley Trust, the University of Texas at Austin, and Indiana University. His previous and forthcoming publications include articles in *Itinerario*, *Environment and History,* the *International Review of Social History*, the *Journal of the History of Biology*, and the *British Scholar Journal*.

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Rajive Tiwari is a Professor of Physics and Mathematics at Belmont Abbey College in North Carolina, USA. He received his PhD in Physics from Rutgers University. He is a recipient of the Adrianne Faculty Excellence Award. His paper 'A Transnarrative for the Colony: Astronomy Education and Religion in Nineteenth Century India' was published in *Economic and Political Weekly*. He has also published a Hindi-language Dictionary of Physics.

Michael Worboys is a Professor of History and Director of the Centre for the History of Science, Technology and Medicine and Wellcome Unit for the History of Medicine at Manchester University in England. His many publications include (with N. Pemberton), *Mad Dogs and Englishmen: Rabies in Britain, 1830–2000* (2007), (with S. Bhattacharya and M. Harrison), *Fractured States: Smallpox, Public Health and Vaccination Policy in British India, 1800–1947* (2005), *Spreading Germs: Disease Theories and Medical Practice in Britain, 1865–1900* (2000), *Tuberculosis and Race in Britain and its Empire, 1900–1950* (1999), (with L. Marks), *Migrants, Minorities and Health* (1997), and (with M. Harrison), *A Disease of Civilisation: Tuberculosis in Africa and Asia, 1900–1940* (1997). He has contributed many articles to journals on the history of science and medicine, including *Osiris*, *Isis*, *Medical History*, *Social History of Medicine*, *History Today*, *British Medical Journal* and many others. He has also contributed chapters to numerous edited book collections.

Part I
Historiography and Overview

1
Science and Empire: An Overview of the Historical Scholarship

Joseph M. Hodge

Over the past few decades a burgeoning new field of historical research has taken shape; one that draws our attention to the relationship that developed between science and British imperialism. Taken as a whole, the resulting corpus of work provides a rich and diverse picture of the part science played in colonial expansion and power. Recent scholarship, in particular, highlights the multi-layered and varied ways in which science supported, justified, and at times challenged, the British colonial enterprise, especially after 1750. What follows in this opening chapter is an overview of some of the more important contributions to the historical scholarship of the last four decades.[1] It also situates the approach taken in this book within the wider fields of the 'new imperial history' and the history of science. We argue that a networked conception of empire, if engaged critically, offers much potential for future research endeavors in the field. Careful attention must be paid, however, both to the unevenness and inequalities of power that operated within specific networks of imperial science, and to the complex and often hybridized nature of scientific knowledge making in particular geographical and historical contexts.

The diffusionist model of colonial science

In the 1950s and 1960s, studies by American social scientists such as Walter Rostow popularized a view of agrarian societies as 'traditional' communities that were constrained by long-term fatalism and stagnation. For Rostow, as for other early exponents of modernization theory, a major cause of this inertia lay in traditional peoples' attitudes towards science and the physical world, which he described as 'pre-Newtonian'.[2] The Newtonian moment was symbolic of a watershed in world history when western man [*sic*] came to believe the external realm was subject to knowable laws, and thus capable of systematic manipulation. The transition to a 'modern growing society' was marked by economic, political, social, and most of all, attitudinal transformations which cleared the way for the fruits of modern science and technology to be fully exploited in ways that would secure sustained economic growth. One's physical environment came to be seen as an ordered world rather than simply 'given' by providence, which if understood rationally could be managed in ways that yielded greater productive surpluses and material progress.

Writing at about the same time, and through a similar lens, George Basalla produced his now classic essay on 'The Spread of Western Science'.[3] Basalla asked the question: how was the 'modern' scientific tradition, which began in Western Europe in the sixteenth and seventeenth centuries, diffused subsequently beyond its original boundaries to the rest of the world? As an explanation, he proposed a three-stage model of the process of transmission. In the initial phase of contact with other lands, European observers – many of them explorers, travelers, missionaries and other amateurs – survey, collect and appraise the flora, fauna and physical features of these new lands in their search for potential sources of wealth or settlement. In time, this period of reconnaissance gives way to a second, more substantial phase of 'colonial science' when the number of scientists involved and the range of activity expands considerably until it encompasses the full spectrum of scientific endeavor as it exists in the metropolitan 'core'. Despite such growth, colonial scientists remain dependent on European scientific institutions for training and affiliation, as well as on European scientific societies and journals for professional recognition. However, colonial science contains in embryonic form the seeds that, with the rise of nationalism, will eventually develop into an independent, 'native' scientific tradition. Colonial science is thus best seen, according to Basalla, as an evolutionary phase in the transmitting of Western science to the non-Western world. And like Rostow's trope of 'take off' to self-sustaining economic growth, self-reliance in scientific matters can only be achieved by consciously struggling to eradicate the barriers of resistance posed by non-European philosophical, religious and cultural beliefs.

Instrumentalist approaches: science as a tool of imperial control

A substantial body of historical research on science, expertise and imperialism has been produced since the publication of Basalla's seminal study, much of it critical of the diffusionist assumptions and progressive stages that underpin his model. Inspired by new directions in development studies, historians of science in the 1970s took a more radical turn as they began to incorporate the insights of dependency and underdevelopment theory into their work. Basalla's own analysis helped lead the way with its depiction of colonial science as dependent on an external scientific culture. Another early analysis was offered by Donald Fleming, who described the 'reconnaissance of natural history' tradition that dominated science in Australia, Canada and the United States until the end of the nineteenth century, as displaying a distinct 'colonial posture'.[4] Investigators in all three countries, he noted, remained foragers and collaborators, focused on the local and particular, while the highest responsibilities of collating data and devising universal theorems were reserved for scholars working at universities in Britain, France and Germany. But whereas Basalla and Fleming saw this dependency as transitional and relatively benign, others have viewed the derivative, fact-gathering nature of colonial science as symptomatic of the unbalanced relationship that imperialism fostered between Europe and much of the rest of the world. Building on the insights of dependency theorists, scholars in the 1970s and 1980s directed their attention increasingly to science as an instrument of imperial control and exploitation. The imperial 'metropole' and its colonial 'satellites', to use Andre Gunder Frank's analogy, were bound together in a system of unequal, extractive exchange in which knowledge and specimens as much as industrial raw materials flowed back to Europe, but rarely the other way.[5]

In their efforts to delineate the origins of this system, historians of science and imperialism focused heavily on the extractive and exploitative nature of what might be termed 'sciences of exploration'.[6] The development of astronomy, cartography, geography, meteorology, natural history and oceanography as bodies of natural knowledge, it has been noted, overlapped closely with the early overseas expansion of Europe. Such sciences played an important role in identifying, surveying, ordering and taking possession of new lands, resources and peoples. It is no coincidence that the Scientific Revolution and the Enlightenment in Britain, as Richard Drayton points out, took place in tandem with the forging of her empire.[7] James Cook's voyages to the Pacific in the 1760s and 1770s, in particular, have been seen by many as signaling the beginning of a novel phase in European exploration, setting new standards for the scope and accuracy of surveying and empirical observation.[8] The novelty of Cook's voyages went beyond the fact that his ships served as surveying devices, for on board were also scientists and artists including on his first voyage the wealthy and influential botanist, Joseph Banks. In his position as President of the Royal Society and close adviser to the king and his chief ministers in the late eighteenth and early nineteenth century, Banks became one of the leading promoters of oceanic and scientific exploration as a means of enlarging British imperial control over territories of strategic and commercial importance.[9]

With Banks' encouragement, the Admiralty and Navy played a central role in enlarging Britain's cartographic and hydrographic knowledge of the world, through an extensive project of maritime coastal reconnaissance and the codification of the famous Admiralty charts. The assigning of naturalists to naval surveying expeditions – a tradition that began with Banks – also meant the Navy became a key conduit in a worldwide operation of plant transfers that extended from the Caribbean and Central America, to the Pacific and Southeast Asia.[10] Through these voyages, naturalists such as Banks, Charles Darwin, Joseph Hooker and others were able to visit the far reaches of the globe in search of horticultural riches; collecting thousands of seeds, plants and specimens in the process. The acquisition of this vast treasure trove of plant materials helped to transform the Royal Botanic Gardens at Kew, London, into a leading center of botanical research and plant exchange. At Kew, as well as throughout the network of colonial botanical stations radiating out across the empire, plants that had been removed or smuggled from their natural habitats were developed and cultivated into 'improved' species by a corps of scientific specialists. From there scientific information was disseminated and new commercial crops were transmitted to colonial planters, thus enabling the formation of new plantation-based industries throughout the 'tropical' world, which complemented Europe's manufacture-based, 'home' industries.[11]

In the mid nineteenth century, as the surveying and charting of the world's major coastlines and great rivers neared completion, attention shifted increasingly to the terrestrial exploration and mapping of continental interiors. Once again, Banks and his associates led the way with the founding of the Association for Promoting the Discovery on the Interior Parts of Africa in 1788. As the name suggests, the Association aimed to foster geographical exploration, but it also had clear imperialist ambitions, as in the case of the tragic Mungo Park expedition along the Gambia River in 1805, which was organized by the Association with the intent of blocking efforts by the French to establish a colony in the area and thereby capture the regional trade in manufactured goods.[12] Although the influence of the African Association waned after 1815, its legacy lived on providing the model for the Royal Geographical Society, which was founded in 1830 (and which absorbed the African Association a year later).[13] Under the influence and direction of Sir Roderick Murchison, the Society was transformed into one of the foremost scientific associations of the mid Victorian epoch. Like Banks, Murchison became a tireless promoter of the utility of scientific knowledge for state power, and of the symbiotic relationship between science and the extension of British imperial and commercial influence. He was the imperial scientific statesman *par excellence*, whose patronage and social prestige helped to turn the fabled search for the source of the Nile into a national mission, and David Livingstone into nothing less than a 'Victorian Superman'.[14] 'Science' as Murchison's biographer, Robert Stafford, concludes,

> implies control, as an instrument both of administration and of knowledge. British natural science in the nineteenth century conquered new lands by reducing them to regularity and providing the requisite information to exploit them. Its importation of overseas data into libraries and museums of the metropolis constituted in one sense a gigantic looting operation which helped maintain British ascendancy…British geology and geography, as well as other sciences…were significantly influenced by Britain's possession of a colonial empire. Imperial concepts, metaphors, data, and career opportunities informed the development of these disciplines, and their institutions in varying degrees expressed this ideological matrix. The Victorian empire, in turn, evolved within an increasingly scientific environment. Geology and geography provided its rulers with new tools of administration and development, instruments of expansion, and methods for conceptualising the world. Murchison's career illustrates both sides of this bargain, for he was its key negotiator.[15]

Africa was not the only geographic region of interest. Inland expeditions of the Australian continent began in 1817–18 and continued through to the 1860s, while the search for a Northwest Passage spurred on the great age of Arctic exploration from 1820 to 1850.[16] The Indian subcontinent was also prized as a vast storehouse of exotic flora, fauna and minerals that could provide metropolitan laboratories with material for more basic or fundamental research.[17] Indeed, the early phase of British expansion in India has been described as the era of 'great surveys' in which a wide range of topographical, statistical, cadastral, cartographic and other surveys were carried out.[18] The most ambitious Indian initiative was the Great Trigonometrical Survey (GTS), founded in 1817 under the direction of William Lampton and George Everest. The aim of the Survey, according to Matthew Edney, was to provide India with a systematic survey by triangulation that would eventually extend across the entire subcontinent, and thereby bring all of the Company's mapmaking efforts and geographical knowledge into a single, coherent whole.[19] This 'mapping' of the Indian territory – not just the topographical maps of the GTS and various other geological, botanical and forestry surveys, but also the collecting of statistics on everything from finance, trade, health, population, crime and much more – was a necessary precondition for the consolidation of the colonial state. From the 1770s onward, for example, the British collected information on land settlement and tenure practices, which they compiled into district settlement reports that provided the basis for the state's all important, revenue assessments.[20]

The many threads of the instrumentalist view of science and empire were tied together, and perhaps summed up best, by the work of Daniel Headrick, who argued that scientific knowledge and technology were indispensable 'tools of empire'.[21] Headrick suggests that technical innovations stemming from a relatively few inventions tipped the scales in favor of European conquest of unprecedented expanses of the globe in the nineteenth century, at very little cost to the conquerors in terms of lives and capital. Improvements in firearms gave Europeans an overwhelming advantage over their Asian and African adversaries, while the introduction of quinine prophylaxis helped reduced the death rate among Europeans allowing them to penetrate deep into the interior regions, especially of the African continent. At the same time, new transportation and communications technologies such as steamships, railways and telegraphs allowed colonial powers to effectively control vast amounts of newly conquered territory. With the aid of such technological advantages, Europeans had by the end of the century brought about a fundamental shift in global relations.

In a later work, Headrick took on the question of technology transfer charging that, although European imperialism brought about a massive diffusion of technology as Western industrial and scientific methods were applied to stimulate the growth of production and population in the tropics, this transfer did not diversify tropical economies nor significantly raise per capita incomes. Such technological changes, which originated in the West through the work of European scientists and engineers, were developed for the benefit of the metropolitan country with little regard for the long range impact on the colonies.[22] In particular, colonial rule brought with it investments in physical rather than human capital, relocating European technologies geographically but without the corresponding cultural diffusion through increased technical education and greater social mobility. The result, Headrick contends, was the transformation of 'traditional' economies into 'modern underdeveloped ones', rather than the industrialized replicas of the West envisioned by nineteenth-century observers like Karl Marx.

Postcolonial theories: science, culture and violence

Although most postcolonial writers and theorists would probably agree with Headrick that the results of European imperialism have been detrimental to former colonial societies, they have taken the argument in new directions by seeing scientific knowledge and techniques as what might be termed 'signs of modernity' that stood at the center of the nineteenth-century 'civilizing mission'. [23] Western science, in other words, must be understood as a form of cultural imperialism, no less than a tool of economic exploitation and underdevelopment. Postcolonial studies, with its origins in the pioneering work of Edward Said, has been critical in drawing attention to the cultural aspects of Western imperialism, rather than its political and economic ramifications. Said's real insight was to suggest that the study of Indian and Eastern languages and culture by Europeans was not embarked on simply out of curiosity in order to gain insight and knowledge, but rather, that such knowledge was critical '…for dominating, restructuring, and having authority over the "Orient"'. 'The Orient', Said asserted, 'is not only adjacent to Europe; it is also the place of Europe's greatest and richest and oldest colonies, the source of its civilizations and languages, its cultural contestant, and one of its deepest and most recurring images of the Other…without examining Orientalism as a discourse one cannot possibly understand the enormously systematic discipline by which European culture was able to manage – and even produce – the Orient politically, sociologically, militarily, ideologically, scientifically, and imaginatively during the post-Enlightenment period'.[24]

Although Said did not explicitly discuss the role of science, his employment of Foucault's ideas about the relation between knowledge and power, and his emphasis on analyzing colonial discursive practices, has had a tremendous influence on those who do. A number of postcolonial writers and theorists, following Said's lead, have depicted science as a form of cultural domination that was inherently violent and destructive of colonial nature and peoples. In doing so, they have produced some of the harshest critiques of the relation between Western science, development and imperialism. Ashis Nandy, for example, contends that science has become an end, and not simply an instrument, of state power in

India, especially since independence. As the scientific establishment has gained greater access to power and resources, Nandy argues that it has led to a decision-making process that is increasingly at odds with democratic rights and governance, and which has increasingly sanctioned the use of violence in the name of science-based development.[25] Vandana Shiva sees this nexus between science and development as the continuation of a process first set in motion by European colonization. With the arrival of the British, for example, India's forests became for the first time the object of intense commercial interests. Indian teak and other timber were extracted for shipbuilding and later for railway construction. Local needs, and local indigenous knowledge and expertise, which had sustainably managed the forests for centuries, were rendered redundant and replaced by colonial forestry. The scientific management of the forests in the second half of the nineteenth century, according to Shiva, 'amounted basically to the formalisation of the erosion both of forests and of the rights of local people to forest produce'.[26] Under colonial scientific forestry, India's complex forest ecosystem was reduced to a timber mine, whose primary objective was the maximizing of exchange value on the market through the extraction of commercially valuable species. The forest policy of postcolonial India has continued along the colonial path of commercialization and reductionism through various social forestry and 'wasteland management' schemes. It is this pattern of resource use, according to Shiva, that has generated the instabilities in the ecosystem which have led to today's ecological and social crises, and in turn, have sparked fierce resistance by local communities such as the women and peasants of Garhwal region, Uttar Pradesh, who began the Chipko movement in the early 1970s.

Shiva's views have been reflected by other critics of 'reductionist science' like Claude Alvares, who contends that precolonial South Asia was a region of dynamic indigenous scientific creativity and innovation, but that this unique cultural trajectory was abruptly and violently dislodged by British rule.[27] Colonialism was thus the agency first responsible for forcibly superimposing 'modern Western science' onto the Third World. Its hegemony was consolidated and extended further by an indigenous class of modernizers whose Oxbridge schooling alienated them from the life and culture of their own people. This colonial heritage of domination and violence continues to be felt through the intimate relationship between science and development. 'If one, in fact, reflects on the events of recent decades', Alvares writes,

> one is indeed reminded that development and science have run through the period, tied together as intimately as a horse and carriage.

> Development was desired by us non-Western societies precisely because it was associated with science. What obtained prior to development, either in the form of pure nature or non-Western subsistence, did not have, we were told, the rationality, slickness and efficiency of modern science. People, societies, nature itself were backward because of its absence…Backwardness was to be substituted by development, an allegedly better way of organizing man and nature based on the rich insights of up-to-date science. Science, in turn, was desired because it made development *possible*. If one developed its associated skills, one could have unlimited development and riches. Science and development both reinforced the need for each other; each legitimized the other in a circular fashion.[28]

Studies such as those described above have come under heavy fire from critics, who note that in their effort to escape the hegemonic claims of the 'West', and to disentangle 'subaltern' voices from the sovereignty of European thought, postcolonial theorists have posited an alternative paradigm, which depicts colonial discourse and power as monolithic and totalizing in scope, and which reinforces, by inversion, the very dichotomies and cultural representations on which imperial power and structures of knowledge rested. 'Science' is portrayed as an all encompassing 'knowledge-power regime' located in a vaguely defined 'West' and based exclusively on the 'modern Western' knowledge system. Such a view often overlooks the enigmatic and fractured nature of Western imperialism as it played out in practice. 'Ironically', as Dane Kennedy remarks, 'this stress on the power of the West countenances the neglect of the power as it was actually exercised in the colonial context, ignoring 'its plural and particularized expressions'. Further, it fails to appreciate the uncertainties, inconsistencies, modifications, and contradictions that afflicted Western efforts to impose its will on other peoples'.[29] Similar biases run through the work of other postcolonial scholars such as Ashis Nandy and Partha Chatterjee, who draw a sharp contrast between Gandhian localism and Nehruvian centralism, championing the former's vision of self-regulating and self-sufficient, harmonious village communities as the authentic 'indigenous' voice of resistance to the modern West.[30] Yet, as Sugata Bose critically observes, the positing of such a dichotomous distinction requires not only '…an analytical sleight of hand to counterpose antimodernist vision to modernist politics', but it also misses out '…on the multifarious ways in which nationalist thought construed the relationship between nation and state as well as the role of the state in development'.[31]

To be fair, not all postcolonial scholars have been as Manichean in their treatment of colonial science as Shiva and Alvares. While not denying the fact that 'India was born in violence', Gyan Prakash suggests that science's cultural authority was even more consequential. The staging of science as an expression of Western dominance was an important facet of colonial rule, lending legitimacy to the ideologies of improvement and rationality that underpinned the new structures of state power in India and elsewhere.[32] The founding of museums in the nineteenth century, such as the Indian Museum in Calcutta in 1878, was a key institutional innovation that enabled the collection, classification and display of Indian artifacts and specimens in a set order that not only made the imperial connection visible, but also showcased the universality of Western scientific knowledge. Exhibitions were another medium through which the use of dramatic displays and visual spectacle instilled a sense of wonder and curiosity in visitors. From this arose the Western educated, Indian elite's enthusiasm for Western scientific values and use of technology, which they sought to meld with revived indigenous traditions, not through a process of dissemination or imposition as diffusionist or instrumentalist models would suggest, but rather, through a process of translation and hybridization.[33] The cultural authority and language of science was thus invoked by many prominent reform intellectuals, such as the Theosophists, to advance the case for the compatibility and oneness of the laws of nature and the 'essential' Hindu religion, shorn of its superstitions. But what is often not realized, Prakash argues, is the degree to which this process involved a renegotiation of power:

> To situate science in the language of the other was to hybridize its authority, to displace its functioning as a sign of colonial power. Hybridization, therefore served as a counter-hegemonic ground upon which the elite pressed their entitlement to modernity even as they misrecognized their aspirations for power as imitation and loyalism … Themselves a product of the translation and intelligibility as subjects, the elite gave ideological direction and force to the emergence of an Indian modernity, and defined it in a predominantly Hindu and Sanskritic idiom.[34]

Prakash's emphasis on the displacement and renegotiation of scientific knowledge and authority represents a significant departure from the binary models of colonial relations that characterized so much of the earlier research on the history of science in the British empire. His work is but one of a number of studies that have appeared in recent years, which have sought to apply the insights of postcolonial theory with increasing sophistication, and which have contributed to breaking down the notion of an all-embracing colonial mission or project. The cross-fertilization of postcolonial theory with other approaches to understanding imperial relations, as well as with more traditional empirical-based research methodologies, has open up new and fruitful ways of understanding the role of science within the British empire. One of the most promising new directions, as the next section details, is to think of the association between science and imperialism in terms of network theory.

Beyond core and periphery: networks and the hybridization of knowledge

Even before the postcolonial critique was widely felt within the field, some reviewers were concerned about the lack of precision used by historians of science and empire in defining the boundaries of the subject or the meaning of its terms. In an important piece written in the mid 1980s, Roy Macleod pointed out that the difference between 'colonial' and 'imperial' science was not always clear, and that 'colonial science' was often conflated with 'scientific colonialism' and 'imperial science' with 'scientific imperialism'. Though the concepts were interrelated, Macleod stressed that historians needed to keep them analytically distinct.[35] Colonial science was the actual practice of science in the colonies operating through a particular historical set of structures, institutions and precepts, whereas scientific colonialism represented a process whereby a conscious ideology or variant of colonial policy was carried out. Similarly, British imperial science was also a network of structures, institutions and staff emanating from Cambridge, Edinburgh, London and Oxford, that could serve quite different political ideologies and policy objectives at different times. Macleod defined scientific imperialism as an explicit version of imperial doctrine associated with the New Imperialism of the late nineteenth century.

Macleod's interjection served as a useful reminder that the dissemination of Western science and its association with European imperialism was not a homogenous or linear process unfolding in uniform stages or driven by a single ideology or project. His call for great analytical precision in distinguishing 'colonial' from 'imperial' science, moreover, was taken up by those who sought to show the importance of the imperial context in shaping the development of science in Britain itself. The work of Michael Worboys has been particularly instrumental in this regard. In a series of chapter-length studies that derived from his doctoral research, Worboys highlighted the significance of science in colonial development policies, beginning with Joseph Chamberlain's 'constructive imperialism' in the 1890s, and he examined the changing place of strategically important colonial sciences, most notably tropical agriculture and tropical medicine, within the larger context of 'Empire science'.[36] Out of Chamberlain's efforts as Colonial Secretary between 1895 and 1903 to use scientific expertise and the state to promote the development of the empire's 'great estates', emerged an ideological alliance between science and development, which continued to hold currency among government officials and advisers through to the end of empire.[37] Following the First World War, a more coordinated 'science for development' movement appeared in Britain, whose leading figures, as Worboys notes, 'expected that science and scientists would be catalysts of development by discovering economic opportunities, making the tropical environment safe, solving technical problems in production, processing and distribution, directing and improving the productivity of investment, and generally demystifying the tropics and their people'.[38] Later studies have extended Worboy's pioneering work on colonial science policy further, demonstrating how the use of science and expertise, in conjunction with the new bureaucratic capacities of the state, came to define the British imperial mission in the late colonial period; so much so that historians have begun to write of the 'technological turn' in colonial policy after 1940.[39]

But understanding the changing architecture of imperial science or the shifting debate over ideologies of scientific imperialism is only part of the story. Worboy's studies of the development of tropical medicine as a scientific specialism in Edwardian Britain, demonstrate not only that public scientists and academics used empire as a way to advance individual careers and secure state funding for research and institutional network-building, but more importantly, that the nature and content of the discipline itself was profoundly shaped by the imperial experience.[40] This is a critically important insight within the field of the history of science, which has not gone unchallenged, most notably from Lewis Pyenson, who in a series of studies on the place of the physical and astronomical sciences in European overseas expansion, claims that the development of the 'exact' sciences was unaffected by the social environment in which they were practiced, regardless of whether that setting was the imperial metropolis or the colonial outpost.[41] Notwithstanding Pyenson's dissension, however, a growing corpus of scholarship over the past 20 years has confirmed Worboy's constructivist standpoint, bringing to light the centrality of imperialism in the evolution of a range of scientific disciplines. Much has been done on tropical medicine, but studies have also shown that the imperial context had an important bearing on the types of research conducted and the forms of knowledge generated in other fields, including geography and geology, botany, ecology, tropical agriculture, forestry and more.[42]

This focus on how science responded to the problems and challenges posed by the imperial encounter can be seen as a part of a wider trend in imperial history that has emerged since the mid 1990s. Contributors to this historiographical shift, which for lack of a better term has been billed as the 'new imperial history', have sought to highlight the tensions and complexity of the British Empire, by noting the presence of different groups of actors operating within the empire's territorial boundaries who engaged in different colonial projects, which produced multiple, and at times conflicting and contradictory, discourses of imperialism.[43] Nineteenth-century missionaries, as Catherine Hall has shown for example, embraced a distinct vision of empire as a space where former slaves might be transformed into 'civilized' men and women as members of a wider Christian community. Their dream, however, was challenged, not only by West Indian planters and their supporters in England, but also by Afro-Caribbean peoples themselves. It was also fraught with internal contradictions which led over time to important ideological shifts as theories of biological racism became more widely accepted by later generations of missionary leaders. Similar complex and layered histories can be traced for other groups such as explorers, travelers, traders, officials, settlers, peasants, and of course, scientists among many others.

Underlying and guiding much of the work of the 'new imperial history' is the conceptual insight that metropole and colony must be placed within a single analytical frame or field of analysis.[44] Such an approach challenges the diffusionist and instrumentalist assumptions of earlier, bifurcated models of colonial relations, insisting instead that those relations be viewed as mutually constitutive, and causality as a process that could run both ways. The experience of empire, in other words, was as important in shaping culture and identity in the 'West' as it was in the colonies themselves. A growing body of research has been devoted to examining the connectedness and mutuality between British domestic history and the history of Britain's overseas involvement. Much has been written on the ways in which Englishness and Britishness were continually forged and reforged through the construction of categories of difference that enable the English and British to distinguish themselves from others who were deemed 'outsiders', be they the Catholic French or rebellious Irish or various subordinate colonial races.[45]

Such interconnections between 'home' and 'away' go beyond issues of identity and belonging. It has been observed, for example, that the Empire, and especially India, was thought of as a social and political laboratory where ideas and policies that were contentious at home could be first contemplated and tested. As Bernard Cohn has pointed out: 'It is not just that the personnel who governed India were British, but the projects of state building in both countries – documentation, legitimation, classification, and bounding, and the institutions therewith – often reflected theories, experiences, and practices worked out originally in India and then applied in Great Britain, as well as vice versa'.[46] This crisscrossing of people, ideas and institutional practices between Britain and its Empire points to the existence of linkages, which cannot be adequately explained by the older national and imperial historiographies. What is required, rather, is an approach that is able to link the colonies with Britain as well as with each other, in ways that move beyond the bifurcated models of the past to capture what might be called the spatial complexity of the Empire.[47]

David Lambert and Alan Lester argue that the heterogeneous and contradictory nature of the British Empire, and the complex connections of ideas, practices and individual lives that linked different imperial sites together, can best be understood through a 'networked' conception of empire. They suggest we think of the empire as a web-like space of layered networks of communication – everything from colonial administrative services to missionary and humanitarian organizations to networks of scientific inquiry to counter-imperial linkages such as the Pan-African Congresses – through which '…multiple meanings, projects, material practices, performances and experiences of colonial relations…' were constructed and circulated.[48] These circuits enable us to think about the relationality of colonial, metropolitan, and even extra-imperial sites, and to follow the movements not only of capital and commodities, but of crucial ideas, practices and people.[49]

What is potentially useful about a networked conception of empire is the view of colonial relations spanning across space in contingent, nondeterministic and unstable ways. It recognizes that multiple colonial projects and discourses existed in tandem, and often in competition and opposition with each other, which took shape through overlapping networks that connected colonial and metropolitan places.[50] Seen from this angle, the empire appears as a web-like structure, rather than a simple binary divide, in which horizontal exchanges of ideas and individuals moving directly between colonies, as Tony Ballantyne's work on Aryanism in India and New Zealand demonstrates, could be just as important as those traveling between the metropole and its peripheries.[51] Ballantyne argues that the development of Aryanism as a racial ideology on the New Zealand frontier in the nineteenth century was the product of a multiplicity of transnational connections between colonial South Asia and the Pacific. Several constellations of imperial networks were particularly crucial, including an emergent imperial newspaper and print culture that connected the colony to the wider world of empire, and the establishment of learned institutions, such as Theosophy and the Polynesian Society, which had strong and direct connections to India. But perhaps most important were well-developed migration networks that linked India and New Zealand, including a large cluster of colonial surveyors and foresters, who began their careers in the service of the East India Company (and later, the Government of India) before transferring to New Zealand. 'Thus', writes Ballantyne, 'two elite cliques of experienced India hands played a pivotal role in state-sponsored colonial science and were at the forefront of the colonial project to map and demarcate land and to police its effective use'.[52]

Ballantyne's study reminds us further that empires were not just structures, but also processes. Colonial knowledge was inherently mobile, moving through institutional webs that brought disparate places, people, and activities together at a given moment in time. These webs were constantly being made and refashioned, and were often fractured and even broken, making them fluid and fragile. Moreover, by conceptualizing empire as structures of intersecting webs, Ballantyne argues that 'it is possible to envisage that certain locations, individuals or institutions in the supposed periphery, might in fact be the center of complex networks themselves'.[53] Thus, Calcutta or Toronto or Melbourne might in some of their relations have functioned as subimperial centers with their regional hinterlands, even while being in a subordinated or 'peripheral' relation to London. Moreover, these networks were not always coterminous with the Empire itself. Trade and commercial exchange patterns in the eighteenth-century Atlantic world, as Natasha Glaisyer observes, provide a particularly good illustration not only of the 'interactivity of peripheral regions', but of the fact that British interests were embedded in more extensive networks that frequently crossed imperial boundaries to include Dutch, French and Spanish metropolitan and colonial places.[54]

Even before such terms as 'webs' and 'networks' were popularized, historians of science were growing increasingly dissatisfied with linear and binary narratives of science and empire. As noted above, Roy MacLeod was one of the first to question the assumptions that informed historians of imperial science in the 1980s, leading him to propose a more dynamic and flexible formulation that could account for the tremendous range and variety of experiences that fell under its general rubric. Noting that in many instances it was institutions and expertise in Britain that depended on discoveries and enterprise in the colonies, MacLeod concluded '…that the idea of a fixed metropolis, radiating light from a single point source, is inadequate. There is instead a moving metropolis – a function of empire, selecting, cultivating intellectual and economic frontiers'.[55] MacLeod thus recognized that colonial relations had gone through various phases, and that centers on the 'periphery' such as Sydney or Calcutta at times enjoyed a degree of autonomy and leadership, even while London remained ultimately in control through its ability to accommodate and assimilate ideas from the margins.

MacLeod was not alone in questioning conventional views of the categories of core and periphery. By the 1990s, scholars such as Richard Drayton and Richard Grove were also moving beyond older, national and imperial historiographical divisions in an effort to integrate Britain's 'island story' with the story of its encounters with the wider world. In his study of botanic gardens as instruments of government, for example, Drayton argues that the wave of British imperial expansion that occurred between 1790 and 1815, and that led to the acquisition of new territories in India, Africa, the West Indies, the Pacific and elsewhere, was paralleled by and closely tied to a surge of new state initiatives at home.[56] Both processes were sustained by new ideological currents of agrarian 'improvement', which envisioned an alliance between science and property that would work toward the dissemination of progress in Britain as well as the Empire. 'Through the most advanced knowledge and techniques', as Drayton explains, '"improvers" would organize the best possible future, both for those they expropriated and subordinated, as for themselves'.[57] Such knowledge and techniques were circulated through various institutions such as the creation of botanic gardens, most notably the Royal Botanic Gardens at Kew, which acted as nodes in a vast imperial, and indeed international, network of information and plant exchange.

The role of botanic gardens in the global circulation of scientific knowledge also features prominently in Richard Grove's pioneering work on imperial environmental history. Grove's research, however, takes a somewhat different course, arguing that concerns for the effects of Western economic activity on tropical environments emerged as a corollary to, and often in contention with, European colonization and capitalist expansion. Moreover, his work attaches considerable weight to indigenous sources and to local colonial contexts in shaping the production of botanic, medical and climatic knowledge during the early modern period. By

1800, a professional, scientific lobby had emerged in the service of the East India Company, with direct connections to scientists working on oceanic islands such as Mauritius and Saint Helena. These colonial scientists, mostly botanists and surgeons, developed a body of new environmental ideas that was influenced by Orientalism and Hindu holistic philosophy as well as by Humboldtian theory, which in turn was widely diffused in the first half of the nineteenth century through international and imperial meetings and scientific societies like the Royal Geographical Society. By the 1860s, Grove argues, a 'desiccationist' school had emerged, which linked climate change to the loss of water supply and rainfall brought on by deforestation.[58]

Building on studies like Drayton's and Grove's, as well as Bruno Latour's highly influential *Science in Action*, more recent scholarship has sought to use networks as an explicit framework of analysis for re-imagining the way scientific knowledge was produce across the multiplicity of connections that wove the disparate parts of Empire together.[59] David Wade Chambers and Richard Gillespie, for example, have proposed the idea of 'vectors of assemblage', which form the local infrastructure of technoscience, but which are also connected to a global information network or international science system, which '…monitors, coordinates, authorizes, legitimates, classifies, and situates the flow of observational and experimental information'.[60] Chambers and Gillespice suggest we think of colonial scientific relationships as 'polycentric communication networks', which crisscrossed the empire and through which scientific knowledge and authority was produced, circulated and legitimated. Similarly, James Delbourgo and Nicholas Dew have employed the idea of 'Networks of Circulation' in their recent edited volume on *Science and Empire in the Atlantic World*. Networks, they suggest, are a useful way of understanding the transnational process by which knowledge was produced, as well as the mechanics of the movement of that knowledge, across such a vast geographical space as the Atlantic region.[61] Sujit Sivasundaram has also endorsed the idea of networks, not only because of its ability to capture the mobility of scientific knowledge, but also, and more importantly, because it emphasizes how knowledge flows were transnational, transregional, and transimperial.[62]

Although a networked conception provides a useful analytical framework for historians of science and empire, it is not without its potential pitfalls. A level of caution, therefore, must be exercised when utilizing a network approach to analyze colonial science relations. As several commentators have pointed out, imperial networks and connections were highly uneven.[63] Some webs and networks were more important than others, which resulted in bottlenecks or lumps at certain meeting points. There is a danger, in other words, in thinking of colonial relations as reciprocal, multiple and fluid, that we may neglect the inequalities of power and the importance of institutional and economic factors. Simon Potter, for example, maintains that imperial connections were often much more like systems than networks or webs, in that they tended to be 'dominated by a restricted number of powerful organizations, whose interests together dictate more formal, entrenched, and limited patterns of interconnection'.[64] Potter agrees that the kind of patterns of long distance, mass communication created by newspapers in Britain and in the colonies in the early nineteenth century could be described in terms of loose and fluid networks or webs. However, he sees a greater tendency towards systematization and homogeneity from the middle of the century onward. This was especially the case after the introduction of telegraphs and undersea telegraph cables, which fundamentally reshaped and restricted the channels through which news flowed. The new submarine cable system was dominated by a small number of large private cable companies, which charged users exorbitantly high rates. Increased costs, in turn, stimulated the formation of international news agencies such as Reuters that came to exercise overwhelming control over the Empire's cable news markets. Although the resulting 'imperial press system' never attained complete hegemony, it was able to exert profound influence on the collection and circulation of news and, writes Potter, 'helped to reinforce London's position as the news hub of the British Empire and further displaced some parts of the empire from the attention of the British public'.[65]

A similar tendency toward systematization and more rigid structures, as this book demonstrates, is evident in the development of British imperial scientific networks and knowledge circuits in the nineteenth and twentieth centuries. As we discuss further in the next chapter, many officials and scientists sought to purposely create and maintain a distinctly British world-system of science. Such a system has its origins in the kind of informal networks and connections developed by Joseph Banks towards the end of the eighteenth century. By the middle of the nineteenth century, these linkages start to become more formalized and institutionalized, and are directly tied to the British state. The system reaches its height in the early twentieth century with the creation of technical and scientific departments throughout the colonies, the formation of schools and research institutions and centers in Britain and the Empire, and the development of professional networks with a shared 'culture of science'. The early twentieth century also witnessed a determined, if ultimately unsuccessful, attempt at coordinating and centralizing of British imperial science through such mechanisms as the holding of special Empire, and later Commonwealth, conferences, and the setting up of imperial bureaux that acted as informational clearing houses. Such a system, of course, was never closed or complete, and by the mid twentieth century was growing increasingly porous and fractured by the emergence of international and national scientific networks.

While a networked conception of empire must be tempered by a realization of the unevenness and inequalities of power that shaped imperial linkages, it is also critical not to lose sight of the specificity of different places that these linkages tied and integrated together. Knowing the particular site or *locality* from which scientific knowledge emerges or is put into practice is the first step, not only to understanding the nature of imperial connections, but to rethinking the very notion of 'Western' science itself. For Chambers and Gillespie, for example, locality is the place where science is accomplished; it is the local frame of reference, including the scientific infrastructure of organizations, museums, laboratories, instruments, journals, but also ideas, theories, strategies, and communities of personnel, which, as noted above, constitutes for them the 'vectors of assemblage'.[66] Investigating these vectors is essential to understanding how ideas are both shaped by, and in turn, reshape the settings in which they are produced. This attention to where science is carried out, and to the way particular places were fundamental in the making of knowledge, has been one of the most important developments in the history of science in recent years.[67]

It has become increasingly clear, for example, that colonial knowledge was as much the product of 'dialogic encounters' with indigenous cultures, as it was imposed or transplanted, *sui generis*, from Europe. Local, native informants pursuing their own agendas, as Lynn Zastoupil reminds us, played a crucial role in the construction of colonial knowledge, especially in the early stages of colonialism.[68] The interracial intimacy and fluid boundaries of early colonial societies created a world of overlapping cultural and diplomatic influences or 'middle ground', in which individuals capable of moving between or straddling both worlds were highly sought after as intermediaries and interpreters.[69] This middle ground, Zastoupil argues, '…was also the crucible of colonial discourses, a place where information and intellectual traditions were exchanged and reconstituted in the same manner as were marriage customs and cultural artifacts…and in this constructed space political and cultural identities were uncertain and produced various attempts to synthesize, rather than divide, European and non-European traditions'.[70]

Kapil Raj has taken the hybridization of ideas and roles even further, insisting that for 'open air' sciences such as geographical surveying, agriculture, botany, forestry and anthropology, which were fundamental to the colonial order, knowledge was co-produced.[71] 'South Asia…' Raj asserts, '…was not a space for the simple application of European knowledge, nor a vast site for the collection of diverse information to be processed in the metropolis, nor indeed 'of complicated and complex knowledge created by Indians, but codified and transmitted by Europeans'. On the contrary, South Asia was an active, although unequal, participant in an emerging world order of knowledge'.[72] Raj uses the example of geographical surveying and map-making practices in South Asia in the early colonial period to show how 'Western' science coemerged in India and Britain through a complex process of cooperation and negotiation. Although triangulation was important, it was used as part of a 'composite method of data collection', alongside other, pre-existing techniques such as pacing and reckoning distance as a function of time.[73] Instruments such as the perambulator had to be modified and redesigned to better suit local conditions. Thus, in contrast to Mathew Edney's work, as well as much of the postcolonial historical writing on the Indian subcontinent, Raj maintains that the East India Company's large scale, terrestrial surveying, far from being a violent imposition, relied heavily on local, indigenous intermediaries, and their skills and techniques. It also proved exceedingly difficult for the Company to control the publication and circulation of maps prepared by their surveyors or the dissemination of their skills and techniques. 'The result' Raj concludes, 'was necessarily a hybrid culture, similar to the one that emerged in Britain and – might one add? – everywhere else in the world'.[74]

The work of Zastoupil and Raj among others, has raised provocative questions about what exactly we mean by 'colonial science' and 'colonial knowledge'. It reminds us of the importance of studying the actions of individual scientific and technical practitioners and their movement across various colonial, imperial and international spaces. As William Beinart, Karen Brown and Daniel Gilfoyle have recently pointed out, many technical officers and scientists spent years in colonized countries, developing in-depth knowledge that was generated through complex interactions with local intermediaries and indigenous expertise.[75] Others were highly mobile, bringing experience gained from different areas to bear on problems elsewhere. They also shared their research with others through extensive correspondence and communication in scientific journals, conferences and officials reports, while their career paths often brought them in contact with wider imperial, and even transimperial, scientific communities. The ideas and technical practices produced by scientists working in the colonies could certainly be utilized for the purposes of imperial control and exploitation, but they could also be employed in more nuanced ways. The critical contribution made by the emerging environmental and social sciences in highlighting the adverse effects of empire on tropical environments and indigenous peoples, is perhaps the best illustration of the ambiguous part science played in the colonial encounter.[76]

What is needed, then, and what the essays presented in this volume endeavor to show, is the importance of studying the activities of scientists, the ideas and practices they generated, and their circulation in specific institutional contexts. What is also needed, as David Livingstone suggests, is a closer examination of how knowledge moves from place to place and how it becomes stabilized; of how it is 'disembedded' from the local setting in which it is produced and transmitted to the larger scientific community, and of how in the process it undergoes translation and transformation.[77] The contributors to this volume, following Chambers' and Gillespie' lead, conceive of colonial scientific relationships as polycentric communication networks that have many layers of authority and interaction. By employing the idea of polycentric networks, we wish to highlight and document the assemblages of information, practices, strategies, theoretical ideas and agendas that circulated among various groups of imperial actors, and across various imperial spaces in Africa, Australia, Britain, India and elsewhere.

The chapters that follow examine a variety of scientific initiatives and circuits, including networks of agronomists, anatomists, botanists, entomologists, foresters, geologists, marine biologists, oceanographers and physicists. Indeed, this is the first edited collection devoted to comparing and analyzing the development of scientific networks and knowledge making across a variety of disciplines and time periods within the British Empire. Taken as a whole, the book seeks to address a variety of questions: How can historians of colonial science move beyond the Eurocentric dichotomy of a 'center' and 'periphery', to produce more useful categories of analysis that reflect the multinodal and contingent reality of knowledge making in an imperial and global context? What can we learn by comparing knowledge production and networks of science during different stages of the British Empire, from the early nineteenth century to the age of 'high' imperialism, to the 'second colonial occupation' and decolonization? How did various actors, both foreign and local, collaborate and interact to create new hybrid forms of scientific knowledge? How did imperial scientific communities evolve and reconfigure into postcolonial scientific networks? In posing and seeking answers to these questions, it is hoped that this book will serve as an important point of departure for future studies within the still relatively young and ever expanding field of the history of science in the British Empire.

Notes

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2 W.W. Rostow, *The Stages of Economic Growth: A Non Communist Manifesto* (Cambridge: Cambridge University Press, 1960), p. 4. Other classic studies of modernization which extol the efficacy of science and technology include: David Lerner, *The Passing of Traditional Society: The Modernization of the Middle East* (New York: Harper, 1958); C.E. Black, *The Dynamics of Modernization* (New York: Harper & Row, 1967).

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4 Donald Fleming, 'Science in Australia, Canada, and the United States: Some Comparative Remarks', *Proceedings of the Tenth International Congress of the History of Science*, Ithaca 26 VIII–2 IX 1962 (Paris: Hermann, 1964), 179–96.

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7 Drayton, 'Knowledge and Empire', p. 231.

8 Glyndwr Williams, 'The Pacific: Exploration and Exploitation', in P.J. Marshall (ed.) *The Oxford History of the British Empire; The Eighteenth Century* (Oxford: Oxford University Press, 1998), pp. 563–4; Benedikt Stuchtey, 'Introduction', in Stuchtey, *Science Across the European Empires,* p. 1.

9 David Mackay, *In the Wake of Cook: Exploration, Science and Empire, 1780–1801* (Wellington, New Zealand: Victoria University Press, 1985); John Gascoigne, *Science in the Service of Empire: Joseph Banks, the British State and the Uses of Science in the Age of Revolution* (Cambridge: Cambridge University Press, 1998); Richard Drayton, *Nature's Government: Science, Imperial Britain and the 'Improvement' of the World* (New Haven: Yale University Press, 2000).
10 Robert Stafford, 'Scientific Exploration and Empire', in Andrew Porter (ed.) *The Oxford History of the British Empire: The Nineteenth Century* (Oxford: Oxford University Press, 1999), p. 295.
11 For Kew's role in empire see the pioneering work of Lucile H. Brockway, *Science and Colonial Expansion: The Role of the British Royal Botanic Gardens* (New York: Academic Press, 1979). Also see, Richard Drayton, *Nature's Government*.
12 Gascoigne, *Science in the Service of Empire*, p. 181.
13 Stafford, 'Scientific Exploration and Empire', p. 295.
14 Felix Driver, *Geography Militant: Cultures of Exploration and Empire* (Oxford: Blackwell Publishers, 1999), pp. 78–9. The term 'Victorian Superman' comes from Niall Ferguson, *Empire: The Rise and Demise of the British World Order and the Lessons for Global Power* (New York: Basic Books, 2002), p. 101.
15 Robert Stafford, *Scientist of Empire: Sir Roderick Murchison, Scientific Exploration and Victorian Imperialism* (Cambridge: Cambridge University Press, 1989), p. 223.
16 Stafford, 'Scientific Exploration and Empire', pp. 296, 302–4.
17 Deepak Kumar, 'Colonial Science: A Look at the Indian Experience', in Deepak Kumar (ed.) *Science and Empire: Essays in Indian Context (1700–1947)* (Delhi: Anamika Prakashan, 1991), p. 7.
18 Zaheer Baber, *The Science of Empire: Scientific Knowledge, Civilization, and Colonial Rule in India* (Albany: State University of New York Press, 1996), chaps. 5 & 6.
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20 Bernard S. Cohn, *Colonialism and its Forms of Knowledge: The British in India* (Princeton: Princeton University Press, 1996), pp. 5–6.
21 See Daniel Headrick, *The Tools of Empire: Technology and European Imperialism in the Nineteenth Century* (Oxford: Oxford University Press, 1981).
22 Daniel Headrick, *The Tentacles of Progress: Technology Transfer in the Age of Imperialism, 1850–1940* (Oxford: Oxford University Press, 1988), p. 7.
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33 Prakash, *Another Reason*, pp. 49–85.
34 Prakash, *Another Reason*, pp. 84–5.
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37 Macleod has detected a similar shift for late nineteenth-century India, where the problem of recurring famines stimulated demands for a more organized and conscious application of scientific knowledge to the development of Indian agriculture and the creation of agricultural departments staffed by specialists in each province. This consolidation reached its zenith in the period 1900–1914 with the setting up of the Board of Scientific Advice under Viscount Curzon to act as a central authority for coordinating the application of science to all economic and agricultural problems. See Roy M. Macleod, 'Scientific Advice for British India: Imperial Perceptions and Administrative Goals, 1898–1923', *Modern Asian Studies* 9, 3 (1975), 344–58.
38 Worboys, 'British Colonial Science Policy', p. 108.
39 Sabine Clarke, 'A Technocratic Imperial State? The Colonial Office and Scientific Research, 1940–1960', *Twentieth Century British History* 18, 4 (2007); 453–80; Joseph Hodge, *Triumph of the Expert: Agrarian Doctrines of Development and the Legacies of British Colonialism* (Athens, OH: Ohio University Press, 2007).
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53 Ballantyne, 'Race and the Webs of Empire', p. 41.
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55 Macleod, 'On Visiting the Moving Metropolis'.
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64 Simon Potter, 'Webs, Networks, and Systems: Globalization and the Mass Media in the Nineteenth- and Twentieth-Century British Empire', *Journal of British Studies* 46 (July 2007), 622.
65 Potter, 'Webs, Networks, and Systems', p. 636.
66 Chambers and Gillespie, 'Locality in the History of Science', pp. 221–40.

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2

The Consolidation and Reconfiguration of 'British' Networks of Science, 1800–1970

Brett M. Bennett

The consolidation of scientific networks, 1850–1920

Prior to the 1850s scientific networks in the British Empire functioned through a patchwork of institutions and personal contacts that developed out of the patronage politics of Britain's old regime. John Gascoigne's chapter, 'Science and the British Empire from its Beginnings to 1850', suggests that prior to the middle of the nineteenth century the old regime 'had been tardy in assuming a direct partnership with science'. What government funded science existed – most often related to agriculture, botany, mapping, and exploration – functioned through a framework of patronage dominated largely by Sir Joseph Banks.[1] The functioning of most scientific networks across the British Empire often relied upon private monies, long-distance correspondence, and amateur interests. A culture of 'scientific colonialism' and agrarian and Christian notions of 'improvement' provided the justification and the reason for independent exploration and expansion, such as the Pacific endeavors of the London Missionary Society or Bank's collection voyages to the southern hemisphere.[2] Only as the polity of the British Empire expanded in the early to mid nineteenth century, and new state functions arose in response to changing notions of governance and a growing economy, did these scientific networks become increasingly formalized within permanent institutions related to the British state, including the Colonial Office and the India Office.

The mid nineteenth century witnessed a watershed in the governance of the British Empire. In 1854, under the pressure of the Crimean War, the War Office was relieved of its responsibilities for colonial affairs and a separate Colonial Office was created under the direction of the Secretary of State for the Colonies. Under his authority were a general department and four geographic departments, which were responsible for managing a plethora of colonial possessions during the Colonial Office's 100 plus year history, including from the 1850s onwards what became the self-governing 'dominions' of South Africa, Australia, Canada, New Zealand, and (a dominion in all but name) Southern Rhodesia, until the Dominions Office was created in 1925 (which in 1947 was renamed the Commonwealth Relations Office). It was also responsible for overseeing the 'crown colonies' and protectorates.[3] India also underwent a change of government. In 1858 Parliament and the Crown took over direct control of India after the Indian Uprising in 1857 eroded the last shred of the East India Company's prestige and power. Afterwards, the India Office in London and the Viceroy directed the Government of India's vast state bureaucracy. India, whose indigenous military policed the vast Indian Ocean arena, was considered the 'jewel in the crown' largely because it paid its own state expenditure (especially the military) through domestic taxes.

The Government of India/India Office and the Colonial Office drew upon pre-existing scientific networks and traditions, but they also constructed their own interlinked systems of scientific institutions, bureaucracies, experts, and cultures. Both staffed and created new scientific institutions by importing people from Europe because Britain lagged behind Europe in many fields of science and technology.[4] The importation of European ideas and scientists helped to consolidate existing amateur scientific knowledge, but it also created conflict. Starting as early as the 1860s in India, British administrators and state scientists began to protest against the use of European scientists and the sending of British students to European schools to study forestry. This protest grew louder throughout the next 20 years. In response to the need to import foreign scientists and to use foreign ideas, British imperial officials and scientists began to create centralized sites of state science, such as schools, located within British polities and based upon British culture.

To some extent, this process of centralization and control worked: the identity, culture, and education of scientists became more 'British' and less European by the late nineteenth and early twentieth centuries. European scientists ebbed in and then flowed out of the British Empire throughout the Victorian era. By the early twentieth century, newly created or restyled universities, colleges, and institutions in the British Empire were producing sufficient graduates to fill most of the scientific and technical positions available. A strong sense of 'Britishness', and what some term the 'British World', pervaded the mindset of imperial scientists, even when they received their training in Melbourne, Toronto, Cape Town, or Auckland.[5] This sense of 'Britishness' was heightened by *fin-de-siècle* nationalism and competition between Britain and its continental neighbors, France and Germany, arguably the two other world leaders in science. Once governments and scientists established new schools and scientific departments, they often sought to control these entities by closing off the fluid and 'open ended' nature of earlier networks – such as by accepting only students trained in approved British centers or by denying British scientists the ability to work for foreign governments or international agencies. Officials instead tried to fashion centralized systems of science that regulated educational requirements and cultural identity. The movement to centralize scientific research, education, and identity lasted in a variety of forms until the last days of the British Empire.

Yet, despite their best efforts to establish and uphold a system of British imperial institutions, personnel and values, a close study of the historical configuration of diverse scientific networks operating within the Empire indicates that such networks were frequently influenced and structured by transnational and crosscultural exchanges. Governments often failed to centralize and control the movement of scientists, their ideas, or their schooling. Despite strong nationalist sentiments among many Britons, many new scientific institutions took their inspiration, blueprint, and training from international models, such as the German influence in botany, forestry, and the organization of scientific education. Several chapters in this book show how notions of 'Britishness' were porous, with regional identities (primarily England and Scotland) and differing personal beliefs and governmental agendas making a pan-British identity difficult to construct and maintain. Even if administrators and nationalists had *de facto* policies that barred Europeans from entering into scientific service, the ranks of scientific and technical corps, first in India and later in Africa, were soon filled with indigenous staff.

In the Empire, indigenous and local knowledge strongly shaped the formation of institutions and the practice of science. Recent research by Kapil Raj asserts that scientific knowledge and culture was 'co-produced' by indigenous groups and imperial scientists.[6] The creation of new knowledge – what Gregory Barton terms the 'imperial synthesis' – requires what Sujit Sivasundaram calls a 'cross-contextualization', which requires 'reading across genres and cultures'.[7] A number of contributions to this book show how crosscultural interaction encouraged the development of unique scientific cultures, theories, and practices. Agriculturalists and foresters borrowed techniques for crop rotation, the cutting of trees, and used local names and natural knowledge about climate, ecology, and plant and animal life. This was not a one way street: Supposedly 'Western' conceptions of science, many of which matched pre-existing beliefs, were debated and often incorporated into indigenous knowledge systems.

India functioned as a laboratory for the creation of professional departments of state science within the larger British Empire. Its vast size and autocratic government gave Indian state-science a dual nature throughout the late nineteenth and early twentieth centuries: its scientists went out into the Empire to found forestry departments and create large dams, but its autocratic structure meant that the faculty at its native universities pursued little scientific research and had little contact with scholars in the settler colonies or the Colonial Office. The Government of India and the India Office started to develop a number of scientific, technological, and medical corps in India in the mid to late nineteenth century.[8] Creating departments of science required harnessing existing informal scientific networks, such as drawing from botanical knowledge created by local doctors and missionaries. But the Government of India also created new systems of science to serve the state.[9] Before and after the Indian Uprising in 1857, the Government of India applied science to solve problems of irrigation, sanitation, health, forestry protection, and the building of railways, roads, and telegraphs. The state established schools to train British and Indian engineers, cartographers, foresters, irrigation experts, and telegraph engineers to manage India's resources and peoples.

One of the most discussed scientific departments in India is the Indian Forest Service, the bureaucratic entity responsible for managing India's vast state forests, demarcated by the British beginning in the middle of the nineteenth century. Brett Bennett's chapter, 'A Network Approach to the Origins of Forestry Education in India, 1855–1885', critiques the notion that the Indian Forest Service merely copied its educational and scientific models from Germany and France and argues that instead of becoming 'European', foresters in India took on a hybrid identity that was strongly influenced by Britons who did not want British students educated on the Continent. Bennett shows that there was never a single consensus about what actually constituted 'German' or 'French' forestry compared with 'Indian' or 'British' forestry. Moreover, the notion of 'European' forestry maintained by scholars does not fit the descriptions and ideas maintained by foresters themselves, who invoked European traditions and methods. The decision to move forestry education to the Royal Indian Engineering College at Cooper's Hill in England in 1885 was the culmination of 20 years of criticism of the decision by the leading German forester in India, Dietrich Brandis, to send foresters to study in France and Germany. After 1885, Indian foresters studied in Britain and made short tours of European forests only during the summer. In 1905 the school became more deeply ingrained in British imperial science by transferring to Oxford University, where it continued through to the last days of the Commonwealth Forestry Institute.

India was a laboratory for more than the development of professional scientific networks. Indians vigorously debated scientific ideas. Leading philosophers and religious print literature engaged in a conscious debate about the value of 'Western' and 'Indian' scientific knowledge for Hindu culture and society. Rajive Tiwari's, 'Anatomy of Reception: Science, Nation and Religion in Hindi-Language Print Media of Colonial South Asia', examines the responses in the Hindi periodical literature to conceptions of 'modern' science, especially physics. Previous diffusionist explanations of the spread of 'Western' science, Tiwari argues, do not accurately capture the multiple ways in which 'Western' science was accepted or rejected by indigenous thinkers. In the case of northern India, science was both rejected and incorporated into existing religious and local knowledge systems. Reformist Hindu societies, such as Arya Samaj, often incorporated scientific modernity into their discourse as a way of rationalizing Hinduism in a scientific framework. Others rejected scientific conceptions because they interpreted such conceptions as incompatible with the fundamental religious principles of Hinduism.

The Colonial Office slowly grew up in the shadow of India's vast systems of state science in the second half of the nineteenth century. Prior to the 1890s and 1900s, Colonial Office funding and direction of broader scientific research was piecemeal at best, with individuals such as Sir Roderick Murchison and William Thiselton-Dyer securing funding and appointments for geologists, explorers, and botanists to scour the Empire for profitable parts of nature that could be catalogued and utilized.[10] By establishing a culture of reconnaissance and survey for profitable gain, Murchison made the mold for what scientists should be: practical, efficient, and revenue producing. This pattern was replicated in the colonies later in the century, but it was not simply a carbon copy of Murchinson's vision of an imperial science controlled largely from Britain. The scientific networks that formed across the British Empire often focused on newly emerging nationalities and distant geographic regions. Prior to the 1890s, the colonies of settlement funded their own meteorological, geological, forestry, agricultural, veterinarian, and medical sciences through taxes raised by self-governing parliaments, and not from a central fund administered by the Colonial Office. This led to the development of local, colonial scientific identities and research agendas based on the specifics of place, indigenous societies, and local institutions.[11]

This can be seen in the example of Australia. Between the granting of self government to New South Wales in 1855 and the federation of Australia in 1901, Australia's six self-governing colonies were technically subordinate to the Colonial Office, but the development of many scientific networks and identities grew out of a combination of imagined Britishness and local preoccupations related to settlement and constructing colonial and national identities. Peter Hoffenberg's chapter, '"A Science of Our Own": Nineteenth-Century Exhibitions, Australians, and the History of Science', shows how mid nineteenth-century scientists in Victoria and New South Wales borrowed from British displays and ideals while at the same time attempting to define their own 'Australian' identity. The scientists running these exhibits stressed the importance of problem solving and the ability to coordinate scientific research with local economic concerns related to agriculture and mining. This was partly based upon the agrarian and pastoral basis of 'practical' Australian elites, who were afraid to fund speculative sciences with anti-capitalist and supposedly unproductive agendas.[12]

Not all scientific networks in Australia were determined by local economic productivity related to agriculture, mining, or the exploitation of nature. Universities worked with colonial governments to further economic agendas, but many sciences, such as anatomy, were related to the medical profession and larger scientific and philosophical questions of the day. Academic networks of science in the settler colonies worked through colonial structures but remained relatively free from overt 'colonial' scientific influences. Tamson Pietsch's, 'Between the Nation and the World: J.T. Wilson and Scientific Networks in the Early Twentieth Century British World', draws upon the notion of 'imperial careering' developed by the geographers David Lambert and Alan Lester to explore the life of J.T. Wilson (1861–1945), a Scottish-born anatomist who worked in Sydney for much of his life.[13] Like many scientists who worked at universities in the British world, Wilson lived in various cities and worked and studied at different universities. Wilson studied medicine and anatomy Edinburgh but moved in 1887 to work at Sydney University before finally taking up a Chair at Cambridge University in 1921. Despite being removed from supposed 'centers' of science in England and Europe, Wilson carved out a career in Australia, working closely with his colleagues at Sydney, exchanging letters with friends and colleagues around the world, and having easy access to Australian fauna desired elsewhere in the world. Wilson was neither at a 'center' nor a 'periphery' in Sydney, despite considerable physical distance. Rather than employing the concept of the 'tyranny of distance' or 'center' and 'periphery', Pietsch's chapter shows how a networked approach of Wilson's trans-imperial life 'points to a social and scientific community that was neither national nor international, but located instead within a tightly woven network of individuals who moved between certain universities in the British World'.

The reconfiguration of scientific networks, 1920–1970

Between 1890 and World War One, the structure of imperial science in the formal colonies managed by the Colonial Office changed dramatically. This was in large part due to the efforts of Joseph Chamberlain, who was a strong advocate of the forward ideology of scientific imperialism and who used his position as Secretary of State for the Colonies from 1895 to 1903 to increase funding for scientific projects with the aim of developing the Empire.[14] The national efficiency movement, a response to concerns of decline prompted by domestic social fears and a weak British showing during the Boer War, also bolstered the desire among administrators in Britain to use the colonies, and increasingly the African ones, to support the metropolitan economy.[15] During the interwar years the Colonial Office created Empire-wide scientific services for agriculture, forestry, medicine, and veterinarian medicine.[16] Yet a parsimonious Treasury and Colonial Office, coupled with the onset of the Great Depression, meant that many of these programs languished. The Colonial Office and its technical services only came into prominence and money in the 1940s and 1950s, when the so called 'second colonial occupation' of Africa intensified the interest of British and colonial elites in harnessing the continent's natural wealth.[17] After decolonization, most of these scientists transferred to British domestic jobs, other colonies, or found work in the United Nations or other development agencies.[18]

Scientific practices in British India continued to evolve in the early twentieth century to fit the evolving constitutional and cultural make-up of India. Lord Curzon's reforms, including the creation of the Agricultural Research Institute at Pusa (restyled the Imperial Agricultural Institute) in 1905 and the Imperial Forest Research Institute in 1906, centralized scientific research in India and focused questions on 'Indian' problems that arose out of famine, forestry, irrigation, and agriculture.[19] India slowly moved towards dominion status beginning with the Government of India Act of 1919, which created 'dyarchy' or dual governance at the provincial level. Indians comprised a larger percentage of the staffing of state scientific bureaucracies in the twentieth century until decolonization. The foundation of schools that trained Indians dates back to the 1840s. In 1847, the East India Company established the Thompson Civil

Engineering College at Roorkee to train Indian students as assistant and sub-assistant engineers. In 1878, the British founded a forestry ranger school at Dehra Dun that later became a college in 1881. Indians became an important part of the state's survey and forestry departments by the 1880s and 1890s.[20] The Indianization of the technical and scientific services expanded rapidly in the twentieth century, especially after World War One. Indians comprised 42 per cent of the Indian Forest Service by 1939. Lord Hailey, the Governor of the United Provinces from 1928 to 1934, recommended in his revised *Survey of Africa* that British colonial governments in Africa should train more African foresters by drawing from Indian precedent: '[W]hen power was transferred in 1947 [in India], the organization was no doubt put to some temporary strain, but it was not crippled by the withdrawal of…European officers'.[21]

The interaction of imperial scientists and Indians led to the formation of new knowledge that then spread across Empire networks. Gregory Barton's chapter, 'Albert Howard and the Decolonization of Science: From the Raj to Organic Farming' shows how Sir Albert Howard's popular 'Indore' method of organic compositing drew from a romantic view of Indian peasants as well as from a constant interaction among agriculturalists, foresters, and Indian farmers at the agricultural research station in Pusa.[22] Partly because of its popular appeal and romantic portrayal of India, Howard's conception of organic farming became widely known throughout the British Empire, and later, the world. Many leaders of the early organic farming movement looked to 'colonial scientists' as being more ethical and less biased by moneyed interests, than, for example, the promoters of synthetic fertilizers. Once again, Barton's work suggests that much of modern environmentalist thought and practice arose out of structures and cultures in the British Empire, much like the empire forestry movement aided the spread of conservationism and environmentalism.[23]

The synthesis or hybridity of knowledge, and the debate about what exactly constituted 'colonial science', is also at the heart of Joseph Hodge's chapter, 'The Hybridity of Colonial Knowledge: British Tropical Agricultural Science and African Farming Practices at the End of Empire'. Hodge critiques the notion that colonial science and development projects were universally constructed from a 'top-down' perspective that did not take into account the existing practices and beliefs of African farmers. The Colonial Office engaged in many large-scale agricultural development projects, and some like the infamous Groundnut Scheme failed. Hodge points out, however, that colonial scientists' perspectives diverged. Whereas many colonial officials sought to boost agricultural production through mechanization and artificial fertilizers, there was a group of agricultural scientists in the post-1940 era that championed what might be termed the 'Humus School': the belief that farming should not rely so heavily on artificial fertilizers, but should employ mixed cropping systems instead. Others agriculturalists and foresters experimented with long forest fallow practices and multicropping as a way of maintaining the fertility of fragile soils. These scientists worked out some 'of the pioneering works on indigenous agricultural knowledge and farming systems' during the period. This work led to the foundations of later 'Farming Systems' and 'Farming Systems Research' that led to a new development paradigm in the 1970s and 1980s.

One reason why attempts to create improved agricultural systems so often failed is because of the Colonial Office's limited manpower and resources, which could not control such a vast Empire with so many competing colonies, personalities, and conditions. The 'imperial imagination', a desire to envisage scientific methods for increasing the productivity of nature, often outpaced the realities of staffing, finance, and political divisiveness. Christian Jennings's chapter, 'Unexploited Assets: Imperial Imagination, Practical Limitations, and Marine Fisheries Research in East Africa, 1917–1953', examines the desire by Colonial Office officials to create an East African fishery research station during the early to mid twentieth century. A cadre of Colonial Office scientists and officials sought to create marine research stations across the entire British Empire that would study local fisheries and find ways to increase productivity. In the end, marine science was hindered by a lack of funding and complications of personalities and intercolonial politics between Kenya, Zanzibar, and Tanganyika. A research station was created eventually in Zanzibar, but it lacked the funding and support required to maintain it as an economically important part of the British Empire. Ironically, only after the end of Empire did the station become a thriving center of scientific research.

By the 1940s, Colonial Office officials and leading scientists in Britain began trying to create a more regulated system of science for the colonies. Sabine Clarke's, '"The Chance to Send Their First Class Men Out to the Colonies": The Making of the Colonial Research Service', analyzes the efforts of metropolitan scientists and administrators to create an elite and metropolitan directed scientific research corps led by the Colonial Office, one which would provide an Empire-wide service capable of attracting 'high-flying' metropolitan scientists. Colonial Office elites feared that scientists in the colonies were too focused on questions of local concern, rather than on the larger issues of economic growth or 'basic' research. However, the attempt to mold the British Empire into a form manageable from Britain ran into problems: 'high-flying' scientists did not transfer into the Colonial Research Service (CRS) that was created in 1950, largely because the pensions offered them were worse than in the regular technical services and there was a shortage of specialist scientists in Britain. The creation of new institutes after 1945 that were supposed to house elite CRS scientists continued to serve existing technical officers while the CRS faced chronic shortages of researchers. In the end, the CRS did not fail but neither did it flourish. Scientists and administrators at the Colonial Office in Britain could not shape the structure and practice of science in the British Empire as easily as they would have liked. Trying to rationalize networks into systems was more difficult than drawing up a committee report and dictating what people should do. Of course, finances and reorganization had an effect, but it could not fundamentally reshape the supply or desires of scientists.

When faced with the changes brought on by decolonization, many Colonial Office officials scrambled to maintain the systems that had been constructed. The Colonial Office tried to maintain a strong control over its scientists until the last days of the British Empire. Jennifer Gold's chapter, 'The Reconfiguration of Scientific Career Networks in the late Colonial Period', examines how the Colonial Office tried to keep the United Nation's Food and Agriculture Organization (FAO) from making personal contacts with the colonial scientists by invoking its sovereignty over the British Empire and its colonies. Ironically, the 1950s and 1960s were simultaneously a period of revival and decline of the British Empire. There was a perceived shortage of technical staff in the colonies, even as more colonies became independent nations. Leading Colonial Office officials tried to marshal the finite scientific and technical skills of its officers by invoking international law and the constitutional sovereignty of the British Empire and the Colonial Office – all outside contact, they felt, should go through the Colonial Office and not individual scientists. The FAO recruited existing foresters by using personal networks and contacts, something that the Colonial Office felt violated the chain of command. Gold suggests that the FAO's use of personal networks 'exacerbated governmental anxieties of imperial decline' and 'Colonial Office complaint over inflated both the degree of manpower loss and the extent to which FAO was at fault'.

The staffing of scientific departments changed drastically in the final years of Empire as many British scientists retired or moved to another part of the world. Indigenous people took over old institutions, started new ones, and made new scientific techniques that were critical of the previous colonial tradition. Matthew Heaton's chapter, 'Thomas Adeoye Lambo and the Decolonization of Psychiatry in Nigeria', explores how the influential British-educated, Nigerian psychiatrist Thomas Lambo (1923–2004) built a new school of Nigerian psychiatry predicated on the incorporation of indigenous knowledge systems of healing into 'Western' psychiatry and an anticolonial sentiment that sought to 'decolonize' the heavily racialized theories of the nature of the 'African mind' that predominated psychiatric science in the 1950s. Lambo studied in Britain and became the chief psychiatrist at Aro Mental Hospital in Nigeria in 1954. Unlike previous ideas promoted by prominent British psychiatrists, Lambo did not believe in the degeneracy of the 'African mind', a collective term used to describe the supposed inferiority of African psychology to that of Europeans. He argued instead that 'African minds' were actually remarkably similar to those of Europeans in terms of the etiologies of mental illnesses, but that the symptoms tended to be culturally malleable, a situation that had prevented European psychiatrists from accurately diagnosing mental illness in African populations. Lambo's work became prominently known through international journals in the 1950s and 1960s and he networked extensively with psychiatrists from across the globe, who, like him, sought to find culturally sensitive ways of understanding mental illness. But Lambo's work was not merely an imitation of European or American studies – his belief in the importance of studying African culture in the diagnosis of mental illness came about as a result of his own cultural background and anticolonial sentiments. Only after pursuing his own researches in Nigeria, based upon Nigerian circumstances, did he integrate within existing international networks of psychiatrists and begin to develop new ones.

The transition from a world of empires to that of independent nation states and a proliferating assortment of international organizations, such as the United Nations and the World Bank, led to a reconfiguration of science, sovereignty, and international law. Even during the late colonial period, British scientists used their ongoing scientific research in international courts to justify the expansion of British zones of hegemony and control. As Adrian Howkins's chapter, 'The Science of Decolonization: The Retention of 'Environmental Authority' in the Contest for Antarctic Sovereignty between Britain, Argentina, and Chile, 1939–1959' shows, the Colonial Office and the British government used the Discovery Investigations and other scientific research in the Southern Ocean and in Antarctica as the basis for claiming control of the South Atlantic from Chile and Argentina. At the International Court of Justice in The Hague, British lawyers argued that Britain's continued investigations into whales and attempts at conservation proved that only Britain could be relied upon to protect the South Atlantic. Britain tried to use its 'environmental authority', as Howkins defines it, to tie the South Atlantic to a larger British world system that extended beyond the formal British Empire. The British continued to fund scientific research in order to justify their control of the Southern Ocean, the Falkland Islands, and also to counter Argentinean and Chilean scientists and government officials, who claimed possession of Antarctica. But the realization that Antarctica did not have large deposits of easily accessible minerals, and the decline of whale populations in the 1940s and 1950s, led to a softening of Britain's imperial interest in the region. In 1959 the British signed the Antarctic Treaty, which required 'a substantial scientific interest' in Antarctica but also internationalized the region, thus 'decolonizing' the continent for the future.

What happened to former scientific networks of the British Empire after the 1970s is beyond the purview of this collection of essays. There is much work to be done in researching the transformation of lives, institutions, and scientific ideas that once worked within and flowed through imperial networks and systems. Can we characterize international science as maintaining its 'colonial', 'imperial', or 'empire' characteristics? Perhaps. But if the chapters in this book serve as an example, we should be wary of ascribing a totalizing or monolithic description to 'colonial science' or any variant of science that was used during British imperialism. Networks, and especially systems of science, were constantly shifting based upon a complex interaction of personalities, politics, and structures. Individuals and institutions attempted to control these networks of science, but the centrifugal pull of local and global forces was often too powerful to be resisted.

Notes

1 John Gascoigne, *Science in the Service of Empire: Joseph Banks, the British State and the Uses of Science in the Age of Revolution* (Cambridge: Cambridge University Press, 1998).

2 Richard Drayton, *Nature's Government: Science, Imperial Britain and the 'Improvement' of the World* (New Haven: Yale University Press, 2000); Sujit Sivasundaram, *Nature and the Godly Empire: Science and Evangelical Mission in the Pacific, 1795–1850* (Cambridge: Cambridge University Press, 2005). For a discussion of 'scientific colonialism' see Roy M. Macleod, 'On Visiting the Moving Metropolis: Reflections on the Architecture of Imperial Science', in Nathan Reingold and Marc Rothenberg (eds) *Scientific Colonialism: A Cross-Cultural Comparison*, eds. Nathan Reingold and Marc Rothenberg (Washington: Smithsonian Institution Press, 1987). Also see Joseph Hodge's discussion in Chapter 1.

3 These included Aden, Grenada, North Borneo, Tanganyika (Tanzania), Uganda, Northern Rhodesia, Nyasaland (Malawi), Sierra Leone, the Gold Coast (Ghana), Nigeria, Kenya, Ceylon (Sri Lanka), Cyprus, Malaya (Malaysia), Hong Kong, the Falkland Islands, Mauritius, Fiji, Gibraltar, British Guiana (Guyana), Jamaica, Barbados, British Honduras (Belize), Togoland (now part of Ghana), and Zanziba. See Anne Thurston, *Sources for Colonial Studies in the Public Record Office, Volume One: Records of the Colonial Office, Dominions Office, Commonwealth Relations Office and Commonwealth Office* (London: HMSO, 1995), pp. 10, 159–61.

4 India, in particular, drew upon European precedents and utilized German foresters and botanists. See Ulrike Kirchberger, 'German scientists in the Indian Forest Service: a German contribution to the Raj', *Journal of Imperial and Commonwealth History*, 29 (2001), 1–26. Also see Gregory Barton, *Empire Forestry and the Origins of Environmentalism* (Cambridge: Cambridge University Press, 2002) and Ravi Rajan, *Forestry and Imperial Eco-Development 1800–1950* (Oxford: Oxford University Press, 2006).

5 See Tamson Pietsch, '"A Commonwealth of Learning?" Academic Networks and the British World, 1890–1940' (University of Oxford, DPhil thesis, 2009).

6 Kapil Raj, *Relocation Modern Science: Circulation and the Construction of Knowledge in South Asia and Europe, 1650–1900* (Basingstoke: Palgrave Macmillan, 2007).

7 Gregory Barton, 'The Imperial Synthesis', *British Scholar* 1, 2 (2009), 151–4; Sujit Sivasundaram, 'Science and the Global: On Methods, Questions, and Theory', *Isis* 101 (2010), 146–58.

8 For an intellectual history of these changes see Eric Stokes, *The English Utilitarians in India* (Oxford: Oxford University Press, 1963); Thomas Metcalf, *The Aftermath of Revolt in India 1857–1870* (Princeton: Princeton University Press, 1964).

9 See Richard Grove, *Green Imperialism: Colonial Expansion, Tropical Island Edens, and the Origins of Environmentalism 1600–1860* (Cambridge: Cambridge University Press, 1995), pp. 309–486.

10 Robert Stafford, *Scientist of Empire: Sir Roderick Murchison, Scientific Exploration and Victorian Imperialism* (Cambridge: Cambridge University Press, 1989).

11 Saul Dubow talks about Jan Smuts's 'patriotism of place' and the indigenization of colonial identities of science. See 'A Commonwealth of Science the British Association in South Africa 1905–1929', in Saul Dubow (ed.) *Science and Society in Southern Africa* (Manchester: Manchester University Press, 2000), pp. 66–99. Also see his discussions of indigenization of scientific identities in S. Dubow, *A Commonwealth of Knowledge: Science, Sensibility, and White South Africa, 1820–2000* (Oxford: Oxford University Press, 2006).

12 See Roy MacLeod, 'Colonial Science Under the Southern Cross: Archibald Liversidge, FRS, and the Shaping of Anglo-Australian Science', in Benedikt Stuchtey (ed.) *Science Across the European Empires, 1800–1950* (Oxford: Oxford University Press, 2005), p. 194.

13 See David Lambert and Alan Lester, 'Introduction: Imperial Spaces, Imperial Subjects', in D. Lambert and A. Lester (eds) *Colonial Lives Across the British Empire: Imperial Careering in the Long Nineteenth Century* (Cambridge: Cambridge University Press, 2006), pp. 1–31.

14 See Michael Worboys, 'Science and British Colonial Imperialism, 1895–1940' (University of Sussex, DPhil. Diss., 1979); *idem.*, 'Science and the Colonial Empire, 1895–1940', in Deepak Kumar (ed.) *Science and Empire*, pp. 13–27; *idem.*, 'British Colonial Science Policy (1918–1930)', in Patrick Petitjean (ed.) *Colonial Sciences: Researchers and Institutions* (Paris: Orstom Editions, 1996), pp. 99–111.

15 Joseph Hodge, *Triumph of the Expert: Agrarian Doctrines of Development and the Legacies of British Colonialism* (Athens, OH: Ohio University Press, 2007), p. 38.

16 See Kenneth Robinson, *The Dilemmas of Trusteeship: Aspects of British Colonial Policy Between the Wars* (London: Oxford University Press, 1965).

17 D.A. Low and John Lonsdale, 'Towards the New Order, 1945', in D.A. Low and A. Smith (eds) *History of East Africa Vol. III* (Oxford: Oxford University Press, 1976), pp. 1–63. Also see Sabine Clarke 'A Technocratic Imperial State? The Colonial Office and Scientific Research, 1940–1960', *Twentieth Century History* 18, 4 (2007), 453–80.

18 For a discussion of the institutional context of this 'diaspora' see Anthony Kirk-Greene, 'Decolonization: The Ultimate Diaspora', *Journal of Contemporary History* 36, I (2001), 133–51.

19 Roy Macleod, 'Scientific Advice for British India: Imperial Perceptions and Administrative Goals, 1898–1923', *Modern Asian Studies* 9, 3 (1975), 345.

20 Berthold Ribbentrop, *Forestry in British India* (Calcutta, 1900), pp. 126–33.

21 Lord Hailey, *An African Survey Revised 1956: A Study of Problems Arising in Africa South of the Sahara* (Oxford: Oxford University Press, 1957), p. 966.

22 Also see Gregory A. Barton, 'Sir Albert Howard and the Forestry Roots of the Organic Farming Movement', *Agriculture History* 75, 2 (Spring 2001), 168–87.

23 See Barton, *Empire Forestry*.

Part II

Knowledge and Networks in the Nineteenth and Early Twentieth Centuries

3
Science and the British Empire from its Beginnings to 1850

John Gascoigne

The British Empire in the period up to the mid nineteenth century was largely the creation of an old regime, the workings of which was based on traditional institutions. The very term 'Empire' was still, at the beginning of the nineteenth century, linked to the more local concerns of the British Isles though, after the end of the Napoleonic Wars in 1815, the British were beginning to see themselves more as rulers of an empire that spanned the globe.[1] After the Great Reform Bill of 1832 and the associated constitutional revolution, the institutions which ruled at home and abroad were gradually modernized but they still bore the mark of the accumulation of ages. Imperial policy was gradually achieving greater coordination through a centralized Colonial Office which was only granted the dignity of having its own minister, the Secretary of State for the Colonies, in 1854. India, the jewel in the imperial crown, was still ruled by a chartered company, the East India Company, with a measure (albeit ever more constrained) of independence, until its rule was overthrown and resumed by the Crown in 1858 following the Indian Rebellion of 1857.

Just as the British state was only slowly assuming control over the empire so, too, it had been tardy in assuming a direct partnership with science. There were, however, some increasingly important steps taken in that direction by the mid nineteenth century: Kew Gardens, which had been founded as a royal pleasure gardens but had increasingly become the hub of a worldwide network of botanical gardens and collectors, came under state control in 1841 being charged by a Treasury Commissioner with 'aiding the Mother Country in everything that is useful in the vegetable kingdom'.[2] The Royal Society, though it remained a voluntary body with many of the mores of a gentleman's club, formed in 1849 a more formal partnership with government with the establishment of the government grant to the Royal Society.[3] Like so much else in Britain, the relationship between science and the British Empire reflects the evolution of a polity which was gradually reshaping traditional institutions to meet the needs of a very different world into which Britain had been thrust as a result of the rapid acceleration in its economic and military power which the Industrial Revolution had made possible. The advancement of science in the imperial sphere required considerable ingenuity in the absence of governmental institutions directly devoted to such ends. As a consequence, then, the cultivation of science was often the outcome of networks which had an ambivalent relationship with the central organs of the state. Only gradually were such networks given clearer and more permanent institutional forms which enabled them to assume a more direct role in the promotion of science within the British Empire.

From its origins, however, the British Empire bore the imprint of a culture which celebrated the mastery of nature. Empires may be created by force but they generally need to be sustained by belief. Such beliefs justify the position of the conquerors and, to some extent at least, bind the conquered to them. In most times and places such belief has taken a religious form but this formed only part of the complex ideological tapestry of the British Empire. Ruling over such diverse populations and creeds, a nation that was itself religiously divided, needed other ways of justifying its imperial might. One of the most potent of these was the belief that its rule brought with it greater prosperity based on the rational ordering of nature. Such belief in the importance of making the earth more productive had very deep roots. From the book of Genesis the Judeo-Christian tradition reinforced the message that the earth and the fullness thereof were for the use of humankind. 'Christian Providentalism …', as Richard Drayton writes, 'was the ideological taproot of European imperialism'.[4] It followed, then, that turning waste land into productive fields was God's will both at home and abroad. So intertwined were the religious and scientific connotations of the concept of improvement that, as Sujit Sivasundaram shows, when the London Missionary Society encountered the South Sea islanders at the end of the eighteenth century, their vocabulary mirrored that of the promoters of 'agrarian patriotism' and their account of their missionary endeavors was couched in similar terms to that of the natural historians with sanctification being regarded as a form of spiritual improvement.[5]

This fundamental belief in the importance of improvement was given a secular as well as a religious foundation with the work of John Locke who argued that such an approach to the natural order could be deduced by reason as well as having the sanction of Holy Writ.[6] Locke dismissed the sorts of religious justifications that the Iberian nations had used for imperial expansion based on bringing the true faith to the benighted, and argued instead that possession should be based on use – especially turning waste into productive land.[7] Locke, then, as Irving stresses in her recent important book on the linkage between science and the early origins of the British Empire, was a watershed figure embodying both the biblical traditions of the idea of Adamic possession of the earth and a more secularized concept of improvement which was to provide much of the ideological momentum for British imperial expansion.[8] The force of such a conviction that agricultural improvement based on rational principles could change the world was reinforced by the way in which in England the production of food began to increase spectacularly as the hold of tradition was weakened and the land and its uses were remoulded along more productive lines. Such successes of what became known as the Agrarian Revolution of the eighteenth century within Britain set the tone for imperial expansion abroad as colonial rule was justified on the grounds that it could bring greater prosperity to those under British rule as well, of course, to Britain itself.

In the early seventeenth century such belief in the power of improvement had been given an explicitly scientific character in the work of Francis Bacon with his ambition to use science for the 'relief of man's estate'. Bacon explicitly linked the way in which knowledge of Nature was improving with the imperial expansion of European powers into new parts of the globe. In his *New Organon*, a manifesto for a new form of logic to replace that of traditional scholastic philosophy, he urged: 'Nor should this fact count for nothing: that by prolonged voyages and journeys (which have become prevalent in our times) many things in nature have been disclosed and found out which shed new light on philosophy'.[9]

Greater knowledge of the globe as a whole brought with it the opportunity of unlocking the secrets of nature thus opening up the possibility of undoing the curse of Adam by making possible a less arduous and uncertain way of earning one's daily bread than by the sweat of one's brow. Inspired by Francis Bacon, the early Royal Society espoused similar goals and again looked to Britain's increasing imperial might to bring scientific as well as commercial riches. 'We have long and fully resolved with Ourself', proclaimed the Royal Society's second royal charter of April 1663 in the name of the king, 'to extend not only the boundaries of empire, but also the very arts and sciences'.[10] To aid such an endeavor the early Royal Society devised questionnaires to elicit information from seamen and travelers on the resources and possibilities of improvement of the lands they encountered.[11] That prominent member of the early Royal

Society, the devout Robert Boyle, gave such a mission an overtly religious impulse when alluding explicitly to the biblical roots of the concept of improvement: 'Tis recorded in the Book of Genesis, the Design of God in making man was, that men should Subdue the Earth (as vast a Globe as 'tis) and have dominion … over all the Earth'.[12]

The goal of improvement and its linkage with science formed, then, a part of the mentality of the British elite in the formative period of its empire. Turning such goals into a programmatic strategy for the advancement of knowledge within the imperial setting required, however, a commitment on the part of the British state which was slow to be realized. Francis Bacon had tried in vain to interest James I in his plans for the reform of learning and many of his successors and their administrations were equally slow in embracing the view that the state should serve as a patron of scientific progress. British government had long been based on the view that the state should limit its functions as much as possible, leaving much of the day to day administration to be carried on at the local level through the voluntary service of a landowning class which accepted the need to act as Justices of the Peace and other such functionaries as a just return for their social position. In science, too, voluntary service was seen as the natural way to proceed – a message underlined by the fact that at its foundation the Royal Society in 1660 received no more than a royal title and a mace from Charles II.

Matters, were, however, conducted differently across the Channel in France where the absolutist regime directly sponsored the Royal Society's equivalent, the Academy of Science, the better to promote the glory and the prosperity of the royal regime. Science, then, was in France much more integrated into the workings of the state both at home and abroad. As French imperial power took root around the globe, scientists were expected to contribute their expertise to ensuring that colonial possessions became more productive to the benefit both of themselves and their colonial masters.[13] Symptomatically, the Jardin du Roi in Paris, the hub of French global natural history, was founded in 1635 well before its British equivalent, the Royal Gardens at Kew (1759). While the French (drawing on the earlier example of the Dutch) began establishing a worldwide network of colonial gardens with the Jardin du Roi at its center in the early eighteenth century – Guadeloupe in 1716 and Île de France (Mauritius) in 1735 – the first British colonial botanical garden was not founded until 1764 (at St. Vincent in the West Indies).[14] In 1788 Robert Kyd, the first superintendent of the Calcutta botanic garden (which was founded in 1786), bemoaned 'the shame of being 20 years behind our neighbours [the French] in everything of this kind'.[15]

The French example was gradually to spur the Royal Society and others concerned with the reputation of British science and the promotion of national prestige and wealth into doing more to link scientific progress with Britain's imperial expansion. The need to do so was underlined by the increasing demand for scientifically informed initiatives at home. The shock of the Jacobite uprising of 1745 and the difficulties encountered in putting it down because of poor knowledge of the topography of the Highlands prompted the Military Survey of Scotland from 1747 to 1754. The major figure in completing the survey was William Roy who in 1765 took up the newly created post of surveyor general of coasts and engineer of directing military surveys in Great Britain under the Board of Ordnance – the beginnings of the Ordnance Survey. Roy's work in achieving greater accuracy through the method of triangulation owed much to the French who had a much longer tradition of cartographical surveying to serve the needs of the French absolutist state. Indeed, the British and French joined together in a common scientific endeavor, the Paris-Greenwich triangulation of 1784–8. Along with mapping, the British state was beginning to need greater scientific expertise to deal with the problems of navigation and particularly the problem of establishing longitude at sea (the province of the Board of Longitude which was established in 1714) and the issue of calendar reform with the introduction of the Georgian Calendar into Britain in 1751. The British, too, had to respond to the French initiative of mounting a worldwide campaign to exploit the scientific potential of the transits of Venus of 1761 and 1769 – something which prompted an unparalleled royal largesse to the Royal Society thus making possible the first of James Cook's great Pacific voyages (that of the *Endeavour* from 1768–71). What, however, most drove home the necessity for the British to emulate the example of the French in the better exploitation of their empire was the bitter taste of defeat in the War of American Independence and the need to redirect imperial policy following the final loss of the American colonies in the wake of the Treaty of Versailles of 1783.

The person who did most to draw science within the domain of imperial policy in the period which followed the American Revolution was Joseph Banks, who had been elected as President of the Royal Society in 1778, a post he retained until his death in 1820. An unofficial acknowledgement of this role, which also alluded to French leadership in drawing together science and government, was the tribute paid by Banks's friend, Lord Auckland, when referring to him in 1791 as 'His Majesty's Ministre des affaires philosophiques'.[16] To realize such a position, unofficial though it might be, Banks had to build up networks of influence both at home and abroad in the array of institutions which collectively determined the direction of British imperial policy. The need to work in this manner was an indication of the difference between the British and the French state. For, though the French may have provided an example and a catalyst for scientific endeavor in the imperial realm, French absolutist methods could not be readily translated into parliamentary Britain. The continuing challenge for those wishing to make the British Empire more scientifically attuned was to work through a British polity which lacked any central institutions concerned with science. The nearest was the Royal Society yet, as it proudly proclaimed, it was a voluntary body which served government without being subject to it, just as the landowning class served government while jealously guarding their liberties. The difference between the *modus operandi* of the British and the French scientific academies in relation to the state reflected the difference in character of the two polities. French absolutism contrasted with the forms of British government which, as McClelland writes, 'depended on a loose, de facto co-ordination among many bodies, in theory separate but in fact linked together by a ruling class'.[17]

The promotion of science in the British imperial realm required much patience and ingenuity as the traditional organs of government had to be utilized and to some extent reshaped to bring about the application of scientific goals to imperial ventures. This was very much Banks's terrain as he worked through whatever organ of government was most amenable to his plans to bring to the empire at large that improving spirit that had boosted the fortunes of himself and many of his fellow landowners.[18] Banks's Lincolnshire estates had been showcase examples of what could be achieved by such improving measures as the draining of the fens. Banks's rise to governmental prominence owed much to his alliance with the equally imperially-minded first Earl of Liverpool who, from the time that he became President of the Board of Trade in 1786, looked to Banks to help compile the 'political arithmetic' which would help guide state policy in the reconstruction of empire that followed the American defeat. But Banks's influence in that wing of government largely ceased after the replacement of Liverpool in 1804 – an indication of the limited and even precarious hold of Banks on the levers of power. To some extent Banks compensated for the loss of his connection with the Committee on Trade with greater involvement with the Secretary of State for War and Colonies, a position created after 1801. Generally, however, Banks had to move with whatever shifting political tides made possible the advancement of his projects working closely with the Admiralty, for example, in bringing to pass the ill-fated *Bounty* expedition of 1787–9 or its more successful sequel, the *Providence* expedition of 1791–3, which achieved the goal of bringing breadfruit from Tahiti to the West Indies and thus providing a cheap food source for the slaves there. It was an expedition which was an instance of Banks's more general preoccupation with moving around the flora and fauna of the globe the better to serve the interests of the British Empire.

More problematical was Banks's relation with the East India Company, a body jealous of outside interference particularly since it had been brought under some measure of government control with the establishment of the Board of Control in 1784. At this governmental level Banks had a valuable ally in the person of Henry Dundas, President of the Board of Control from 1793. It was to Dundas, for example, that Banks addressed his plans for ensuring that Kew might become 'a great botanical exchange house for the empire'.[19] But the East India Company retained considerable autonomy and Banks had mixed fortunes with its Court of Directors as his exasperated comment of 1798 to William Roxburgh (who had become Superintendent of the Company's botanic garden at Calcutta in 1793) suggests: 'I am tir'd of promoting projects with a fluctuating body who are sure to be chang'd by the time I have convinc'd the first set of the propriety of any measure recommended to them'.[20]

Wide as they were, then, Bank's networks were never encompassing enough nor secure enough to enable him to realize many of his projects. But, in the absence of any central institution of government, Banks had to work by such piecemeal methods. Nonetheless, his directing presence stamped some sense of direction on the varied scientific activities of the British Empire during his lifetime – so much so that Macleod, for example, refers to British imperial science in the period up to 1820 (the year of Banks's death) as having characteristics which can be best described as 'Banksian'. Banksian science was informed by the spirit of classifiers such as the great Linnaeus with an emphasis on recording and systematizing the manifold productions of nature with a view, particularly, to the exploitation of what could be useful to humankind (and, *a fortiori*, to the British Empire).[21]

After Banks's death the mantle of scientific adviser to government and empire fell to others who continued to operate in similar ways to Banks though with a more restricted institutional base. John Barrow, who had worked closely with Banks at the Admiralty (where he was second secretary from 1804–6 and 1807–45), did much to advance the cause of scientific exploration through the agency of the Admiralty but also worked through institutions such as the Royal Geographical Society of which Barrow was one of the founders in 1830. Another of that body's founders was Roderick Murchinson who, like Banks before him, sought to link science and empire through a variety of bodies whether voluntary such as the Royal Geographical Society or the British Association for the Advancement of Science (founded 1831) or more formal state instrumentalities such as the British Geological Survey (founded as the Ordnance Geological Survey in 1836) of which Murchinson was the second director.

The foundation of these new scientific bodies in the 1830s, the great decade of reform, was, however, an indication of the increasing pace of change and the growing number of avenues by which scientific concerns and advice could be brought to bear on the concerns of government. Banksian methods of patronage and networking continued but there was now a much wider arena in which science could operate. In such an increasingly institutionally multifaceted world there was less room for scientific advice to be shaped by the dominance of a single individual in the way that Banks' formidable bulk had loomed so large during his long reign as President of the Royal Society from 1778 to 1820. Important though Murchinson was, for example, in carrying on the Banksian technique of linking science and empire through what his biographer, Robert Stafford, describes as his 'capacity to operate though the interstices of the civil service', his influence on government was shared with a growing number of scientifically-inclined civil servants.[22] Among these were Sir William Hooker, Director of Kew Gardens from 1841 to 1865 (where he was followed by his son, Sir Joseph Dalton Hooker, 1865–85), Sir Francis Beaufort, head of the Admiralty's Hydrographic Department from 1829 and 1846, and Sir William Sabine. A general in the Royal Artillery, Sabine succeeded in drawing together several institutions, both governmental (the army, the navy and the Kew Observatory) and non-governmental (the Royal Society of which he was secretary from 1827–9 and president, 1861–71; the British Association of which he was secretary from 1838–59), in order to promote the 'magnetic crusade': the result being the establishment from 1839 onwards of a worldwide network of observatories throughout the British Empire under the control of the Colonial Office to study the behavior of terrestrial magnetism – a branch of science critical to correct navigation.[23]

When viewed from London, then, the linkage between science and the British Empire can be traced through networks of influence based on dexterous bureaucratic maneuvering both within the formal arena of government or the closely related patterns of patronage derived from such elite bodies as the Royal Society or the British Association. Such webs of influence were the natural terrain of Banks or those, like Murchison or Sabine, who carried on his mission of linking science with empire. This London-centered view of the workings of science within the British Empire fits well with the influential and fruitful model developed by the sociologist, Bruno Latour. For Latour the dominant metaphor is that of a map where local details can be recorded and brought back to a metropolitan center so that the world can be reconstructed in ways which benefit the imperial power. But such 'mapping' extends to the activities of scientists more generally so that distant lands are in a sense brought back piecemeal to the great metropolitan 'centers of calculation' through the data and specimens built up by a series of expeditions – a process which Latour terms 'cycles of accumulation'.[24] By these means a model of different parts of the globe is then constructed which enables the imperial power to seek to reconstruct the world by building up networks which translate knowledge into action (such as the transfer of plants around the globe to advance imperial interests pioneered by Banks and continued at Kew Gardens). As David Miller has brought out, Banks's role – what Captain James King (who sailed with Cook on his third disastrous voyage) called 'the common centre of we discoverers' – fits this Latourian model well.[25] Miller also comments, however, on the way in which, over the course of Banks's lifetime, the role of a single individual such as Banks in acting as the 'center of calculation' gradually gave way to a network of metropolitan institutions such as the Royal Society or the Natural History Museum (much of which originally derived from Banks's private collections).[26] It is a comment, however, on the lack of a clearly demarcated institutional center for British imperial science that Stafford aptly describes Murchison as continuing the Banksian role of a one man imperial scientific coordinator right up to the last quarter of the nineteenth century.[27]

But the British Empire could be viewed from other angles than London and was wide enough and fluid enough to encompass many networks. Scientific activity within the empire can be usefully viewed through the lens of Latour's 'centers of calculation' model, but other vantage points also can be usefully employed. From its origins science has been cosmopolitan with different centers which could carry on separately while engaging with each other. This geographical dispersal, combined with linkages which create a common purpose, has led Chambers and Gillispie to describe the history of science as being characterized by 'a polycentric communication network'.[28] Within this larger picture, empires, which by their nature depend on linking different parts of the globe together, have functioned to further the global reach of science by bringing different centers of science, whether in the colonies or the metropolis, more closely together. Thus Ballantyne writes of the importance of 'imperial knowledge networks'.[29]

Such networks depended very much on the global reach of empires. European empires in their early stages of development relied very much on the institution of the chartered company to which the state granted commercial monopolies over prescribed parts of the globe. Such privileges led in time to these chartered companies becoming, in effect, states within a state controlling the government of the regions in which they conducted their business. The Dutch East India Company soon after its foundation in 1602 became the colonial authority over the East Indies and its way station at the Cape – in effect, it was the world's first multinational company pioneering the issuing of shares. Such worldwide corporations have been described by John Harris as natural networks for the dissemination of information – particularly scientific information. The rationale of these chartered companies was commercial so the information that they so energetically recorded was based around trade, but such data could have scientific implications particularly in the area of natural history. In any case, as Cook has recently emphasized, the discipline of recording and classifying such information was a natural breeding grounds for the habits of mind which were to promote science.[30] But what Harris terms 'long-distance corporations' could have other objects apart from trade – hence one of his key examples is the globally dispersed Jesuit order and its missionary activities.[31]

The British Empire in its early stages was largely shaped by the institution of the chartered company which fitted well the mercantilist ideology that prevailed until the nineteenth century. Different parts of the globe were parcelled out to a wide array of companies but the one which, like the Dutch East India Company, developed the widest global reach was the East India Company (founded in 1600) with its base primarily in India, but with considerable interests in China and Southeast Asia as well. As Banks discovered, its size and complexity meant that the East India Company was a world unto itself so that it was not easily drawn into the larger Banksian scientific net. More obliging was the smaller and more malleable Hudson Bay Company, which from its origin in 1670 worked closely with the Royal Society.[32] Part of the difficulty lay in the fact that the East India Company had many heads: the state directed Board of Control (from 1784), its own Court of Directors, and the various local authorities who also had their own agenda. It is a useful reminder that a London centered view does not always do justice to the array of networks which collectively shaped the British Empire. Such a view of the British Empire as a coat of many colors has also been underlined by the study by David Lambert and Alan Lester of trans-imperial careers in the nineteenth century. The diversity and mobility which their work reveals has prompted an emphasis on viewing the empire as 'an interconnected space' which could foster 'multiple, and often contesting 'projects' of colonialism'.[33]

Within the East India Company there were indeed contesting projects at work though the company was bound together, like all companies, by a common desire to make money. On the one hand the Company needed the support of the British state, but it also wished to discourage projects (like sending Christian missionaries to India) which had support within governmental circles but which might be bad for business. The success of the East India Company largely depended on building up sources of information and, as Bayly has demonstrated, one of the reasons for the successful expansion of the East India Company was the way in which it supplanted previous regimes as the center of local networks of intelligence and succeeded in classifying such data into more readily usable forms.[34] On such foundations, servants of the Company such as the Scottish physician, Francis Buchanan (who served in India from 1794 to 1815), amassed further statistical repositories of topographic and ethnological knowledge which assisted the Company's commercial and strategic goals as well as provided rich sources for the student of Indian natural history.[35]

Sharing such information with other bodies (such as Banks and the Royal Society) might weaken its commercial advantage. The sifting of information about India was done in India with local goals in mind. The needs of international scientific enquiry were very much subordinate to these.[36] On the other hand, having access to the information amassed by what David Miller has called the 'Banksian learned empire' could also be to the advantage of the Company. Scientific activity within the realm of the East India Company largely depended on local and often individual initiative, which might or might not have the support of the upper echelons of that body.[37] The guiding principle, as one would expect of a company, was what would make money and this strong imperative meant the Company could be more responsive to scientifically-based innovations than the metropolitan British government, which was increasingly dominated by *laissez-faire* principles.[38] In the first half of the nineteenth century the need for such innovation became more marked as the Company became less involved in trading handicraft goods – these having being largely replaced by British factory manufactures – and turned, instead, to reshaping the Indian economy and natural environment to become a source of raw materials such as cotton, indigo or hemp.[39] Most spectacularly the Company made India the great source of tea which previously the British had to acquire by the reluctant surrender of silver bullion to China – thus bringing to pass a project which had formed part of Banks's plans for the botanical reconfiguring of the world to the benefit of the British Empire.[40]

As the Company grew in size and increasingly took on the role of government, larger policy considerations than simply profit also became significant. One of the most fundamental of these policy issues was the way in which the Company could ensure the obedience and loyalty of those over whom it was more and more coming to rule.[41] Science and the activities linked with it could, in the traditions of the ideology of improvement which had shaped the British Empire from its foundation, be seen as a justification for its rule. Linking India with the empire of science became a justification for incorporating it into the British Empire.[42] Such considerations help to explain the Company's early support for such Banksian projects as the establishment of a botanic garden at Calcutta in 1786 as a center for cultivating crops which would help diminish the likelihood of the sort of famine to which Bengal had recently been subjected.

One of the most conspicuous ways in which the Company could be seen as an agent of improvement and the promotion of scientific advance was through its patronage of mapping. For mapping was the pre-eminent example of the Enlightenment quest to shine the light of science on the dark corners of the earth and to draw the different quarters of the globe together. From the Company's point of view maps provided tools to bring its territories under effective control both commercially and militarily. The mapping of India, as Edney stresses, provided the Company and the British Empire more generally with an image of India which was clearly shaped by British initiative and well removed from the jumble of territories that had been conquered piecemeal in the wake of the decay of the Mughul empire.[43] The beginnings of such major British cartographical work in India derive from the appointment of James Rennell as Surveyor General of Bengal from 1764 to 1777. On his return to London he completed his *Bengal Atlas* (1780–1) eventually producing his masterpiece, an overall map of India in 1793. Though his work followed the familiar pattern of European mapping practice of the time, in some respects it was in advance of work being done in Britain. Hence when awarding Rennell the Royal Society's Copley medal in 1791 for such achievements, Joseph Banks remarked on the way in which, thanks to Rennell, Bengal was now more comprehensively mapped than Britain.[44] It was an instance of the way in which imperial regimes often found it easier to introduce innovations abroad than at home where tradition and vested interests was treated more circumspectly. India, indeed, became the particular focus of imperial cartography leading to the establishment of the Great Trigonometric Survey of India in 1800, a project which, in its scope and achievements, was on a scale few European cartographical enterprises could emulate. Such an achievement and the scientific aura associated with it rebounded to the credit of the Company and its view of itself as a force for scientific improvement.[45]

Science served as a source of profit and a justification for empire but it also provided part of the cultural ambience and 'ornamental' learning of some of the servants of the Company and of the empire more generally.[46] One of the ways to illustrate one's social and cultural standing and espousal of the goals of improvement was to cultivate science. The cultivation of science in the context of empire provided the opportunity to tap into scientific sources largely unfamiliar to the world of European science – an illustration of the wide reach of 'imperial knowledge networks'. The late eighteenth century saw a remarkable flowering of interest in Indian culture by prominent members of the East India Company of whom the judge and student of Indian languages, William Jones, was the best known. Jones and those linked with him in the Asiatic Society saw the study of Indian science as part of this reaching out to the cultural riches of India. This meant both the study of traditional Indian science and the study of the Indian natural terrain. Thus in the first 20 volumes of the Society's journal, *Asiatic Researches*, covering the period 1788 to 1839 there were 219 articles on scientific subjects as against 148 on topics which could be classified as the humanities.[47] Consistent with the Society's declared aim of studying '*MAN and NATURE*; whatever is performed by the one, or produced by the other', Jones's respect for traditional Indian knowledge extended to the study of science: his presidential address to the Society of 1785 urged its members to direct their gaze to subjects such as Indian chemistry, an area in 'which the Indians, as well as the Chinese, are thought to have practised in higher perfection than ourselves' adding, too, that 'we cannot entertain a doubt that their Sanscrit books on dying and metallurgy, contain very curious facts'.[48] Interest within the Society in the study of Indian science led in 1800 to the formation of a physical committee 'to propose such plans, and carry on such correspondence as might seem best suited to promote the knowledge of *Natural History*' (though this body had to be revived in 1828).[49] Later, in 1873, the Society absorbed another body known as the Bombay Geographical Society, which was founded by officers of the Company's navy in 1832.[50]

Elsewhere in the British Empire, too, science formed an important part of the elite culture and its cultivation was both a mark of gentility and an espousal of the goals of improvement which formed an important part of the justification of empire.[51] The growth of local scientific societies was one index of the increasing local consolidation of colonial elites. Such local scientific bodies provided an opportunity for rational amusement, social and political networking and, it was hoped, the promotion of the goals of improvement. Accordingly, particular emphasis was placed on the study of possible sources of improved economic well-being – one of the major goals espoused by Jones in his presidential address on the importance of Indian science. When, for example, the Van Diemen's Land Scientific Society was founded in 1829, it was 'constituted … in imitation of the Royal & other literary & scientific societies of Europe & India', and it took as one of its major goals the 'eliciting and discovering the properties and uses to which the vegetable productions of the island may be applied and to ascertain the improvements which may be adopted in their cultivation'.[52] Its successor body, the grandly named, The Royal Society of Van Diemen's Land for Botany, Horticulture and the Advancement of Body (founded in 1843 as the first Royal Society outside Britain) urged its members to promote 'the advance of Science and the progress of the Colony'.[53]

From the perspective of London this body, and others like it, might appear to be part of an imperial network concerned with the first of these goals, 'the advance of Science'. Its members, then, could be seen as contributing raw data to Latourian 'cycles of accumulation', which would enable scientists in the metropolis to recreate scientific models of distant Van Diemen's Land (or Tasmania as it became in 1856). Ensconced as director of that great imperial 'center of calculation', Kew Gardens, Joseph Hooker certainly looked at the world that way. In the preface to his major works on the flora of India and New Zealand he firmly put local naturalists in their place making clear that it was their task simply to forward on local specimens leaving the work of detailed taxonomy to the better qualified and equipped metropolitan scientists.[54] But the view from Van Diemen's Land was not always the same. For a few local members the approval of major figures in the metropolis was important as a gateway to international scientific esteem and information. The naturalist, Ronald Gunn, for example, conducted a considerable correspondence with Sir William Hooker at Kew and had the advantage of being able to offer specimens and reports on a unique flora and fauna that was at risk of vanishing. 'Many of our animals and Birds', wrote Gunn to Hooker, 'will become extinct or nearly so'.[55] But for many other local members it was the goal of the 'progress of the Colony' which was more important and the local scientific society provided a means of disseminating knowledge of local resources and the means of better improving them along with the opportunity to cultivate local social and political contacts. From such a vantage point the relations of The Royal Society of Van Diemen's Land for Botany, Horticulture and the Advancement of Body with its London counterpart seem less like a Latourian centripetal movement to the center and more like Chambers and Gillispie's 'polycentric communication network'.

There was, however, a major contrast between these Tasmanian scientific societies and Jones's Asiatic Society. In India there was considerable interest in indigenous understandings of nature whereas in Australia and in much of the nineteenth-century British Empire more generally there was very little. The eighteenth-century empire, in contrast, was much less an empire of settlement and more one of trading posts or plantations which lessened the divide between the colonizers and the colonized and this was reflected in a greater openness to indigenous knowledge. Drawing on its 'imperial knowledge networks' the *Philosophical Transactions of the Royal Society* published articles based on indigenous knowledge with subjects such as the manufacture of maple syrup by Canadian or New England Amerindians (1685 and 1720–1), tanning techniques of the Amerindians of Virginia (1686) or the use of dyes in Tonga (1775).[56] In late eighteenth-century India, as we have seen, there was considerable interest in Indian traditional knowledge including in the sciences. In the nineteenth, however, such learning was more likely to be dismissed in the manner of Macaulay's famous minute on Indian education of 1835: 'a single shelf of a good European library was worth the whole native literature of India and Arabia' and thus if education were based on Indian classics 'when we can teach European science, we shall teach systems which, by universal confession, whenever they differ from those of Europe, differ for the worse … medical doctrines which would disgrace an English farrier, astronomy which would move laughter in girls in an English boarding school'.[57]

Earlier debts to Indian knowledge had been largely forgotten by the nineteenth century. The British mapping of India had, for example, largely divorced itself from Mughal mapping which had still been significant in the work of early British cartographers such as Rennell. Rennell had based his maps of India around the Mughal subas or provinces and had used visual representations similar to those employed by Mughal commanders in their route maps.[58] In 1795, Buchanan acquired a local map of the Ava district of Burma which he thought valuable enough later to publish.[59] But, in contrast to the Spanish Empire, the length of colonization and the integration of peoples through intermarriage in the British Empire had been relatively limited, so that there was less of a localized culture which drew together indigenous and European sources of knowledge. This more deeply rooted local culture meant that in the Spanish Empire scientific enquiry formed a different sort of network than in the British with less direct connections back to the imperial center. As Lafuente writes of Hispanic imperial culture: 'modern science did not land on barren terrain but on separate centers – each with deeply rooted local scientific traditions'.[60] Such a perspective has led historians of science in the Hispanic empire to argue for the limited utility of a Latourian perspective on the relations between the scientific metropolitan core and the periphery.[61]

In India there have been a few steps in the direction of what, in the Spanish world, was thought of as a Creole culture blending the indigenous and the European. About a dozen of the articles in the first four volumes of Jones's *Asiatick Researches* were by Indians though no Indian became a member of the Asiatic Society of Bengal until 1829.[62] The area where there appears to have been greatest contact was in medicine. In the eighteenth century, Indian remedies were to some extent used to counter the diseases of the subcontinent and there was some dialogue between European and Indian medicine leading to what Harrison describes as a 'distinctive Anglo-Indian medical tradition'.[63] Such crosscultural contact diminished, however, as Western medicine developed theoretical frameworks that questioned the model of human physiology based on a balance of humours or fluids that had provided a bridge between older largely Galenic-based Western medicine and its Indian counterpart; importantly, too, Western medicine also moved away from environmental explanations. Greater emphasis on intrinsic racial differences over the course of the nineteenth century also further limited such a meeting of cultures. Where there was scientific contact it tended more to be on European terms such as the involvement of the mathematical prodigy, Radhanath Sikdar, in the Great Trigonometric Survey.[64]

In India, as elsewhere around the globe, the British Empire brought into contact diverse peoples and cultures. These many different 'contact zones', to use Mary Pratt's term, engendered a continuing, if often unequal, interaction which had repercussions for science as for much else.[65] Thus Kapil Raj wants to widen the original meaning of 'contact zone', which focused on the dynamics produced by the encounter between geographically and ethnically diverse peoples, 'to that between different types of human activity – trade, statecraft, and knowledge-making'.[66] Along with a number of recent works Raj here emphasizes the extent to which science reflects the local circumstances of its formulation even though it might subsequently be generalized to a more global level. 'Scientific findings', writes the cultural geographer, David Livingstone, 'are both local and global'.[67] Intercultural contact could lead to the world being seen differently as familiar British assumptions were called into question in the very different contexts of the empire. Certainly, the empire provided a vast collecting ground which brought with it a stimulus to view the world in different ways using the vast array of specimens and data which poured in from around the world to substantiate new forms of science. British science was shaped by its empire especially in fields like geology or biology which needed a global laboratory.[68] Such a wide sweep meant that the many local details which often emerged from a 'contact zone' where British scientists were the beneficiaries of local guides, porters and those with detailed knowledge of particular sites or the behaviour of animals or the properties of plants were assimilated into a generalized structure which encompassed the earth. Once so established such science brought with it the possibility of further control of the earth and its fruits which could be put to use both at home and in the larger empire.[69]

Having an empire was certainly a stimulus to the promotion of science but the British Empire was too diverse and had too many masters to be able to speak of unified 'imperial science'.[70] It is symptomatic of the absence of a centralized directing body in British science that it was not until 1916, under the pressure of total war, that science achieved the dignity of a government department in the form of the Department of Scientific and Industrial Research.[71] In some ways the conduct of science within the British Empire never again achieved the degree of centralized direction which had come with Joseph Banks's looming presence as President of the Royal Society from 1778 to 1820 and the dominance of a single individual presiding over a single institution. In any case, as Banks certainly knew when he reached out to the French scientific world during the Napoleonic wars, science was not readily contained within national or even imperial boundaries. Empires might act as a stimulus to scientific enquiry but science had broader boundaries and a wider reach than even the far flung British Empire could provide.

Notes

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3 Marie Boas Hall, *All Scientists Now: The Royal Society in the Nineteenth Century* (Cambridge: Cambridge University Press, 1984), p. 163.

4 Richard Drayton, *Nature's Government: Science, Imperial Britain, and the 'Improvement' of the World* (New Haven: Yale University Press, 2000), p. 270. On this point see also Richard Drayton, 'Knowledge and Empire', in P.J. Marshall (ed.) *The Oxford History of the British Empire* II, *The Eighteenth Century* (Oxford: Oxford University Press, 2001), p. 233.
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4
A Network Approach to the Origins of Forestry Education in India, 1855–1885

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The history of forestry of British India is one of the most frequently discussed topics in the environmental and scientific history of South Asia.[1] Historians have been particularly interested in finding the origins of forestry education, science, management schemes and laws in India. The need to pinpoint the origins of forestry became important when self-identified subaltern historians of India in the 1980s and 1990s offered a strong critique of the detrimental social and ecological effects of state forestry policies. Locating the origins of forestry mattered to them because by finding the root cause – in this case British capitalism and colonial domination – one could then undo some of the damage to society and nature caused by exploitive forestry laws and science.[2] A variety of scholars have continued this interpretation. Most recently, Ravi Rajan argues that there was 'nothing unique' about the development of Indian forestry – the Indian Forest Service directly imported 'coercive' models of German and French forestry laws, science and management practices into India that disposed people of lands.[3] A counter argument to these perspectives comes from the works of Richard Grove, Gregory Barton and others who argue that, on the contrary, the science and practice of state forestry arose in an imperial, Indian context when Europeans witnessed ecological destruction and created laws, scientific technique and management programs in India to stop the degradation caused by exploitive forms of colonialism and capitalism.[4] A variety of competing interpretations exist on the origins and meanings of forestry in India.

This chapter offers a new perspective of the origin of forestry education for foresters working in India. It examines a series of intense debates surrounding the decision to send British students to study forestry in France and Germany in the mid 1860s, and the opening of the forestry school at the Royal Indian Engineering College at Cooper's Hill in 1885. I make two interrelated arguments drawing from these examples. First, I argue that because foresters and officials had no single, agreed upon conception of what actually constituted French or German forestry, it is problematic to call certain Indian forestry laws, scientific methods, and educational practices as derivative of any single 'European', 'French', or 'German' forestry system. Even self-identified supporters of French or German forestry disagreed with each other on the true nature of European forestry. Instead of stressing a rigid and formulaic system, as some scholars today do, many Britons and Europeans imagined European forestry as either a general principle or a diversity of practices that defied easy categorization. Second, I argue that instead of becoming more European, the institutions and culture of forestry in Britain and British India actually became increasingly British because a vocal and influential group of officials and foresters continually tried to create, and eventually succeeded in founding, a forestry school in Britain to educate foresters instead of sending them to study in Europe. The movement to create a school in Britain eventually won out over attempts to keep the school in Europe or open a school in India. After 1885, foresters preparing to work in India no longer went to Europe to study forestry, but instead studied at the Royal Indian Engineering College at Cooper's Hill and made tours of European forests only during the summer. This is part of a larger pattern whereby the staffing, self-identification, and location of the institutions where foresters studied became markedly British and Indian, not French or German. In the end, forestry in India developed into a hybrid of the competing set of visions, practices, and meanings that were available.

To make these arguments, this chapter studies Indian forestry by examining its networks and the different ideas about forestry held by foresters and state officials in India, Britain, France, and Germany.[5] A study of networks helps to destabilize the generalized assumptions scholars maintain about forestry in British India that do not accurately reflect the complexities and realities of how forestry originated and functioned in the subcontinent. As Alan Lester notes:

> Scholars who propose a networked conception of empire generally consider it more useful to try to examine multiple meanings, projects, material practices, performances and experiences of colonial relations rather than locate their putative root causes, whether they are 'economic', 'political' or indeed 'cultural'. These relations were always stretched in contingent and non-deterministic ways, across

> space, and they did not *necessarily* privilege either metropolitan or colonial spaces.[6]

This chapter does not use networks to suggest a single root cause of forestry in India, but rather suggests that a multiplicity of methods and meanings existed that historians have failed to recognize.

We can only understand the history of forestry in British India by situating it within its various networks, institutions, and historical contexts beginning in the 1850s through to the 1880s, which were the critical decades for the development of forestry institutions in India. Forestry became a state tool and a profession at the same time that many other nascent and established scientific disciplines also became self-regulating professions and services of the state. Yet unlike other established scientific disciplines, scientific foresters had little previous cultural, economic, and political standing in mid Victorian Britain. Thus when it came to creating forestry institutions, a great debate ensued.

The origins and development of forestry and forestry education in India, 1855–1870

The East India Company governed much of what we now know as India in the early to mid nineteenth century. Before 1855, the various presidencies and provinces of the East India Company maintained differing policies towards their forests. By the early to mid nineteenth century, a growing number of Indian officials who were connected to international scientific networks began to worry about the detrimental environmental effects and economic problems caused by rapid deforestation. The first attempts by the governments in Madras and Tennaserim (in Lower Burma) to protect forests in the early 1800s ended after free trade advocates helped repeal state laws that restricted forest usage based on the argument that the state's intervention into the felling and taxing of timber violated the free market.[7] The first state forestry departments developed in the 1840s–1850s during a period when British officials in India feared that deforestation was devastating forests.[8] During these 20 years the Bombay Presidency, the Bengal Presidency (for Burma), and the Madras Presidency began employing conservators to create plantations and stop excessive deforestation, which these governments believed led to declines in rainfall and a shortage of fuelwood and railway sleepers.[9] Despite these localized developments, no single government department or movement existed to centralize forestry policies across India until the mid 1850s.

Lord Dalhousie, the Governor-General of the East India Company from 1848 to 1856, institutionalized a strong utilitarian tradition of Indian forestry when he claimed the state ownership of Pegu's teak forests and set strict limits on how many trees could be cut and how much tax would be paid per tree. Dalhousie brought in a German botanist, Dietrich Brandis, to be the Commissioner of Forests for Burma in 1855 (Brandis arrived in Burma in early 1856). Yet the creation of Dalhousie's state forestry laws remained a sore subject for many British merchants and administrators in Burma who felt that the regulation of forests constituted a monopoly of naturally free resources.[10] British merchants in Rangoon tried to get Brandis, the Commissioner of Forests, to open the forests after Dalhousie left India.[11] After the Indian Uprising in 1857 these powerful merchants suggested to the Commissioner in Rangoon and the Viceroy in Calcutta that the newly constituted Government of India might return a handsome profit by harvesting teak trees. British timber merchants in Rangoon disliked Brandis's strict policies of conservancy, and they lobbied and convinced Lord Canning, the British Viceroy of India, to repeal these stringent laws in late 1861.[12]

Brandis used his position of authority and British connections to complain to the India Office in London about Canning's newly instituted policies. Brandis wrote a frustrated letter to the Secretary of State for India, Sir Charles Wood, criticizing Canning's decision and asking Wood to repeal the ruling. Wood followed Brandis's advice and overruled Canning's decision in a sharply worded letter that resurrected the utilitarian, state-directed system promoted by Dalhousie in 1855.[13] Although Wood was a pragmatic Liberal who sought to find new ways to collect revenue to pay for debts incurred during the Indian Uprising, he deeply believed that forests should be conserved for the long term and not cut down for short-term gains in tax revenue. Wood also rejected the argument of the Wallace brothers, the leading timber merchants in Burma, that the 'self-interest' alone of European timber merchants provided enough incentive to stop excessive deforestation. To Wood and Brandis, only the state could conserve India's forests.

Brandis used Wood's support to institutionalize his vision of forestry education, laws, and science in the mid 1860s.[14] The Government of India chose Brandis for 'special duty' in late 1862 to organize a forestry department for the Government of India that would be overseen by the Public Works Department.[15] Brandis became the newly titled Inspector General of the Forests, a position created in 1864 to direct the economic, legal and scientific policies of each forestry branch in the different political districts. In 1864 the Government of India created the India-wide

Indian Forest Service, a bureaucratic organization that attempted to centralize the pay scale, rankings and policies of the officers in different provinces across India.

It was a tall order to harmonize the policies and staffing of the various branches of the Indian Forest Service. A professional corps had to be formed out of a gangly forestry system that developed ad hoc in each different political unit. There was no common rank or pay scale for foresters across India until the 1869 when a new scale came into effect. Each political division of India had its own idiosyncratic forestry corps. The majority of foresters recruited to staff these departments before the 1870s and 1880s had no formal scientific training in forestry. These men included self-trained botanists, government officials, medical doctors, ordnance officers, and military men, who, as an 1871 Indian forestry report declared, 'beyond a turn for sport and camp life, had no peculiar qualifications for the duties of forestry in other provinces'.[16] These institutionally ensconced foresters proved to be some of the biggest critics of Brandis's efforts to change the education, ethos, and policies of the Indian Forest Service.

The movement to create a more professional scientific forestry department should not be viewed as merely a continental European import. This period witnessed a watershed in the governance of India. The 1858 Government of India Act abolished the East India Company in the wake of the Indian Uprising of 1857, and made the newly styled Government of India responsible to Parliament and the Crown through the Secretary of State for the India. Previous to the mid 1850s, many of the scientists in India during Company rule worked as amateurs or self-financed 'gentlemen' scientists, and not as scientists working for the state.[17] There was a movement in India to professionalize and centralize existing but ad hoc scientific and technical programs. Irrigation, engineering, telegraphy, and medicine also became more professionalized bureaucracies. The professionalization of forestry (as well as all other state-directed professions) exhibited as much continuity of existing policies as new changes.

At the core of Brandis's proposal to professionalize the Indian Forest Service, laid out in a series of reports from 1865–6, he sought to create a new class of Indian forestry officials by sending all new recruits to study at forestry schools in France and Germany.[18] Existing French and German forestry schools taught forestry law, silviculture, and other scientific disciplines, such as elementary and applied mathematics, natural history, botany, zoology, mineralogy, geology, and chemistry.[19] The costs would be kept low because the French forestry school at Nancy would let students study for free, an important financial consideration to the penurious India Office and Government of India. After two or three years of education, these foresters would come to India to begin forming the new elite officer corps of the Indian Forest Service. To fill the current shortage of trained foresters, Brandis asked to import a few highly skilled German foresters to help place the forests of India under a more rigorous system of forestry management than existed. To implement his plans, Brandis went to London for support. Brandis talked to Wood about bringing some German foresters to India to help establish scientific forestry when he visited London in the summer of 1865. The new Secretary of State for India, Lord Cranborne, eventually agreed to Brandis's proposal to bring Germans to India, and Brandis chose William Schlich and Berthold Ribbentrop, both of whom subsequently succeeded him as the Inspector General of the Forests of India after his retirement.[20]

The larger plan to educate foresters in Europe opened up an intense debate regarding the future of Indian forestry. The Government of India circulated his plans and asked for comments from foresters and officials. His plan drew an immense amount of support and criticism. A two-year debate raged in Scotland, England, India, France, and Germany about how best to create an educational system for foresters bound for India. This debate, which has never been critically analyzed by historians, brought to light the contested concepts of forestry that existed amongst foresters and officials. There was no consensus about what French, German, European, British, or Indian forestry was or should be. People imagined European forestry to be different things. Some thought it was a general principle that was easily taught while others thought forestry education in Germany and France focused too much on theory and European environmental conditions that differed drastically from the conditions that prevailed in India. Many wanted a school in England, others in Scotland, still more in India.

Brandis set the tone of the debates by writing a number of circulars defining his ideas. By training foresters in Europe, he sought to make forestry a respectable profession and science. Brandis appealed to elites in Britain and India by emphasizing that in France and Germany forestry was 'a calling followed by young men of the best families'.[21] He favored selecting 'pre-eminently picked men, of a high moral character…and it may be found, as a rule, advantageous to give preference, *caeteris paribus*, to young men of good family connections'.[22] He had to prove that forestry was a gentlemanly profession because in the 1860s and 1870s, many high placed officials in India and Britain feared that the values of professional science challenged the entrenched status of elites who saw themselves as 'gentlemen' and 'amateurs' rather than as professionals.[23] Paralleling conflicts within the scientific community, the governing classes of Victorian India and Britain mistrusted the rise of a powerful professional class because many British elites had little professional training and held anti-industrial and anti-professional 'gentlemanly' values.

In India, the class backgrounds of recruits became a question of considerable debate. The Chief Commissioner of the Central Provinces concurred with Brandis's belief that foresters should be men of good standing because, '[i]f they belong to a lower class, and if they have not received a liberal education, they would not…have full weight with their subordinates, or with the officers of other departments'.[24] After the Uprising, many Indian officials worked to recruit men who would not tarnish Britain's fragile prestige. Yet some disagreed with Brandis's elitist notions. The Governor of Madras disliked Brandis's plan. He suggested that the Indian Forest Service should recruit from the 'lower middle and middle orders, the sons of farmers, factors, foresters, schoolmasters, [and] Scotch ministers'.[25]

The most contentious issue arose over Brandis's plan to send students to Europe and not to create a school in Britain or India. Many criticized the plan and proposed ways of sending foresters to Britain or India for their education. Some Scots wanted to create a forestry school in Edinburgh, or, failing that, at least in England. This desire was not without reason. Scottish botanists and arboriculturalists played an important role in the development of state forestry in India in the 1840s, 1850s and 1860s.[26] These Scots felt left out by Brandis's proposal, even though it did allow for Indian foresters to study for a period of a few weeks in Scotland on furlough. In Brandis's proposal, he suggested that Britain did not have adequately managed forests, good teaching facilities, or enough trained foresters to competently teach forestry there. John Hutton Balfour, Director of the Edinburgh botanical garden, disagreed. He believed that the botanic garden in Edinburgh and Scotland's pine plantations provided the facilities to properly educate foresters bound for India. Balfour railed against Brandis's plan, arguing that it cut against national interests of Britons. Brandis, however, discounted Balfour's scheme to bring students to Edinburgh by saying it 'would be an excellent education for a scientific gardener, but not a forester'.[27]

Many Government of India officials wanted to build a forestry school in India. They criticized the idea of sending Indian forest trainees to study in Europe or in Britain. These officials feared that Brandis's proposal would fill the heads of trainee foresters with untested theories and foreign practices that might work in Europe but would not be transplantable into

India's vastly different forests. F. Williams, the Commissioner of Meerut in the Northwest Provinces, aptly summed up the position of many who wanted 'practical' men, rather than overly 'theoretical' foresters:

> I should prefer officers trained practically to work in India – men like those by whom I am ably assisted – men who can manage natives and look properly after them, and get work out of them – men who can, and will, and do, turn their hands to anything and do it, notwithstanding circumstances are against them, in heat and cold, in rain and malaria. I should prefer such an assistant to one who, however highly trained in German or French forestry he might be, would be for a long time totally useless in an Indian forest, under Indian laws, in an Indian climate with Indian trees, and the vernacular languages of India the only means of communicating with those he had to work with.[28]

This criticism often came from Indian forestry officials, most of who started their careers in India in the military or government and then worked their way up the ranks of forestry departments. At a personal level, many forestry officials resented Brandis's plans to require a degree or diploma in forestry in order to be hired by the Indian Forest Service. They feared that newly trained foresters would get promoted ahead of foresters who had already invested their careers in the forests of India and who knew the languages and conditions of India, but who did not possess formal training. Henry Leeds, the largely self-trained conservator of forests for Burma, argued that the India Office should pick men from India who had shown promise, instead of freshly recruiting untested students from Britain or Europe.[29] A lingering fear existed amongst some self-trained foresters that German scientists would replace the British entirely. The Government of India required all officials in the Northwest Provinces to reread Brandis's original circular because of the widespread misconception that Germans would replace Britons.[30]

A more pervasive argument came from Indian officials who argued that the Government of India should found its own school in India. Under this scheme, Roorkee, the engineering college in India, would add a forestry lecturer.[31] Some believed that this school could educate both natives and Britons, although others wanted a school in India but they did not believe the Government of India should recruit Indians.[32] The advocates believed that the basic methods of European forestry were actually quite simple. E. Colvin summed this point up: 'The fundamental principle enunciated by Dr. Brandis, 'not to cut more in one year than is produced within the same time', is fully understood; and as [such] no necessity exists for the elaborate plans of France or Germany'. While the suggestion to build a forestry school in India intrigued the India Office, the India Office decided to first send British students to Europe to create a trained class of foresters that might then open a school in India.[33]

Support for Brandis's idea was often based upon the belief that his plan would be a temporary step and the best general plan available.[34] For example, Hugh Cleghorn, the influential Scottish forester from Madras, supported Brandis's plan but disliked certain aspects of French forestry, especially the strict military discipline instilled in students at the French forestry school at Nancy. Cleghorn wanted foresters educated in France and Germany primarily because 'there is *no existing* school [in Scotland] for training candidates in the administrative branches'.[35] The Governor of Madras supported Brandis's plan not because he wanted to replicate German forestry, but rather because the Germans offered a better ready-made model than British arboriculture and estate forestry could provide: 'I do not mean to say that the Indian forest can be reduced to the symmetry, neatness, and order of the mountain tree gardens, for such they are, of Germany…but…it is the German pattern that we must generally approximate'.[36] To a great many supporters, Brandis's plans were not ideal, but they were the best option at the time.

In the end, the Secretary of State for India, Sir Stafford Northcote, decided to continue Brandis's 'experiment' and send eight more men to Europe in March 1869. Four students would go every following year 'until some different arrangement is made'.[37] Recalcitrant governments, such as in the Northwest Provinces, would be forcefully reformed and re-staffed with professional foresters.[38] Brandis succeeded partly because he provided a ready-made plan. He also knew how to appeal to the hierarchical Government of India and India Office officials. Leading scientists, such as Joseph Hooker and Hugh Cleghorn, lent his plans scientific credibility. The fact that France would not charge for foresters, because the state paid for all students, played an important role in making the plan financially feasible. It was cheaper to send students to established forestry schools in France and Germany than to create one from scratch in Britain or India.

The debate about forestry in India reflected a number of conflicting perspectives. Supporters of Brandis's plan argued that it offered the best model from which to build a forestry department in India; it was not a manifesto. The divisions among Brandis's supporters, and the various administrative and educational schemes they offered, show how the bureaucratic networks of the Government of India influenced the development of policy. There was no single Indian 'state' dictating how the profession of forestry would function. The concept of nationalities also fails to accurately assess the situation: Brandis played to English elitism. The Scottish supporter, Hugh Cleghorn, disagreed with his nationalist counterpart, John Balfour. And Britons in India claimed a special knowledge of a foreign country. No one agreed on what was really 'European' about European forestry. The acceptance of Brandis's ideal occurred largely because it offered a British state still reluctant to diffuse scientific patronage too widely a combination of economy, ease, and scientific credibility. Brandis had the only coherent plan, and this took the day.

Competing conceptions of forestry, 1867–82

Even after successfully launching his plan to send forestry recruits to Europe, Brandis still struggled to build a coherent system of forestry based upon a common educational experience and professional ethos in the late 1860s and 1870s. The majority of Indian Forest Service officials still had no formal scientific or professional training in forestry science, management, or law. Brandis garnered increasing support from incoming recruits, but he still had to fight with forestry government officials who did not support his plans to send foresters to Europe. Many Government of India officials jealously guarded their powers and rejected the scientific rationale for the control of large amounts of forests – and more importantly, their revenues – by the Indian Forest Service. For example, officials from the Department of Land Revenue and Agriculture distrusted the environmental sentiments of foresters that meant fewer crops and less revenue.[39] District officers, like agricultural and revenue officials, also disliked foresters who tried to use science to justify controlling a larger portion of the resources of India.[40]

These officials resisted Brandis's plans to create new professional and scientific forestry system. At a forestry conference in 1872 he complained bitterly about his critics:

> I regret to say that such persons, as a class behind the age, are not yet extinct in India, and though perhaps like a snake, 'scotched but not killed' they are dangerous in their half alive state, for they are still able to bring the dead weight of an unexpressed enmity to

> bear against projects for advance and for the rational management of our forests…[41]

This sentiment was widely held by the cohort of foresters who wanted a more professional and scientific Indian Forest Service. One of the strongest self-described advocates of 'European' forestry, B.H. Baden-Powell, lamented in the second volume of the *Indian Forester*, 'The truths taught by Forest Science, unfortunately for progress, are involved in more than usual difficulties in the way of their acceptance'.[42]

Despite resistance from sectors of the Government of India, by the 1870s, several building blocks for reform were in place. The Indian Forest Service became a more coherent bureaucratic structure when the Government of India created a single forestry department for officers across all of the provinces, with the exception of Bombay and Madras.[43] The background of forestry officers slowly shifted during the century, as more foresters who studied in continental European schools came to India. In 1867 there were only two foresters in India with training in Europe; by 1876 there were 33, or one-third of all of forest officers.[44] While this meant that approximately two-thirds of forestry officers still had no continental training, a slow change was occurring in the educational background of officials.

Forestry education still remained a highly controversial topic in the 1870s. Owing to an expansion of the size of the staff and forests under the management of the Indian Forest Service, the IFS required more forest guards and rangers to enforce laws, guard the forest, and help officers with experiments, revenue collection, mapping and other jobs. Brandis, Richard Temple, and William Schlich led a movement to open up a school in India for forest rangers.[45] The Viceroy agreed with the plan, opening Dehra Dun in 1878 for practical instruction (theoretical instruction opened in 1881). Not everyone celebrated the opening of the forestry school at Dehra Dun. Many officials in the Department of Revenue and Agriculture disliked the idea of opening a school in India for natives because they felt that forestry education was too theoretical for officers, let alone rangers. To these officials, Brandis noted, 'professional training of young Englishmen for Forest Service, was still regarded as a needless, nay as a mischievous attempt at over-refinement'.[46] The Secretary of State for India, Lord Salisbury, alleviated some of the criticism by suggesting that the new school's 'object [should at first be] confined to the education of candidates for subordinate posts, and gradually to attempt professional education of the higher character'.[47]

The largest conflict of the 1870s and early 1880s arose over a debate surrounding the newly implemented 1878 forestry act. The first forestry act in India, the 1865 Indian Forest Act (with various provincial promulgations), did not provide the legal processes that allowed foresters to regulate access and redefine and settle the rights of forest users in declared state forests. The passing of the 1878 Indian Forest Act throughout most of India, and the 1882 Madras Forest Act (patterned directly on the 1878 Act), gave governments the upper hand in determining forestry management policies: it required claimants who wanted to continue their existing rights to the forest to submit their claims in writing within a specific period to be assessed by government officials. The state now could claim complete ownership of certain forests, redefining forest communities as having 'privileges' but not 'rights'.

Historians have interpreted the passing of the Act differently. Ramachandra Guha sees the 1878 Act as signifying a larger annexation of territory and rights by the Government of India. The state expanded using the argument of one group (not the entirety) of foresters. Three positions framed the debate: the 'annexationists', who wanted the state to have total control of forests and lands; the 'pragmatists', who wanted the state to take total control of ecologically sensitive areas while allowing community forestry in other areas; and lastly, the 'populists', Madras officials who rejected state intervention and wanted to maintain rights as they then existed.[48] In this view, Dietrich Brandis fits within the pragmatist position. Baden Henry Baden-Powell, a leading forestry official and former Judge in the Punjab, led the annexationist position.[49] Baden-Powell focused on the rigid policing of the forests by the French and Prussians, suggesting that in Europe peasants had privileges, not rights. Brandis strongly disagreed with Baden-Powell's belief that forest dwellers had to prove their rights in writing before they could be considered as actual rights or privileges. Brandis countered with European examples. He argued that in Europe peasants *did* have rights to the forests, not just privileges, as suggested by Baden-Powell. He also denied the suggestion by Baden-Powell that because the Amirs of Sindh extinguished customary rights in their forests, it justified the legality of Madras appropriating existing forest rights. European forestry law, in Brandis's view, balanced the rights of those living in and around the forests and the larger needs of a national economy.

Other historians see the 1878 Forest Act as a distinct victory for continental European forestry law. Ravi Rajan sees the victory of Baden-Powell as the apotheosis of German and French forestry. In this perspective, the desire of the state to control resources arose out a desire to imitate continental techniques of law and management, not out of pre-existing attempts by the EIC and the Government of India to claim total control over the forest resources. He notes that there was 'opposition to the adoption of continental methods' by certain foresters and administrators, but he fails to note that they *also* argued for following continental methods, just different ones.[50] Rajan's definition of 'continental forestry' includes the more authoritarian legal aspects of Prussian or French forestry law while denying Brandis's belief that European forestry incorporated the rights of forest dwellers.

The 1878 Forestry Act was not merely a continental import. British Indian foresters and the Secretary of State for India had also been pushing for the expansion of their policing powers since the early 1860s.[51] The Utilitarian tradition in India, which espoused the concept of 'the greatest good for the greatest number', held a powerful sway over government thinking, even after the Uprising.[52] Trying to cajole the Governor of Madras into passing a stricter law in 1870, the Secretary of State for India, the Duke of Argyle, told him, 'it must be remembered that as civilization advances these rights become less and less necessary to the cultivators, and are found frequently incompatible with the super rights of the whole community'.[53] This philosophy is indicative of a larger shift in legal and political thought during the nineteenth century away from private legal theory to a corporatist legal theory. While Baden-Powell believed he was drawing from existing precedents in European forestry law, the idea of strengthening forestry laws in Madras had more varied origins. Brandis, a German by birth, interpreted what it meant to practice 'European' forestry in vastly differently ways than did Baden-Powell.

A 'British', 'Continental', or 'Indian' forestry school?

In 1880, the French overseer of British students at the forestry school at Nancy reported that the British students had scored poorly on their exams because they failed to pay attention to their studies. Colonel George Pearson, the India Office liaison at Nancy, disagreed with the French analysis. He defended his students. Pearson believed that another problem was to blame for the low scores. British students at Nancy scored poorly on their exams because an increasing number of British students were attending school there; instead of socializing with the French students, and thus learning the French language fluently, the British consorted with each other and learnt bad French. Without knowing French adequately, they could not learn the material. Pearson suggested that British students should instead study in Britain because with the increasing numbers of British students, French-British tensions were bound to flare because '[t]he tastes and habits of the two races [French and British] are too different'.[54] Pearson advised hiring a forestry instructor at the Royal Indian Engineering College at Cooper's Hill, the engineering college for students bound for India, and bringing the British forestry students back to Britain. After studying in England, students could visit Europe during the summer to see how the French, German and Swiss managed their forests.

Pearson's message found its way to the desk of the Secretary of State, Lord Hartington, who then asked for the opinion of Hugh Cleghorn, an advisor on forestry matters.[55] Cleghorn was receptive to the idea of creating a forestry school outside of continental Europe. He suggested sending half the students to Nancy, to minimize the problems Pearson noted, and bringing the other half to Dehra Dun in India. Cleghorn disagreed, however, with Pearson's belief that British students could learn enough about continental forestry through a summer tour. Cleghorn believed British students could study in Britain for a year or two, but they must study for at least a year in Nancy as well. Only in France and Germany could students see forests that had been systematically managed for over a century. Britain or India offered no such possibilities. Cleghorn firmly maintained the importance of continental training. In response, Pearson pointed out that France's touted systematic management of the forests 'is relatively new' and could be 'applied to any large tract, such as Dean or New Forest'.[56]

Upon being asked by Hartington, the Government of India disagreed with Pearson's idea. Lord Ripon, the Viceroy of India, and his Council wrote that they would rather wait for at least five years, and in that time they could set up a forestry school at Dehra Dun for Britons. Their conclusions, they wrote, stemmed from a 'purely Indian point of view'.[57] The Viceroy's council believed there would be 'a distinct deterioration in the quality of training which our Indian candidate will receive if transferred to an English school'. Cooper's Hill, they believed, was a school fit for engineers, not for foresters.

Brandis took a middle position. He agreed that students needed to study existing continental forest management schemes. But he also believed that Cooper's Hill would provide a good home for students bound for India. Brandis praised the school:

> The tone of management of the institution [Cooper's Hill] is excellent, it is entirely under the control of the India Office, and it is an advantage that the officers of the three largest scientific departments

> in India, the Public Works, Telegraphs and Forests, should receive their education at the same place.[58]

The 'tone of management' at Cooper's Hill followed the desires of its president at the time, Sir Alex Taylor, who was famous for trying to form gentlemen and inculcate a public school *esprit de corps* instead of producing theoretical scientists.[59] Brandis did not believe, however, that a school should be set up in India because it was too far away from continental Europe, where the students could see properly managed forests.

The foresters who insisted that students must study on the continent believed that it was the continent's diversity of forest types – both ecologically and under management – not their homogeneity that mattered. Whereas many historians now see German and French forestry as a rigid model of forest management – essentially a silviculture predicated on monoculture, a forcing out of people living in forests, and a technocratic management of nature – advocates of continental forestry wanted students to *experience* a diversity of methods and forests, instead of merely cramming a single theory into their heads. As an India Office report explained, 'The science of Forestry, M. Puton [a forestry professor at Nancy advising the India Office] explains, is not to be acquired in so many lessons like mathematics or physics; it is a science of observation requiring a certain time to ripen in the mind'.[60] Puton's belief that forestry was a body of tacit knowledge based on a mastery of diversity disagrees with the popular portrayal of continental forestry as being totalizing and largely theoretical.

After consideration, the new Secretary of State for India, Lord Kimberly, told the Viceroy his decision. Students would be sent to Cooper's Hill starting in September of 1884. The first year students would follow the same course of study as engineering and telegraph students, except they would take organic instead of inorganic chemistry, and forestry instead of architecture. The second year students would study forestry more exclusively. Both summers would be spent visiting the forests of continental Europe and suitable forests in Britain. Kimberly again dangled the prospect of opening up a school in India for the practical field education of foresters. 'The time is not far distant, I trust, when the practical training of the young Forest Officers may be completed in India'.[61] The only thing left to do was to find a professor of forestry. Brandis would not take the position, as he retired from India at the end of 1882. Eventually the second Inspector General of the Forests in India, William Schlich, accepted the job and the Secretary of State approved his appointment.[62] Forestry education moved to Britain.

Scholars have interpreted the creation of the forestry school at Cooper's Hill differently. Ravi Rajan does not analyze the causes of the move, although he notes, 'the forestry curriculum at Nancy was deemed perfectly adequate'.[63] Instead, to Rajan the move was a moot point because in the end the 'French…had the last laugh, because the distinguishing feature of forestry in the second half of the nineteenth century in British India was strongly continental in its thrust'.[64] Ulrike Kirchberger disagrees by arguing that the debate centered on what type of curriculum should be employed to create the ideal Indian forester. As she notes,

> On the British side, the ideal representative of British forestry in India was to be a gentleman with a broad general knowledge of Indian affairs. German scientists, in contrast, wanted to produce scientific experts, academically schooled, and trained to do research on the spot.[65]

This view also posits that distinctly 'British' and 'German' (which in Rajan's model would include French) perspectives existed on forestry. Yet while Kirchberger suggests that foresters themselves viewed the question of forestry education in these polar terms, she also notes that British financial interests and German scientific methods actually had similar goals of revenue enhancement: 'It is thus difficult to define a distinct "German" contribution to the Raj – that is, something which existed in Germany only and was completely alien to the British colonial administration before the German foresters arrived'. In her historical model, European forestry did not replicate itself in India via the importation of German foresters and students educated there; rather the conditions for the replication of German models already existed because the models themselves existed.

The debate centers on different notions of what defined the 'proper' European forestry education. The question was in reality one of practice: how long did foresters need to study the existing silvicultural and management systems used in Europe? Indeed, the European tour went to the heart of Brandis's initial plans for a continental forestry education. There was not a single, identifiable British, French, and German perspective on the issue. Brandis, a German, was flexible in his vision of forestry education and he understood and supported the creation of an imperial and Indian ethos, rather than the rigid French military ethos that Cleghorn so disliked. Yet Cleghorn, a Scot, still supported keeping the school in Europe whereas Brandis was more conciliatory. The Government of India offered its own position – foresters should be trained in India, not in Britain or Europe.

Why did the forestry school move? Geopolitics, finance, domestic British nationalism and different notions of what constituted European forestry all played an important role in the decision to move the site of training from Nancy to Cooper's Hill. Pearson pushed a hot button at the right time. The India Office had to pull its students out of France during the Franco-Prussian War. Even with peace in Europe, the British were at the mercy of a French government that could at any time deny the entry of British students or charge for tuition. It also rankled the pride of many Britons to have to send their students abroad to study forestry. Cleghorn himself admitted to the India Office 'this country stands almost alone among European nations in not possessing a forestry school to meet her own wants'.[66] Finally, there was no agreed upon definition of European forestry. Pearson echoed the long standing belief of many in Britain and India that European forestry merely involved the notion of not cutting more trees than grew back, a simple proposition. Brandis and Cleghorn countered that a European education involved a tour of many forests. Brandis and Cleghorn both agreed that the theoretical training could be pursued outside of Europe. India Office officials listened to Pearson, and decided that students could gain enough practical experience in continental silviculture and management by taking short trips.

In the end, the forestry school at Cooper's Hill was set up to cater to professional foresters and government officials who saw forestry as an important extension of state policy. Both sides employed flexible understandings of the curriculum of continental forestry education. Advocates in favor of sending students to the continent stressed its variety of forest types and management systems, and the extensive professional development of scientific forestry. Critics of sending students to the continent suggested that European models were either inapplicable to India or were so new and simple as to be easily applied in Britain or taught at Dehra Dun. Even French and German foresters described forestry in terms of *experience* rather than reason or rationality, ostensibly the hallmark of continental European forestry programs. Because the governing of India was only done through the overlapping of networks and individuals, each with differing ideals of how the state should manage people and nature, the end result was a compromise among those who wanted a national school but still cared about the quality of forestry education.

Conclusion

This chapter has argued that forestry in British India from the 1850s through to the 1880s was characterized by a tension among competing visions of forestry that were articulated during intense debates about forestry education. The terms of these debates focused on differing notions of what actually characterized French, German, or European forestry. Studying the 'multiple meanings, projects, material practices, performances and experiences of colonial relations', as Lester suggests, makes it clear that there was no single, identifiable European forestry that was imported into India.[67]

Notes

1 A review of the historiography of forestry in India by K. Sivaramakrishnan started to outline the broad congruence among seemingly disparate literature. See K. Sivaramakrishnan, 'Science, Environment and Empire History: Comparative Perspectives from Forests in Colonial India,' *Environment and History* 14, 1 (2008), 41–65.

2 A few works include Gopa Josh, 'Forests and Forest Policy in India', *Social Scientist* 11 (1983); Ramachandra Guha, *The Unquiet Woods: Ecological Change and Peasant Resistance in the Himalaya* (Oxford: Oxford University Press, 1989); Madhav Gadgil and Ramachandra Guha, 'State Forestry and Social Conflict in British India', *Past and Present* 123, 1 (1989), 141–77; Madhav Gadgil and Ramachandra Guha, *This Fissured Land: An Ecological History of India* (New Delhi: Oxford University Press, 1992).

3 Ravi Rajan, *Modernizing Nature: Forestry and Imperial Eco-development, 1800–1950* (Oxford: Oxford University Press, 2006), p. 201; *idem.*, 'Imperial Environmentalism or Environmental Imperialism? European Forestry, Colonial Foresters and the Agendas of State Management in British India, 1800–1900', in Richard Grove, Vinita Damodaran and Satpal Sangwan (eds) *Nature and the Orient: The Environmental History of South and Southeast Asia* (Oxford and Delhi: Oxford University Press, 1989), pp. 324–71.

4 Richard Grove, *Green Imperialism: Colonial Expansion, Tropical Island Edens and the Origins of Environmentalism, 1600–1860* (Cambridge: Cambridge University Press, 1995); Gregory Barton, *Empire Forestry and the Origins of Environmentalism* (Cambridge: Cambridge University Press, 2002); Gregory A. Barton and Brett M. Bennett, 'Environmental Conservation and Deforestation in India 1855–1947: A Reconsideration', *Itinerario: International Journal of the History of European Expansion and Global Interaction* 38, 2 (2008), 83–104.

5 Other attempts to analyze the networks of forestry in the British Empire and India have failed to look at the politics, culture, and shifts in networks. For a study that uses the terms 'center' and 'periphery' and sees networks as single entities see Donal McCracken, 'Fraternity in the Age of Jingoism: The British Imperial Botanic and Forestry Network', in Benedikt Stucktey (ed.) *Science Across the European Empires 1800–1950* (Oxford: Oxford University Press, 2005), pp. 49–62.

6 Alan Lester, 'Imperial Circuits and Networks: Geographies of the British Empire', *History Compass* 4, 1 (2006), 131.
7 Raymond Bryant, *The Political Ecology of Forestry in Burma* (Honolulu, 1997), p. 24; Barton, *Empire Forestry*, p. 46.
8 For a summary of the causes of deforestation in India see William Beinart and Lotte Hughes, *Environment and Empire* (Oxford: Oxford University Press, 2007), pp. 112–14.
9 Grove, *Green Imperialism*, pp. 414–62.
10 Not all professional foresters supported Brandis. See the *laissez-faire* ideas of Robert Abreu. Robert Abreu, *Journal of a Tour Through Pegu & Martaban Provinces in the Suite of Drs McClelland & Brandis Successively Superintendents of Forests, Pegu* (Maulmain [Burma], 1858).
11 See his memories of timber merchants and his fight. Dietrich Brandis, *Indian Forestry* (Woking [UK], 1897), pp. 33–7.
12 Barton and Bennett, 'Conservation and Deforestation', pp. 84–6.
13 The documents cited in the next section are from *A Selection of Despatches and their Enclosures to and from the Secretary of State for India in Council on Forest Conservancy in India, showing the Measures which have been adopted, and the Operations which are going on in the several Presidencies and Lieutenant Governorships, beginning with the Despatch from the Governor General in Council of the 21st day of May 1862 to the present time Vol. 1* (London, 1871).
14 Brandis, *Indian Forestry*, p. 37.
15 The Governor General of India in Council to the Secretary of State for India, 2 February 1863, in *A Selection of Despatches*; Enclosure 1, in No. 5 Resolution by the Government of India, Public Works Department, 21 October 1862, in *A Selection of Despatches*.
16 G.F. Pearson, *Report on the Administration of the Forest Department in the Several Provinces Under the Government of India, 1870–71 With Appendices*, Indian Office Records, British Library [hereafter IOR BL] V/24/1242, p. 49. Pearson was himself a Lieutenant-Colonel.
17 David Arnold, *Science, Technology, and Medicine in Colonial India* (Cambridge: Cambridge University Press, 2000), p. 25.
18 See Dietrich Brandis to the Undersecretary of State for India, 23 Nov 1866, in *A Selection of Despatches*; The Governor General of India in Council to the Secretary of State for India, 11 April 1867, in *A Selection of Despatches*; Secretary of State for India to the Governor General of India in Council, 15 June 1871, in *A Selection of Despatches*.
19 Dietrich Brandis to the Undersecretary of State for India, 23 Nov 1866, in *A Selection of Despatches*.
20 The Secretary of State for India to the Governor General of India in Council, 14 Sept 1866, in *A Selection of Despatches*.
21 The Secretary of State for India to the Governor General of India in Council, 14 Sept 1866, in *A Selection of Despatches*.
22 Dietrich Brandis to the Secretary to the Government of India, 6 Oct 1866, in *A Selection of Despatches*.
23 See the sociological argument of gentlemanly capitalism by P.J. Cain and A.G. Hopkins, *British Imperialism 1688–2000* (London: Longman, 2nd Edition, 2001).

24 Secretary to Chief Commissioner, Central Provinces to Secretary to the Government of India, 21 June 1867, in *A Selection of Despatches*.
25 Minute, Governor of Madras, 25 Aug 1867, in *A Selection of Despatches*.
26 McCracken, 'Fraternity in the Age of Jingoism', p. 56.
27 Dietrich Brandis, letter enclosed in The Secretary of State of India to the Governor General of India, 28 Feb 1867, in *A Selection of Despatches*.
28 F. Williams, Commissioner of Meerut Division, to the Secretary to the Government of the Northwest Provinces, 26 Aug 1867, in *A Selection of Despatches*.
29 H. Leeds, Conservator of Forests, British Burmah, to the Secretary to Chief Commissioner of British Burmah, 4 June, 1867, in *A Selection of Despatches*.
30 C.H. Dickens, Secretary to the Government of India, Public Works Department, to Secretary to the Government of the North Western Province, in the Public Works Department, 20 Sept 1867, in *A Selection of Despatches*.
31 For a summary see, Lieutenant Colonel C.J. Hodgson, Secretary to the Government of the North Western Provinces, in the Public Works Department, to Secretary to the Government of India, Public Works Department, 24 Feb 1868, in *A Selection of Despatches*.
32 Colonel H. Ramsay, Commissioner of Kumaon, to Secretary to the Government of the North- West Provinces, in the Public Works Department, 12 Feb 1868, in *A Selection of Despatches*.
33 The Governor General of India in Council to the Secretary of State for India, No Date Sept 1868, in *A Selection of Despatches*.
34 Like many, Dr. J.L. Stewart, Conservator of the Forests in the Punjab, did not see European forestry as the only means by which forestry should proceed upon. Memorandum from Dr. J.L. Stewart, Conservator of Forests, Punjab, to Secretary to the Government of Punjab, in the Public Works Department, 16 Sept 1867, in *A Selection of Despatches*.
35 Hugh Cleghorn to Secretary to the Governor of Madras, 12 June 1867, in *A Selection of Despatches*. His italics.
36 Minutes, Governor of Madras, 25 Aug 1867, in *A Selection of Despatches*.
37 Secretary of State for the India Office to Governor General, 24 Nov 1868, in *A Selection of Despatches*.
38 Secretary of State of India to Governor-General in Council, 16 Dec 1867, IOR BL L/E/3/593.
39 Barton and Bennett, 'Environmental Conservation and Deforestation', pp. 88–9.
40 For a discussion of the tense relationship between district officers and foresters see C.F. Amery, 'On the Relation Between District and Forest Officers', *Indian Forester* 1 (1876).
41 *Report of the Proceedings of a Conference of Forest Officers* (Calcutta, 1876), p. 87.
42 Baden Powell, 'Forestry Conservancy in its Popular Aspect', *Indian Forester* 1 (1876), 1.
43 India Office to Governor General, Revenue No. 27, London, 24 Nov 1868, IOR BL L/E/3/593.
44 See 'Forest Officers Appointed,' *The Indian Forester* 4 (1878), 158. The total of trained foresters in India were as follows: 1867 (2), 68 (2), 69 (1), 70 (4), 71 (4), 72 (9), 73 (16), 74 (22), 75 (26), 76 (33). In 1876 Brandis wrote that one-third of all foresters in India were trained in European forestry schools.

See Dietrich Brandis, *Memorandum on the Establishment of a Central Forest School* (Simla, 1877), p. 1.
45 Secretary of State to Governor of Fort St. George, India Office, London, 24 Feb 1868, IOR BL L/E/3/767. There was a long correspondence relating to the opening of the forestry school, with those in favor writing a number of papers. For the views of Dietrich Brandis, William Schlich, and Sir Richard Temple see Brandis, *Memorandum on the Establishment of a Central Forest School*.
46 Dietrich Brandis, 'Indian Forestry: The Extended Employment of Natives', *The Imperial and Asiatic Quarterly Review and Oriental and Colonial Record* 3 (1897), 247.
47 Secretary of State to Viceroy, 23 Feb 1877, IOR BL L/E/3/594.
48 For this paragraph see Gadgil and Guha, *This Fissured Land,* pp. 124–32.
49 Powell was the son of the mathematician and Church of England priest, Reverend Baden Powell (1796–1860).
50 Rajan, *Modernizing Nature*, p. 93.
51 *Forest Reports of the Bombay Presidency for the Years 1860–61 to 1867–68* (Bombay, 1869), pp. 12–13.
52 The classic on this subject is Eric Stokes, *The English Utilitarians and India* (Oxford: Oxford University Press, 1959). Barton and Bryant both note the importance of utilitarian philosophies for forestry policy in India and Burma. Barton, *Empire Forestry*; Bryant, *The Political Ecology of Forestry in Burma*.
53 Secretary of State for the India Office to the Governor of Madras, 27 Jan 1870, IOR BL L/E/3/767.
54 Colonel Pearson to Under-Secretary of State for India, 8 Dec 1880, File No. 2, IOR BL L/PWD/8/42.
55 Secretary of State for India to the Governor General of India in Council, 28 April 1881, File No. 2, IOR BL L/PWD/8/42.
56 G. Pearson, Memorandum, 7 March 1881, File No. 2, IOR BL L/PWD/8/42.
57 Viceroy of India to the Secretary of State of India, 9 Sept 1882, File No. 2, IOR BL L/PWD/8/42.
58 Training of Candidates for the superior Staff of the Forest Service in India by D. Brandis, 1 July 1883, File No. 2, IOR BL L/PWD/8/42.
59 Christopher Hill, *Environmental History of South Asia* (Santa Barbara: ABC-CLIO, 2007), p. 120.
60 See Puton's note on the training of students in Practical forestry 26 Dec 1883, File No. 2, IOR BL L/PWD/8/42.
61 Secretary of State for India to the Governor General of India in Council, 6 March 1884, File No. 2, IOR BL L/PWD/8/42.
62 India Office to Sir A. Taylor, 3 Nov 1884, File No. 2, IOR BL L/PWD/8/42.
63 Rajan, *Modernizing Nature*, p. 88.
64 Rajan, *Modernizing Nature*, p. 89.
65 Kirchberger, 'German Scientists in the Indian Forest Service', p. 9.
66 Hugh Clegorn, Memorandum No. 6, File No. 2, IOR BL L/PWD/8/42.
67 Lester, 'Imperial Circuits and Networks', p. 131.

5

Anatomy of Reception: Science, Nation and Religion in Hindi-Language Print Media of Colonial South Asia

Rajive Tiwari

'Fire may change once again our fortune for the better, otherwise [our civilization] is like a garden choked by thorns'.[1] Mirza Ghalib, the renowned nineteenth-century Urdu poet, penned this couplet after a visit to Calcutta where, for the first time, he witnessed the power of steam and coal. Hope and optimism were only some of the myriad reactions stirred among South Asians of Ghalib's generation by the newly arrived knowledge from the West. Ghalib, like many Indians, viewed the importation and development of new scientific disciplines and techniques from a unique cultural perspective that historians have rarely explored. As David Livingstone has shown, the meaning of science is not fixed and strongly depends on the location where it is received.[2] It is this contextually formed meaning of science which this chapter aims to explore. The development of knowledge systems is rarely a process that takes place in intellectual, cultural or geographical isolation. Often it is driven by encounters between ideas generated by webs of sources so complex that it is futile and even meaningless to try to identify ideas with sources in any exclusive manner. The adjectives 'Western', 'European', 'indigenous' and so on, used in the present work are therefore to be taken simply as contingent yet convenient labels to distinguish pre-existing knowledge from new knowledge in the limited context of nineteenth-century South Asia and not in any essentialist sense. The use of such terms in the primary sources studied here suggests their ideological construction. The ambivalent treatment of the new knowledge in the print medium underscores the fluid nature of these terms.

Understanding the transmission of scientific ideas and practices in India requires an understanding of the historical contexts that surrounded, aided, or hindered their acceptance and development. In terms of the reception of physics and astronomy in northern India, the topic explored in this chapter, the process of this transmission and the Indian response to it was influenced by the pre-existence of a body of classical Indian knowledge with concerns that overlapped with those of Western science, but whose methods and conclusions were often at odds with those of the latter.

In this chapter a detailed examination is undertaken of the Indian response to Western science as reflected in popular Hindi-language magazines of Northern and Central India from the middle nineteenth to the early twentieth century. Simon Potter has shown how the development, at the levels of both organization and operation, of mass media across the British Empire was instrumental in the formation of local, national and imperial identities.[3] The present study finds that the *content* of the media too played a formative role in the construction of identity. More specifically, the articles on science surveyed here are found to have taken part in a larger discourse on transforming identities. Furthermore, the investigation reveals a nuanced response to European science and not a simple acceptance or rejection. Both the affirmation of and resistance to Western science were very much situated in the prevailing cultural, political and intellectual milieu of the subcontinent. The encounter with Western science was always marked by a negotiation that offered opportunity for reflection on the nature of science, society, tradition and power.[4]

Contrary to George Basalla's conception of how science traveled through the Empire,[5] the transmission of Western science in South Asia did not resemble the process of thermodynamic diffusion, with molecules of new knowledge bouncing around in a steadily increasing volume of space. Rather, the complex and nonlinear nature of this process is now generally accepted.[6] The field of optics provides a more accurate analogy – as Western science radiated across the sub-continent's boundaries, it was constantly absorbed and re-emitted by various contextually constituted agencies or nodes, so to speak, in the network's circulating scientific ideas, which infused it with new colors. The Hindi print media was one such node that mediated science for the indigenous population of India.

The early nineteenth century

At the beginning of the nineteenth century, the East India Company was faced with the issue of how best to achieve its economic goals without risking unrest among the native populations. The dominant view was that a basic infrastructure of security must be built with minimal impact on the social and cultural practices. Christian missionaries opposed this stance and argued that Indian society could be reformed if they were allowed to do their work. This argument was complemented by Radicals and Utilitarians in Britain who were convinced of the superiority of European Enlightenment ideas and wanted to expand its influence on the Subcontinent.[7] Company administrators gradually came around to accepting this view but wanted to proceed with caution. In 1813 the decision was made to establish the Committee of Public Instruction which examined the relative merits of Western and Eastern knowledge. Around the same time the doors were open to let missionaries operate in the region.

During his tenure as Governor General from 1828 to 1835, William Bentinck took steps to bring about reforms by banning the practices of sati and thuggee. There was no serious opposition to these actions even from orthodox Hindus. In fact, some Indians like Raja Ram Mohan Roy were already demanding such moves.[8] Clearly a desire for social reforms had already developed within the Hindu community. The growing presence of Christian missionaries and the introduction of technologies like the telegraph were seen by many as being antagonistic to the existing social order and engendered discontent among native religious leaders. It didn't help matters that the education system that was being established by the British initially included native learning but eventually focused exclusively on European scholarship. Around the same time, changes in land ownership laws resulted in many landholders being displaced. Princely states were annexed, titular sovereignties were abolished and the pensionary Mughal Emperor in Delhi was given notice that his title would not pass on to his heir. These sources of resentment reached a critical point when the widespread revolts of 1857 were triggered by rumors of sacrilege being committed against beliefs of Muslim and Hindu soldiers of the British army.

The various distinct but interconnected transformative processes unfolding on the Subcontinent provide a useful context in which to place the various responses to novel scientific ideas presented here. The spread of Western education, social reform, missionary activity, new technologies and bitterness towards British rule in the first half of nineteenth century were clearly reflected in the ideas captured by the print media. Educational institutions imparting European learning embodied crucial loci at which the new knowledge was encountered. The range of issues that these encounters prompted were captured in the Hindi periodicals which themselves constituted another set of nodes in the networks carrying European science.

Local responses to western science

During its encounter with colonialism in the nineteenth century, the Indian subcontinent witnessed changes in the economy, educational system and in communication and transportation systems among other things. Out of these changes was born a new awareness which motivated South Asians to assess and grapple with their social and economic problems. The print media played an important role in this process.[9] In Hindi print media, articles dealing with the sciences indicate the arrival of new knowledge and vividly reflect the nationalist and religious concerns of its authors and illustrate a socially contextualized reading and deployment of Western science. This finding echoes Livingstone's observation that a society receives science and works with it in ways consistent with its 'sense of self-understanding'.[10]

As the teaching of European science became more widespread in educational institutions, an interest in science among generally educated Indians increased.[11] The increasing curiosity about science was satisfied by articles that reported on new scientific discoveries in Europe or expositions about scientific topics. An item published in 1849 describes the round shape of the earth, as well as its size and the ratio of land to water.[12] It also describes the non-material nature of sky, the brilliance of the moon as reflected sunlight and the distance between the sun and earth. Other pieces dealt with a range of topics from thermal radiation[13] to contemporary understanding of earthquakes,[14] to the discovery of insulin and its medical implications.[15] These articles represent a node in the network carrying scientific knowledge from Europe to South Asia. They presented this knowledge in a language accessible to its readers. In functional terms, these articles supplemented the efforts of the growing number of educational institutions that were conduits of Western science on the Subcontinent.

As the exposure to scientific ideas recently imported from the West increased, a reflection on the classical body of South Asian knowledge was stimulated. This phenomenon is manifested in numerous treatments of scientific topics that include discussions of Eastern and Western thinking on the subject. By and large many of these articles do not make the case of absolute superiority of one tradition over the other and thereby implicitly accept the universality of science. An article from 1883 on planetary eclipse notes that ancient Indian astronomy was limited in its scope and accuracy by the non-availability of observational instruments that were commonly used by European astronomers. The article also takes some ancient astronomers to task for not making a clear distinction between astronomy and astrology.[16] Developments in astronomical knowledge were viewed as a function of the advancements in observational techniques. Epistemological progression, for the authors, was a universal process independent of the specific geographic locations and cultural contexts in which the science was practiced. Many articles take universality a step further and explore interconnections between Eastern and Western astronomical knowledge. In 1896, for example, one author suggested that

> …both Pythagoras and Aryabhatt knew that the earth was round. But South Asians in the Middle Ages believed that the earth was at the center of the universe and was surrounded by seven types of oceans [reference to a Puranic lore]…Scholars in India who were contemporary of Pythagoras had deep knowledge of astronomy and there was an intellectual exchange between South Asia and Greece.[17]

The author recognizes the similarities between Greek and Indian astronomy in ancient times but also acknowledges the mixing of myth and science. As a sign of their increasingly modern sensibility, many authors made a careful distinction between *phalit jyotish* (astrology) and *ganit jyotish* (astronomy), excluding the former from the realm of science. Such an intellectual outlook, which led to the differentiation between scientific and nonscientific with a greater desirability of the former, was a clear signal of the influence of Western science led modernism, even in the Hindi heartland far removed from the Westward looking elite of the Bengal Presidency. Commonalities between Eastern and Western thought were highlighted in the writings not just between scientific knowledge but also between knowledge generally not accepted as scientific. This indicates an attempt at identifying a broader universality encompassing all knowledge. This work also recognizes the collaborative process through which scientific knowledge develops.

After the revolts of 1857 had been forcefully suppressed, the British wanted to prevent any recurrence of insurrection and became more attentive to native sentiments. Attempts towards Westernizing were scaled back and infrastructural public works projects, like railways, canals and land system improvements were initiated.[18] On the education front, although primary education lagged, higher education made progress and natives were allowed to run their own colleges.[19] On their part, Indians felt an increasing sense of resignation towards British hegemony – the traditionalists accepted the superiority of British power and the Westernizing middle classes became enamored by the new knowledge and its ever increasing visibility in the form of new technologies. These developments were reflected in magazine articles that praised Western science for its pragmatic benefits.

In an article from 1866 the author presented a point of view that was critical of traditional philosophies of South Asia not only for their lack of utility but also for their methodology. The article began by stating that India had gained a great deal from European knowledge. The English education system, the author argued, had forced Indians to critically confront the strengths and weaknesses of their traditional learning.[20] The article adds:

> …the primary function of any science is to provide us with a specialized knowledge and help make progress. …[but]…Indian philosophies …are entangled in endless arguments and counterarguments about inconsequential niceties. Therefore no importance can be attributed to this knowledge. In order for a knowledge to carry any weight it has to be based on self-evident axioms as is the case for geometry, for instance…

Knowledge that was not easily translated across cultures was also considered inferior to a universal knowledge whose validity was considered immutable. What interested these authors in science was its power to usher in a modernity comprised of what were perceived as universal values of utility and objectivity. Such responses reflected the hope engendered in sections of the middle classes by modernity and the science-based technological miracles of nineteenth century Europe. Modernism and technology mediated by the colonial system became objects of desire through their association with power. For the moment, of course, the power resided in the hands of the colonial rulers. But the possibility of the transfer of this power to the native elite was already taking shape in the collective imagination.

Works encompassing the old and the new, Eastern and Western, can be seen as a node in an epistemological network running across not only the spatial dimension but also a temporal dimension. The knowledge freshly arrived at this node from Europe stirs up ontological memories from a familiar past. Encounters with the new become a moment of reflection on the old and subsequently a universality of knowledge is imagined. The composite nature of knowledge derived from diverse sources that these articles recognize, parallels the intermixing of ideas that was taking place in the broader public sphere as increasing numbers of Indians were being employed in the colonial courts and administrative offices.[21] This amalgam resulting from the mutual exposure was intellectually transformative for both the British as well as the native elites.

Religious transformations

The absorption of the new science and its assessment in South Asia was taking place in a social space that was also the site of religious changes. The nature of religious and also social reforms was influenced not only by the internal dynamics of the traditional society but also by technological changes and the growth of Christianity. Influence of Christianity began to rise after missionaries were allowed to operate in regions controlled by the East India Company.[22] The second half of nineteenth century witnessed a sprouting of various Hindu reform movements such as Arya Samaj. Arya Samaj was formally started in 1875 by Dayanand Saraswati. It aimed to take Hinduism back to its origins found in the Vedic scriptures. Saraswati believed that over the centuries, Hinduism had accumulated many undesirable ideas and practices like the caste system, idol worship, child marriage, and polytheism. Arya Samaj responded to the efforts of Christian missionaries on the subcontinent as well as to the rising influence of English education. Aryasamaji discourse reflected on and addressed these concurrent phenomena. For the leaders of Arya Samaj, the project of rationalizing Hinduism was in part intended to overcome the challenges posed by the perceived threats of colonial rule and evangelical Christianity.

According to Lala Lajpat Rai, a devout Aryasamaji and a political leader promulgating Hindu nationalism, one of the roadblocks Arya Samaj had to overcome was '[t]he analytic tendencies of modern science, which denied God, revelation and religion, and established secularism and materialism on the throne formerly occupied by God'.[23] Aryasamajis supported an educational system that focused on indigenous knowledge. There was a faction within Arya Samaj, however, that also advocated 'incorporating…all that is best and assimilable in Occidental thought'.[24] This view provides a theoretical basis for the receptiveness towards Western science. At the same time, more traditionalist Aryasamaji authors displayed a deep resistance towards Western science. Within Arya Samaj there was thus an ambivalence towards Western knowledge, which reflects its view on the one hand that the Vedas contained seeds of all that is worth knowing and, on the other hand, its quest to modernize Hinduism by drawing on Western rationality. Modernity and science were not accepted or rejected in their totality but were negotiated from the perspective of a Hindu nationalist ideology.

Many of the responses to the new science in the Hindi press displayed Aryasamaji influence. The meaning of science was constructed here in a religious context. The authority of Western science and its methodology were used to validate elements of Hindu philosophical and religious thought. An 1890 article finds the observational aspect of Western science to be useful and finds this epistemology to strike a familiar chord. The author points out that Sanskrit words for eye and philosophy share a common root. This indicates the importance that ancient Indian scholars placed on observation-based reflection.[25] The author saw the methodology of empirical science to be a natural corollary of Hindu philosophy and implied its rationality by association. An article from 1901 argues that both speculative as well as empirical knowledge should be accepted. It observes:

> scientific knowledge is developed by speculation-disprove cycle and so should philosophy. Newton's speculated theory of light was accepted until it was disproved and superseded by Fresnel's theory. This process enhanced our knowledge. Similarly, Patanjali's theory that God can be known through Yoga should be accepted until proven wrong.[26]

The author advocates the use of modern scientific methodology to test the validity of traditional thought and in so doing appropriates the modernist perspective and deploys it to reclaim the traditional.

A 1920 article also detects a unity between Western science and indigenous thought. According to the author,

> love occupies the same place in this world as divine joy which is called Krishna. The word Krishna is derived from the Sanskrit word *karsh* which means to attract. Krishna is that which attracts. What is in this world that attracts us with more force than love? This is precisely what the modern scientists call the force of attraction. This is the basic element of all magnetic and other attractive forces. When this love is pure its attractive force is complete and eternal.[27]

This article uses the authority of Western science for legitimizing Hindu religious lore by making farfetched connections. Such deployments of Western scientific knowledge are consistent with the Aryasamaji project of reclaiming the rational roots of Hinduism. It was hoped that this would undercut the projection of Christianity by the missionaries as a religion uniquely based on reason.

While this group of writings accept the validity of European science, European science is not at the center of their attention. These articles explore epistemological and ontological elements of the new science that can be related to indigenous thought and can serve to validate it and thereby support the project of Hindu reform. It is noteworthy that the indigenous scholarship in question falls outside the realm of what is commonly understood as science. This crossing of disciplinary boundaries is an assertion of a holistic ontology – a broader universality of knowledge which erases the distinction between scientific and nonscientific knowledges and seeks to unify the two in a single category.[28] This was an attempt to forge a new indigenous modernity distinct from Western modernity. These works represent a node that attempts to connect the new science and traditional myths and philosophy by stretching both beyond their European frameworks. Gyan Prakash has characterized this transgression of borders between modern science and ancient learning as the 'plac[ing of]...Hindu soul and Hindu practices at the service of modern science'. This 'colonized the indigenous culture' but at the same time it entails a 'renegotiation of knowledge and power' and modernity itself.[29] The main interest of these articles was in the reclamation of an indigenous past by situating it in a modernist problématique. The use of the modernist narrative to certify the traditional narrative was not simply a tactical act. It was in fact an act of taking possession of modernity and at the same time reconstructing it in the specific historical and cultural context of South Asia. The narrative constructed in these responses to the fresh knowledge was also an inversion of what, in an earlier work, I have called the transnarrative – a narrative of Western science constructed by colonial educators by using elements of indigenous classical scholarship to make Western science more palatable.[30] The transnarrative aims to demonstrate the superiority of Western science and in an ironic twist the works discussed above, even in accepting modernity, shatter the hierarchy of roles of indigenous and European knowledge that the transnarrative tried to establish.

The new science was used not just to legitimize and provide a rational basis for Hinduism but the authority of this science was also deployed for the purpose of affecting modernizing change in native social and religious practices and beliefs. Periodicals in Indian languages from their earliest years in the nineteenth century played an important role in spreading the message of social and religious reformers.[31] The authority of science was sometimes used to counter certain religious tendencies and promote others. In the process, a modernity informed by their respective ideologies was constructed. Many of the works in this category, for instance the ones influenced by Arya Samaj, were interested in transforming Hinduism by making it more 'scientific'.[32]

A science-based commentary from 1850, aiming for such transformation, was inspired by a recently published picture of a water drop taken through a microscope. The article remarks on the practice, common among upper-caste Hindus, of keeping the mouth covered and straining water before drinking. This was supposed to prevent small organisms from entering the body. The author proposed:

> If a drop of water is seen through a microscope one can see countless organisms in that drop. If one wants to avoid these germs one would have to give up drinking water altogether....God's creation is such that the whole world is full of creatures, seen and unseen. Even vegetables carry organisms that survive by feeding on it. Lord Krishna says in Geeta that one life form survives by consuming another life form.[33]

The author advocated abandoning religion-based practices that he considered irrational. The argument cleverly referred both to scientific observations and to Hindu scripture for persuasive impact.

As part of the reforms, Arya Samaj discouraged idol worship and instead proposed replacing it with the chanting of Vedic verses in the presence of *havan*, a ritualistic fire which was considered to have a purifying effect on the body and the world. A 1936 editorial is intended as a rebuttal to those who complained that the inhaling of the smoke from *havan* was harmful. The editorial cites works of European scientists that discuss the curative effects of smoke produced by burning certain substances.[34] Elements of the new science were thus seen as an ally by many reformists seeking changes in religious ideas. To understand why this new knowledge was acceptable to large segments of Hindu reformers deeply entrenched in the earliest forms of Hinduism, we could recall Spear's observation that this knowledge was presented not as part of a religious system but as universal knowledge framed in secular terms; and therefore it could be accepted without betraying one's social and religious tradition.[35] S. Irfan Habib extends this argument by concluding that in fact the linking of modern science with the West itself was being abandoned. Acceptance of scientific laws for the external world did not preclude Eastern religions from guiding the internal world.[36] The conversation between religion and modern knowledge in the nineteenth century was not limited to Hinduism but a similar modernist perspective on Islam was being developed by Syed Ahmad Khan and others in Aligarh.[37]

The excerpts from articles considered thus far reveal the effect that the increasing spread of English education, especially in the sciences, had on the intellectual outlook of the Indian elite. The engagement with European science was accompanied by an inward directed gaze which evaluated the nature and structure of indigenous knowledge, both physical and metaphysical. The authority of the new knowledge was coopted for furthering religious goals and social reform and also for drawing philosophical inferences about science. Chambers and Gillespie have similarly recognized 'local intellectual and socio-economic interests' as an important considerations in understanding the transportation of European science.[38] Through these writings a web was formed by linking the new with the old, occidental with oriental and natural with the human. It was this web that embodied the meaning of science constructed by its receivers.

Search for a nation

As higher education expanded in South Asia the ideas of civil liberties, human rights and political liberalism began to take root among the professional middle classes. These changes inevitably took the shape of national aspirations. The Indian Association was established in Calcutta in 1876. The Association was critical of British rule on several counts – policies in Afghanistan, tough laws against the native press, making it difficult for Indians to enter the upper echelons of civil services, and, tariff policies that favored British businesses over Indian. The first meeting of Indian National Congress (INC) in 1885 marked the beginning of an organized widespread movement for self-governance.[39] The nascent nationalist aspirations were being formulated in terms of not only political action but also discourses that looked back in time to construct a basis for a cohesive nation and looked ahead to envision forms for a future nation. On one hand, retroconstructing a pristine and idealized indigenous scientific tradition provided legitimacy to the claim of nationhood; and on the other hand, science and technology held the promise for a viable future nation. It is quite revealing that Jawaharlal Nehru named his influential study on subcontinental history, completed just before the end of colonial rule, 'Discovery of India'. The title suggests a scientific past that needed to be recognized and a future that needed to be built upon science.

The reconstruction of a history of science and yearnings for self determination free of colonial dominance were palpable in many of the periodical articles. The authors contested the premises and methodology of Western science on theoretical grounds, questioning its epistemology as well as its ontology. A 1901 article took Western science to task for not dealing with the entity that separates the living from the nonliving.[40] Our own learned men, the author claimed, on the basis of *scientific principles*, have called it *atma* [soul] for centuries. And then to bolster the case for the alleged scientific basis the author adds that even in Western science electrical charges and gravitational force are not seen and yet their effects are. Another article addresses the epistemology of empirical astronomy:

> Ancient scholars didn't delve into intricacies of logic and rationality but instead used their innate spiritual power to predict future events. Modern scientists lack this power and cannot arrive at theories that are universally accepted as truth. And yet we should seek answers based on science alone [presumably since we lack the requisite spiritual powers]. Newton and Laplace have suggested that planetary orbits will never change precluding any catastrophic event. Thus there is always the possibility that a comet like body may someday destroy the earth. Modern science is therefore valid only until a catastrophe proves it to be conditional and thereby legitimizes ancient knowledge.[41]

The argument echoes a common theme from the philosophy of knowledge in the Hindu intellectual tradition, whereby conclusions arrived at through divine insights, which scholars of yore were said to have possessed, were more reliable than what ordinary humans can learn through their senses which are prone to false perceptions. The attitude towards Western science is clearly ambivalent. On one hand, science is seen as being incomplete not just in how and what it studies, but also in what it leaves out. And yet seeking legitimacy for classical Hindu philosophy from the new science is deemed necessary.

Several pieces of writing were replete with narratives of a past intellectual glory, and, its loss and victimization at the hands of the overlapping forces of modernity and colonialism. Many expressed their resistance to colonial rule through literary forms with scientific references. The use of natural imagery was common. Many of the articles made the point that the new science that was being touted as the glorious achievement of the West and its gift to the East was already contained in the works of indigenous scholars of the past. A clear nationalistic tenor that contests colonial rule is discernible here. The plea for recognizing the indigenous contribution to science is reminiscent of an example discussed by Brett Bennett elsewhere in this volume in which Dietrich Brandis insisted on acknowledging that certain techniques used in Indian forestry were in fact developed and used by the indigenous populations long before their encounter with European foresters.

An article from 1882 argues that scientific and mathematical knowledge was exported from ancient India to Greece and the Arab world from where it traveled to Europe. The author holds Muslim, and then British, invasions responsible for the stagnancy of indigenous knowledge production.[42] In describing a flourishing scientific past that was destroyed by outsiders, the author chose to ignore the scientific exchanges between Greeks, Arabs and Hindus – something that his contemporaries had observed, as cited above. This was therefore an exercise in forging a selective history to help imagine a nation.

Authors imagining a golden past often raised concerns about the deleterious effect of new technology on social and spiritual mores. In 1885 an article bemoaned the growing materialism of recent decades. Glowing admiration for technologies like railways, steam and electricity was seen as a sign of undesirable worldly entanglements which were upstaging the spirituality of the past.[43] Here the author expresses his resentment of British rule by attacking its technological symbols. The products of English education who constituted the growing urban middle class were criticized for trading in their tradition for the hollow conveniences provided by their colonial masters. The freedom of an unchanging past is imagined and pined for in the face of a subjugated present.

The focus of a 1902 piece is not technology but knowledge in general. It presents an allegorical fantasy in which the narrator is walking around in the large dense forest *Vidyaranya* [forest of knowledge]:

> A woman named Vidya [knowledge] is his guide. Vidya points to a large healthy tree named *Kavyataru* [Tree of Poetry]. And then she shows him an old, sickly tree called *Jyotish Vriksha* [tree of astronomy]. The roots of this tree were not in the ground but were planted on another tree called *Ganit-Gachh* [Tree of Mathematics]. Vidya explains that enterprising people from other countries come in as intruders and take away cuttings from the trees and plant them in their own lands. Both *Jyotish* and *Ganit* trees are native of here but foreigners have enriched themselves by planting their cuttings in their own lands. They have similarly benefited from trees of arts, philosophy, medicine etc. But our own people have neglected them and that has led to their decay.[44]

The author imagines a past in which learning flourished but was subsequently destroyed by outsiders. Again, this knowledge is depicted as being exclusively homegrown and contributions of exchange with

Greeks and Arabs are ignored. In a 1907 article inspired by a recent solar eclipse, the author compares the colonial exploits of the British with the swallowing of the sun and the moon by the mythic serpent Rahu in the Puranic lore about eclipses. The article asserts that colonial rule has encouraged 'lust, anger, greed, jealousy, envy, dishonesty, arrogance and other base desires'. It is also critical of foreign goods being dumped into the domestic markets.[45]

An astronomical event reminds the author of the moral and economic troubles that the loss of autonomy has caused. Puranic mythology, including the tale about Rahu and eclipses, was often upheld in the colonial narrative as examples of superstitions that South Asians accepted as truth and which were supposed to demonstrate the inferiority of classical indigenous scholarship. This article appropriates the myth and deploys it metaphorically in order to critique the impact of the trade policies of the colonial regime.

The article is critical of Western science, claiming not only that it had not added anything new to the indigenous body of knowledge, but that it was incapable of doing so because of its flawed epistemology. Moreover, much of Western science was, in fact, acquired from the classical learning of the Subcontinent. This conclusion along with the nationalistic references in these responses indicates a process of constructing a sublimated agency, and an attempt to appropriate that agency in knowledge production which has been constricted in the political and economic realms under colonial regime. Gyan Prakash sees this crediting of Hindus as the developers of scientific learning as a 'justi[fication] of the modern existence of Indians as a people'.[46] Commentators looked back upon the past wistfully but in doing so they also dream of a future nation justified by the past achievements.

Many articles took up the issue of alienation that the new science engendered. They alleged that the content as well as the language of the new science were elitist and unsuited to the subcontinental milieu. The articles argue that there is a chasm between the needs of the society and what science delivers. Moreover, the use of the English language as the medium of instruction for science inhibits the learning process. Some of the arguments in this response parallel the view, discussed by Brett Bennett in Chapter 4, of some colonial foresters who advocated the use of 'Indian methods, [and] not an exotic European import' for effective practice of forestry.

In an article from 1888 the author complained that books on various branches of science are only available in English and so before scientific knowledge could be acquired one had to spend time learning English. He continued:

> The main objective for studying science is to get government jobs and not work as scientists. From ancient times uneducated people have been working in all kinds of trades as locksmiths, scissor makers and textile workers. These people had never studied English. No scholar of English has ever done anything to improve the work of traditional artisans.[47]

The author exhibited a keen eye for the sociology of education. He saw a persistence of the caste hierarchy of knowledge under the British education system. The Brahmins had elevated certain sciences, such as literature and philosophy, to a status where they were considered suitable only for the members of the upper castes. A lower status was accorded to technical skills of practical trades which were practiced exclusively by members of the lower castes. Under colonial rule even the status of the superior learning had been diminished as its education was intended to prepare the upper caste men for junior positions in the governing bureaucracy and not as scientists. This new science, as well as its linguistic mode of propagation, was seen as an agent reinforcing the power structures as manifested in the dialectically related hierarchies of social relationships and knowledge. Instead, the author charged, the form and priorities of science should be compatible with the needs of the people. This model for what science ought to look like in a future nation is further clarified in a 1938 piece. It discusses an article by Mahatma Gandhi which was published in *Harijan Sevak*. Gandhi was not against higher education, the article stresses, even in European science and literature. But he insisted that instruction be conducted in native languages. This, according to Gandhi, 'would ensure that new knowledge which is acquired will belong to the whole society and that it won't be a mere mimicry but true and real knowledge'.[48] Gandhi was cognizant of the relationship between knowledge and its linguistic representation and believed that the authenticity of one was dependent upon the authenticity of the other. The linguistic concerns reflected a desire for a democratization of knowledge as a gateway to a democratization of power. The resistance here was not to Western knowledge per se but to its linguistic mode of transmission which had an alienating effect.

In writing about the transmission of science into the non-Western world, George Basalla called for the overcoming of philosophical and religious resistance to science and replacing it 'by positive encouragement of scientific research'.[49] This simplistic exhortation does not recognize the complex nature and roots of the resistance to science that have been elicited here.

In responses surveyed in this chapter, a South Asian history of science is deliberatively fashioned to establish grounds for replacing colonial rule with a new national formation. This effort parallels analogous efforts in religious reforms (interventions by Arya Samaj and other similar movements), political mobilization (for instance the formation of Congress) and even in literature.[50] Habib and Raina, based on their study of Bengali positivists, have concluded, '…if the historical precedents of a scientific tradition could be established, then in one stroke the orientalist imputation of the Oriental mind and British cultural superiority would stand repudiated'.[51] Gyan Prakash has observed, 'the idea of India as an expression of ancient Hindu science also ended up signifying the nation as homogeneous, whole, and Hindu'. This deployment of ancient learning in the service of nationalism is seen by Prakash as unavoidable. Whereas the West had used its colonizing endeavors to project its rationality as being universal, the colonized did not have this mechanism at their disposal. It was thus, writes Prakash, 'their historical fate…to assert the autonomy and universality of their culture in the domain of the nation'.[52]

These responses to Western science were acts of subversion against the colonial establishment at that historical juncture. Nevertheless, these perspectives on science had their problematic aspects. The projection of a preexisting science as a component of national identity was an ahistoric act as it exclusively emphasized the role of the South Asian Hindu discourse at the expense of contributions from other agencies outside its perimeter. As Kapil Raj and others have shown, moments of encounter resulting from the crosscultural movement of knowledge themselves become loci of knowledge production.[53] Affixing a rigid national/religious identity to knowledge then becomes an exercise of dubious merit. In the postcolonial era these positions that once negotiated colonial domination from a repressive horizon have degenerated into dogma lending support to the chauvinistic ideology of Hindu nationalism and aggression from a position of power.

To the extent that these narratives articulated a case for a future nation, differences among them are significant, for they anticipate the split in the nationalist movement which was crystallizing in the period in which these articles were published. Among the early leaders of the INC, Bal Gangadhar Tilak represented the branch which advocated a future nation to be fabricated after the glory of the Hindu past, whereas Gopal Krishna Gokhale spearheaded those who placed their hopes in Western modernity.[54] In due course the traditionalists found their voice in Gandhi, while Nehru saw the salvation of a future India in the embracing of science and technology.

Conclusion

The network of schools and colleges imparting English education and especially modern science in India experienced unprecedented growth in the second half of nineteenth century. These institutions were the major source for disseminating scientific ideas in the region; many articles in Hindi periodicals also contributed to this process. Graduates of these institutions were employed in various offices of colonial administration and populated the growing middle class. Religious reforms in several parts of the Subcontinent strove to emphasize rational aspects of Hinduism and Islam, which could be harmonized with modern science. By promoting rational ideas and discouraging superstitious practices through, among other avenues, writings in Hindi magazines, sects like Arya Samaj hoped to promote social reforms and simultaneously minimize the influence of growing Christian missionary activities by coopting their rhetoric of rationality. Religious reformers sought an ally of authority in modern science that could be leaned on for seeking legitimacy for their own agenda. On the political front, transformations, in part fueled by English education and entangled with religious transformation, centered around the idea of the nation. The magazine articles examined the scientific past to look for a nation and also wrestled with the nature of science and its place in a future nation. In the context of the asymmetric power relations created by colonial rule, the responses to the new science must be understood as an attempt to reclaim the center by the native elite. For this purpose an idealized indigenous knowledge tradition was imagined. The resulting narrative sought to make the case for a nation by storming the epistemological fort perched on the hill which was at the time being used by the British to defend colonialism. In the scientific realm, South Asian nationalism crystallized through the fashioning of a Hindu scientific tradition that demanded to be included in the scientific discourse dominated by European knowledge. This conceptualization for the purpose of inclusion was perverted from the outset by the exclusion of any non-Hindu contributions to the tradition. And yet the power imbalance had to be acknowledged even in its negation. It was found necessary to show the compatibility of indigenous knowledge with the new knowledge even as its methodology and domain were being criticized.

By their very nature journalistic works function dialectically by reflecting what is on a people's collective mind, and at the same time, helping cultivate these ideas. In this sense, the Hindi periodicals, as nodes in the network of science, mediated the subcontinental encounter with the new knowledge and modernity. In Chapter 6, Peter Hoffenberg discusses the role of exhibitions in shaping and anchoring the scientific community in colonial Australia. This defining of the scientific community became part of a larger attempt at constructing an Australian identity. In an analogous manner, the encounter of South Asia with the new knowledge was influenced by and at the same time had an influence on collective identities that were being defined by intellectual, religious and political transformations. The multiplicity of nuanced perspectives on science found in the magazines reviewed here is indicative of the varied yet interlinked historical currents flowing across South Asia in the nineteenth century. Ultimately, it was the meaning of science itself that was being laid out in these writings – a meaning that did not reside solely in the new science but was co-constructed by the unfolding set of collective identities.

As the struggle against colonialism intensified in the twentieth century, Nehruvian advocacy for Western science and technology gained a dominant position in the nationalist movement *vis-à-vis* the more pastoral vision of Gandhi. In postcolonial India, Hindu fundamentalism has made dramatic political gains at the expense of Nehruvian secularism. One of the outcomes of this shift has been an attempt to revive the 'Vedic Sciences'. The rhetoric associated with this attempt has become a part of the Hindu political ideology. The narrative weaved around the tradition of Hindu science that was once counterposed against European science and imagined as a source of national identity in the struggle for liberation from colonialism, has moved up the power structure in postcolonial India and now feeds into an exclusional discourse. It would be useful for a future study to explore the linkages between the resistive responses to modern science that developed in the nineteenth century, with the late twentieth century Hindu nationalist discourse.

Notes

1 A. Rahman, 'Science and Cultural Values in India', *New Orient* 1 (1960), 19–22.

2 David N. Livingstone, *Putting Science in its Place: Geographies of Scientific Knowledge* (Chicago: The University of Chicago Press, 2003), p. 4.

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6
'A Science of Our Own': Nineteenth Century Exhibitions, Australians and the History of Science

Peter H. Hoffenberg

Introduction: science and exhibitions

Exhibitions, or world's fairs, were popular events in Europe, Great Britain, the United States, and many European colonies during the second half of the nineteenth century.[1] Host cities included Paris, London, Vienna, and Philadelphia, as well as Hobart, Melbourne, and Sydney in Britain's Australian colonies. Such spectacles appeared to display, in the words of one London weekly in the early 1860s, 'nearly all possible and impossible things under the sun', and seemingly did so without any differentiation between the profound and the banal, the permanent and the ephemeral.[2] Visitors could observe pigs, as well as steam engines, performing fleas around the corner from paintings. That was 'nearly' the case in 1851 at the Great Exhibition in London's Crystal Palace, the first world's fair, as it was one generation later at a less ambitious colonial show, the Melbourne Intercolonial Exhibition in 1875. Thousands of visitors to the Australian show, for example, walked amidst and observed, if not in some cases sampled and purchased, Japanese vases, French hats, local wines and gold nuggets, American harvesters, and Australian Aboriginal weapons.[3]

Popular exhibits at the Melbourne Exhibition also included the physical elements of modern science, among which were specimens, publications, and instruments created, collected and used by Australian scientists. Local organizers solicited such exhibits beforehand, encouraging potential exhibitors to send a wide array of 'Scientific Innovations, and New Discoveries'.[4] Those included zoological models, geological sketches, maps, plant samples, and scientific essays written by local scientists about local scientific matters. Many were forwarded after the show for display the following year at the more ambitious Philadelphia Centennial Exposition. Such exhibits and the public appreciation of them were part of the exhibition experience in Britain and its colonies, but also in the United States, France and elsewhere, as organizers drew upon the long-standing tradition of exhibiting science at the exhibitions. That tradition began as early as the French National Exhibitions held between 1798 and the 1840s, and picked up momentum at the Great Exhibition.[5]

In the case of the Melbourne show, the display of science also drew upon significant local interest in and not insignificant government support of science. That was true, as well, in the neighboring colony of New South Wales and for the exhibitions hosted by its capital city, Sydney. Australians took their scientific displays rather seriously at overseas and local shows before the turn of the twentieth century, although certainly not as seriously as they did economic exhibits, such as ores and wheat. While instruments and specimens were never as popular as gold nuggets and harvesting machines, they and other scientific exhibits were not ignored, insignificant, or peripheral. Considerable monies and labor were devoted to collecting, displaying, explaining, and then exchanging such exhibits.

Additionally, there was considerable commentary about the scientific exhibits written by Australian and foreign scientists, as well as by journalists and other non-experts. There was a common effort at the exhibitions to make sense of the scientific displays not only for fellow experts, but also for the general public, and the resulting texts, including catalogues and science essays, were eventually housed in the libraries, museums, and mechanics' institutes in the major Australian cities and their provincial, or 'country' little brothers and sisters. That was the case in Victoria, where visitors to Melbourne's central library, as well as to provincial Ballarat's museum and library, could peruse publications from a variety of exhibitions.[6] The same could be said about a handful of scientific exhibits – samples and instruments among them, – which also awaited visitors to those institutions.

As early as 1854, organizers of Melbourne's first major exhibition explicitly solicited an array of scientific and 'natural history' displays. Some were bound with their Sydney complements for Paris and its Universal Exposition the following year. All were expected to have attached to them 'local' information, such as names, locations, and 'other descriptive particulars'. It was noted among 'the special instructions' for commissioners and exhibitors that visitors would also appreciate information about the commercial and economic applications.[7] Not to be outdone by their rival, Sydney's organizers in 1854 ensured that among the many exhibits on display in their Australian Museum would be several hundred 'Geological Specimens Illustrating the Succession of the Rock Formations in New

South Wales'.[8] Complementary scientific exhibits awaited the visitors to later Australian exhibitions, notably the more ambitious intercolonial and international exhibitions of the 1870s and 1880s. In one of the more notable examples, the Garden Palace at Sydney's International in 1879 housed extensive displays for 'Classes 300–307. Scientific and Philosophical Instruments and Methods'. These included local chronometers, scales, and time-pieces as part of the expansive 'Education and Science' category.[9]

Australians were also keen on studying and collecting foreign science exhibits at overseas shows and putting on display their own Australian scientific exhibits at such events. Eager to take advantage of the upcoming American Centennial Exposition in Philadelphia, local exhibition advocates in Sydney instructed their traveling commissioners to obtain for use and study back home in New South Wales foreign fossils, minerals, physical and mechanical scientific *apparati*, and information about scientific museums and education. Overseas timber and mineral displays were among the many scientific exhibits that returned to the colony with those commissioners.[10]

Visiting Australians often acquired French, British, American, and other foreign scientific displays by offering their own Australian ones in exchange. Australian officials at several exhibitions offered copies of Brough Smyth's early ethnographic study of New South Wales' Australian Aboriginals, mineral samples, and unique local flora and fauna for European, most commonly French, English, and German scientific instruments and natural history samples, or South Asian zoological models. Such exchanges were part of the global multiparty nineteenth-century superhighway of material culture and both those exchanges and the study of overseas science were among the expected responsibilities of official Australian participants, including visiting Australian scientists. The latter and not necessarily government officers arranged the exchanges of these public goods. Not surprisingly, there was great overseas interest in Australian Aboriginals, local gold and coal, and the nature and uses of colonial timber and other plant forms.

Among many cases of overseas Australian scientific exhibits, New South Wales shipped to the Paris Universal Expositions of 1867 and 1878 collections of human and animal fossils, minerals and ores, and zoological models, among which were stuffed birds. These were catalogued and displayed in the 'Class 45. Natural History, etc'. category at the later show.[11] The 1867 scientific collections attracted considerable attention among experts and visitors, one of whom later recorded in his comments about '[t]he very interesting geological specimens' and 'the large collection of fossil remains of mammals, birds, and reptiles'.[12] Nearly 20 years later and across the English Channel, the New South Wales' commissioners displayed at the Colonial and Indian Exhibition in South Kensington a series of stuffed animals, descriptive scientific catalogues and essays, and scientific instruments, including a 'Recording Anemometer' and a 'Compound Microscope'. Both of those were manufactured in the Australian colony. Those exhibits for the 1886 show were provided by an array of sources: the Trustees of the Australian Museum, the Government Astronomer, and a private instrument maker.[13] In turn, they were studied by non-Australians and many were used in the common post-exhibition exchanges among scientists, governments, and scientific institutions, or voluntary societies. In London, that included direct exchanges between Australian and Anglo-Indian scientists and museum curators, more often than not without official British participation and approval.

Science was on display at the exhibitions in at least one other way: the active and open participation of scientists themselves. Scientists, including those from the Australian colonies, officially participated as advocates and organizers before the shows opened, and then as exhibitors and commissioners during the shows. These experts not only solicited, catalogued, described, and displayed scientific exhibits, but also wrote and distributed scientific essays, and exchanged and judged exhibits. In one representative case, the New South Wales Astronomer provided government scientific exhibits for the popular Sydney International Exhibition in 1879 and also judged scientific instruments for official citations.[14]

He was most certainly not alone, as most of Australia's prominent scientists participated in one way, or another, if not in many ways, at the exhibitions. That list of exhibition participants reads like the who's who of mid and later nineteenth-century Australian scientists: Joseph Bosisto (1824–98), Reverend William B. Clarke (1798–1878), Frederick McCoy (1823–99), Charles Moore (1820–1905), and Ferdinand (von after 1867, and 'Baron' after 1871) Mueller (1825–96). Mueller, for example, participated in nearly every major exhibition in the colony of Victoria and at those which Victoria officially exhibited between the first Melbourne show in 1854, at which he exhibited colonial woods and plants, and served on the organizing committee for 'Group III. Vegetable Products', and the Paris Universal Exposition of 1889, for which he contributed ornamental ferns and 'specimens of timber in book form', an exhibit with which he was associated during the 1880s.[15] Thus, at various times and places, he was some combination of exhibitor, commissioner, and even author, preparing specialized essays on scientific topics such as timbers and vegetable products.[16]

These scientists were immigrants, arriving in the Australian colonies from England, Scotland, or continental Europe; they generally held both official scientific and administrative positions in local governments, museums, and voluntary societies; and they more often than not specialized in geology, botany, and other fields of natural history, with a few chemists thrown in for a very good measure.[17] Bosisto, for example, was a prominent chemist, who combined his entrepreneurial spirit and scientific enterprise to become, for want of a better term, 'the Godfather' of eucalyptus oils. Among those scientists working hard before, during, and after the shows were the official Colonial Botanists, who were also often in charge of public gardens and scientific museums. Moore in New South Wales and Mueller in Victoria held such positions for their respective colonies. The efforts of these scientists as exhibition commissioners and exhibitors connected the practice of government science and the general public, as well as connecting science among the many public and private institutions dotting the nineteenth-century cultural landscapes.

These scientists and many of their assistants, whether in their roles as government experts, or more private *savants* (and businessmen), also used the exhibition experience to navigate and shape the growing personal and professional networks crisscrossing the Australian colonies, the British Empire, and much of the 'modern' world.[18] Such networks of correspondence, exchange, and travel most certainly contributed to the exhibitions, but, additionally, the shows contributed to such networks, including the distribution of material culture, expertise, and personnel. One might note that such connections contributed to the development and expansion of Western science, perhaps in the forms of globalization and empire-building. That was only part of the story.

A complementary, and sometimes conflicting, part of the convergence of networks at exhibitions was the development of two other collectivities: a more distinctive 'Australian' science for the colonies – and a science which contributed to imperial and global science – and a society of Australian scientists, or the development of science as an 'interest' and scientists as a 'class', in the ways that Charles Babbage used such terms at the time of the Great Exhibition.[19] Networks might both encourage and retard such developments, as rarely did two scientists travel in and benefit from the webs and networks in precisely the same way. This was true whether one was comparing Australian scientists or Australian and British scientists. Networks did not always annihilate or limit distances, whether in terms of geography and/or power.

Even with such uncertainties and restrictions, the participation of influential and well-placed Australian scientists, such as Mueller and Clarke, and the many different Australian scientific displays that they organized, exchanged, and wrote about at exhibitions, contributed to the development of an early, yet distinctive, 'Australian', or 'New South Wales' and 'Victoria' public science, rather than the more general (if not abstract) 'national', 'colonial', or 'imperial' science. It did not matter whether the exhibitions were at home in the Australian colonies or overseas, and whether they were bold international worlds' fairs or less ambitious metropolitan and intercolonial shows. Exhibitions in Sydney and Melbourne, but also in Paris, London and Philadelphia, provided regular opportunities during the second half of the nineteenth century to create such a public science. This was the case at the 1866–7 Melbourne Intercolonial Exhibition, as it would be at the later 1889 Paris Universal Exposition. Scientific activities at the exhibitions addressed the challenge articulated at the official opening of the Sydney Mechanic's School of Arts in the early 1830s: 'If we mean to rise in the scale of nations, we [New South Wales, Australia] must possess…a science of our own'.[20]

The Australian exhibition experience and the history of science

In suggesting the development of an Australian 'science of our own' at the exhibitions, this chapter draws upon both older and more recent studies in the expansion, export, if not selective adaptation, of the Western scientific enterprise. Notable among these, are studies that emphasize the intellectual, social and institutional contexts in which scientists, the scientific community, scientific knowledge and the practice of science developed in the colonial world.[21] That world included white settler colonies, such as New South Wales and Victoria.[22] Over the years, the suggestive scholarship on science in overseas European colonies including that of George Basalla, Donald Fleming and Ian Inkster, among others, has considered the relative influences of local, or internal, and overseas, or external factors in the seeming 'spread' of European, or Western science.[23]

The early model of unilinear hegemonic diffusion, if not imperial imposition, and three-step marching towards independent science in the colonies has given way to more nuanced considerations of local conditions and the ways in which overseas scientific enterprises resulted from some combination of metropolitan and peripheral, or imperial and local activities and ideas. 'Locality', whether in geographical, political, social, or institutional terms remains an important context and perspective, alongside the common paradigms of indigenous-foreign, or center-periphery.[24] 'Locality' reminds us of the context in which external and internal forces shaping science interacted with a specific moment, experience, space, and institution to create something new and different. Exhibitions might very well have been such a creative, connected, dynamic, and not ephemeral, reflective, or isolated 'locality'. If museums are part of the discussion as examples of 'locality', as suggested by some influential scholars, then why not exhibitions, as well? [25]

More recently, the paradigm of networks has taken center analytical stage, a position re-confirmed by many of the chapters in this volume.[26] Network analysis has contributed to not only our understanding of the history of science in many ways, but more particularly, the development of imperial and national scientific enterprises and communities. Some would make the claim that the British Empire itself was such a network, circulating personnel, material, ideas, and authority. Networks and webs occupy a prominent scholarly position these days, and their position on that stage can most certainly be shared with the concept of 'locality', most notably if 'locality' includes the nodal points connecting various strands of a network. Exhibitions were among those nodal points, a set which included governments, voluntary societies, universities, archives, perhaps even nations themselves, but also the more specific scientific infrastructure. Why not consider the exhibition experience among the many networks connecting nineteenth-century groups, interests, regions, civil societies, and states? Experts and expertise, material and non material culture flowed in, around, and out of the exhibitions in many ways, including common scientific exchanges between institutions and governments.

Robert Rydell, the well-respected exhibition scholar, has even claimed that exhibitions, including those held in the Australian colonies, were and can be studied as specifically 'cultural networks', rather than simply as events, spectacles, or experiences.[27] A recent essay of his emphasized the global nature of such networks. One might extrapolate from that important consideration and point out that exhibitions were part of a series of intertwined networks, webs of often complementary and mutually reinforcing professional, material and informational links. Scientists and their displays were part of more than one exhibition, both the individuals and their exhibits flowing through and shaping overlapping exhibits, commissioners, perhaps even display and management techniques. Science exhibits and scientists participated at such metropolitan, or civic, national, colonial, imperial, and international events, thereby generating, exploiting and enhancing links, or networks that were very local, as well as those that were nearly global.

Scientists responsible for exhibition activities enjoyed existing and at times constructed new intellectual, professional, and social bridges linking Australian public and private interests and institutions with one another and with their counterparts overseas. In this way, Australian scientists at the exhibitions contributed to what one scholar has termed 'a delicate network' connecting voluntary societies, individuals, and governments throughout the British Empire and within Australia itself.[28] One would not doubt the existence and utility of that network running in and through exhibitions. One might only doubt its characterization as 'delicate', as such networks were often 'strong' in many directions and for many purposes.

Exhibitions and the participation of scientists at such events provide an opportunity to further consider the creative tensions at play within such networks. Those tensions within and between the flows of public opinion, scientific information, personnel, material culture, knowledge and authority amidst the exhibition experience reveal the development of an Australian science which was at times and in parts elite, popular, official, and public; to a great degree, science at the exhibitions was all four, but not so in equal parts and not always so in ways that those parts worked well together.[29] While recognizing the importance of public support for science in general and the exhibits most particularly, noted scientists, including Mueller, were reluctant to sacrifice scientific accuracy and professional integrity for such support. Rather, they pursued at the exhibitions a public, if not always popular, science.

At times the effort to create a public and useful science, particularly one that could not be directly connected to the generation of mineral and other natural wealth, resulted in practical, but not always popular, scientific displays. Mueller was repeatedly criticized for being too interested in taxonomies and formal science, and not devoted enough to science as a public spectacle. He was a man of shrubs and not of flowers, in the terms of the time. The English writer Anthony Trollope drew that distinction in his travel memoirs of Australia and New Zealand, noting that Mueller, in particular, was devoted to shrubs. No fan of Victoria's Colonial Botanist, he criticized the scientist's Botanic Gardens in Melbourne as 'a perfect paradise of science for those who are given to botany rather than beauty'.[30] Perhaps not a completely fair conclusion, but one that provoked the English visitor (and others) to hope that 'the flowers may carry the day against the shrubs'.[31] They often did at exhibitions, but not in the case of Mueller's exhibition labors. Victoria's Colonial Botanist generally pursued the other half of that duo at the shows, his displays and essays pursuing 'mainly scientific and predominantly instructive' objectives (hence, shrubs), rather than entertainment and amusement (hence, flowers).[32] Thus, in many cases, Mueller's was a public science, but not necessarily a popular one.

This is not to suggest that Mueller and his scientific colleagues did not participate in and shape the many networks converging at the exhibitions. Those networks and the exhibition experiences shaped and were shaped by combinations of professional and personal contacts, their connections linking the many scientific voluntary associations and institutions crossing and connecting parts of individual Australian colonies, as well as connecting the various colonies with one another. Participants included public museums and Royal Societies, which housed exhibitions, provided displays, and subsequently gained new exhibits from exchanges. Exhibitions were public life writ large and the role of scientists and scientific displays at such shows not only made science more public, but also public life more scientific. In doing so, scientific networks at such shows also connected the Australian colonies with other recognized polities and, more specifically, Australian scientists and scientific institutions with their foreign complements. That included British scientists and societies, but also French ones, as well as those found in British India and French New Caledonia. Exhibitions were important nodal points for networks within the colony of New South Wales, as well as between that colony and other Australasian colonies, Britain, other British colonies, and France, among other polities.

Science as a practice, form of knowledge, relationship to truth and public life, and community of practitioners – that is, as a network of knowledge generation and reception – was imagined, debated, created, and experienced at the exhibitions. Our understanding of the architecture and flow of science as it informed public life is more fully understood by considering the roles that science and scientists played at those popular festivals. Such events were essential to the generation, distribution, reception, and legitimacy of scientific knowledge and approaches, and the application of both to more general political, social, cultural and economic life. Exhibitions connected important scientific institutions, associations, and individuals. They offered opportunities to develop 'social capital' and to achieve professional access, thus empowering and drawing near the participating scientists, such as Bosisto from Victoria, or the Rev. Clarke from neighboring New South Wales.[33]

An individual Australian scientist, such as Bosisto, the chemist interested in eucalyptus and eucalyptus oils, could turn to exhibitions in the colonies, Paris, London and Calcutta to make connections with overseas chemists, scholarly societies, commercial bodies, and government officers. Those connections ran in and through the exhibitions, providing scientific, economic, political, and social capital in many forms. Bosisto, for example, assumed a trinity of roles at the Calcutta International Exhibition in 1883–4: he was a scientific expert, helping to organize, label, and exchange samples; a businessman selling his oils; and an official public speaker for the colony of Victoria, extolling in lectures the virtues of residence for retiring Anglo-Indians and of overseas trade between his colony and British India.[34] He was scientist, businessman, and executive commissioner, a trinity of public roles that he would assume a few years later at the Colonial and Indian Exhibition, for which he also filed the colony of Victoria's final official report.[35] Those roles resulted from and contributed to Bosisto's participation in the many networks converging at the exhibitions.

It was also true, however, that exhibitions as networks in and of themselves, and as part of longer and wider networks, sometimes could imprison and separate, or at the very least restrict. Bosisto, Mueller, and others experienced this downside of traveling and contribution to the various networks, as they were the targets of criticism, as well as recipients of praise. Organizing and experiencing exhibitions remind us, then, of how networks and their nodal points work and sometimes don't work as part of the active give-and-take of negotiated identity, authority, and legitimacy. What might have been the limits, costs and tensions as various strands converged at the exhibitions within such networks? In one notable case, Mueller devoted considerable time and energy to his exhibition activities, but was met with resistance, criticism, and eventually the stripping of some of his scientific responsibilities – in addition to official and unofficial praise for his exhibits and essays.

The Colonial Botanist's devotion to 'shrubs', rather than to 'flowers' came at a personal and professional cost, reducing some of his professional and social capital. Participation in the nearly global network of exhibitions did not protect Mueller's professional portfolio, or his scientific budget. The colonial government stripped him of his laboratory and the Botanic Gardens in 1873, less than ten years after he had created the former, but over 15 years as Director of the latter.[36] Mueller's exhibition activities had benefited both of those projects, but, in the end, did not prevent his losing control of them. Were exhibition networks as useful for specialists with a particular agenda, such as Mueller, as they were for generalists, or for experts as well as administrators? What about risk and choice for the scientists participating in such networks, particularly when they might be controversial, such as Mueller was? In general, a turn to how economists study and use networks proves helpful in answering such historical queries about the costs and benefits of participating in networks and whether or not that participation can be isolated from or independent of other relationships.[37] More specifically, the study of exhibitions can show how in particular contexts networks functioned for and against purposes of civic, national, imperial, and global information, status, governance, career advancement, pride, and other objectives. Sometimes those objectives could be realized; sometimes not.

Historical context of nineteenth-century exhibitions in Australia

Exhibitions were both the cause and effect of the growing system of networks and of the Australian public 'scientific super-structure', to borrow Inkster's suggestive and apt phrase. The complex relationship between science and exhibitions in Australia cannot be fully understood by limiting ourselves to the imperial and scientific contexts. Exhibitions revealed the varied and sometimes conflicting ways in which public science and public scientists developed in relationships to other social, political, cultural, and economic practices and institutions. Those were interactive relationships in which, for example, science shaped culture and society, as well as culture and society shaping science. It was as if exhibitions were public focal points for many of the 'interlocking intellectual, social and economic strands', as Rod Home calls them, which shaped science and scientists in nineteenth-century Australia.[38]

Those strands converged at the exhibitions. There are then, at least two critical historical contexts for this study: the representation, or production and consumption, of science at the exhibitions as part of the larger universe of public culture on display, and the development of science within Australia and its peculiar settler society during the mid to late Victorian era, in which the 'new' social and political orders resulted from the ironically tragic condition of being both colonizer and colonized. Public science played an increasingly important role in that social and political transformation and its accompanying reconciliation of the Australians' dual identity, a reconciliation which helped define the Australian nation and society by the time of Federation at the beginning of the twentieth century.

What did the invention, or, more precisely, re-invention, at the exhibitions of Australian science mean during the mid and late nineteenth century? In part and not surprisingly, scientists in Australia were mirroring scientific activities in Britain, Europe, North America, and other developing colonies. Those included establishing permanent scientific institutions and collections, lobbying for governmental funding and official sanction of activities, soliciting public recognition of scientific services and labor, and advocating the general application to public policy of scientific methods.[39] This was the radical transformation and improvement of what Charles Babbage called in 1851, 'the position of science', a predicament in which the Englishman thought that its practitioners were not recognized as a class or interest, and science itself was not considered a profession.[40] Babbage hoped that the Great Exhibition would be the crucible to forge that professional identity and status for English science and scientists. To some degree it did, as did participation at exhibitions at home and abroad for the Australian scientists of his generation and later. The historian of anthropology, George W. Stocking, Jr., concludes that a community of scientists developed at the Crystal Palace, its members forging lasting social, intellectual, and material connections.[41] Those connections were often competitive, as well as collaborative.

This is not to argue that 'science', or 'scientists' did not exist in Australia before the wave of exhibitions starting in the 1860s and reaching their apex two decades later by the time of the Melbourne Centennial International in 1888. That earlier history provided a foundation for science and scientists at the exhibitions, including an existing public presence and at least some public authority. As noted above, scientific displays alone were popular at the first two metropolitan exhibitions held in Sydney and Melbourne in 1854, primarily as a way to collect Australian exhibits for the Paris Universal Exposition one year later. Such exhibits and the participation of colonial scientists drew upon general scientific interest in the colonies. The practice of science itself was part of settlement from the very first British generations in the forms of mapping, mineralogy, botanical gardens, natural history, and other practical exercises.[42] Scientific enterprise of this kind benefited from the pattern of colonial state intervention in public affairs, a precedent established during the early years of official colonization in New South Wales and Victoria, and consented to by even the most 'conservative' pastoralists and politicians.[43] Scientific societies pursuing ambitious projects inevitably developed a close relationship with local, or colonial governments, such as those in the city of Melbourne and the colony of Victoria. Since many Australian politicians were active in these philosophical and scientific societies and Colonial Governors served as patrons, it is not surprising that requests for official assistance were often fulfilled, if offers themselves were not forthcoming.[44]

The institutional foundations and networks were clearly present in the young colonies of the Australian continent. Key scientists were active in public institutions, voluntary societies, perhaps even commercial life, their various positions and roles often connected and mutually reinforcing. Officers and staff of the major scientific collections were also major players at the exhibitions. In this way, colonial public life mirrored to a great degree English developments. John Stuart Mill noted in 1836 that England 'is covered with associations', or 'societies', including those for political, religious, philanthropic, and scientific purposes.[45] Notable among such societies were the British Association for the Advancement of Science and the provincial Mechanics' Institutes. By mid-century, similar associations were found throughout at least eastern Australia, where agricultural societies and mechanics' institutes provided the Antipodean reflection of the metropole's mid Victorian institutional image. As was the case with their British brethren, such associations in Australia offered lectures, journals, museums, libraries, and art and industrial expositions, creating the sinews of nineteenth-century local, civic, colonial and intercolonial, or national culture, both artistic and scientific.[46]

Colonial scientists and others in Melbourne created the Royal Society of Victoria, which was intended to 'elicit original communications on scientific subjects', promote and popularize science, and form connections with similar voluntary associations in New South Wales and England.[47] Governor Barkly, the Society's inaugural speaker in 1860, suggested that members follow the examples of intercolonial cricket matches and horse races. They should organize similar 'gatherings', but 'for the interchange of intellectual ideas', rather than for sport and money. Conferences and exhibitions with other colleagues in the Australian colonies were examples of such gatherings.[48] Redmond Barry, perhaps the most prominent public figure at the time in the colony of Victoria, was among the keenest advocates of such institutions and societies. Just after the mid-century mineral rushes, the Melbourne leader claimed at the inauguration of the Victorian Institute for the Advancement of Science – one of the precursors of the local Royal Society – that the colony could only benefit from the institutional stability of its members' inquiries, material collections, and public discussions. The demographic, distance, and social characteristics of the new colony of Victoria called out in particular for the assistance of the resulting 'scientific innovation'.[49] This was a practical point with a social message: Barry noted the importance to colonial society and economy of 'the mechanic', as well as of the philosopher.

Those fundamental institutional and personal 'associations' are an important part of the story, but not the entire story. The invention of Australian science also included articulating and achieving such objectives within the specific context of the colonies themselves, conditioned as they were by their subordinate position within the British Empire, their relationships to one another, and their own particular institutions, structures and ideologies.[50] Many scientists in nineteenth-century Australia held public government offices created in Britain as the result of British ideas and expectations, rather than consideration, at least initially, of colonial ideas and expectations. That did not preclude the importance of local conditions and imperatives as the offices developed over time. Australian society helped define the practice of science and the social positioning of scientists, but science and scientists also helped shape that society. Exhibitions then tell us about the social positioning of science within Australian society and about the dynamics of dependence and independence *vis-à-vis* Britain and Europe as we try to more fully understand what shaped the production and consumption of scientific knowledge and the growth of an Australian scientific community.

This chapter also suggests that the connections in the colonies between science and exhibitions predated 1851. 'Science' had been a part of early, more localized exhibitions, or shows held by Australian learned societies, agricultural groups, and mechanics' institutes. The holding of such science shows was considered to be one of the major objectives when the Sydney Mechanic's School of Arts was first publicly proposed in 1833. One of its vocal public advocates claimed that:

> The collection of apparatus and models for the sake of illustrating, under the guidance of competent lecturers, the principles of science and art, forms another important part of the plan laid down for the conduct of this association. The necessity and importance of this part of the provision are sufficiently apparent. Lectures on the principles of science and delineations of processes pertaining to the arts, whether mechanical or chemical, would be comparatively useless without such illustrations and experiments as are contemplated in the execution of this part of the society's plans of operation. The effect of experiment in fixing a knowledge of principles on the mind, is such as to render an adequate apparatus a necessary part of the furniture of a lecture-room. The importance of making this provision,

> therefore, is proportioned to the importance of communicating scientific knowledge to the working mechanic.[51]

Scientific samples and apparati in keeping with those bold ambitions were displayed at shows organized by various Schools of Art and by other voluntary associations, including in the 1840s the Illawarra Horticultural and Agricultural Society.[52] These were, therefore, small-scale local precedents for the larger scientific displays that occurred in the bolder expositions of the 1850s.

Local exhibitions and their scientific displays were visited at the same time as the popular *conversazioni* held by learned societies in Sydney and Melbourne, as well in the colony of New Zealand.[53] Such meetings celebrated scientific innovation, including 'rare scientific instruments', and philosophy, but often in isolation from other enterprises and aspects of material culture, or as separate and distinct objects and processes in a 'cabinet of curiosities', and to smaller audiences than contemporary and later exhibitions.

The Royal Society of New South Wales and the Victorian Institute organized such *conversaziones* starting in the mid 1850s to introduce local scientific discoveries without articulating explicit connections to assorted overseas art works and technologies, in contrast to the intellectual networks, or connections, and interlocking classifications developed for the scientific displays at later exhibitions. Among the scientific works observed and discussed at the many *conversaziones* held during the last half of the century were electrical and optical experiments. Those events attracted between 500 and 800 participants, so they were not trivial or unpopular, but relatively small in scope, popularity, and scale when compared to the later exhibitions.[54]

Once embedded in the larger exhibitions, though, science could not be isolated, but rather was perceived as part of the vast, nearly limitless world of public culture, social order, imperial expansion, and national development. This was the case when scientific exhibits were in their own courts, or displayed as part of more inclusive national courts. Exhibitions were part of conceiving and organizing host societies and colonies, or nations, such as New South Wales, or transnational units, including the British Empire, as immense administrative and informational challenges during the Victorian era.[55] As part of those challenges, scientists as commissioners and exhibitors organized local resources, or, one might interpret, the colony, empire, and nation, if not society itself, into accessible and representative scientific objects and categories. In the process, such scientists validated their own sources of authority and their role as a social group within the 'new' society and polity of Australia.

This was not necessarily a matter of 'popular science', but of a 'public science', and a public science made possible by the various networks running in, through, and out of the exhibitions. Those networks included avenues of power and authority. The power to collect, label, organize, and evaluate objects and people at the exhibitions – and thus create national and social identities and inventories – both created and relied upon the underlying authority of these experts, their spectacles, and of both the society and nation being represented. The ability to make such connections accessible to the general public revealed the power of the commissioners and the scientific community within Australia. Colonial governments also wanted those exhibits to showcase their authority and territory.

Scientific samples and technology were now regular, if not expected, parts of what one Australian visitor to the shows termed a 'cosmos' of material culture from the colonies and overseas, and they were explicitly connected to other forms of that material cosmos by public lectures, guidebooks, essays, and classification systems.[56] The larger exhibitions offered the scientific community official government support and vast audiences in Australia and abroad. Scientists were formally linked to the State – in full public view. There was a revealing transparency about the networks running between science, the State, and the colonial governments.[57] Public funds subsidized the collection, transportation, and arrangement of scientific exhibits and the scientists themselves, as well as the publication of scientific reports. The use of public monies at the Sydney Intercolonial Exhibition in 1870 offers one such case.[58]

Scientific materials were also observed by vast new oceans of visitors, whether in Australia or abroad. Over 5.5 million walked through the turnstiles at the Colonial and Indian Exhibition at South Kensington in 1886 and back home in the colonies more than 2.2 million visited Melbourne's Centennial Exhibition.[59] The dimensions of those audiences were unprecedented for this generation of scientists. Noting the impressive numbers visiting and enjoying Australian exhibitions, members of the Royal Society of Victoria lobbied for official participation in the 1873 Melbourne Intercolonial Exhibition. Proponents argued that the exhibition would help make the Society's projects and science in general more popular in the colony. The Society's Council took advantage of the show to display 'new discoveries and inventions' and introduce 'a popular element' in its membership and activities.[60] Refreshments were served and both theoretical and practical scientific topics discussed at a series of 'extra meetings' before the Exhibition officially opened. The results included new members and a renewed impulse for the Society's efforts to foster science in the colony.

Reverend Clarke's vision of Australian science

Looks can be deceiving, though, and both scientists and scientific societies struggled in early colonial Australia, battling, among other forces, their members' sense of distance from European learning and isolation from one another within the chaotic colonial society of pastoralists, convicts, and miners.[61] Limited general interest in science was reflected in and reinforced by the lack of a critical mass of professionals.[62] Scientists were anxious about their place in colonial society, seized by a sense of impermanence and disregard, or homelessness in all of its meanings. Reverend W.B. Clarke addressed such concerns in his 'Anniversary Address' to the Royal Society of New South Wales in 1875 amid the flurry of exhibitions in the Australian colonies, Britain, and Europe.[63] Clarke was perhaps the most well-known and active geologist in the colony, if not throughout Australasia, and his public scientific life included organizing exhibits, writing essays, and serving as commissioner for Australian exhibitions starting with the first Sydney Metropolitan show in 1854.

In fact, Clarke's participation at exhibitions even preceded that show, as he was a member of the first Australian exhibition commission, organized in late 1850 by the Australasian Botanic and Horticultural Society to arrange New South Wales' displays at the Great Exhibition in London.[64] Clarke later exhibited gold nuggets at the first Melbourne Exhibition and was also subsequently called upon to write about other colonies' exhibits.[65] Such writings included a review in the *Sydney Morning Herald* of Tasmania's contributions to the Paris Universal Exposition in 1855. By the mid 1870s, he had participated as exhibitor, judge, essayist and commissioner at various exhibitions in Australia and his name was attached to New South Wales exhibits and commissions at overseas exhibitions, as well. For example, he served as a member of the New South Wales commission for the 1878 Paris Universal Exposition. Readers interested in local geology could do far worse than consult his 'scientific papers' published as part of the official exhibition reports.[66] Clarke's biographer considers him 'the father of Australian geology', a claim that few have contested, then or now. It is a claim given even more contemporary prominence by his position as Vice-President of the local Royal Society.[67]

Clarke prefaced his review of the Royal Society's activities and finances by addressing the fragile and uncertain status of science within New South Wales. He offered ways for science and the Royal Society to transcend their status as 'an evening's amusement' for the colony and achieve permanence, authority, status, utility, and stability.[68] The Royal Society held an official title and was recognized both at home and abroad as it evolved from the earlier Philosophical Society of New South Wales. Scientific literature arrived from afar and the group held meetings. So far so good. But Clarke recognized that 'all Associations of a literary or a scientific kind in a new country have innumerable difficulties' which must be addressed and resolved for advancement. The Society required a spacious, permanent home; it should be formally and actively incorporated, expecting its members to be more than 'simply annual subscribers'; and its endeavors must be more independent, but simultaneously less parochial.

To those ends, significant and enduring connections with other learned societies in New South Wales, across the borders in the other Australian colonies, and abroad should be pursued. The Royal Society needed to be part of the various networks potentially connecting it and its members to a wider world, both at home in its own colony and beyond the colony's borders. Science and its public face, the Royal Society, might then become a permanent and well-funded institution, recognized as part of colonial society and generator, recipient, and representative of wider civic and national, if not imperial, interests. Science was seen as a vital connection creating and a vital metaphor representing the nation and society. It provided not only a language comprehensible at home and abroad, but also the social, cultural, and intellectual authority necessary to justify public policies. Might not society and the nation work the way that science and scientists did?

Where to gain such publicity, subscribers, connections, permanence, and authority? Where to make the bold claims for science, society, and the nation on their own and linked together? One answer was the exhibitions. Exhibitions suggested a particularly participatory vision of society and the nation, although not one without distinctions and hierarchies, and most certainly one grounded in modern economics of labor, trade and capital. Exhibitions also sanctioned science and encouraged its public role, bringing scientists and their societies out of the wandering sense of exile and into the society and nation, not as passive subjects, but as active, engaged, and observed citizens, if not nation and society builders, participants in the various networks of people, material culture, and ideas. This not only addressed the sense of external exile from Britain and Europe, but also the sense of wandering, or internal exile, within colonial society itself. The older moorings and social networks found in Britain and Europe for scientists did not exist in the same form and vitality in Australasia; but new ones might. Exhibitions could contribute to this social and intellectual positioning as a complement and inspiration to geological surveys, botanical gardens and scientific institutes. Exhibitions were potential loci linking not only Australia with the outside world, but Australian scientists with their new society and with other Australian scientists. Colonial scientists would no longer need to be 'like dwellers in the desert living in tents, without a spot of earth to call our own'. In turn, they could help define and create at the exhibitions that civic and national Australian 'spot of earth'.

Exhibitions played a central role in addressing Clarke's concerns about science and scientific societies in Australia. Members of various other colonial learned societies also comprehended the advantages offered by exhibitions and lobbied local governments to host shows and fund Australian exhibits at their overseas complements. Such societies often assisted colonial governments in the organization and collection of exhibits and, in some cases, prepared the official displays in the Antipodes. In one instance, a deputation from the Royal Society of Victoria lobbied the Chief Secretary to provide public funds for the collection, display, and forwarding of exhibits for the Victorian Exhibition of 1861 and its successor, the grand International Exhibition held at South Kensington the following year.[69] Similar deputations solicited funds at other times in Victoria and at various times in the other colonies, most notably in the interest of holding a local exhibition as a preliminary to a larger overseas one, or ensuring a visiting deputation to such foreign exhibitions.

Rev. Clarke included a strong dosage of civic identity and responsibility in his 'Address' to the N.S.W. Royal Society, transcending the strictly utilitarian contributions to mineral wealth to suggest that the Society might be a base for constructing colonial culture and society. Those were contentions with which Sir Redmond Barry across the border in Melbourne could concur. Writing at the time of the Australian mineral rushes, he echoed Clarke's sentiments, noting that applied science exhibits, such as ores, woods and gold, could promote a local, or civic, if not national, society and culture anchored by 'scientific application to economise [sic] labour [sic] and time'.[70] The scientist as a professional and public figure could participate in and strongly shape not only the intellectual and economic development of Clarke's and Barry's colonial societies, but also their cultural and political advancement.

Barry was a keen advocate of exhibitions, sponsoring local shows and Victoria's participation at ones held in neighboring colonies and overseas countries. He often served as an official commissioner, a position which included soliciting scientific exhibits and essays. Among his projects, was the collection of papers written by local scientists and other experts 'in a simple, concise, and striking form, at once authentic and authoritative' for the 1861 Victorian Exhibition and the following year's larger London International.[71] More particularly, Barry solicited papers from Mueller, Frederick McCoy, and Brough Smyth, among others, on the topics covering local geology, botany, mining, and natural history. The colony of New South Wales followed a few years later at the 1867 Paris Universal Exposition with essays on similar scientific topics written by 'several gentlemen who are prominent in letters and sciences'.[72] Those were most certainly cases in which exhibitions contributed to the larger project of creating an Australian science 'of our own'.

In practical terms, those middle-class scientists and their advocates contributed to the identity of Melbourne and Sydney by their regular proceedings, imperial, international, and more local recognition, government projects, and activities at civic festivities, including exhibitions. In this way, they were not much different from their British counterparts in Manchester, Birmingham, or Glasgow. Professional groups, such as scientists, were active throughout the British Empire as cultural activists and civic-builders. In the case of Australia, they did not have to compete with British aristocrats or indigenous elites to do so, as did their fellow scientists in the British Isles and some of the other colonies, British India included.

Australian scientists echoed Clarke and used the local and overseas exhibitions to at times invent, but more generally define and represent an 'Australian', or 'New South Wales', professional scientific community and, at the same time, actively participate in the British Empire's scientific system and networks. Imperial and local science were not necessarily antagonistic or mutually exclusive. Scientific links and reputations that were forged at the exhibitions complemented those generated by publications and by correspondence with those who controlled such publications. That was the case in taxonomic biology, for example, where Australian and British publications, letter writing and exhibition participation complemented one another.[73] Such objectives were not always realized, but they drove the active embracing of the exhibitions by a variety of scientists. Scientific contributors to the exhibitions often attempted to reconcile tensions between England and Australia, as well as within the larger settler community and the more limited scientific one, positioning themselves and other local scientists as influential Australasian public servants.

Scientific exchanges and the distribution of scientific exhibits and publications embodied a reconciliation across political borders. The contributions of exhibition commissioners to the larger project of Australian nation-building and social order remind us of the strong interconnections at home and abroad during the nineteenth century between science, public service, social status, commercial enterprises, and civic political identity, as well as the difficulties faced by those trying to negotiate such demands.[74] In part, those interconnections and negotiations developed in light of the peculiarities of Australian society; they also helped prefigure Australian federation, as science at the exhibitions was a form of federation, negotiating distance, articulating commonalities, yet at the same time appreciating distinctions. Exchanges and displays established a political economy of scientific material culture and information complementary to federal political and social networks, whether federal was a matter of imperial federation or Australian federation.

Among the distinctive characteristics defining Australia as a settler community were the dominant sense of distance and isolation, the self-conscious 'newness' of a society without tangible and social attachments to the past, and the 'pathos of exile', or migration slowly transforming itself into a state of permanence by claiming the land and by the rise of Australian-born generations.[75] Scientists were affected by these conditions and, in turn, shaped them.[76] Scientists were not merely exercising utilitarian values by emphasizing mineralogy, natural history, and botany, but also the essential settler drive to 'claim' the land and landscape by possession, use, and historical connections. Scientists sought to end the shared sense of wandering and achieve a stable social order and source of wealth for Australia as much, if not more, than create a powerful imperial order for Britannia. Mastering the physical environment with scientific skills and knowledge was undertaken not only for the economic purposes of settler capitalism and British wealth, but also for the fundamental sense of settler national identity and social order. The legitimation, though, worked all ways, cleaving together science, economic development, or capitalism, and exhibitions so that they legitimated one another.[77] Scientific exhibits and publications encouraged new economic endeavors and the strengthening of existing ones in the name of the public interest. That included timber, gold, and other 'modern' enterprises authorized in the name of science and utility. All of those ambitions, visions, and policies came into play at the exhibitions, as part of the larger galaxy of networks criss-crossing the Australian colonies, the British Empire and, at times, nearly the globe.

Conclusions

The participation of scientists at nineteenth-century exhibitions and the display of scientific exhibits at such shows were important parts of the larger nineteenth century history of science, as well as of much more. Those 'localities' were key points at which the many webs and networks of personnel, material culture, ideas and authority converged. These were multi-directional, polycentric networks, connecting voluntary societies, government offices, individual scientists and the general public. We might then add exhibitions to the list of factors creating a distinctive Australian science before the end of the nineteenth century and before the creation in 1888 of the Australian and New Zealand Association for the Advancement of Science. Scholars working on the history of science in the Australian colonies have also tended to focus on 'local' criteria and conditions, contextual factors which clearly shaped and were shaped by scientific networks. Among those considered are the relationship between scientists and the State, the impact of the mineral rushes and pastoralism, the settlers' distance and isolation from Europe and from one another, local political conflicts, the peculiar psychological profile of colonial scientists, the limited number of professionals, and Australia's position on the pendulum swinging between Britain and America.[78] Those are among the factors determining the success of science at the exhibitions and elsewhere, and, in turn, the exhibition experience shaped them. After all, participation at the exhibitions reduced the sense of isolation among Australian scientists and the distance between themselves and the outside world, Britain included.

After multiple volleys across the historical net, we are left with Sally Kohlstedt's important reminder that there are no simple formulas to accurately measure the relative degree of imperial influence and colonial autonomy in nineteenth-century Australian scientific activity and the construction of knowledge. We are also left with Ian Inkster's suggestive conclusion that 'local imperatives and colonial relations' produced the multi-faceted Australian scientific enterprise.[79] Colonial imperatives and local relations converged at the exhibitions, shaping that public scientific enterprise, an enterprise which was surprisingly, but quite sensibly, interactive and beneficial to all parties. At times, Australian scientists could even take advantage of and exploit the exhibition network, as James Belich has recently suggested settlers might very well do as participants in many different exchanges with and links to Great Britain.[80] Mueller's 'reciprocal interchanges' with English scientists and institutions was only one of many examples of a system and network which served Australian and local, as much as English and overseas interests on terms not always determined by the English.[81] Expertise, status and authority, and material culture were only a handful of the many advantages to be gained by settler, or Australian scientists.

This discussion has taken up Kohlstedt's and Inkster's challenges and considered the immediate historical context in which 'imperatives' and 'relations' at home and abroad converged in a far from simple way at the exhibitions, thereby transforming the infant Australian scientific community between the mineral rushes and urban booms of the 1850s and the centennial of colonization in 1888. Australians came to create and use 'a science of our own' in good part because of the public roles of scientists and scientific displays at exhibitions, both at home and abroad before Federation in 1901. Science as part of the exhibition experience both shaped and reflected the many interconnections of science and public life in the colonies, helping to define Australia and Australians, including their place in the wider world. Those roles for science and scientific displays were in addition to the more commonly understood practical sides of science, such as the exercise of cultural power, the advancement of knowledge, and the manipulation, if not exploitation, of resources. The practice of science at the exhibitions and its reception by the public contributed to organizing and shaping the nation and society in the Australian colonies. Science became more public at the exhibitions, and public life became more scientific, as well.

Notes

1 For information about major nineteenth-century exhibitions see, John E. Findling and Kimberly D. Pelle (eds) *Encyclopedia of World's Fairs and Expositions*, 2nd edition (Jefferson, NC: McFarland & Company, 2008); John Allwood, *The Great Exhibitions* (London: Studio Vista, 1977); Paul Greenhalgh, *Ephemeral Vistas: The Exposition Universelles, Great Exhibitions, and World's Fairs, 1851–1939* (Manchester: Manchester University Press, 1988); Robert Rydell, *All the World's A Fair: Visions of Empire at American International Expositions, 1876–1916* (Chicago: University of Chicago Press, 1987); Robert Rydell (ed.) *The Books of the Fairs: Materials About World's Fairs, 1834–1916, in the Smithsonian Institution Libraries* (Chicago: American Library Association, 1992), pp. 1–62.

2 *Illustrated Weekly News*, 12 October 1862, p. 2. This column was published during the London International Exhibition, held at South Kensington.

3 'Social Aspects of the Exhibition', *The Australasian Sketcher*, 30 October 1875, pp. 118–19, 121–2.

4 *Prospectus of Melbourne Intercolonial Exhibition, 1875*, La Trobe Library, State Library of Victoria, MS 11308/MSB 401.

5 French organizers employed a rather straightforward system to sort such exhibits according to basic scientific categories: 'Chemistry', 'Mechanical Engineering', and 'Health'. See, John Allwood, 'General Notes: International Exhibitions and the Classification of their Exhibits', *Journal of the Royal Society of Arts* 128 (1980), 450–1; Richard D. Mandell, *Paris 1900: The Great*

World's Fair (Toronto: University of Toronto Press, 1967), pp. 3–14. The scientific displays at the Great Exhibition are discussed in Jim Bennett, *Science at the Exhibition* (Cambridge: The Whipple Museum of the History of Science, 1983); Richard Bellow, 'Science at the Crystal Focus of the World', in Aileen Fyfre and Bernard Lightman (eds) *Science in the Marketplace: Nineteenth-Century Sites and Experiences* (Chicago: The University of Chicago Press, 2007), pp. 301–35.

6 'The Museum and Library Report', *The School of Mines, Ballarat, Annual Report Presented at the Meeting of Governors, held January 24, 1882* (Ballarat: Charles Boyd, 1882), pp. 22–7.

7 *Exhibition, Melbourne, 1854-Paris, 1855. Special Instructions for the Guidance of Local Committees and Intending Exhibitors* (Melbourne: Office of the Commission, 1854), pp. 10–16.

8 *Catalogue of the Natural and Industrial Products of New South Wales Exhibited in the Australian Museum by the Paris Commissioners, Sydney, November 1854* (Sydney: Reading and Wellbank, 1854), pp. 41–70.

9 *Official Record of the Sydney International Exhibition, 1879* (Sydney: Thomas Richards, Government Printer, 1881), pp. clxxiv–clxxv, 363. For a comprehensive description and commentary see, 'General Report. Classes 300–329. Education and Science', pp. 361–6.

10 'Report from the Committee on Mineral Products' and 'Report from the Committee on Vegetable Products, 25 and 26 August, 1875, Philadelphia and Melbourne Exhibitions Committee', *State Records NSW: Colonial Secretary: Special Bundles, Philadelphia Exhibition, 1875–76* [4/799.2].

11 *Official Catalogue of the Natural and Industrial Products of New South Wales, Forwarded to the Universal Exposition of 1878, at Paris* (Sydney: Thomas Richards, Government Printer, 1878), pp. 61–78.

12 Eugene Rimmel, *Recollections of the Paris Exhibition of 1867* (Philadelphia: J.B. Lippincott & Co., 1867), pp. 331–2.

13 *New South Wales. Official Catalogue of Exhibits from the Colony, Forwarded to the Colonial and Indian Exhibition, London, 1886* (Sydney: Thomas Richards, Government Printer, 1886), pp. 74–5, 348.

14 *Official Record of the Sydney International Exhibition, 1879*, p. 363.

15 *Exhibition. Melbourne, 1854–Paris, 1855. Special Instructions for the Guidance of Local Committees and Intending Exhibitors* (Melbourne: Office of the Commission, 1854), p. 3; *British Section Handbook and Catalogue, Paris Universal Exposition, 1889* (London: George E. Eyre and William Spottiswoode, 1889), pp. 134, 137.

16 For example, see Mueller, 'Names of Different Woods, etc., Used by the Yarra Natives for Weapons and Implements', *Intercolonial Exhibition of Australasia, Melbourne, 1866–67. Containing Introduction, Catalogues, Reports and Awards of the Juries, Essays, and Statistics on the Social and Economic Resources of the Australasian Colonies*. Linden Gillbank discusses some of Mueller's exhibition activities in 'Scientific and Public Duties: Ferdinand Mueller's Forest Contributions to Exhibitions and a Museum', in Kate Darian-Smith, Richard Gillespie, Caroline Jordan, and Elizabeth Willis (eds) *Seize the Day: Exhibitions, Australia and the World* (Clayton, Victoria: Monash University ePress, 2008), pp. 7.21.1–21.13; *idem.*, 'Nineteenth-Century Perceptions of Victorian Forests: Ideas and Concerns of Ferdinand Mueller', in John Dargavel and Sue Feary

(eds) *Australia's Ever-Changing Forests II: Proceedings of the Second National Conference on Australian Forest History* (Canberra: Centre for Resource and Environmental Studies, 1993), pp. 7–8.

17 Lionel L. Gilbert, 'Plants, Politics and Personalities in Nineteenth-Century New South Wales', *Journal of the Royal Australian Historical Society* 56 (1970), 5–35.

18 For example, Joseph Hooker took advantage of such imperial networks of collectors, correspondence, and exchanges, to and from his site at the metropolitan center. That network included connections to and from Australia and New Zealand. See Jim Endersby, *Imperial Nature: Joseph Hooker and the Practices of Victorian Science* (Chicago: The University of Chicago Press, 2008).

19 *The Exposition of 1851; or Views of the Industry, the Science, and the Government of England*, 2nd edition (London: John Murray, 1851), pp. 190–201.

20 '"Introductory Discourse Delivered at the Opening of the Sydney Mechanics" School of Arts, April 23, 1833, by the Rev. Henry Carmichael, A.M. Vice-President of that Institution', *The New South Wales Magazine* 1 (1833), 78.

21 Nathan Reingold and Marc Rothenberg, 'Introduction', *Scientific Colonialism: A Cross-Cultural Comparison* (Washington, D.C.: Smithsonian Institution Press, 1987), pp. vii–xiii; Roderick W. Home and Sally Kohlstedt (eds) 'Introduction', *International Science and National Scientific Identity: Australia Between Britain and America* (Boston: Kluwer, 1991), pp. 1–17.

22 Scholarship on 'settler science', or science in settler colonies and societies, is now rather extensive. See, for example, Katrina Dean, 'Inscribing Settler Science: Ernest Rutherford, Thomas Laby and the Making of Careers in Physics', *History of Science* 41 (2003), 217–40.

23 Ian Inkster, 'Scientific Enterprise and the Colonial 'Model:' Observations on Australian Experience in Historical Context', *Social Studies of Science* 15 (1985), 677–704; Donald Fleming, 'Science in Australia, Canada, and the United States: Come Comparative Remarks', *Proceedings of the Tenth International Conference of the History of Science, 1962* 1 (1964), 179–96; George Basalla, 'The Spread of Western Science', *Science* 156 (1967), 611–22.

24 For a review of the various approaches to studying science in European colonies, see Roy MacLeod, 'Introduction', in Roy Macleod (ed.) *Nature and Empire: Science and the Colonial Enterprise*, *Osiris*, Vol. 15, 2nd series (2000), 1–13 and MacLeod, 'Discovery and Exploration' in Peter J. Bowler and John V. Pickstone (eds) *The Cambridge History of Science, Volume 6: The Modern Biological and Earth Sciences* (New York: Cambridge University Press, 2009), pp. 34–57.

25 David Wade Chambers and Richard Gillespie, 'Locality in the History of Science: Colonial Science, Technoscience, and Indigenous Knowledge', in MacLeod, *Nature and Empire*, pp. 221–40.

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7

Between the Nation and the World: J.T. Wilson and Scientific Networks in the Early Twentieth Century

Tamson Pietsch

The categories of 'metropole' and 'colony' have long been fundamental to scholars' imagination of empire. However in recent years, against the background of the contemporary consciousness of global forces, migration and postcolonialism, historians from both Great Britain and from the countries that previously fell under its influence have started to question their utility.[1] Increasingly, the work of researchers has focused instead on the complex connections and the multiple and mutually constitutive practices that occurred between those who lived in and across imperial spaces. In doing so it has also challenged the partition of domestic and national from imperial history.

In particular, a number of scholars have argued that one way of understanding this revisioned empire is to see it as a series of exchanges or networks. As noted by Joseph Hodge in Chapter 1, a number of distinct, but overlapping strands of scholarship characterize this new field.[2] Influenced by colonial discourse theory, 'new' imperial historians have come to see Western culture as not just influenced but itself forged in the perpetually changing process of interaction between metropole and periphery. They have explored the ways that 'raced', 'classed' and 'gendered' imperial 'Others' helped to construct the identities of both colonized and colonizer, both in Britain and abroad. Catherine Hall's work has been particularly influential and studies by Paul Gilroy, Mrinalini Sinha and Antoinette Burton among others have been guided by similar aims.[3] British history, these historians argue, 'has to be transnational': challenging the binary of imperial and national histories 'and critically scrutinising the ways in which it has functioned as a way of normalising power relations and erasing our dependence on and exploitation of others'.[4] But, whereas the focus of these 'new' imperial historians has been on transnational connections in the context of difference, 'British World' historians have sought to recover what Bridge and Fedorowich term 'the heart of the imperial enterprise, the expansion of Britain and the peopling and building of the trans-oceanic British world'.[5] Historians working within this approach see this as a world of commonalities, held together not only by 'sentiment and shared institutional values' but also by 'a plethora of networks'.[6] Yet the concept of the British World remains somewhat ill-defined, and questions of race and power overlooked within it. Despite some notable exceptions, its call for a history of greater British connections has also gone largely unheeded.[7]

In *Colonial Lives Across the British Empire*, David Lambert and Alan Lester have sought to overcome these challenges by focusing on the lives of individuals (such as colonial governors and their wives, missionaries, and civil servants,) who themselves moved between the spaces of empire.[8] The 'imperial careering' of these individuals, Lambert and Lester suggest, might help historians 'gain insight into the dynamic trajectories and networks of knowledge, power, commodities, emotion and culture that connected the multiple sites of the empire to each other, to the imperial metropole and to extra-imperial spaces beyond'.[9] Yet, the extent to which such lives were representative of wider conditions is also disputable. Though collectively this scholarship has helped denaturalized 'metropole' and 'colony' and turned attention instead to the multiple sorts of networks that patterned the empire, understanding the worlds these networks created has proved more challenging.

These questions are not unfamiliar to historians of science. Since the late 1980s, as both Hodge and Peter Hoffenberg elsewhere in the volume point out, they also have contested the linearity of the diffusionist model proposed by George Basalla, with its presumption of the existence of an homogeneous and all-powerful expanding Western scientific ideology.[10] Instead their focus has increasingly been on the sophisticated scientific negotiations, reciprocal appropriations and mutual influences that, although uneven, were undertaken both in Europe and its dependent empires.[11] Polycentric networks and trading zones have displaced the old model of center and periphery and the various social sites of science have been emphasized.[12]

Together with the other authors in this collection, this chapter seeks to understand the ways in which a networked approach might reframe our understanding of science and empire in the late nineteenth and early twentieth centuries. It holds that individuals must be understood within the context of the broader institutions and social structures in which they operated. Paying close attention to these contexts highlights the connections, disconnections and topographies of power that conditioned the production of knowledge in this period. Such perspectives recast the old geographies of empire and point to new alignments of proximity and distance.

The life of J.T. Wilson – graduate of Edinburgh, Professor of Anatomy at the University of Sydney and Professor at Cambridge – provides a starting point for examining these questions. This chapter explores the informal systems and practices that characterized his career and those of his colleagues in their work in various universities across the British Empire before the Second World War. By investigating the material, human, and intellectual traffic that linked Wilson to his often geographically dispersed friends, this chapter suggests that his life points to a social and scientific community that was neither national nor international, but located instead within a tightly woven network of individuals who moved between certain universities of the British World. Such networks of social and professional connection themselves constituted imperial spaces, functioning as sites productive of scholarship, identity and careers.[13] They did not stretch across the reaches of empire, but ran between select locations mapped out by the travels of their members. Helping to mitigate the tyrannies of distance, these sub-imperial spaces were a vital aspect of the workings of science and empire in the first part of the twentieth century.

J.T. Wilson and the Edinburgh diasporic community

J.T. Wilson was born in Dumfriesshire, Scotland, in 1861, the son of a Free Church schoolmaster.[14] A keen naturalist from boyhood, he went to Edinburgh in 1879 to study medicine where he came under the influence of the Professor of Anatomy, William Turner. Following graduation he made three voyages to China as a ship's surgeon. It was on the return leg of one of these expeditions that Wilson saw a passing Orient Line steamer bound for Australia, and was inspired to write to his former Edinburgh classmate, T.H. Anderson Stuart, who since 1882 had been Professor of Medicine at the University of Sydney. Stuart offered Wilson the position of Demonstrator of Anatomy, suggesting also that a Chair might soon be created. For the young Scot the offer was an attractive one, with superior pay and career prospects to those available to him at home. Neither was the idea of moving to Australia an entirely foreign one for Wilson. He already had family there with an aunt and an uncle having separately emigrated the previous decade. Moreover, the young doctor was in love with Jane Elizabeth Smith, the sister of one of his Edinburgh classmates, and attaining a professorial post would enable him to marry her.[15] Wilson accepted the post and sailed out in 1887 onboard the steamship, the *Orient*.

After three years Wilson received the hoped for promotion and in 1891 Jane duly joined him, followed also by his parents. However, the year after their marriage Jane died, leaving behind a three day old daughter. Wilson remained in Sydney and in 1898 married the Sydney born Mabel Mildred Millicent Salomons, daughter of a prominent Jewish lawyer and Member of the colonial Parliament. Together they had three daughters and three sons. In 1905 the family traveled to Britain during Wilson's first sabbatical leave. They visited relatives and friends in Scotland and Wilson for the first time toured the laboratories of England and Germany. He also journeyed to Geneva to attend the First International Congress of Anatomists where he presented his research on Australia's marsupials and monotremes. Returning to Sydney, Wilson resumed his teaching and research at the University. He was elected Fellow of the Royal Society of London in 1909 and continued to publish many articles in both British and Australian journals. He visited Britain and Europe again in 1912–13 before leaving Australia permanently in 1921, following his election to the Cambridge Chair of Anatomy. His eldest daughter stayed behind in Sydney and in time two of his other daughters would also migrate there. Retiring from his Chair in 1934 Wilson remained in Cambridge, returning once in 1935 to visit his family in Australia.[16] He died in 1945.

This peripatetic life was not unique to Wilson. Between its foundation in 1850 and the Second World War, over 75 per cent of his colleagues at the University of Sydney had some experience outside Australia.[17] During the period 1900–30 in particular, most professors at Sydney had, on average, relocated overseas two or more times. These moves were only very rarely to Europe or the United States. Overwhelmingly they traced a path between Britain and Australia. During the 1890s and early 1900s, Wilson formed strong relationships with a number of anatomists and zoologists whose careers, like his own, were spread between imperial locations and these relationships significantly influenced the nature of his career.

These colleagues came to Australia in much the same way as Wilson had: through a process of personal recommendation that explains the large number of Edinburgh graduates appointed to Sydney in the 1880s and 1890s. Anderson Stuart had recruited John Shewan before he left Scotland in 1881 and appointed Alexander MacCormick by cable after his arrival. Another of their Edinburgh classmates, Robert Scot Skirving, was the medical superintendent at Prince Alfred Hospital, and he later combined university teaching with his surgical practice. Skirving, in turn, was succeeded by yet another Edinburgh friend; James Graham. In the Chair of Biology too, was the Edinburgh trained William Haswell. When Anderson Stuart offered the demonstratorship to Wilson in 1886, he did so knowing the attractions that this diasporic community presented: 'We are five of us here now, all young Edinburgh fellows and…with our influence and help we could push you into *anything*'.[18] Personal connection increased the chances that appointees would be qualified and trustworthy.

Edinburgh in particular served as a marker of prestige. For much of the nineteenth century it had been the leading center for medical education and research in the United Kingdom. There, anatomy (the study of the structure of organisms) had long been taught alongside physiology (the study of their function) as a crucial part of the medical curriculum. The subject was divided into two sub-disciplines: human and comparative anatomy, the latter being concerned with different species of vertebrate animals and sometimes called morphology. By the nineteenth century both had developed a microscopic (or histological) focus. John Goodsir (Professor 1846–66) and his student and successor William Turner (Professor 1867–1903) at the University of Edinburgh were leaders in this field.[19]

In England, however, the medical syllabus was largely controlled by the College of Surgeons, whose exams rewarded rote learning, restricted students' focus to the human body and effectively sidelined comparative anatomy. However, the subject did flourish in the laboratory of Richard Owen who worked outside the world of medicine at the British Museum (1856–84) and work proceeded in the related fields of physiology (under Michael Foster at Cambridge) and zoology and biology (under G.B. Howes at the Royal College of Science in South Kensington.) As well as recruiting Edinburgh graduates, on Foster's advice Stuart also appointed as demonstrator of physiology, C.J. Martin (who had also worked in Leipzig). When, in 1892, Haswell was looking for a demonstrator, Howes recommended his student, J.P. Hill. Hill, in fact, came with further endorsement. Not only was he working with Howes in London, but he was simultaneously pursuing his medical degree under Turner in Edinburgh. Built initially upon British (particularly Scottish) networks of trust, the appointment of these men to Sydney helped extend such connections outside Britain itself.[20]

Comparative anatomy at the end of the nineteenth century

For the first half of the nineteenth century, these comparative anatomists had been largely concerned with the task of classifying organisms into 'morphological types', or species, differentiated according to their appearance. At the beginning of the century advances in microscopy had also led to the development of the theory of the cell (or cytology) and alongside cytology developed the new discipline of embryology (the study of the development of the embryo).[21] In this field German scholars were especially pre-eminent. Karl von Baer of Königsberg put in place the foundation for the modern development of the subject with his 1828 'biogenetic law' which held that embryos of different animals resemble each other more closely the further back they are traced in the evolutionary line. This idea was revised by Ernst Haekel of Jena when in 1866 he proclaimed that 'ontogeny recapitulates phylogeny', or in other words, each successive stage in the development of an individual organism represents one of the adult forms that appeared in its evolutionary history. The theory – now discredited – was based on the assumption of progressive perfectibility and seemed to suggest that it would be possible to discover the secrets of evolutionary development by examining the embryos of various species. It supplied the basis on which descriptive embryology emerged. Darwin's ideas gave a powerful stimulus to this field. The big questions for embryologists and morphologists in the second part of the nineteenth century were associated with determining evolutionary lines of descent and working out the mechanisms of heredity.

Despite some promising beginnings, British anatomists were for the most part slow to take up these questions. Interest in England was mainly centered in two laboratories. Working on the borders of the as yet not fully differentiated fields of experimental biology and zoology, T.H. Huxley, Michael Foster (before his move to Cambridge in 1870) and G.B. Howes established a vibrant center for the study of animal morphology at the Royal School of Mines in South Kensington, while embryology was taken up enthusiastically in Cambridge by F.M. Balfour until his accidental death in 1882. Neither did the discipline flourish in Scotland. William Turner and the zoologist John Beard undertook comparative embryological work at Edinburgh, but with student numbers escalating towards the end of the century and no parallel investment in staff, the pre-eminence of Edinburgh's medical schools, and with them the study of comparative anatomy, had begun to wane.[22] Moreover, there were divisions within British anatomy itself. Writing to Wilson from Cambridge in 1896, his former Sydney student, Grafton Elliot Smith made this clear: 'Wright is reviling me for going to Cambridge. The London people seem to be more partial to Camb than any other school. But Edinburgh & Cambridge do not seem to be fond of one another'.[23]

As H.A. Harris (Professor of Anatomy at the University of Cambridge, 1934–51) later wrote, by the turn of the century the subject in Britain had 'suffered an eclipse': 'the scalpel and the injection needle grew rusty; the fascinating study of experimental biology and embryology did not flourish in Britain'.[24] The momentum that had been developed in Edinburgh, in London, and in Cambridge in the second part of the nineteenth century, was instead taken up by anatomists in America and Germany.[25]

In Germany, Wilhelm Roux at Innsbruck and Halle (and earlier at Breslau) and Hans Driesch at the Naples Marine Biological Laboratory, were advancing the development of descriptive embryology's twin sister, experimental embryology, through an animated disagreement about the nature of embryonic cell differentiation. Roux believed that the process was hereditary, while Driesch believed it was environmental. Across the Atlantic embryologists held that neither position could be fully correct. With strong links to German embryology, C.O. Whitman at the University of Chicago and his school engaged in heated debates, published annually in the *Biological Lectures*.[26] A reconciliation between the two theories was proposed by August Weissmann of Freiburg in 1893 with his germ plasm theory. He delineated two kinds of cells: germ cells (the cells from which an embryo develops, for example in humans the sperm and the eggs) and somatic cells (every other type of cell in the body). To the nucleus of germ cells alone he ascribed the role of hereditary transmission. This 'germ plasm' (what is now thought of as DNA) was, Weissmann proposed, the substance around which each new body (made up of somatic cells) was built and it was this body that carried the germ cells from one generation to the next. Following Darwin, Weissmann saw heredity as the source of variation. Among the differences produced by heredity, natural selection operated as the instrument of evolution. Though controversial until the 1940s, Weissmann's theories laid the path for the acceptance among biologists of the rediscovery of Mendel's laws of inheritance.

Australian animals like the platypus, echidna and lungfish were of particular interest to scientists investigating these questions. Lungfish, which could breathe air in fouled water, were thought to be a possible 'missing link' between fish and amphibians and similarly the monotremes, because of their reproduction system and other features, were believed to link reptiles and mammals.[27] As such, research on Australian material was considered enormously significant by the international scientific community. Since the 1830s, local collectors had been in thrall to the authority of Richard Owen at the British Museum, to whom they sent most of their specimens. He, however, showed no interest in the evolutionary ideas of Darwin, and as a consequence, in the 1880s and 1890s both British and German scientists were making their own expeditions to Australia in search of this material. In 1884, the Cambridge embryologist W.H. Caldwell traveled to Queensland's Burnett River and 'perpetuated mass slaughter' on marsupials and monotremes on a generously funded expedition taking back to England 1300 Echidna specimens alone.[28] His famous telegram to the British Association meeting in Canada that year, announcing his discovery that platypus and echidnas lay eggs, reawakened, as Professor Liversidge of the University of Sydney subsequently reported, 'interest in the peculiarities of Australian Natural History'.[29] British researchers were not alone in expressing interest in Australia's unique fauna. The Norweigian Carl Lumholtz had visited north Queensland in 1883 and 1884, and in 1892 the German zoologist Richard Semon undertook another mission to the Burnett River.

However, from the 1880s on a new generation of naturalists also began mounting sustained investigations into Australian fauna from within the local universities. The wider fascination with this material was certainly one reason Wilson – and Spencer Baldwin, his colleague at the University of Melbourne – had initially found Australia attractive. Proximity to monotremes in their natural habitat conferred upon them a real advantage. The platypus was difficult to find and, despite extensive and exploitative use of expert aboriginal collectors, Caldwell and Semon were limited in what they were able to acquire by the very rapaciousness of their technique.[30] In contrast Wilson was much more successful. Though there is no evidence that he relied on indigenous support, he did use other collectors.[31] But Wilson and his colleagues also spent a great deal of time themselves out on the Duckmaloi River in the Blue Mountains not far from Sydney. 'Those were years', recalled Hill,

> of intensive activity, with the days often prolonged far into the night and relieved by 'working holidays' in the Blue Mountains during the long summer vacations and by camping expeditions into the bush in search of monotreme and marsupial material during the short winter breaks. These camping trips were memorable and joyous occasions when we reverted to the primitive life – shot and cooked our own food, hunted by day and yarned over the camp fire by night.[32]

Because they knew more about the local area and about breeding times, and because their collecting extended over several successive annual cycles, Wilson, Hill, Martin and other locally based investigators were able to acquire better quality and more useful material than the more voracious and aggressive expeditions of Caldwell and Semon. Their colonial knowledge trumped imperial extraction, helping at the same time to 'indigenize' or 'nativize' its producers.[33]

A scholarly network of the 'British world'

To this material Wilson and Hill and Martin brought their collective intellectual experience. In Sydney the zoologist, the physiologist and the anatomist were thrown into each other's company in ways that they may not have been in Britain. Although the boundaries between the three disciplines had long been porous, the practicalities of academic departments meant that in a bigger university, like Edinburgh, the Professor of Anatomy and the physiology and biology demonstrators would not have had much contact. Indeed, returning to Edinburgh in 1897, Hill found it a 'stagnation place': 'to find the Dean', he wrote to Wilson, 'you wait about a week & then get two mins'.[34] In Sydney, all three worked together in what must then have been one of the most spacious and best appointed medical schools in the British Empire. Opened in 1889, the newly built School of Medicine made lavish provisions within one building for laboratories, teaching space, offices and a museum.[35] In the early years when medical student numbers were low, Wilson, Hill and Martin had ample time, as well as ample facilities, with which to pursue their researches. Hill and Wilson in particular were known for their vigorous collaborative working relationship. Hill's successor in the Jodrell Chair at University College London, wrote that in Sydney 'it was reputed that the discussions between [Hill and Wilson] could be heard a quarter of a mile away'.[36] Elliot Smith said the two 'wrangled like a pair of Scots'.[37] In Sydney, the evolutionary approach of Foster's school of experimental physiology and the comparative anatomical tradition of Edinburgh, leavened by Martin's German experience, combined in the context of a particular physical and institutional environment to produce an impressive stream of research that significantly contributed – or so was thought at the time – to understandings of evolution.[38] Perhaps it is valid to say that in the far-flung Colony of New South Wales, comparative anatomy truly was 'British'.[39]

The research these anatomists undertook at Sydney was not undertaken in intellectual isolation. In Sydney, Wilson and his group had access to the leading specialist international journals of the day. Included among those the University subscribed to were: *Archiv für Anatomie und Physiologie, Archiv für Mikroskopische Anatomie, Brain: A Journal of Neurology, Journal de Anatomie, Morphologisches Jahrbuch,* the *Neurologisches Centralblatt* and the *Zeitschrift für Wissenschaftliche Zoologie*.[40] Wilson, who was more proficient in German than Hill, translated from these journals articles that pertained to his and Hill's work.[41] Throughout the 1890s the two also avidly read the *Biological Lectures* that came out of the University of Chicago.

However, though they engaged with German and American research, Wilson and Hill orientated themselves primarily toward the British anatomical community.[42] Most of Wilson's own work was published in British journals and it was in these that he first learnt of the most significant anatomical research to come out of Germany in the late nineteenth century – that of August Weissman.[43] Weissman initially expounded his ideas about particulate inheritance in lectures delivered at the University of Freiberg in the early 1880s. At the time, however, they were not widely disseminated outside Germany. Wilson and Hill in Sydney first came across them, along with other English speaking readers, in 1885 in the pages of *The Nineteenth Century* and *Nature*.[44] A particularly vigorous debate erupted in the latter journal in 1889 following the translation of Weissmann's lectures into English under the title, *Essays upon Heredity*.[45] The University of Sydney purchased this, and Weissmann's second major work, *The Germplasm: A theory of heredity*, translated in 1893, soon after they became available. Though they received and read the German scientific periodicals, it was thus largely still through the filter of British scholarship that the group in Sydney engaged with German ideas.

But perhaps more importantly, the Sydney group were deeply embedded in the social and institutional network of British academia. One of the contributors to the body of scholarship emanating from Sydney was the young Sydney medical student, Grafton Elliot Smith. Like many Australian students of promise at the time, he sought to continue his studies in Britain. In 1896 he was awarded one of the University of Sydney's 'Travelling Scholarships' that he used to fund advanced research on neurological material held in the Museum of the Royal College of Surgeons, basing himself in Cambridge. Through the offices of his Sydney teachers, Elliot Smith was introduced to the web of connections that stretched between Australia and Britain. Writing to Wilson and Hill from Port Melbourne on his way to England, he thanked them for the letters of introduction to old friends in Britain that they had given him.[46] After arrival in Edinburgh, he reported that he 'saw a good deal of Sir Wm

Turner', 'met quite a crowd of Australians', and had just missed their old hunting companion, Robert Broom, who was also passing through.[47] Almroth Wright, who had previously held Martin's post in Sydney, looked after Elliot Smith in Cambridge where he also managed to convince Michael Foster that not all Sydney students were as brusque as Anderson Stuart.[48] 'If I do not attain something', Elliot Smith wrote to Wilson, 'it will not be the fault of my Sydney friends, whose disinterested devotion to my interests has impressed upon me a debt of gratitude which it will be difficult to repay'.[49]

Elliot Smith's presence in England helped reinforce the connections that stretched between Sydney and Britain. These ties were also maintained and extended by the regular travels of group members. Hill, too, was in Edinburgh during the winter session of 1897–8. He had returned to complete his still unfinished medical degree and to graduate. In 1900 he again traveled to Britain, this time to get married, making the journey a third time in 1902–3 for research. In 1902 Elliot Smith returned temporarily to Australia. Wilson himself, as already noted, went to England, Scotland and the laboratories of Germany in 1905. Moreover, strengthened by regular contact, the connections between the members of what Wilson called 'the Fraternity of Duckmaloi' were further reinforced by the introduction to their circle of new members. Sydney students A.E. Mills and T.T. Flynn went to the University of London to work with Hill (he moved there in 1904), and J.I. Hunter, Raymond Dart, J.S. Shellshear and Una Fielding worked at University College, under Elliot Smith (who, after 1919, held the Chair of Anatomy). Martin (at the Lister Institute from 1903) developed a particularly strong connection with the Walter and Eliza Institute for Medical Research in Melbourne, nurturing the careers of C.H. Kellaway and Neil Fairley and those they in turn sent to work with him, including the Nobel Prize laureates Howard Florey and MacFarlane Burnett.[50] These human exchanges helped consolidate the personal connections of those who enabled them, strengthening old ties even as they established new ones.

Nor was it just human capital that flowed along these routes. During their various migrations the members of Wilson's group also used their connections with each other as a way of transmitting all kinds of intellectual and material traffic. The exchange of specimens between them is particularly revealing. When Elliot Smith was still a student at Sydney, Broom – then working as a doctor in rural Camperdown, New South Wales – was sending him various native bat specimens.[51] When Broom traveled to Edinburgh in 1896 he took his large collection of Australian specimens with him and continued to send material, including possum and glider specimens to Smith who was by the end of the year in Cambridge.[52] This line of connection continued following Broom's move to South Africa, with Cape Golden Moles, Elephant Shrews, lizards and *Insectivora* specimens all making their way to Elliot Smith, first in England, and then in Cairo.[53] Broom also sent specimens to Wilson and Hill in Sydney, and Wilson and Hill sent Elliot Smith platypus material and bat's brains.[54] In Cairo, Elliot Smith reciprocated. He sent Broom, at the University of Stellenbosch, Egyptian human bones in 'exchange for S. African bones of known races'.[55] In 1908 he offered material from the Nubian Survey 'quite unofficially' to Wilson in Sydney.[56] Though these exchanges did involve the removal of natural resources from their place of origin for study elsewhere, they are significantly different from the models of extractive exchange identified by historians like Fleming and Basalla.[57] Specimens did not simply flow back to Europe from collectors on the colonial periphery, but moved along lines of personal connection that had been established in a colonial university. These connections traveled with individuals as they undertook their 'imperial careering' and constituted an important part of an individual academic's 'social capital'.[58]

As well as specimens, these interpersonal channels also carried a host of 'soft information'.[59] Accounts of current research, tales of meetings with other anatomists, unpublished papers and speculation about the activities of colleagues, flowed between Australia and Britain. This was not just idle gossip. The information about mutual friends at the University of Sydney that Wilson conveyed to Hill and Martin and Elliot Smith, and the news they sent back to him of friends and colleagues in Britain, served to bring these individuals, separated by thousands of miles, into each others' lives. Such gossip disseminated news about vacant positions, scoped out potential candidates for jobs in both countries, and helped to refresh and lubricate friendships and connections.[60] 'I thought I had better wire to let you know', wrote Wilson's old classmate J.S. Haldane in 1909, 'that the Edinburgh Chair is vacant, in case you hadn't heard of poor Cunningham's death'.[61] Wilson in fact had learnt of Cunningham's death from at least three separate sources. Neither did information travel in only one direction. When he left Sydney for Cambridge, Wilson's continuing connections with former colleagues, his daughter and the Sydney Registrar, H.E. Barff, meant that in England, he was able to stay informed of university politics in New South Wales.[62] Far from being cut off in Australia and Cairo from the British anatomical world, Wilson and Hill and Elliot

Smith were part of a dense network of relationships that embedded them within it.

These social connections had intellectual implications. They were an important part of the process of bringing research to publication. In Sydney in the 1890s Wilson and Hill used Turner and Howes to communicate their papers to the Royal Societies of Edinburgh and London.[63] When Elliot Smith moved to Britain in 1896 he took over this representative function. Robert Broom later described him as having 'act[ed] as a sort of Ambassador [for him]…in London'.[64] After 1906, Hill also took on the role.[65] Wilson's shift to Cambridge in 1921 in turn enabled him to assist friends in exactly the same way.[66] Through expediting the publication process, group 'ambassadors' in Britain helped mitigate the constraints imposed by geographic distance. They functioned not simply as 'bridgeheads', but rather as crucial actors within a web of relationships that straddled the distances of empire and in doing so helped diminish them.[67]

Wilson's sense of belonging was forged within this web of relationships. Far from being eager to escape, he found leaving Sydney difficult. Replying in 1920 to congratulations on his appointment to Cambridge, Wilson confessed that though he was 'pleased at being chosen for Cambridge', pleasure was 'by no means uppermost in [his] mind': 'It is a painful thing to contemplate separation from so many friends & associations of an entire generation'.[68] Working in Johannesburg, Raymond Dart gave voice to the spatial and temporal slippage that life within such a web of connections entailed. 'I felt in Cambridge', he wrote to Wilson following a visit with him in 1931, 'that I was back once more in Sydney & it did me more good than you can know'.[69] Neither was this sense of spatial collapse just in these men's imaginations. Following his move to Britain, Wilson continued to work as an important member of the University of Sydney. Between 1921 and his death in 1945, he repeatedly served on the selection committees that the University habitually operated in London when recruiting new staff. He represented the institution at several conferences, served as a contact point for arriving students and funneled information back to his former colleagues. In this way Wilson continued from Cambridge to participate in the community in Sydney of which he still felt a part: 'I may say that it is a great satisfaction to me', he wrote to Barff, the Sydney Registrar in 1923, 'to feel that I can be of the slightest service to dear old Sydney University in any way, so do not be afraid to ask me to anything'.[70]

In the interwar period, Wilson and his Sydney school played a major role in reviving the teaching of anatomy in Britain – a subject that had, under strictures of high student numbers in Edinburgh and the College of Surgeons' exams in England, by the turn of the century fallen into decline. Writing to Wilson in 1909 from Cairo on the eve of his own departure to take up the Chair in Manchester, Elliot Smith implored his former teacher to return to Britain: 'It is your simple duty to British Anatomy to come over to the old country for there is no one but yourself to take the lead'.[71] Ten years later, in 1919, Elliot Smith again looked to Wilson, whom he was '[anxious] to see…in [Britain] where things anatomical badly want stirring up'.[72] When Macalister in Edinburgh died several months later, there finally seemed to Elliot Smith 'no one available in [Britain] worthy of the job or capable of upholding the past reputation of the [Edinburgh] school'.[73] When Elliot Smith was finally successful in luring Wilson to Cambridge in 1921, he was himself by that time fully engaged at University College, London, in the task of revitalizing the subject. With J.P. Hill also there, Martin at the Lister Institute, Wilson in Cambridge, T.T. Flynn at Belfast and Frederick Wood Jones in Elliot Smith's old Chair at Manchester from 1930 and 1937 respectively, Broom at the Transvaal Museum, Dart at Witwatersrand in Johannesburg, J.S. Shellshear in Hong Kong, and J.I. Hunter, A.E. Mills and A.N. Burkitt in Australia, the Sydney school that developed under Wilson provided British anatomy with many of its senior interwar professors. Though this might at first look like reverse colonization in action, such a view in fact reinscribes the very notions of metropole and colony that this chapter is seeking to contest. Rather, these anatomists moved within a single space that stretched between these regions.

It would, for the same reasons, not be accurate to see the migrations of these men merely as an appropriation of 'Australian' talent; an early instance of what would later be called the 'brain drain'.[74] Though they moved away from Australia, Wilson and his colleagues did not leave this greater British network of connections. Just as from Sydney Wilson and Elliot Smith and Martin participated as members of the extended British anatomical world, from Britain they continued to foster science in Australia. As traders in 'soft information', advocates and ambassadors and nodal points in vital webs of social connection, their contribution cannot be quantified by statistical analyses of migration alone.[75] As this chapter has sought to show, though inflected with local characteristics, in the first part of the twentieth century the realms of 'British' and 'Australian' science were not as distinct as subsequent scholarship has sometimes suggested.

Conclusion

Personal connections were central to the careers of scientists like Wilson. His social ties stretched across the regions of the British world, creating a space that does not map exactly onto the geographic notions of center and periphery traditionally favored by historians. Though physical distance was real and did affect the way he pursued his career; though local characteristics did influence his work; though power – intellectual and institutional – did at various times accrue in one location or institution more than another, what also affected Wilson was his relationship to a *social* plane that, although uneven, helped significantly to facilitate the making of appointments, the traffic of specimens, and the circulation of people, information and ideas. Produced neither wholly in Britain nor wholly in Australia, scientists like Wilson operated within a sub-imperial space; a space that extended along the routes of empire yet not to all its parts or members. It was in this limited space – somewhere between the nation and the world – that scientific careers and ideas and identities were also fashioned. Considering this territory, rather than a political or geographic one, as the site of 'British' science lends new insight into the functioning of the greater British academic and scientific community in the first part of the twentieth century.

Notes

1 On the need to see 'metropole' and 'colony' in a 'single analytic field' see, Fred Cooper and Ann Laura Stoler, 'Between Metropole and Colony: Rethinking a Research Agenda', in Fred Cooper and Ann Laura Stoller (eds) *Tensions of Empire: Colonial Cultures in a Bourgeois World* (Berkeley: University of California Press, 1997), p. 15.

2 For a good overview of the origins of this departure and of its various manifestations also see, Alan Lester, 'Imperial Circuits and Networks: Geographies of the British Empire', *History Compass* 4, 1 (2006), 124–41.

3 Catherine Hall, *Civilising Subjects: Metropole and Colony in the English Imagination, 1830–1867* (Chicago: University of Chicago Press, 2002); Paul Gilroy, *The Black Atlantic: Modernity and Double Consciousness* (Cambridge, Mass: Harvard University Press, 1993); Mrinalini Sinha, *Colonial Masculinity: The 'Manly Englishman' and the 'Effeminate Bengali' in the Late Nineteenth Century* (Manchester: Manchester University Press, 1995); Antoinette Burton, *Burdens of History: British Feminists, Indian Women, and Imperial Culture, 1865–1915* (Chapel Hill, NC: University of North Carolina, 1994).

4 Catherine Hall and Sonya O. Rose, 'Introduction: Being at Home with the Empire', in Catherine and Sonya O. Rose (eds) *At Home with the Empire: Metropolitan Culture and the Imperial World* (New York: Cambridge University Press, 2006), p. 5.

5 Carl Bridge and Kent Fedorowich, 'Mapping the British World', *Journal of Imperial and Commonwealth History* 31 (2003), 11.
6 Bridge and Fedorowich, 'Mapping the British World', p. 6.
7 Research has tended to be more often concerned with the influence of the British connection on various national communities than on a greater British world conceived of as a whole. For example, see Phillip A. Buckner and R. Douglas Francis (eds) *Canada and the British World: Culture, Migration, and Identity* (Vancouver: University of British Columbia Press, 2006). Other British World historians have been concerned with recovering the role of various national groups from within the United Kingdom – the Welsh, the Irish, the Scottish – in the story of Britain's empire. See the essays collected in Carl Bridge and Kent Fedorowich (eds) *The British World: Diaspora, Culture and Identity* (London: F. Cass, 2003). Exceptions are Simon Potter, *News and the British World: The Emergence of an Imperial Press System, 1876–1922* (Oxford: Clarendon Press, 2003); and Zoe Laidlaw, *Colonial Connections, 1815–45: Patronage, the Information Revolution and Colonial Government* (Manchester: Manchester University Press, 2005).
8 David Lambert and Alan Lester (eds) *Colonial Lives Across the British Empire: Imperial Careering in the Long Nineteenth Century* (Cambridge: Cambridge University Press, 2006).
9 Lambert and Lester, *Colonial Lives Across the British Empire*, p. 24.
10 George Bassala, 'The Spread of Western Science', *Science* 156, 3775 (1967), 617.
11 For the limitations of Basalla's model see Roy MacLeod, 'On Visiting the 'Moving Metropolis': Reflections on the Architecture of Imperial Science', in Nathan Reingold and Marc Rothenberg (eds) *Scientific Colonialism: A Cross-Cultural Comparison* (Washington, DC: Smithsonian Institution Press, 1987), pp. 217–49. For work that explores mutual influence in science see, Michael Bravo, *The Accuracy of Ethnoscience: A Study of Inuit Cartography and Cross-cultural Commensurability* (Manchester: Department of Social Anthropology, 1996); Gyan Prakash, *Another Reason: Science and the Imagination of Modern India* (Princeton, NJ: Princeton University Press, 1999).
12 David W. Chambers and Richard Gillespie, 'Locality in the History of Science: Colonial Science, Technoscience, and Indigenous Knowledge', in Roy MacLeod (ed.) *Nature and Empire: Science and the Colonial Enterprise*, *Osiris* 2 (2001), 221–40; Peter L. Galison, *Image and Logic: A Material Culture of Microphysics* (Chicago: University of Chicago Press, 1997), p. 783; David N. Livingstone, *Putting Science in its Place: Geographies of Scientific Knowledge* (Chicago: University of Chicago Press, 2003).
13 Mrinalini Sinha proposed the term 'imperial social formation' to describe the simultaneous and interlinked development of metropole and colony. See Sinha, *Colonial Masculinity*, p. 10.
14 Much of the information concerning Wilson's life is drawn from Patricia Morison's excellent biography, *J.T. Wilson and the Fraternity of Duckmaloi* (Amsterdam: Rodopi, 1991).
15 Jane's brother was James Lorrian Smith, Professor of Pathology at the University of Edinburgh (1909–22).
16 P. Morison, 'Wilson, James Thomas (1861–1945)', *Australian Dictionary of Biography* 12 (Melbourne: Melbourne University Press, 1990), pp. 525–7.

17 For a more extensive analysis of professorial migration see Tamson Pietsch, '"A Commonwealth of learning?" Academic networks and the British World, 1890–1940' (University of Oxford, DPhil thesis, 1990).
18 Anderson Stuart to Wilson, 11 April 1886 and 15 August 1886, University of Sydney Archives, P162 (J.T. Wilson Papers) [hereafter USA P162] 3/1.
19 D.J. Cunningham, one of Turner's other students, also carried comparative anatomy to Trinity College Dublin, where he held the Chair before succeeding his former professor at Edinburgh (1903–9).
20 The role of trust networks has recently become the focus of historians of empire. See Sebouh Aslanian, 'Social Capital, 'Trust' and the Role of Networks in Julfan Trade: Informal and Semi-formal Institutions at Work', *Journal of Global History* 1, 3 (2006), 383–402.
21 The 'cell theory' – which held that cells were the fundamental particles of both plants and animals – was first stated by two Germans, the botanist Matthias Schleiden (in 1838) and the biologist Theodor Schwann (in 1839).
22 For a more extensive elaboration of late nineteenth-century embryology, see Morison (1991) pp. 139–53.
23 Australian Academy of Science, Basser Library, MS56 (G. Elliot Smith Papers) [hereafter AAS MS56] 1/590, Elliot Smith to Wilson, 7 September 1896.
24 Harris, H.A. (1938) 'At University College, London', in W. Dawson (ed.) *Sir Grafton Elliot Smith* (London: Jonathan Cape), pp. 169, 170.
25 ibid. See also C. Dean, 'The early history of anatomy and anthropology in and around UCL', http://pc74.anat.ucl.ac.uk/history/history.htm, date accessed 18 January 2008.
26 See T. Horder, J. Witkowski and C. Wylie (eds) (1986) *A History of Embryology* (Cambridge: Cambridge University Press), esp. T. Horder, 'Origins of the embryological tradition in the United States', pp. 109–10.
27 Morison, *J.T. Wilson and the Fraternity of Duckmaloi*, p. 91.
28 Morison, *J.T. Wilson and the Fraternity of Duckmaloi*.
29 Quoted in Libby Robin, 'The Platypus Frontier: Eggs, Aborigines and empire in 19th Century Queensland', in Deborah Rose and Richard Davis (eds) *Dislocating the Frontier: Essaying the Mystique of the Outback*, published online, http://epress.anu.edu.au/dtf/mobile_devices/ch07.html, date accessed 28 January 2008.
30 Libby Robin, 'Paradox on the Queensland Frontier: Platypus, Lungfish and other Vagaries of Nineteenth-century Science', *Australian Humanities Review* (2000), published online, http://www.australianhumanitiesreview.org/archive/Issue-September-2000/robin2.html, date accessed 8 August 2008.
31 The most notable of these collectors included Robert Broom (at the time a doctor in rural New South Wales), Harry Burrell (an amateur naturalist and platypus protector) and Robert Etheridge (curator of the Australian Museum in Sydney).
32 D.M.S. Watson, 'James Peter Hill', *Biographical Memoirs of Fellows of the Royal Society* 1 (1955), p. 113.
33 Saul Dubow has shown how science could serve as both a colonizing ideology and, particularly when carried out by local scientists and scholars, 'an assertion of acquired indigeneity'. Saul Dubow, *A Commonwealth of Knowledge: Science, Sensibility, and White South Africa, 1820–2000* (Oxford: Oxford University Press, 2006), p. 14.

34 Hill to Wilson, 12 October 1997, USA P162 3/5.
35 Rising student numbers, however, meant that 20 years later it was overcrowded. See Clifford Turney, Ursala Bygott and Peter Chippendale, *Australia's First: A History of the University of Sydney Volume 1: 1850–1939* (Sydney: University of Sydney Press, 1991), p. 221.
36 Watson, 'James Peter Hill', p. 112.
37 Quoted in Watson, 'James Peter Hill'.
38 Martin worked on snake venom, collaborated with Hill on platypus embryos, with F. Tidswell on monotreme femoral glands, and with Wilson on the platypus snout; Elliot Smith dissected marsupial and monotreme brains; Hill worked on the placentation of bandicoots, and on their urogenital organs; and Wilson published on the musculature of the nocturnal mole and on the platypus skull, with Stewart McKay on monotreme scapula, with Martin again on the platypus snout, and with Hill on marsupial dentition. From 1900 Wilson and Hill also began to work on platypus embryos.
39 Keith Robbins speaks of the 'paradox' that the 'colonies of settlement were, in a sense, more genuinely British than Great Britain because there the various peoples of Britain lived more closely alongside each other than they did at home'. See Keith Robbins, *Great Britain: Identities, Institutions and the Idea of Britishness* (London: Longman, 1998), p. 214.
40 Other journals directly relating to anatomical research held by the University of Sydney in 1892 included *Archives fur de Physiologie, Archiv für Pathologische Anatomie und Physiologie, Archives de zoologie, Brain: A Journal of neurology, Centralblatt fur Physiologie, Jahrasbarichte von Anatomie und Entiscklungsgastr, Jahrsbuch und Forts de Physiologie, Journal de Anatomie, Journal of Anatomy and Physiology, Journal of Anthropology, Journal of Morphology, Journal of Physiology, Journal Royal Microscopical Society, Quarterly Journal of Microscopical Science, Trans Pathological Society London, Zoological Record, Zoologischer Jahrasbaricht*.
41 See Morison, *J.T. Wilson and the Fraternity of Duckmaloi*, p. 145.
42 Wilson's first visit to Germany was in 1905.
43 Wilson published mostly in the *Quarterly Journal of Microscopical Science*, the *Philosophical Transactions of the Royal Society,* the *Proceedings of the Anatomical Society,* and the *Journal of Anatomy*. Wilson did publish two papers in German. See *Zeitschrift Fuer Wissenschaftliche Mikroskopie und Mikrosopische Technik* 17 (1900), pp. 169–77 and 27 (1910), pp. 227–34.
44 See A.E. Shipley, 'Death', *The Nineteenth Century*, May (1885), 827; H.N. Moseley, 'The Continuity of the Germ-Plasma Considered', *Nature* 33 (1885), 154; and 'Dr August Weissmann on the Importance of Sexual Reproduction for the theory of Selection', *Nature* 34 (1886), 629.
45 See *Nature* 40, 25 July and 24 October 1889.
46 Elliot Smith to Wilson, April 1896, AAS MS56 1/387.
47 Elliot Smith to Wilson, 7 September 1896, AAS MS56 1/590.
48 Elliot Smith to Wilson, 18 November 1896, AAS MS56 1/393. Anderson Stuart had a reputation for being peremptory. Almroth Wright was an Anglo-Irish bacteriologist best known for his anti-typhoid inoculation and his outspoken opposition to women's suffrage. From 1892–1902 he was Professor of Pathology at the Army Medical School at Netley, and from 1902 associated with St Mary's hospital in London.

49 Elliot Smith to Wilson, April 1896, AAS MS56 1/387.
50 Kellaway worked with Martin in London before returning to Australia to direct the Walter and Eliza Institute in Melbourne. Fairley pursued his interest in tropical diseases in London and in India before joining the Walter and Eliza Hall Institute in 1927, where he worked with Kellaway before going to London in 1929 to work in the London School of Hygiene and Tropical Medicine. See F.C. Courtice, 'Research in the Medical Sciences: The Road to National Independence', in Roderick W. Home (ed.) *Australian Science in the Making* (Cambridge: Cambridge University Press, 1988), pp. 277–307.
51 Elliot Smith to Robert Broom, 10 March 1896 – from Sydney requesting *miniopterus*, AAS MS56 1/20; Elliot Smith to Robert Broom, 23 March 1896 – from Sydney regarding bat's heads, AAS MS56 1/21.
52 Elliot Smith to Robert Broom, 2 September 1896 – from London regarding *foetal Phalangista*, AAS MS56 1/26; Elliot Smith to Broom, 11 December 1896 – from London regarding the same, British Library, Add. 56303 (Warren Dawson Papers, including transcripts of Elliot Smith's letters) [hereafter BL Add 56303], XLVI.
53 Elliot Smith to Broom, 3 September 1897 – from Montreal regarding *Chrysochloris*, AAS MS56 1/31 (Elliot Smith was in Canada for the British Association meeting); Elliot Smith to Broom, 25 December 1901 – from Cairo, Egypt regarding *Macroscelides*, AAS MS56 1/42; Elliot Smith to Broom, 5 November 1902 and 2 March 1903 – from Cairo regarding lizards and *Insectivora*, respectively, BL Add 56303/XLVI.
54 Elliot Smith to Wilson, 21 November 1902, USA P162; Elliot Smith to Wilson, 27 May 1897, AAS MS56 1/97.
55 Elliot Smith to Broom, 4 April 1903, from Cairo, AAS MS56 1/47.
56 Elliot Smith to Wilson, 12 April 1908, from Cairo, AAS MS56, 1/433.
57 See David Fleming, 'Science in Australia, Canada, and the United States: Some Comparative Remarks', *Proceedings of the Tenth International Congress of the History of Science, Ithaca, 1962* (Paris: Herman, 1964), pp. 179–96; Bassala, 'The Spread of Western Science'.
58 Whilst there is no universally accepted definition of social capital, most theories understand it as accruing because of network membership. Pierre Bourdieu defined social capital in contrast to economic and cultural capital as 'the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance or recognition'. For him it is a positive attribute. See Pierre Bourdieu, 'The forms of capital', in J.G. Richardson (ed.) *Handbook for Theory and Research for the Sociology of Education* (Westport, CT: Greenwood Press, 1986), p. 248. By contrast, for James Coleman social capital is neutral: 'a variety of different entities having two characteristics in common: They all consist of some aspect of social structure, and they facilitate certain actions of individuals who are within the structure'. See James Coleman, *Foundations of Social Theory* (London: Belknap Press, 1990), p. 302.
59 Soft information is considered to be essentially qualitative in nature (such as suggestion, opinion, rumor, anecdote, speculation, and tips), unlike hard information, which is quantitative.
60 See J.S. Haldane to Wilson, 1 July 1909, USA P162 3/2; C.J. Martin to Wilson, 7 January 1903, USA P162 3/3; Elliot Smith to Wilson, 27 January 1920, USA P162 3/4.

61 J.S. Haldane to Wilson, 1 July 1909, USA P162 3/2.

62 On at least one occasion Barff wrote to Wilson entirely off the record, 'without authority from the Chancellor or the Senate'. See, Barff to Wilson, 14 December 1923, USA P162 5/3.

63 Hill to Wilson, 21 January 1903, USA P162 3/5; Elliot Smith to Wilson, 27 May 1897, AAS MS56 1.

64 Copy of letter from Broom to Lady Elliot Smith, 12 January 1937, BL Add. 56303 70–1.

65 Hill to Wilson, 18 January 1907, BL Add 56303 70–1.

66 Lightholler to Wilson, 14 August 1933, USA P162 5/6; Editor of *Nature* to Wilson, 15 August 1936, USA P162 5/9; Lightholler to Wilson, 28 March 1938, USA P162 5/9; Edgeworth David to Wilson, 8 July 1924, USA P162 5/3. G.H.S. Lightoller studied under Wilson and pursued research in the Anatomy Department at Sydney while working as a consultant physician.

67 John Darwin has used concept of the 'bridgehead' as a 'hinge or interface between the metropole and the local periphery' to explain the variations in British imperial policy. See John Darwin, 'Imperialism and the Victorians: The Dynamics of Territorial Expansion', *English Historical Review* 112, 447 (1990), 629.

68 Quoted in Morison, *J.T. Wilson and the Fraternity of Duckmaloi*, p. 286.

69 Dart to Wilson, 17 June 1931, from Johannesburg, USA P162 5/6.

70 Wilson to Barff, 27 March 1923, from Cambridge, USA P162 5/3.

71 Elliot Smith to Wilson, 19 June 1909, USA P162 3/4.

72 Elliot Smith to Wilson, 25 January 1919, USA P162 3/4.

73 Elliot Smith to Wilson, 15 September 1919, USA P162 3/4.

74 The term was first coined by the *Evening Standard* in 1963 in reference to a report of the Royal Society that highlighted what seemed to be an increase in the emigration of British scientists and engineers to North America.

75 Referring to Roy MacLeod and E. Kay Andrews' article, 'Scientific careers of 1851 Exhibition Scholars', *Nature* 218 (1968), 1011–16. Katrina Dean makes a similar point when she presses for the necessity in examining the negotiation and advocacy strategies central to the awarding of 1851 Scholarships to the physicists Ernest Rutherford and T.H. Laby. See Katrina Dean, 'Inscribing Settler Science: Ernest Rutherford, Thomas Laby and the Making of Careers in Physics', *History of Science* 41 (2003), 217–40.

Part III

Knowledge and Networks at the End of Empire

8

Albert Howard and the Decolonization of Science: From the Raj to Organic Farming

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The decolonization of certain environmental narratives runs parallel with the fall of the British Empire. While the idea of a 'household of nature' developed by empire foresters in colonial India merged with mainstream ideas of ecology, certain shades of this scientific narrative did not make the successful jump from imperial to democratic scientific circles with the same ease. This is particularly the case with environmental ideas that revolved around the 'Law of Return' that formed the basis of the organic farming movement pioneered by Albert Howard. If, as Roy Macleod points out, 'knowledge has been a companion of commerce, and both have followed the flag', then we can see how the advocates of wholeness after the Second World War began the process of separating knowledge of commerce from knowledge of the flag, in this case imperialism.[1] Drawing heavily on romanticism and the observation of Indian culture, Howard published widely in scientific journals and his work soon resonated with a broad popular audience scattered throughout the British Empire and elsewhere.

This chapter traces the development of Howard's ideas within its imperial laboratory, and then examines how one journal in particular, the *Organic Farming Digest*, absorbed and circulated these narratives to farmers, gardeners, and amateur 'health food' enthusiasts. The *Organic Farming Digest*, founded in 1946, was the first journal to use the word 'organic' in its title and bridged the work of imperial scientists, politicians, and amateur enthusiasts. It reveals that 'health food movement' enthusiasts favored an 'imperial science' over a suspect 'capitalist science'. This dichotomy between imperial and capitalist science helps explain how the post Second World War environmental movement drifted, after decolonization, from it origins on the political right into a green movement largely on the political left, while at the same time, retaining a distinct partiality for scientists with outsider status free from vested capitalist interest.

Historians, as Joseph Hodge points out in Chapter 1, have been attempting to escape the Eurocentric divide between center and periphery and to grapple with the complexities of how knowledge circulated in and around the British Empire, not only as spokes radiating from the wheel of London, but with and between colonists and indigenous peoples. Albert Howard stands out as a prominent, if hitherto under investigated, contributor to this imperial synthesis of local and European knowledge; in this case produced through a network of scientists, settlers and Indian farmers. As Alan Lester and Tony Ballantyne have suggested, and as this chapter illustrates, knowledge and experience moved in a globalized web of interaction within the British Empire.[2] This chapter seeks to understand how the ideas that drove the organic farming movement – which continues to exert a profound influence on the thinking and consumer practice of the modern world – arose as part of this imperial synthesis.

In the twentieth century, a confluence between government and science was used to develop the empire into a sustainable entity. The circulation of ideas then filtered into development projects and then into a broader environmental movement.[3] Yet, a number of questions still stand out. Why did this imperial synthesis of local and European knowledge occur in India, and in particular, with the scientist Albert Howard?[4] Why did followers of organic farming divide knowledge into a trustworthy imperialist tradition from an unworthy capitalist origin? Finally, how did organic farming, which was and still is an integral part of the conservation and environmental movement, shift from a far-right imperial narrative to a left-of-center anti-capitalist narrative; what I am terming here the decolonization of science?

This study argues organic farming arose in India because a unique culture of independence evolved in British Indian institutions. This greater scope of action in turn allowed a scientist like Albert Howard to have more freedom in his investigations than he would at home in Britain. Curzon in particular attempted to create space for, in Deepar Kumar's words, a 'science in India [that] could and should be cultivated without supervision from London'.[5] Curzon had this precisely in mind with the creation of the Board of Scientific Advice (BSA) in 1902 and later, the Imperial Research Institute in Bihar. Thus this new imperial synthesis arose more by the design of the Indian government than by accident.[6] A study of the organic farming movement in India also shows that 'colonial science' as a discrete concept is not the invention of historians of imperial science that arose during the last three decades. Rather 'colonial science' is a concept that was understood – and utilized – by settlers around the British Empire since the early and mid part of the last century.[7] It is also interesting that indigenous 'problems' more than indigenous knowledge led to this new imperial synthesis. Europeans attempted to solve indigenous problems, such as nutrition or soil fertility, in an institutional framework sponsored by the British Indian government.

Howard arrived in India with not only a romantic attachment to traditional agricultural methods, formed under his mentor Marshall Ward at Cambridge, but with a philosophy that rapidly crystallized into a quest for wholeness in human and societal health. He formulated the 'Indore Method' that drew heavily upon scientific experiments carried out by the Indian Forest Service. He came to believe that farms, like forests, must recycle nutrients through a mycorrhizal process that involved composting the soil. His new method would keep the cycle of nutrients moving through the ecological chain of life from compost to soil, animals, plants, and humans. Howard propagated this organic farming philosophy, in addition to his popular writing, by establishing a network of research stations and model farms in Australasia, Africa, Britain, and other parts of the empire.[8] This organic network gave rise to an army of supporters who in turn further popularized this particular scientific narrative of wholeness. These included figures on the far right like the Earl of Portsmouth and Sir George Stapledon; the Chair of the Soil Association in Britain, Lady Eve Balfour; nutritionists like Sir Robert McCarrison and G.T. Wrench; medical clinics like the Pioneer Health Center in Peckham, South London; and activist publishers like Jerome I. Rodale in the United States. Howard's work also came to be admired by a diverse array of political figures, from the Labour premier of New South Wales, William John McKell, to National Socialists like Joseph Goebbels and anti-imperialists like Mahatma Gandhi.

Albert Howard in India

As the economic botanist working for the Imperial Agricultural Research Institute at Pusa, Howard considered himself a respected member of the mainstream scientific community. He loathed, however, overspecialization and had little truck with jargon. He advocated cross-fertilization of specialties and decompartmentalization of research. He insisted that scientists learn to research in an atmosphere that brought specialists together in a crossdisciplinary manner. He had much sympathy with the burgeoning field of forestry because forest management involved scientific specialists such as botanists and ecologists who worked with forest rangers to manage the whole 'household of nature'.[9] Howard's emphasis on a big picture of wholeness, even while specializing in plant disease and crop yields, opened the possibilities of popularizing his work in the future. At the time of his arrival in India he had not formed any definite theories of wholeness that would separate him irrevocably from the mainstream scientific community. But his work at the Imperial Agricultural Research Institute at Pusa, built near the banks of the Ganges river in Bihar, would force his views to take flight from what he considered the iron cage of scientific specialty and to reinforce in the mind of his many followers around the British Empire a distinction between a trustworthy and objective imperial science and a capitalist science beholden to vested interest.

Pusa was (and still is) a small village, close to the Ganges River on the broad swath of alluvial soil between the Himalayas and the elevated central plains of India. Lord Curzon established the Agricultural Research Institute at Pusa in 1905, renamed in a few years the Imperial Agricultural Research Institute (IARS), and overruled all objections to the new imperial center. He preemptively rejected pleas from scientists to fund regional and highly specialized research stations sensitive to the peculiar climatic and soil needs of each province and substituted instead a grand vision for a new imperial temple of science to support a unified India. He established Pusa to reflect the status of the IARS as the central research hub of agricultural science for the whole of the Indian empire, similar in function to the Imperial Forest School at Dehra Dun. Once proposed to the British Cabinet in 1903 the project moved forward swiftly. Mr. Phipps, a Chicago millionaire and Curzon's father-in-law donated 30,000 pounds. The location of the IARS also came to bear his name; 'Phipps' and 'USA' combined became 'Pusa'.[10]

The IARS represented the power and it was hoped, the future of the Raj. The building hoisted a central dome with four adjunct domes, each topped again by a second-tier open-dome in the Indo-Saracenic style. These overlooked massive Roman wings fronted by two marching rows of neoclassical columns and fit in well with the new empire style favored by Curzon. The new temple of science was symbolic of the imperial synthesis where modern Europe met ancient India. Curzon predicted that 'an enormous future lies before Agricultural research, experiment, administration, and education in India. This large central institution, with proper officers and scientists would turn a seed into "a mighty tree"'.[11] Thus, Pusa would formulate solutions to agricultural problems that threatened to undermine British imperial power on the subcontinent. Curzon saw the station as a blend of east and west, a 'unity of European science and native art', in Metcalf's description of Saracenic architecture.[12] Curzon personally oversaw the architectural plans for the Agricultural Research Institute. Interestingly his notes in the margin of the plans questioned the soundness of the design against earthquake. The prospectus of the new institute, published in 1906, anticipated an agricultural chemist, a mycologist, an entomologist, an agriculturist, and an economic botanist.[13]

Under the new Viceroy, Lord Minto, Albert Howard arrived in 1905 to take up the duties of the economic botanist charged with researching plant diseases and raising the yield of staple crop varieties, particularly of the most important crop grown on the subcontinent, wheat. Previously Howard had conducted research on raising the fertility and yield of the hops plant in England by fertilizing the female hops plant. His research led him to conclude that emulating a 'natural approach' to plant resistance was the most beneficial. But his earlier work did not inevitably steer him to his later conclusions in India.[14] In fact there are reasons to believe that when Howard arrived in India he held a far more mainstream view of the use of chemicals to enhance agricultural productivity, and even had little aversion to the use of chemical pesticides. Howard did not unpack his ideas about the 'Law of Return' from his luggage when he arrived at Pusa from England.[15]

The earlier views of Howard have never been explored. His work on a committee investigating the problem of reducing plant disease and insect pests through fumigation clarify an important point – that his ideas on organic farming were not formed before he arrived in India. A speech by T. Bainbrigge Fletcher, speaking at an entomological meeting held at Pusa in 1919, reveals the background to this remarkable episode. At this meeting, Bainbrigge Fletcher assailed the lax laws throughout the British Empire that 'until about a year ago' had left India as 'a free dumping-ground for the plant-breeding pests of the whole world'.[16] Anyone, he argued, was at liberty to bring in fruit, ornamental plants, sugarcanes and other plants with 'any insects that happened to be living on them'. Insects and plant diseases had thus spread widely. While a parasite may have lived for 'innumerable thousands of generations' in its own country with little harm due to natural predators, the change of climate and conditions that this biological *laissez faire* offered to parasites and predators, including animals, led many to go on a relatively unopposed rampage.[17] The West Indies and Guiana had been ravaged by a sugarcane weevil from Antigua (Spenophorus sacchari). India had a sugarcane beetle from Java (Holaniara pecesen), and the aphis from Ceylon and England feasted on young coconut trees and apples.[18] While the Indian Government had tried in the past to avoid these problems with legislation, it had been to little avail. A committee, however, had been appointed to meet at Pusa in November 1911 at the order of the Agricultural Department and the Inspector General of Agriculture.[19] At last, he boasted, a project had been initiated on the advice of the committee: the restriction of importation to a few ports, and effective fumigation of plant material in fumigation devices that soaked the plants in hydrocyanic acid gas at the point of entry.[20]

Albert Howard served on this committee and approved its decision. There is no record that he held any reservations. This heavy reliance on artificial chemicals to fumigate select fruits, vegetables, and other plant materials applied to the seven ports in India that were allowed to import plant material by sea. Land routes were exempt on the assumption that ancient roadways had already normalized botanical exchange between neighbors. Further, the Government of India was strongly urged to consult 'foreign Governments and Native states' with seaports in India to implement similar restrictions.[21] Howard's work on this committee indicates that his strongly expressed aversion to chemical pesticides was not imported into India with him from England. As will be shown below, he also had the main outline of his ideas for organic farming in place at Pusa before he developed his now famous 'Indore' compost method that lies at the core of his ideas for organic farming. These markers are important because they indicate that his ideas developed in the milieu created by the Imperial Agricultural Research Institute at Pusa, and that he then tested and further developed these ideas at the research station at Indore. Since Albert Howard would later rail against the use of pesticides, chemicals and artificial methods of agriculture, the early views of Howard only highlight the apparently transformative effects of the IARS at Pusa, and the imperial synthesis that Curzon had advocated.

Albert Howard did not stand out from his colleagues as a unique advocate of mixed farming techniques or as a scientist that romanticized traditional agriculture. Others at the IARS shared such romantic notions as did D. Clouston, the Director of the IARS, who oversaw the team of specialists that included Howard.[22] In a report on Indian agriculture Clouston used language similar to romantic farming literature published in England, and appealed to the same popular sentiments that Howard addressed later in books aimed at a popular audience. He praised an 'Eternal India…whom to know well is to love'. The Indian peasants, he wrote, possessed 'patience, [a] high standard of honesty and rustic charm' while 'the common feature is the hamlet and the village, and it is in rural life that both in the past and present India has found her most distinct medium of self-expression'.[23] Written in 1925 his language on rural India is almost identical in tone and sentiments to the romantic farm literature that lavished praise on the peasants of Europe and on Anglo Saxon farming methods. He described the Indian village as largely self-contained, with peasants living a simple and happy life, free from capitalistic usury where even 'finance [was provided] by country traders who were found mostly in the large villages and small towns'. The railway, the steamship, and the construction of the Suez Canal, ruined the 'Arcadian economic conditions' to be found in these Indian villages. Good intentions had bad effects, where 'the extension of peace and security by the growth of British power effected great changes in our time'.[24] Clearly, to Clouston, if Merry England had been lost to modernity, so too had Merry India.

Howard worked with colleagues who developed ideas along similar lines – he was not an aberration. The bacteriologist C.M. Hutchinson worked on the nitrifying organism in the soil, and ways to encourage its growth.[25] He experimented with ways of 'supplying such organism to soils in which they are deficient, or, ...adopting methods of agricultural practice which would allow the fullest development of those already naturally present'.[26] In one annual report he suggested that the 'biological factor on soil fertility' is of 'prime importance in agricultural practice'. This included the biological availability of plant nutrition found in the soil, and above all, those biological factors 'concerned in the decomposition of organic matter in Indian cultivated soils', and how that relates to manuring, weathering of soils, and plowing.[27] This research gets tantalizingly close to Howard's later breakthrough on compost at Indore, and in fact makes it clear that though his early colleagues have not been discussed in the historical accounts of organic farming, his narrative of organic farming arose from interaction with a web of imperial scientists working on similar problems.

Howard began his work at the IARS by producing a botanical survey of the varieties of wheat in India.[28] His India-wide investigations had as the main object the improved resistance to disease and better hybridization of wheat. But his work also focused on fruit, fibers, oil seeds, barley, opium, and cassava varieties, as well as tobacco, tea and an abiding interest in tree diseases that affected Indian forests.[29] He also advised the Kashmir Durbar on hop cultivation, and consulted on the development of the fruit industry in Baluchistan. On leave back in England he worked on rust resistant wheat, and the opportunities for the importation of Indian wheat and tobacco. He wanted Indian and Kashmir products to 'enter the market of the world as a competitor with California'.[30] He was proud that his new wheat varieties were in demand in Hungary, the United States, and Australia.[31] He also visited agricultural stations in Ceylon and revisited stations of interest in England.[32] His constant touring of the Indian empire, his scientific publications, and his praise from superiors tell us that he was not a maverick working outside established scientific networks in India. Bernard Coventry, the Inspector General of Agriculture in India, and his supervisor, offered exceptional praise for Howard and his achievements at Pusa.[33]

In Howard's first major publication, *The Wheat of India*, co-written with his first wife, we see how early in his career – well before he arrived at the Indore research station – he absorbed assumptions about the need to return nutrients to the soil and to learn from the Indian farmers themselves. He framed his investigation by noting, in a similar manner to empire foresters, that India required the 'application of Western Scientific methods to the local conditions', in order to improve Indian farming 'on its own lines'. He traveled personally over the ancient 'alluvial plain' that lay south of the Himalayas, stretching from Bombay to Bengal, and rapturously described the soil of northern India, from the fringes of the central plateau, to the rice swamps of Bengal, which had 'only recently recovered from the sea'.[34] His extensive survey of wheat varieties in India included a close reading of regional farm experiments that had taken place in most of the Indian empire. This breadth of research gave him food for thought. The voluminous literature on Indian agriculture that he read for this survey provided key concepts that formed the nucleus of his thinking well before the Indore experiments that followed. Rather than artificial fertilizer, the return of nutrients to the soil in the form of manure and plant products lay at the core of his innovative compost idea. His book, *The Wheat of India*, shows that experimentation with manure by other imperial science officers was already widespread at experimental farms throughout India.

Before Howard had formulated his Indore compost process, he had already concluded that new growth accelerated by nitrogen did not produce a healthier plant. He also concluded that it was time to pay attention to the 'quality as well as on the yield of wheat'.[35] He noticed that continuous application of Saltpeter, a nitrogen-heavy mineral used as a fertilizer, injured the tilth and the humus of the soil, and resulted in 'a gradually diminishing yield compared with the animal nitrogenous manures'. He also discovered that plowing a crop back into the soil as a green manure was 'not very encouraging'.[36] Significantly he saw that old plant refuse gave a higher yield than fresh refuse. These conclusions led him very close to the design of the 'compost pile' where bacteria broke down plant and manure refuse until ready for dispersion over the soil. While Howard's ideas at the IARS came together in collaboration with colleagues, there is very little hint of such indebtedness in his popular writing. In *An Agricultural Testament*, the IARS at Pusa is blamed for hindering his work because it divided crop research 'into no less than six separate sections'. No progress could be made 'without complete freedom' and the bureaucratic specialists at the IARS stood in the way of such progress. He escaped these limitations, he wrote, by his move to the Indore research station where he could follow his own agenda.

The Indore Process described the composting method devised by Howard at the Institute of Plant Industry, Indore. In this location, from 1918 to 1924, Howard planned a new research station where he could experiment on the whole life of the plant from soil fertility, to seedlings, growth, harvest, and finally plant nutrition. He needed freedom of action to cover the broad range of mixed agriculture to mimic a model farm. It also meant observing the whole life of the plant, from returning plant debris, manure, and other material to the soil in order to guarantee plant health and then, human health through proper nutrition. Just before moving to Indore, he had suggested that he wanted to apply 'the Chinese-Japanese principles of composting to Indian conditions'.[37] Such observations of wholeness were simply not possible, he felt, if his investigation divided into subspecialties.

He launched his new agenda when he gained a grant to undertake research from the Indian Central Cotton Committee and land, donated by a local prince, and then financial support from the Central Indian States. His new research station operated under the sponsoring umbrella of the Institute of Plant Industry. This gave him the resources he needed to conduct experiments as he saw fit, and in a wholesome fashion. Here he worked from 1924 to 1931, and experimented with the effect of composting on humus.[38] He concluded that farm waste, manure, plant cuttings, leaves, forest products like leaves and twigs, urine, wood ashes, and any other organic material could be mixed with water, air, bacteria and fungi in a compost pile constructed to quickly enhance the natural breakdown of the materials. When spread on the soil, the roots of the plant absorbed the microorganisms in the soil – a process called the mycorrhizal association. This process suited India because it fit the economic reality of the Indian peasant. It returned nutrients to the earth; it maintained the balance and health of soil; it produced if not a higher yield, a more nutritious food that, in turn, had a positive effect on human health. Artificial fertilizers, or chemical dope, he argued, lacked this natural process. In a white heat, and soon after the death of his first wife, he wrote his ideas down as his term of service at Indore expired. Exhausted from his labors, he left India in 1930 with the draft of his first book for a popular audience, detailing his new ideas. These ideas soon became a campaign, and were picked up by enthusiasts in and out of scientific circles throughout the empire.[39]

The biography of Howard, written after his death by his second wife, is partially responsible for the exclusive focus on Howard's innovation to the exclusion of his colleagues. It also explains the heavy romantic focus on traditional methods. Yet his imperial mission was not glossed over. It was taken for granted, she said, 'that it was the function of the British Government in India to confer on the peoples of India all the advantages of Western scientific discovery'. In this capacity he lacked, she claimed, all class bias. He was equally at home with his colleagues, the Princes of India, and members of the House of Lords. He listened to the humblest Indian peasant of Bihar, and Indore, as well as the British planters in the West Indies. 'More especially did he acknowledge the lessons to be got from the century-old experience of the Indian peasants, whom in later life he most happily named his "professors"'.[40]

It is probable that the romantic lesson that Howard learned from Indian farmers was overplayed, and credit to his colleagues somewhat overlooked. In this same biography Gabrielle Howard (his first wife) admitted, tellingly, that the Howard's spent little time in social engagements, which had not 'added to their popularity' at the Pusa station. That might explain why Howard stressed the importance of his work at the Indore research station. Not only did many of his colleagues share a romantic attachment to traditional agricultural methods, and an appreciation of indigenous peasant knowledge, but the publications that his colleagues at the IARS produced showed an active and abiding interest in the mycorrhizal process, and in the use of manures to restore soil fertility. More specifically, only two years after Howard arrived at the IARS his colleague, E. Shearer, published a detailed review in the IARS published, *Agricultural Journal of India*, titled 'Note on Agriculture in Japan'. In this article Shearer reviewed in substantial detail those portions of a book by F.A. Nicholson that related to Japanese agriculture. Shearer, following Nicholson's lead, laid out a formula for composting that almost exactly corresponds to Howard's Indore compost method. There is no reasonable likelihood that Howard did not know of the interest, or the publication of his colleague, and it is very odd that Howard never referenced

Nicholson's book or this article by Shearer. This does not distract from the remarkable accomplishment that Howard attained at Indore, because Howard clearly gave a scientific rationale for the methods practiced by Japanese, Chinese, Indian, and European peasant agriculture. But the lack of candor about the debt that Howard owed his colleagues at the IARS has obscured what is only now becoming clear: Curzon set up the IARS to apply Western scientific knowledge to an Eastern culture, and the IARS succeeded in this imperial synthesis with the development of organic farming, which has now proved such a central part of the modern environmental movement and become embedded in global culture. Howard's reticence to share credit has obscured the institutional origin of organic farming.[41]

The IARS was, along with the Indore research station, the birthplace of organic farming. An earthquake took down this monumental construction in 1934, leaving the famous central dome, the Phipps Laboratory, in ruins. The viceroy Lord Lithgow then moved the IARS to Delhi in 1936 where it has remained ever since. The earthquake can be seen as a tragic metaphor for the loss of prestige that would in the next few decades befall the narratives of wholeness and organic farming pioneered by Howard. While many scientists in and out of the empire accepted the principles of organic farming well into the 1950s, the scientific community increasingly became suspicious of Howard's blend of science, romance, and orientalism, favoring instead the more practical mainstream model of specialization and artificial chemicals that raised crop yields. The 'Green Revolution' of the 1960s and 1970s depended upon artificial pesticides and fertilizers, which successfully raised yields in India, Mexico and other parts of the world. But this revolution also built upon much of the work accomplished at the IARS, particularly the knowledge base laid down by its pioneering work on wheat varieties and farming techniques. But the distance from the Phipps laboratory dome that oversaw the institute at Pusa to the small-scale organic farming journals that sprung up all over the empire illustrated the monumental loss of institutional support – a decolonization of scientific narrative – that sent Howard's 'Law of Return' into the wilderness for decades.

The organic farming digest

It did not take long for popular circles around the British Empire, as well as in England and the United States, to pick up on Howard's scientific narrative. The way that amateurs interpreted Howard's work partially explains its popularity. It also sheds light on that crucial point in environmental history after the Second World War when the environmental movement began a slow but steady shift away from the right of the political spectrum to the left. In the late 1940s and early 1950s, organic farming literature arose as part of a larger quest for pre-industrial wholeness, and a return to traditional agricultural methods. This literature often promoted a sharp distinction between a noble 'imperial science' that seemed to capture the virtues of public service and objectivity, even aristocratic ethics of duty, over and against an industrial age, 'capitalistic science' that served a new elite of large industrial combines and cosmopolitan financiers.

Although the early followers of Albert Howard tended to express far right inclinations, they could nonetheless be found all over the political spectrum; from former fascists and ultra-Tories, to Labourites in Britain or Labourites and Liberals in Australia. All however had a profound political appreciation for the importance of race and soil. These overt fascist sympathies, however, evaporated slowly during and after the Second World War, as did overt support for the British Empire as decolonization set in during the 1950s. We see this clearly in the first journal to use the word 'organic' in its title, the *Organic Farming Digest*. Howard's breakthrough on organic farming is credited to the Raj, while those who disagreed with Howard produced a suspect scientific narrative influenced by ill-intentioned chemical manufacturers. However in the years following the independence of India and against the steady drumbeat of decolonization, references to an imperial science faded, leaving behind a deep residue of hostility to large-scale industrial capitalism and a penchant for scientific outsiders that have remained an indelible characteristic of the modern environmental movement.[42]

A cattle grazer, H.F. White, and a farmer, V.H. Kelly, started the world's first journal to have the name 'organic' in its title, published in Sydney, New South Wales, Australia in 1946.[43] William John McKell, the Premier of New South Wales and the future Governor-General of Australia, introduced the *Organic Farming Digest* in the first article, linking the preservation of trees with the preservation of farmland.[44] Albert Howard served as the honorary patron of the society. The journal adapted Howard's ideas to the local Australian scene, along with those of fellow travelers of the organic farming and nutrition movement, such as G.T. Wrench, Robert McCarrison and others. It lasted only a few years, from 1946 to 1952 and disbanded due to lack of funds. But this early organic farming journal, like a handful of others around the British Empire, inspired a populist response to scientific narratives that originated in the British Raj.[45]

Australian farmers suffered from very particular challenges unique to the great southland. The continent, with the exception of a narrow strip of land along its indented coast, most of it on the eastern side, had nutrients washed out of the soil for millions of years. This ancient land in particular lacked phosphorous, and after a few years of good crops soon produced lower yields. Therefore the introduction of artificial fertilizers with phosphorous, and the remarkable success of the Correll Family, who introduced in South Australia the use of seed drills simultaneously with phosphorous use, led to the wholesale abandonment of traditional methods of farming. This occurred despite a cultural bias against 'experts'. Scientists and company salesmen who had recommended nitrogenous fertilizers for Australia based on results in Europe or the United States, had cost obliging farmers dearly – the soil, as Alfred Pearson, chemist of the Victorian Department of Agriculture had warned, was actually high in nitrogen and potassium. But the application of phosphorous proved so successful that by the 1920s its use, along with improved methods for dealing with drought and weeds, turned Australia into a powerhouse exporter of agricultural products, particularly wheat.[46]

Problems with chemical fertilizers soon followed however. As both Michael Williams and Lionel Frost have pointed out, modern farming methods had accentuated problems with drifting sand, leading to American-style erosion similar to the dustbowl desertification that drove thousands of small farmers off the land. Soil exhaustion led to soil problems which after the First World War affected large swaths of agricultural land that stood well outside Goyder's line in South Australia. Thus in the aftermath of the Second World War many farmers were receptive to solutions of soil fertility, yield, and plant health that did not rely on the same chemical fertilizers that had contributed to soil degradation. This explains, in part, why the *Organic Farming Digest* filled such a need in Australia.[47]

What is of particular interest in these early articles however is how the editors and readers of this pioneering organic journal translated scientific narratives from India into 'imperial science' and 'capitalist science', though these were not always the terms specifically used by the authors. The flashpoint of conversation that led to the emergence of these two scientific genealogies, often (but not always) revolved around the doctrines of the Liebig era and the Rothamsted Experimental Station in England, both of which were seen by Howard's followers to contradict his work. The Liebig era is associated with doctrines that explained plant nutrition through simple chemical analysis, and arose in the latter part of the nineteenth century when chemical fertilizers became the norm for most farmers in Europe and the United States.[48] But it was the challenge of the Rothamsted Experimental Station that aroused the greatest fury in the organic farming movement. John Lawes, who founded the Rothamsted Research Station in 1843 also manufactured and sold artificial fertilizers. As the oldest agricultural research institution in the world, this station in the 1930s investigated statistics and genetics, and after 1943 under the directorship of William Ogg, added yet more specialized departments in biochemistry. It stood in the minds of organic farming supporters as the symbol of the triumph of industrial chemistry over botany, biology, and ecology. It was, in their minds, the Liebig movement run amuck.[49]

The *Organic Farming Digest* manifested a theme of hostility toward the Rothamsted Experimental Station from the start. One writer, A.S. Neeham, highlighted an argument repeated throughout the journal:

> Howard had the unique opportunity in India of carrying out a lifetime of research with public funds and no interference from vested interests. His conclusion was that chemical manures are anathema. Sir Albert has shown that animals fed on food grown with chemical manures are disease-ridden, while comparable animals on the same diet grown on soil treated with organic manure are healthy. Such vital research gets no publicity, and the food we eat is mostly grown with artificials.[50]

Neeham also pointed out that in the Rothamsted annual report 'you will find that considerable sums are received from the Fertilizer Manufacturer's Association, the United Potash Co. Imperial Chemical Industries, the Association of British Chemical Manufacturers, British Basic Slag Companies, etc'. He argued pointedly that '[a]gricultural research in Britain is largely supported by, and its direction controlled by, the Chemical Combine'. While good work had been done at Rothamsted, he observed, 'it has always been largely concerned with methods of using chemical manures'. This science of the vested business interests has been behind modern agricultural practice, and 'vast tracts of the earth's surface was being turned into desert by mechanized chemical farming'. Behind it all was the fact that '[a]gricultural research in this country is concerned mainly with devising methods of using chemical manures so that their long-term destructive effects are not immediately apparent'.[51]

Articles in the journal argued repeatedly that vested interest ruined scientific enquiry, and that usury had ruined the soil. Excerpts from the 'Alternative to Death', by the Earl of Portsmouth (Viscount Lymington) lambasted a financial system that led to the indebtedness of farmers. This debt forced farmers to mine the soil instead of farming it properly for long-term sustainability.[52] Examples from the empire abounded, Portsmouth argued, of ruined soil caused by capitalist monocrop cultivation. Albert Howard, in a review of an article by E.J. Salisbury, from the *Journal of the Royal Horticultural Society,* lamented that Barbados in the West Indies had been ravaged by 'forty years [where] artificials have steadily replaced pen manure' and this was followed inevitably by 'virus disease....[and] the loss of productive power in the cane'. This compelled the imperial government to seek a grant of £171,810 under the authority of the Colonial Development and Welfare Act to develop 'mixed farming based on animal husbandry'.[53] In North Bengal he had witnessed tea plantations in 1937 rejuvenated with the restoration of 'nature's law of return' when the 'Indore Process' was implemented without 'artificials'. The tea was then, 'to all intents and purposes free from disease'.[54]

Vested interest ruined science. In a reprinted article titled 'Milk and Soil Fertility', F. Sykes opined that 'enormous vested interests' were behind chemical fertilizers, which produced 'conniving and extremely clever propaganda' that had all but abolished natural manures. These powerful interests devastated the soil of the farms. The effect of big business on human nutrition was equally deleterious. Those 'interests employed in the making of artificial concentrates for humans, sold in packets and tins' deprived the 'whole germ and life-giving qualities [of grain]'. Then the same business interests turn around to sell these 'extracts of wheat (the germ) and sell these foods at ridiculous prices as real vitalizing foods'. The result is the devastation of human health and the enrichment of the 'pill and drug trades, whose immense wealth is built upon' unhealthy soil. He concluded that 'these manifold forces of immense power stand right in the way of food reform'.[55] However Sykes suggested an alternative: 'Government enforcement of...composting processes using animal residues for their activation' that would restore health to the soil and to the humans depending upon the soil.[56]

This vested interest created a capitalistic science that placed a premium on chemistry because chemistry could raise crop yields at the expense of nutritional quality. One article titled, 'Cheapness is Expensive', argued that 'the really important point [was] that statesmen, scientists, farmers, consumers, wholesalers, and retailers alike, would get cheapness out of their minds – cheapness necessarily concentrates attention on gross yield per acre – and consider first and foremost ultimate nutritive value'.[57] Another entry reprinted from a speech delivered at the Hawkesbury Agricultural College in New South Wales in 1946, saw disconcerting connections between chemistry and capital. The science of chemistry, so easily dominated by vested interests, missed the biological activity of the soil involved in the mycorrhizal process, and thus missed the value of the process that lies behind organic farming. Biology is not about cheapness and capital. There were 'disconcerting biological facts which utterly destroy chemical theories'. Chemistry misses the 'interrelation of living things – plant, animal, insect, etc, – [biology] is termed ecology'.[58] Can anyone doubt, he concluded, that human health 'depends more upon food than upon any other single factor in our environment', and thus, he concluded, 'upon biology, and not upon chemistry?'[59]

One entry reprinted an introduction to a New Zealand seed catalogue from Arthur Yates and Company who sold a wide variety of fertilizers. The introduction by this small company concluded with 'Yours sincerely, for our country against "rackets".' The article, penned no doubt by Arthur Yates, the business owner, made a clear distinction between small enterprises like his own and the 'vested interests' with their 'hundreds of millions of pounds capital' that they use to 'buy or kill serious opposition'. Yates claimed that these capitalists had even bought off the government departments in New Zealand through financial influence. Superphosphate companies, he said, received £1,500,000 of subsidies each year yet none came to the manure-based fertilizer companies, such as his own.[60]

The editors of the *Organic Farming Digest* offered readers a brilliant contrast with scientists from India. These imperial scientists were praised as lavishly as the Rothamsted Research Station and the Liebig system was condemned. On the publication of G.T. Wrench, *Reconstruction by Way of the Soil*, a book reviewer gushed that 'it is refreshing to encounter this latest work…an inspiring account of what might well be the norm for a healthy humanity, the now oft-quoted Hunza race [in India] so lauded by Sir R. McCarrison…and other investigators'.[61] These investigators of wholeness in British India, the review suggested, approach the world like Howard – ecologically and as a unified whole. The review concludes by lauding travel as a key to understanding these differences:

> The traveler comes to the opinion that the modern scientific farm, and especially the experimental farm, is a mixture of forcing house and hospital. It fragments the lifecycle. It is the offspring of a defect of thought, the splitting or departmentalizing of the mind, which disables it from seeing wholeness and that men, animals, plants and soil are inseparably united.[62]

The journal praised Lord Louis Mountbatten who like Curzon had admonished broader visions of scientific investigation to solve the ills of society.

The journal quoted Mountbatten in an address to radio engineers suggesting that 'the scientist has been too much inclined to sit in his ivory tower, washing his hands of the results of his discoveries and inventions. The world is moving fast, and it is up to the scientist to see that it does not move downhill'.[63] Weston Price stood as a perfect example beside Albert Howard of a scientist not bought off by capitalist industry; who investigated nutrition among hunter gatherer societies in and outside the British Empire. He had 'found all over the face of the earth, groups of so called primitive peoples who had learned to live in harmony with their surrounding'.[64]

In a book review of *Thoughts on Feeding* by Lionel Picton, another reviewer pointed out the distinction between true agricultural interests, and 'our Ministry of Agriculture'. Government agencies in Britain almost always represented vested interests versus the honor roll of true scientists, most of whom worked in the British Empire, and the Indian government in particular. Into the hallowed ranks of such true scientists as Rayner, Howard and McCarrison, the author placed Picton.[65] In a defiant note, the author of the review concluded that,

> [i]f a Government cannot be persuaded to express this new knowledge of human nutrition in a practical form, even if it means a complete regulation of our national agriculture, even if it means war with Big Business and the financial interests, then that Government must go.[66]

When Albert Howard died the *Organic Farming Digest* reprinted an obituary from an English magazine, *The Guild Gardener*, that contrasted the 'two schools of agricultural science'.[67] One school, as Howard had put it, learned more and more about less and less, while the other learned more and more about nature, and took, as Howard had, 'the Indian peasant, the cattle, and the whole army of underground workers – earthworms, bacteria, and soil fungi' for its teachers. 'England preferred the first type of agricultural school, the specialist. But the great outer world has accepted him [Howard] wholeheartedly…Reports pour in from every part of the British Empire giving vivid accounts of plantations which were wearing out and crops becoming disease-ridden, now cured through practicing the full cycle of soil fertilization'. The 'democratic government' in Britain however was run by 'rackets' and 'the very force of this movement has, of course, brought reactions from what are known as vested interests'.[68]

As the term 'Commonwealth' began to replace references to the British Empire, a similar unique role for agricultural science along organic lines was articulated. The editor of the January–March 1949 issue of the *Organic Farming Digest* cited with approval the comments made by John Boyd Orr, who served as the first Director-General of the United Nations' Food and Agriculture Organization. The British Commonwealth had 'more manpower', he argued, more land, more nations, than any other entity, and she could lead the world in 'good husbandry which can bring salvation'. America looked down on Britain, and treated her as of 'little account in world affairs'. But America had run out of land, and Americans were ruining the land they had. 'We are the people who can give the lead. We in Britain must stop looking to America'.[69] Interestingly the separation between an imperial and capitalist science expressed by the *Organic Farming Digest* was a reflection of a worldview that was anti-finance, anti-bureaucratic, and pro-empire. It was a view that was soon to undergo a conceptual decolonization, and would soon change dramatically in the process – not only its own view of a dual scientific narrative, but the views of many in the environmental movement of which it was an integral part.

We see in the *Organic Farming Digest* an archival bridge that has been largely missing in the historical literature. It shows how the organic farming movement on the political right adopted a critique of capitalism that would soon segue into a broader environmental movement situated largely on the political left. How? After the Second World War the loss of the empire led to the loss of a positive imperial science that had served to oppose the narratives of vested capitalist interests. Soon not imperial science, but scientific outsiders, many (but not all) on the left of the political spectrum spoke appealingly to popular audiences and replaced the role of pro-imperial spokesmen who had offered such devastating critiques of vested capitalist interests. Outsiders like Rachel Carson, who was also mentioned in the *Organic Farming Digest*, and thousands involved in the counterculture movement of the 1960s joined in the critique. Of the imperial and aristocratic little remains, with the exception of a few very high profile figures like Prince Charles whose support for organic farming continues to tap into an environmental tradition of scientific narrative on the sidelines of mainstream professional and scientific institutions. Having moved from Right to Left and then more recently, to the Center of the political mainstream, it is beyond the scope of the historian to predict the political direction of the environmental movement in the future.

Conclusion

While the scientific narrative about health and wholeness in agriculture and nutrition developed vigorously within an imperial context, it thereafter dropped out of mainstream scientific work (though not completely) and instead was picked up around the empire by amateurs and 'anti-expert' enthusiasts who championed organic farming and the 'health food movement' through the 1940s and 1950s. Tracing the rise, fall and reintegration of the work of Howard into global scientific narratives has potent historiographical implications. It reinforces Richard Drayton's optimistic assessment that environmental history has the potential to dismantle the simplistic and politically driven critique of imperialism and point the way toward understanding the imperial experience on its own unique terms, without the cast of heroes and villains.[70] This investigation also seriously undermines the assertion that British colonial science sought only to control and improve, without a corresponding desire to learn and to change. There was, in the projection of imperial power, a counter flow – not an empire strikes back effect on the metropole – but a symbiosis where new knowledge arose in an imperial setting to change not only the empire, but global culture. There is a hitherto unexplored scientific strain of colonial science that reflected the orientalist romance, not of Westerners modernizing the world but sustaining ancient knowledge.[71] This history remains largely unwritten.

Historians of science have pondered the question of the development of new and creative scientific ideas on the European frontier, or in a colonial setting, often with North America in mind. While distance in the white dependencies could hamper development, as McLeod argues regarding Australia, it may equally be true that the American frontier allowed American scientists to escape the confines of British and European conventions that hampered creativity. Geoffrey Blainey has argued that distance from the European center created a sense of exile that shaped colonial, and in this case, Australian science. Peter Hoffenberg emphasizes that distance from the metropole cuts both ways, and that time and space from the 'aristocratic science of the ancient regime' led to a greater focus on local knowledge, and to creativity.[72]

A similar argument could be made for the advances of an imperial science that sought to discover methods of returning agriculture and human nutrition to a more natural and wholesome mode of living. Organic farming and nutrition narratives developed in imperial India, but once established in England were quickly picked up in the white dominions who faithfully reproduced studies, articles, and results from experimental stations around the British Empire. This leaves a remarkably layered historiographical trail. What is clear is that imperial science cannot be simplified into a cookie cutter analysis by simplistic claims that science strove primarily to 'improve' the colonies, or 'colonize the body' or order, regulate, and control nature. Science represented power and the desire to change the world into the Western image, it is true, but the point borders on the banal because such characteristics are both obvious and integral to all human nature. There is nothing unique about the pursuit of power; it would only be interesting if an exception to this universal human trait were manifested. That is why the quest for agricultural and nutritional wholeness, by Western scientists in a colonial setting, in this case the Raj, forging an imperial synthesis, is interesting and important.

It is also interesting to see the narrative of science go through a process of decolonization, as the environmental movement, bereft of the empire that gave it birth, retained a fondness of the outsider scientist, and retained also an aversion to vested capitalist interests. Because the scientific narrative of desertification and the cycling of nutrients moved from forestry to agriculture, the organic farming movement did not attain its ideal of mixing indigenous and Western knowledge. Rather organic farming was a hybrid of science and romanticism, unified by a search for wholeness that parallels a similar search among orientalists in the British Empire. Even with all of the trappings of the Raj that gave it birth conveniently stripped away, it remains a permanent and central fixture of the environmental movement; one that still poses as a fusion of science and wholeness. The 'health food movement' like environmentalism drew much from an imperial synthesis that has changed the world and now floats free from its roots, a cut flower phenomenon whose future may depend upon successfully reconnecting to a political and scientific culture that supports the universal longing for wholeness that the Industrial Revolution displaced.

Notes

1 Roy Macleod, 'Introduction', in Roy Macleod (ed.) *Nature and Empire: Science and the Colonial Enterprise*, *Osiris*, 2nd series, 15 (2000), 1.
2 See Alan Lester, 'Imperial Circuits and Networks: Geographies of the British Empire', *History Compass* 4, 1 (2006), 134–5; Tony Ballantyne, *Orientalism and Race: Aryanism in the British Empire* (Basingstoke: Palgrave, 2002), 39.
3 Joseph Hodge traces a parallel development in Africa where during the 1940s–1960s a new colonial mission sought to expand tropical production through mechanization and artificial fertilizers. Sabine Clarke's work on the Colonial Research Service confirms this shift to a more metropolitan directed research vision which in turn frowned on local knowledge and experience in the 1940s and 1950s. See Chapter 10 by Joseph Hodge, and Chapter 9 by Sabine Clarke.
4 Gregory Barton, 'The Imperial Synthesis', *British Scholar* 1 (2009), 151–4. Roy Macleod argued that India and Africa particularly were scenes of inter-

action between rulers and ruled. See Roy Macleod, 'Introduction', in Macleod (ed.) *Nature and Empire* 5.

5 Deepar Kumar suggests that British scientists in Indian institutions sought to create a culture of independence and autonomy. See 'Reconstituting India: Disunity in the Science and Technology for Development Discourse, 1900–1947', in Macleod (ed.) *Nature and Empire* 243.

6 Kumar, 'Reconstituting India', in Macleod (ed.) *Nature and Empire*. See also Roy Macleod 'Scientific Advice for British India: Imperial Perceptions and Administrative Goals', 1898–1923', *Modern Asian Studies* 9, 3 (1975), 343–84.

7 I must disagree with Macleod who states that the concept of 'colonial science' owes its origin to historians of science in the last three decades. See Macleod, 'Introduction', *Nature and Empire*, p. 7.

8 David Wade Chambers and Richard Gillespie explore a 'global information network', that includes 'laboratories, journals, public and private funding agencies, museums, libraries, educational institutions, corporations, doctors surgeries, administrative reports, and so on.' See David Wade Chambers and Richard Gillespie, 'Locality in the History of Science: Colonial Science, Technoscience, and Indigenous Knowledge', in Macleod (ed.) *Nature and Empire*, p. 231.

9 Gregory A. Barton, 'Sir Albert Howard and the Forestry Roots of the Organic Farming Movement', *Agriculture History* 75, 2 (Spring, 2001), 168–87.

10 F.G. Sly, 'The Departments of Agriculture in India', *Agricultural Journal of India* (Calcutta: Thacker and Spink , 1906), pp. 1–4; Louise E. Howard, *Sir Albert Howard in India* (London: Faber and Faber, 1953), pp. 13–15.

11 Curzon to St. John Brodrick, Secretary of State for India, 12 January 1905, India Office, Mss. Eur. F. 25–26.

12 On colonial architecture see Thomas R. Metcalf, 'Architecture and the Representation of Empire: India, 1860–1910', *Representations* 6 (Spring, 1984), 56.

13 *The Prospectus of the Agricultural Research Institute and College, Pusa* (Calcutta: Superintendent Government Printing, 1906), p. 2.

14 Albert Howard, 'Fertilization and Cross Fertilization of the Hop', in Alfred C. Chapman (ed.) *The Hop and its Constituents: A Monograph on the Hop Plant* (London: The Brewing Trade Review, 1905), pp. 17–29.

15 The Law of Return refers to the necessity of recycling nutrients that agriculture takes from the soil back to the earth. Both traditional agriculturalists and agriculturalists who relied on chemical fertilizers struggled with the challenge to maintain the necessary nutrients for plants. See Barton, 'Sir Albert Howard', p. 178.

16 T. Bainbrigge Fletcher, 'Note on Plant Imports into India', *Proceedings of the Third Entomological Meeting – held at Pusa 3rd–15th February 1919*, p. 1052.

17 Fletcher, 'Note on Plant Imports into India', p. 1052.

18 Bainbrigge Fletcher, 'Note on Plant Imports into India', p. 1053.

19 The committee members were 'Messrs. B. Coventry (Inspector-General of Agriculture), E.J. Butler (Imperial Mycologist), A. Howard (Imperial Economic Botanist), T. Brainbregge Fletcher (Imperial Entomologist), A.T. Gage (Director, Botanical Survey), R.F.L. Whitty (Customs Department, Bombay), and R.D. Anstead (Planting Expert, South India).' See Fletcher, 'Note on Plant Imports into India', p. 1054.

20 In response in 1906 the Government directed that cotton-seed imported from the new world be fumigated with carbon bi-sulphide at the port of entry. See Fletcher, 'Note on Plant Imports into India', p. 1055.
21 Fletcher, 'Note on Plant Imports into India', p. 1054.
22 D. Clouston was Agricultural Advisor to the Government of India and Director of the Agricultural Research Institute, Pusa.
23 Sameul R. Christophers, *Souvenir: The Indian Empire* (Calcutta: Trackers Directory, 1927), p. 142.
24 Christophers, *Souvenir*, p. 142.
25 Christophers, *Souvenir*, pp. 48–9.
26 Christophers, *Souvenir*, p. 50.
27 Christophers, *Souvenir*, p. 52.
28 Albert Howard and Gabrielle Howard, *Report of the Agricultural Research Institute and College, Pusa (including report of the imperial cotton specialist) 1907–09* (Calcutta: Superintendent Government Printing, 1910), p. 6. For the book that emerged from their survey of Indian wheat varieties see Albert Howard and Gabrielle Howard, *Wheat in India: Its Production, Varieties and Improvement* (Calcutta: Thacker and Spink, 1909). The Howards published a condensed version of the book the same year in the *Memoirs of the Department of Agriculture in India*. See Albert Howard and Gabrielle Howard, 'The Varietal Characters of Indian Wheats', *Memoirs of the Department of Agriculture in India* (Calcutta: Thacker and Spink, 1909), pp. 1–66.
29 Howard and Howard, *Report of the Agricultural Research Institute, 1907–09*, p. 35.
30 *Report of the Agricultural Research Institute and College, Pusa (including report of the imperial cotton specialist) 1910–11* (Calcutta: Superintendent Government Printing, 1912), p. 6.
31 *Report of the Agricultural Research Institute, 1910–11*, p. 13.
32 *Report of the Agricultural Research Institute, 1907–09,* p. 32.
33 *Report of the Agricultural Research Institute, 1909–10*, p. 2.
34 Howard, *Wheat in India*, p. 9. Many took such a romantic view of the India soil. See George Watt, 'Conditions of Wheat Growing in India', *Journal of the Royal Agricultural Society of England*, Vol. 24 (1888), 26.
35 Howard, *Wheat in India*, p. 52.
36 Howard, *Wheat in India*, p. 58.
37 Louise E. Howard, *Sir Albert Howard in India* (London: Faber and Faber, 1953), p. 203. His statement should not be taken too literally. Howard was inspired by how Chinese and Japanese farmers recycled waste and kept soil fertile, but he also found inspiration among the Hunza tribe, and from Anglo-Saxon mixed farming techniques. His own rigorous experimentation to find a solution to Indian soil fertility problems is seen in a paper he delivered just one year prior to his move to Indore, and gives a clear indication that most of the ideas of the Indore compost method for which he is so famous, had already been conceptualized before his move to Indore.
38 Albert Howard, *An Agricultural Testament* (Oxford: Oxford University Press, 1956), pp. 40–1.
39 Albert Howard and Yeshwant D. Wad, *The Waste Products of Agriculture: Their Utilization as Humus* (London: Oxford University Press, 1931).
40 Howard, *Sir Albert Howard in India*, p. 203.

41 E. Shearer, 'Notes on Agriculture in Japan', *Agricultural Journal of India*, III (Calcutta: Thacker and Spink, 1908), 52–64. In this article Shearer reviews Frederick Augustus Nicholson, *Notes on Fisheries in Japan* (Madras: Superintendent, 1907).

42 Rachel Carson is an example of a scientist who, like Howard, also worked for government agencies but took her concerns to a popular market. See Rachel Carson, *Silent Spring* (New York: Houghton Mifflin Company, 1962).

43 The observation that the *Organic Farming Digest* is the first to use the word 'organic' in its title was suggested by John Paull in a science-oriented online journal. See John Paull, 'The Lost History of Organic Farming in Australia', *Journal of Organic Systems* 3 (2008), 2.

44 W.J. McKell, *Organic Farming Digest* 1, 1 (April, 1946), 1–2.

45 When Albert Howard retired from service in India, he visited farmers and researchers throughout the British Empire who experimented with his methods, and quickly found supporters around the world, including in Britain. These supporters included activists for traditional agriculture such as; the Earl of Portsmouth, Lady Eve Balfour, Sir George Stapledon, as well as the nutritionist Sir Robert McCarrison, and the visionary writer G.T. Wrench.

46 The traditional methods of agriculture that Australian settlers practiced were derived from Ireland and Britain. See Ted Henzell, *Australian Agriculture: The History and Challenges* (Collingwood, Victoria: CSIRO Publishing, 2007), p. ix; Lionel Frost, 'The Correll Family and Technological Change in Australian Agriculture', *Agricultural History* 75, 2 (Spring, 2001), 238–41; Department of Agriculture, *Annual Report 1900–1* (Melbourne: Government Printer, 1901), pp. 5–24. The young commonwealth government of Australia sought advice from officials in Britain and the British Empire to raise agricultural productivity. Especially readable is the Scottish Agricultural Commission to Australia, *Australia: Its Land, Conditions and Prospects: The Observations and Experiences of the Scottish Agricultural Commission of 1910–11: A Report with Numerous Illustrations* (Edinburgh: Blackwood, 1911).

47 Lionel Frost, 'The Correll Family', pp. 240–1. For a good overview of the challenges faced by settlers in Australia see Michael Williams, *The Making of the South Australian Landscape: A Study in the Historical Geography of Australia* (London: Academic Press, 1974). George Goyder, surveyor-general of South Australia, suggested in 1865 that the Mallee scrub south of the suggested line was most suitable for agriculture.

48 Justus von Liebig (1803–73), a German chemist, has been credited with launching the modern fertilizer industry. He demonstrated the role of nitrogen in plant growth and identified key elements of plant nutrition. The role of humus in soil fertility interested him little. See Justus Liebig, *Organic Chemistry in Its applications to Agriculture and Physiology* (Cambridge: John Owen, 1841). The use of chemical fertilizers did not become the norm in the English-speaking world until the 1880s. See Richard A. Wines, *Fertilizer in America: From Waste Recycling to Resource Exploitation* (Philadelphia: Temple University Press, 1985), pp. 160–1.

49 Albert Howard, *The Soil and the Health: A Study of Organic Agriculture* (New York: Devin-Adair, 1947), pp. 77–81; E.B. Balfour, *The Living Soil and the Haughley Experiment* (London: Faber and Faber, 1943), pp. 134–6.

50 S. Needham, 'Rothamsted Experimental Station', *Organic Farming Digest* 1, 2 (July, 1946), 10–11.

51 Needham, ‘Rothamsted Experimental Station’.
52 Earl of Portsmouth (Viscount Lymington), ‘Alternative to Death’, *Organic Farming Digest* 1, 2 (July, 1946), 13.
53 E.J. Salisbury, ‘Organic and Mineral Fertilizers’, Review, by Albert Howard, *Organic Farming Digest* 1, 2 (July, 1946), 18.
54 Salisbury, ‘Organic and Mineral Fertilizers’, p. 20.
55 F. Sykes, ‘Milk and Soil Fertility’, *Organic Farming Digest* 1, 4 (January, 1947), 20.
56 ‘Poison Sprays Destroy Bees’, *Organic Farming Digest* 1, 4 (January, 1947), 25.
57 ‘Cheapness is Expensive’, *Organic Farming Digest* 1, 5 (April–June 1947), 15.
58 Sir Stanton Hicks, ‘Food Production is Everybody’s Business’, *Organic Farming Digest* 1, 6 (July–September, 1947), 11. This article is a transcript of a lecture delivered by Stanton Hicks at Hawkesbury Agricultural College, New South Wales, in 1946.
59 Hicks, ‘Food Production is Everybody’s Business’, p. 12.
60 Arthur Yates, ‘A New Zealand Message’, *Organic Farming Digest* 1, 6 (July–September, 1947), 19–20. The author may refer to mining concessions which would appear as either free or nearly so, compared to manure-based fertilizer companies that must purchase raw material at considerable expense. Yates owned Arthur Yates and Co., Ltd, in Auckland, New Zealand.
61 D.M. Lewis, Review of *Reconstruction by Way of the Soil*, by G.T. Wrench, *Organic Farming Digest* 1, 6 (July–September, 1947), 31.
62 Lewis, Review of *Reconstruction by Way of the Soil*, p. 32.
63 Harold White, ‘Whiter Civilization’, *Organic Farming Digest* 1, 7 (October–December, 1947), 22.
64 White, ‘Whiter Civilization’.
65 A.G. Badenoch, Review of *Thoughts on Feeding*, by Lionel James Picton, I, pp. 26–7.
66 Badenoch, Review of *Thoughts on Feeding*, p. 29.
67 ‘A Tribute to the Late Sir Albert Howard’, *Organic Farming Digest* 1, 9 (April–June, 1948), 5.
68 A Tribute to the Late Sir Albert Howard’, p. 6.
69 ‘The World Food Situation’ *Organic Farming Digest* 1, 12 (January–March 1949), 1–4.
70 Barton, ‘The Imperial Synthesis’.
71 Richard Drayton, ‘Science, Medicine, and the British Empire’, in Robin Winks (ed.) *Oxford History of the British Empire: Volume V Historiography* (Oxford: Oxford University Press, 1999), p. 265.
72 See Chapter 5 by Peter Hoffenberg in this volume; and Geoffrey Blainey, *The Tyranny of Distance: How Distance Shaped Australia’s History* (Melbourne: Sun Books, 1966).

9

'The Chance to Send Their First Class Men Out to the Colonies': The Making of the Colonial Research Service

Sabine Clarke

Perhaps the most obvious rejoinder to the suggestion that the period after the Second World War can be seen as the gradual winding down of the British colonial empire is the fact that the number of individuals employed in the colonial services reached their peak in 1954, with a total of 18,000 officers (from 8,000 in 1938).[1] The growth of the colonial services in the postwar period was driven by substantial expansion in specialist and professional roles including teachers, policemen, lawyers and engineers. Many of these officers had been employed to execute and manage development schemes funded through the Colonial Development and Welfare Acts of the 1940s and 1950s. The first of these in 1940 marked a shift in policy by the Colonial Office in London towards a more interventionist and planned form of development for the British colonies. This reform was prompted in part by the need to restore the credibility of British imperial rule in the face of colonial unrest and international and domestic criticism of the failure of previous development initiatives by Britain. It was hoped that the full extent of British altruism would be demonstrated by replacing loans to the Colonies by free grants and emphasis was placed on the need for development projects of social value along with schemes intended to increase economic prosperity.[2] In an attempt to ensure that development plans after 1940 affected real change in the colonies, officials in London gave a privileged role to specialist advisers and officers in the creation and implementation of these schemes. One feature of postwar recruitment neglected in the literature is that in the case of science, officials did not merely seek to increase recruitment of officers in the existing technical branches of the colonial service. They wished to see a shift towards the deployment of highly qualified scientific specialists for research. The reform of colonial policy that resulted in the passing of the CD & W Act of 1940 included provision for a Research Fund of unprecedented magnitude. Officials in London expressed the view that scientific research would provide the facts about colonial environments needed to ensure the efficacy of development planning. By 1945 the Research Fund had been increased to one million pounds each year, elevating the Colonial Office to the position of Britain's second largest sponsor of scientific research in the civil sphere.[3]

The Colonial Office was engaged in lengthy debate during the 1940s on the question of how to best increase the number of officers working on scientific research. The view expressed by the office's technical advisers was that an expansion of research could be achieved by increasing the numbers of specialists in the existing Colonial Agricultural, Veterinary, Forest and Medical Services. By 1950, however, officials in London had been persuaded that it was necessary to create a new and separate Colonial Research Service. One aim of this chapter is to consider the reasons why the Colonial Office became convinced that a new branch of the colonial service needed to be created specifically for scientific researchers. It will focus on the arguments made by a group of eminent British scientists drawn from the domestic research councils that the creation of a research service was essential in order to provide the special conditions necessary to attract greater numbers of research staff for work in the colonies. The elite scientists that sat on the new Colonial Research Committee often had little or no experience of working in the colonies, and their plans for organization of scientific research in Britain's overseas territories were disputed at times by those that had.

The issue that lay at the heart of debate at the Colonial Office was status. There was recognition amongst officials and technical advisers that research officers in the colonies with qualifications in entomology or biochemistry, for example, felt their status to be lower than medical and veterinary officers. In practice this meant not just lower pay but also at times a lack of opportunity for specialists to devise and carry out their own research programs, having instead to submit to direction in their work by doctors, vets or generalist agricultural officers. The elite scientists that formed the Colonial Research Committee argued that the creation of a Colonial Research Service would resolve the issues of subordinate status and freedom for researchers in the colonies. The rationale they provided for the creation of a new research service, and the separation of research from other technical activities in the colonies, relied for its weight on particular characterizations of the nature of 'research' and 'researchers'. A great deal of rhetorical effort was expended to define research as a distinct mode of science which required particular conditions to ensure its successful prosecution and which enjoyed greater prestige than other activities that fell within the rubric of science. Researchers as a breed were differentiated from other scientific workers, in terms of temperament, ambition and their relations with the British research councils. The Colonial Research Committee claimed that the factor that would be decisive in attracting high-flying scientists to the new service was the direction of colonial research initiatives by representatives drawn from the domestic research councils. The elite scientists that had been drawn from outside to advise on the matters of research were doing much more than just creating a new branch of the colonial service; they were defining the very nature of research and their own role in its organization. The meaning of research, researchers and the research councils were all being produced at the same time.

The organization of the colonial services before 1940

The Colonial Office in London was staffed by members of the Home Civil Service whilst individuals who worked in the colonies belonged to one of a number of Colonial Services. These services included the Colonial Administrative Service and various professional or specialist services such as the Colonial Education Service, the Colonial Mines Service, the Colonial Legal Service and the Colonial Engineering Service.[4] The interwar period saw initiatives to improve the prestige of many branches of the colonial services in an effort to increase recruitment. These initiatives included the introduction of professional training courses for candidates and the unification of services that previously had been comprised of separate territorial services. Unification was intended to provide greater career opportunities by allowing easier movement of officers between colonies.

There were increasing numbers of doctors, agriculturalists, foresters and veterinary surgeons in the colonies from around 1900 onward, a growth in technical and professional personnel that accompanied the creation of the first specialist departments.[5] Michael Worboys estimates there were 72 new appointments for agricultural posts in the colonies between 1895 and 1915; a period in which many colonial botanical gardens were replaced by Departments of Agriculture. In the period after the First World War, a shortage of agricultural recruits with the appropriate biological qualifications led to the suggestion that the Colonial Office should take responsibility for the training of candidates itself.[6] From 1922 the Imperial College of Tropical Agriculture (ICTA) in Trinidad offered training, an attempt, in part, to provide instruction in agriculture equivalent to that made available by the Dutch in Java and Germany in Tanganyika before 1914.[7] By 1925, agricultural scholarships had been introduced for potential agricultural officers. This training was comprised of a two-year course involving one year at the University of Cambridge and another at the ICTA.[8] According to the historian of the Colonial Agricultural Service, G.B. Masefield, the introduction of this qualification for agricultural officers in 1925 was a huge boost to morale and was seen to be 'a recognition of tropical agriculture as a academic discipline in its own right, a fact which greatly enhanced the prestige of the subject'.[9] From 1924, forestry probationers spent a year at the Imperial Forestry Institute at Oxford and in 1929 university scholarships were created for graduate study for individuals wishing to enter the Colonial Veterinary Service.[10] Medical officers received training at the London School of Hygiene and Tropical Medicine, or the Liverpool School of Tropical Medicine.

A unified Colonial Medical Service was created in 1934 incorporating officers who had formerly served with territorial and regional services such as the West African Medical Staff and the East African Medical Service. The Colonial Agricultural, the Colonial Forestry and the Colonial Veterinary Services were formed as unified services in 1935.[11] Worboys observes, however, that while there was, in theory, a unified Agricultural Service from this point, colonial administrations could be reluctant to let their experienced Agricultural Officers transfer to other colonies. These officers had developed a facility with local languages and an expert knowledge of the specific physical, social and economic problems of the colony in which they worked.[12] It could take several years in a new colony before a similar level of expertise was gained.[13] Indeed, exactly the same point could be made about administrative officers, which raises the question of the extent to which serving officers did actually move between colonies after the official unification of the Colonial Administrative Service in 1932. The key significance of unification, alongside the creation of professional training courses, seems most likely to have been in raising the status of a career in all branches of the Colonial Services.

The Colonial Agricultural Service formed in 1935 was comprised of all officers employed by the agricultural departments in the colonies. These officers were categorized as one of two types, Agricultural Officers and Specialist Officers. In Africa, Agricultural Officers were often given a district or province to supervise and their main duty was usually described as the education of local farmers. These individuals were typically referred to as 'general' or 'administrative' officers in the Colonial Agricultural Service. Specialist Officers were employed in research stations or on technical projects concerned with crop improvement or pest control, and their duties did not necessarily involve daily contact with farmers to provide advice on farming practices. The numbers of specialist staff such as plant breeders and chemists, in relation to generalist agricultural staff, were roughly equal in the colonies in the early twentieth century. In 1938, E.B. Worthington estimated in his survey *Science in Africa* that there were 113 agricultural and veterinary research staff stationed in Britain's African colonies.[14] Some of these staff worked in designated research units including the well regarded East African Agricultural Research Institute at Amani in Tanganyika and commodity research stations that investigated coffee, sisal and cotton. Joseph Hodge and Helen Tilley have argued that these officers were producing increasingly complex and sophisticated understandings of African environments in the interwar period, shaped by interest in ecological systems and an appreciation of indigenous methods of cultivation.[15]

In the case of medical research, Worthington reported in *Science in Africa* that most of the African territories had government-run laboratories employing pathologists or other specialists dealing with work passed on to them by the hospitals. Worthington referred to this as 'routine work', by which he was referring to analytical and laboratory services. The label 'routine work' was significant as Worthington used this term to denote investigations occurring in the laboratory that he did not classify as proper, or 'long-term' research. Worthington's frequent comment was that skilled specialist staff should have more opportunities for research, but the burden of routine tasks imposed upon them often made this impossible.[16]

Aside from the staff of the Colonial Medical Services employed in the central government laboratories, there were a number of institutions in Africa in 1938 that employed specialist staff for medical research. In Tanganyika there were small units that dealt with research into trypanosomiasis, malaria and tuberculosis (often with only one or two medical officers). The Medical Research Laboratory at Nairobi, Kenya, had a staff of three pathologists, two entomologists and a biochemist and was described as an important center for research into physiology, anatomy and biochemistry. In Nigeria, the government had taken over the Rockefeller's Yellow Fever Laboratory in 1933, and ran this as part of its research laboratories.[17] In addition to the small amount of work done by the Colonial Medical Services, research in tropical medicine was carried out in academic institutions in Britain, or by the individuals and teams deployed by these institutions to the colonies. The staff of the London School of Hygiene and Tropical Medicine made visits to Africa as part of their studies in entomology, protozoology, helminthology and clinical medicine, while the Liverpool School of Tropical Medicine ran its own laboratory, the Alfred Jones Laboratory, at Freetown in Sierra Leone.[18]

Research in forestry and entomology was also undertaken by visiting experts deployed from metropolitan institutions; the Imperial Forestry Institute at Oxford and the Imperial Institute of Entomology at the Natural History Museum in South Kensington. Worthington's view was that there were insufficient permanent research workers in the colonies to properly address problems in these fields.[19] He also expressed his concern over the very low numbers of designated researchers working in anthropology, noting that much of the research work done in Africa had been undertaken by members of the Colonial Administrative Service seconded for the purpose, missionaries, or by individuals visiting the colonies from institutions in Britain such as the London School of Economics.[20]

By the time of the Second World War, the scientific and technical provision in the colonies was a diverse mix of educational and advisory services, experimental farms, plant breeding trials, vaccine production, hospitals and laboratory analysis. Research staff were present in the colonies as members of the Colonial Agricultural, Medical, Veterinary and Forestry Services, although the proportion of staff appointed as specialist officers varied between these technical services.[21] Generally, research was said to suffer from inadequate levels of funding and staffing.[22] Worthington's suggestion was that specialist staff in Africa needed to be released from mundane tasks such as vaccine manufacture or routine laboratory analyses and afforded greater opportunities to pursue long-term research.[23]

Debate concerning the recruitment of researchers after 1940

The passing of the Colonial Development and Welfare Act in 1940 gave a key role to scientific research in providing the sure knowledge of tropical conditions that was thought to underpin the success of the new development programs. The question that concerned officials was how to accomplish a substantial expansion in the amount of scientific research in the colonies. The Colonial Office turned to the British research councils for a model of how to organize this work and created a number of new research committees comprised of representatives from these and other bodies. The first of these committees was the Colonial Research Committee created in 1942 and which included amongst its members Edward Mellanby (the Secretary of the Medical Research Council), W.W.C. Topley (the Secretary of the Agricultural Research Council), Edward Appleton (Secretary of the Department of Scientific and Industrial Research) and the head of the Royal Society, A.V. Hill. Research council involvement was deemed necessary to attract British scientists to work on colonial research programs since science practiced by government departments was said to lack sufficient cachet to attract high caliber researchers. Whilst officers existed in the Colonial Medical, Agricultural, Veterinary and Forestry services who were qualified and able to carry out research, the view expressed by the assistant secretary at the Colonial Office in 1940, Thomas Lloyd, was that the numbers of these individuals were low and that the technical services were failing to attract really outstanding researchers. Lloyd stated that training for technical officers, such as the agricultural instruction at ICTA, had worked to raise the level of administrative officers but the colonial services were not successfully competing for research staff.[24]

The issue that was debated during the course of the 1940s was whether an increase in research in the colonies could be achieved by increasing the numbers of designated researchers in the existing technical services. This was the arrangement favored by the Colonial Office's technical advisers; individuals with experience of working in the British colonies and in touch with developments in the organization of science in the period before the Second World War. R.S.F. Hennessey, Assistant Medical Adviser prepared a list of 157 academic papers published by officers of the Colonial Medical Service to demonstrate the significance of the contribution to medical research made by such individuals.[25] The view was expressed by the Adviser on Animal Health, J. Smith and Harold Tempany, Agricultural Adviser, that suitable candidates for research work existed in the technical services but there was a lack of opportunity for these officers to carry out research. This issue could be addressed by freeing well-qualified officers for research duties and by employing more technicians for routine work, as had been suggested by Worthington in his survey of scientific provision in Africa.

Representatives of the research councils such as Mellanby and Topley who sat on new committees at the Colonial Office rejected the suggestion that the colonial services in their existing state were capable of attracting the brightest science graduates. They claimed it was difficult to attract researchers for work in the colonies when they could have better careers at home.[26] It was maintained that workers in the colonies suffered from a form of scientific isolation because they were cut off from the 'main streams of scientific thought'.[27] The academic scientists of the CRC claimed that a new and separate research service was necessary to provide the special conditions that were essential for good research and to attract high-powered researchers. Special terms of service would allow the interchange of colonial research staff with metropolitan institutions, so that greater numbers of researchers could be seconded to the colonies for just a few years at a time.[28] Apart from this, the key requirement for successful research was according to Topley, Mellanby and Hill freedom of action for the researcher in the colonies,

> these workers must be not be [sic] inhibited from working in the way best calculated to allow them to achieve the most valuable results, which means, in the field of scientific research as much as in any other sphere of creative activity, allowing the worker the greatest possible latitude as to his methods of work. Complete freedom of enquiry is not the only, but it is an essential condition of fruitful research work.[29]

In the arguments of the CRC, placing research staff under the direct supervision of the colonial governments would compromise their freedom of action as they would be restricted to work of a short-term or routine nature that met the immediate practical needs of the colony and not the long-term research that it was said was required. When describing the position of existing researchers in the colonies in 1943 the CRC asserted,

> Under existing conditions scientists and research workers in the Colonies frequently have to work in isolation, and with relatively inferior equipment. Moreover, many of them are engaged in routine investigations as well as in research, and the volume of this work is always liable to be increased in accordance with administrative needs. Even if they are freed from the pressure of routine examinations, there is a tendency for research problems to be dictated too exclusively by local and temporary interests, without due regard to scientific possibilities, or to the scale on which a given investigation must be planned if it is to have any reasonable hope of success. Under conditions such as these, there will always be a difficulty in attracting the most able research workers to the Colonies, and unless men and women of outstanding ability can be obtained, colonial research will never be effective.[30]

It was also claimed by Topley that high caliber researchers possessed a temperament that meant they would not submit to direction by officers of the territorial administrations: '[R]eally good men would often have awkward characteristics which might make it difficult for him to fit into a team. One must make allowances for this and be prepared to face local trouble in getting him freedom of action'.[31] The 'local trouble' was a reference to officers in the technical services. In the case of agriculture, administration in the colonies was done by members of the Colonial Agricultural Service and it was these officers who were accused of diverting research officers to tasks that were mundane or overly practical. The desired objective for many of the scientists on the research committees that advised the Colonial Office was the complete separation of the administrative and research functions of the technical departments and the appointment of Directors of Research equivalent in standing to the existing Directors of Agriculture and Medicine.[32] The point was made much more baldly in private by H.H. Storey, Secretary of the Committee for Colonial Agricultural, Animal Health and Forestry Research formed in 1945. Storey wrote to his colleague on the committee, Frank Engledow, concerning plans for new agricultural research institutions in East Africa, that 'it is our policy, and one that I support most strongly, not to place the Director of Research in a position that will require him to take orders from Directors of Agriculture'.[33]

The notion that well-qualified specialists in the technical departments felt burdened by routine tasks and lacked opportunity to undertake research is borne out by some of the exchanges between Colonial Office officials and scientists in the colonies. One group who seemed particularly frustrated in their efforts to undertake their own research were entomologists. These specialists typically worked as members of Medical, Veterinary or Agricultural Departments. In 1948 the Colonial Office was involved in debate concerning the position of K.R.S. Morris, an entomologist in the Gold Coast. Morris worked on a program of tsetse fly and trypanosomiasis control run by the Department of Medicine. It was communicated to the Colonial Office that unless Morris was given greater opportunities for his own research he would take a university position and the Gold Coast would lose an experienced control officer.[34] The issue that had led to Morris' discontent was summed up in a letter from the Colonial Office to the Secretary for Rural Development in the Gold Coast, R.H. Saloway. The letter noted that in the field of tsetse and trypanosomiasis control, entomologists and doctors competed for limited resources and there were frequent disputes,

> the entomologists saying that the fly should be studied with a view to destroying it or preventing its breeding, and the doctors insisting that it was a problem involving the treatment, cure and prevention of a human and animal disease for which the study of protozoology and chemotherapy were the first priorities. This dispute is reflected

> in the Gold Coast. Morris is an entomologist and feels rightly or wrongly, that the medical men do not pay sufficient attention to his professional approach to the subject.[35]

As Morris himself complained,

> I do not feel justified, as one of the more highly paid of the Medical Departments staff, to continue during the next few years in doing a foreman of works job for them. I have offered them my professional help in its fullest capacity, to clear up their tsetse situation, and demonstrated how it can be done. This has been ignored, not even refused. I realize that it is because the work is outside the scope of the medical man.[36]

Scientific specialists in the colonies could be extremely candid when expressing their annoyance at their relatively subordinate position in the technical departments in contrast to doctors and veterinary surgeons. An article was published in *Nature* in 1945 claiming that specialist officers in the colonies received inferior salaries, pensions, accommodation and travel provision compared to professional officers such as doctors and vets, stating: 'The chief veterinary entomologist in Kenya has worked in that colony for more than fifteen years, but is paid less than a veterinary officer of comparatively junior standing'. Apart from a basic lack of parity in these arrangements, the author claimed that,

> [t]he fact that a field zoologist, for example, has to travel second-class by train in Kenya (unless he pays part of his own fare) while a veterinary officer goes 'first' makes an incredible amount of difference to the attitude of native inhabitants to each; particularly as some non-Europeans always travel 'second' but seldom 'first'. I am not condoning this common native attitude – merely stating it.[37]

It seems the officers in the colonies most frustrated at a lack of opportunity for devising their own research projects and conscious of their relative low status were specialist officers with degrees in one of the biological sciences.[38]

Amongst the academic scientists on the Colonial Office's new research committees, however, there was resistance to the suggestion that the technical services in the colonies had previously undertaken any significant research or that these services contained high caliber scientists. Mellanby is reported as saying at a meeting of the CRC in 1942 that, 'much of the research that was being done at present was "jobbing" research and not what he described as the real thing. The problem seemed to be to superimpose the real thing on present institutions'.[39] Mellanby claimed that the introduction of proper research would only be achieved by the deployment of new workers to the colonies and not by encouraging existing personnel to carry out more research. In the view of Mellanby the only real guarantee of the quality of individuals selected for colonial research would be previous employment with the Medical Research Council in Britain, 'the Medical Research Council would welcome the chance to send their first class men out to the Colonies'.[40]

It seems that when Topley and Mellanby dismissed the research work of technical officers in the colonies they were displaying the disdain sometimes shown by academic scientists towards government science in general. The Civil Service at home could find it hard to attract first-rate research workers, because of its relatively low status from the perspective of the university. Appleton, Secretary of the DSIR, claimed that university tutors advised science graduates to seek posts in universities, and if they could not attain this then to go into industry, and if they failed there only then to seek a position in government service.[41] Hill, writing elsewhere, expressed the view that research in government departments was compromised by the need for secrecy, which impeded the interchange of ideas and findings that was a natural part of the life of the researcher, and which was found in the universities.[42] He also claimed that government departmental research further stagnated because of the dull and unimaginative leadership provided by those who had finally achieved senior roles after many years of service.[43] These comments show many similarities to the criticisms that were made about the conditions that existed for colonial researchers. The need for secrecy supposedly cut off government researchers at home from essential exchanges of information and theory with their scientific colleagues whilst workers in the colonies were also distanced, in more obviously practical ways, from the leading centers of work in their field. The significance of this isolation of researchers in government departments both at home and in the colonies was, in the rhetoric of Hill, the fact that it contravened one of the basic tenets of scientific research, free communication between scientists. The solution proposed by Hill for researchers in government departments in Britain was practically identical to the proposals to improve the conditions of work for colonial researchers. Hill wished to see researchers in the Home Civil Service able to move between positions in government establishments, the universities and other research institutions.[44] The introduction of the universities' pension scheme, the Federated

Superannuation Scheme for Universities (FSSU), for scientists in the Home Civil Service was supposed to allow this very movement between the academy and government laboratory.[45]

In the case of colonial research, Topley and Mellanby insisted that it was imperative that the services of new high flying researchers from British institutions were engaged on terms explicitly modeled on those of the domestic research councils, or even to allow these bodies to take over the organization of colonial research. They claimed that first rate researchers were most likely to be in receipt of research council funds in universities and research institutions in Britain and would only be attracted to work on colonial problems if they perceived the conditions on offer to be equivalent to those provided by the research councils at home. In Topley's argument, the advantage presented by the involvement of research councils in selecting personnel and making decisions on funding colonial research was the fact that the research councils were comprised of experienced scientists able to ensure for the colonial researcher the special conditions necessary for their work. The implicit claim was that researchers believed that colonial administrations would be unable to appreciate the requirements of their chosen profession because they were devoid of individuals with direct experience of either the prosecution, or supervision, of research, equivalent to those of the research councils at home. While the absence of a certain research-mindedness in the colonies was debatable, Topley's more persuasive point from the position of the Colonial Office was that without the explicit involvement of the ARC and MRC, colonial appointments would lack the prestige necessary to attract high caliber British researchers. Officials at the Colonial Office were persuaded that researchers were 'quite a different type of being from anyone else' who would need new and different terms of service and who could not be expected to have the same relationship with the colonial governments as the existing technical services.[46]

There were limits, however, to the authority over research that officials were prepared to concede to representatives of the research councils who sat on Colonial Office committees. Demands from the Colonial Medical Research Committee that funds for medical research should be released by the Colonial Office in there entirety and given over to the MRC so this body had the freedom to devise research schemes, make appointments and deploy researchers to the colonies as it saw fit, were firmly rejected. Officials would not permit the MRC to allocate colonial research funds and research staff without sanction by the Colonial Office as they feared that the MRC did not fully grasp the nature of the relationship between London and the colonial governments. Whilst scientists in London could plan research schemes to be executed in a particular colony, protocol meant that the Colonial Office could only make a request to the administration concerned for researchers to be allowed to work in that territory, they could not insist in the way that the CMRC seemed to expect.[47] At the same time, officials feared that the absence of any real experience of working in the colonies amongst representatives of the MRC could result in a situation in which medical researchers deployed from London undertook intrusive or insensitive investigations that provoked dissent, even violent protest, from colonial inhabitants. Plans for medical research must, therefore, be subject to the scrutiny of Colonial Office officials on the basis that 'practically all schemes of development and research have a political aspect, and the question of policy or politics affecting the peoples of Colonial territories must rest with the Colonial Office administrative staff and the Colonial administrations'.[48] Whilst wishing to curtail the power of the CMRC, the Colonial Office did not, however, wish to sever all ties with this body of eminent medical researchers. As put by one official:

> We have had for the last three years a lot of carping and niggling by the CMRC, and above all things we want to put an end to it. We cannot, even if we want to, afford to break with them, because if we do we should not get the research workers that we want.[49]

The Colonial Research Service in practice

The Colonial Office was convinced by the claim that the successful creation of a new corps of researchers would require the introduction of terms of employment that emulated those of the MRC or ARC and that close links with these bodies were needed if the most able science graduates were to be recruited. The Colonial Research Service was formally introduced on 31st January 1950 and in October 1954 was renamed as the Research Branch of Her Majesty's Overseas Civil Service. It was decided that the new service would use the Colonial Superannuation Scheme, similar to the FSSU pension scheme that was available to scientists working in Britain, rather than the pension scheme normally provided for members of the colonial services in order to allow the movement of research staff between metropolitan and overseas posts that the CRC had said was essential.[50] An overseas allowance was created for researchers whilst abroad that varied according to the region in which the officer resided. Tours of service ranged from 12–24 months in West Africa to 2–3 years in the West Indies.[51] Members of the CRS were expected to have a good degree and at least two years postgraduate training or experience in research.[52] The number of new appointments made to the service each year between 1950 and 1961 are shown in Table 9.1, with the total number of serving officers in the service shown for most years. In general terms, the service expanded at a rapid pace during the time of its existence. In the second half of the 1950s, however, the number of new recruits to the service increasingly failed to match the loss of existing officers due to retirement and resignation.

Some scientists transferred to the CRS from a pre-existing post in the colonies. These individuals included researchers that had been appointed on temporary contracts for work on research schemes in the colonies initiated during the 1940s, with the expectation that they would join the CRS once it had been launched. Anticipating the creation of the Colonial Research Service, certain posts in the colonies had been identified as suitable for occupation by research officers in the new service. The East African High Commission submitted a list of 70 such positions in 1950 which was comprised of roles in the many regional research organizations that were the product of funding from the research allocation of colonial development and welfare funds.[53]

Colonial governments were also asked to recommend which specialist officers that currently served as members of their technical departments should be invited to join the CRS.[54] In 1952 the Colonial Research Committee declared 40 such existing members of the Colonial Agricultural, Medical, Veterinary and Forestry Services across the whole of the Colonial Empire as suitably qualified and experienced as researchers for inclusion in the new Colonial Research Service.[55] The committees in London did not necessarily treat a specialist officer qualified in a particular scientific discipline as equivalent to a researcher. Invitation to join the CRS for officers in existing posts was dependent on judgments made in London on the level of the qualifications possessed by these scientists and their supposed capacity for research.[56] Only scientists of sufficiently high caliber were deemed suitable for the Colonial Research Service.[57]

In 1955 the Colonial Office produced a breakdown of the number of specialist personnel working across the whole Colonial Empire for presentation to the Advisory Council on Scientific Policy after this body had expressed interest in how well the Colonial Office was succeeding in its aim of recruiting scientists to the CRS. The data collected by the Colonial Office in 1955 showed there to be 452 specialists

Table 9.1 Recruitment to the Colonial Research Service, 1950–1961*

Years	50–1	51–2	52–3	53–4	54–5	55–6	56–7	57–8	58–9	59–60	60–1
Appointments	20	17	29	31	30	39	34	26	25	24	4
Total number of officers	20	–	–	–	–	176	189	202	207	199	106

*Data taken from the Annual Reports of the Colonial Research Committee/Council, *Colonial Research* 1950–1951, Cmd 8303; *Colonial Research 1951–1952*, Cmd 8665; *Colonial Research 1952–1953*, Cmd 8971; *Colonial Research 1953–1954*, Cmd 9303; *Colonial Research 1954–1955*, Cmd 9626; *Colonial Research 1955–1956*, Cmnd 52; *Colonial Research 1956–1957*, Cmnd 321; *Colonial Research 1957–1958*, Cmnd 591; *Colonial Research 1958–1959*, Cmnd 938; *Colonial Research 1959–1960*, Cmnd 1215; *Colonial Research 1960–1961*, Cmnd 1584.

Table 9.2 Specialist Personnel in the Colonial Empire, 1954

Officers employed in schemes funded by Colonial Development and Welfare Funds		**Officers employed in territorial departments and paid from Colonial Funds**		**Officers serving in Institutes not assisted by Colonial Development and Welfare Funds**	
Total number of officers in post	Number of officers in previous column in the CRS	Total number of officers in post	Number of officers in previous column in the CRS	Total number of officers in post	Number of officers in previous column in the CRS
202	78	207	3	43	10

Source: NA CO 900/13

working across the Colonial Empire. Eighty per cent of these specialists, however, were not working as members of the CRS but were members of the Colonial Veterinary, Medical, Agricultural or Forestry Services. A large number of specialists outside the CRS could be explained in part by the belief of scientists in London that an individual who had specialist qualifications or a specialist title was not necessarily suitable for the CRS. It had also been accepted by the Colonial Research Committee in discussions over the formation of the CRS during the 1940s that colonial governments might wish to retain specialist workers for departmental research of a local and practical orientation.

The most unexpected finding of the survey by the Colonial Office was that only one-third of the specialists working on projects funded from CD & W funds from London, in other words the Research Allocation, were members of the Colonial Research Service. This situation, where most specialists working on centrally funded projects were not members of the CRS, was not what had been anticipated by the research committees. The view had been that scientific specialists working on matters that did not form part of the day-to-day work of the technical departments, and were employed solely to undertake research, would be members of the CRS.

Concern was raised at the Colonial Office in 1954 over the unwillingness of eligible specialists to transfer to the new service and officials were keen to make the service more attractive to suitable officers. It became apparent that of 100 serving officers who had received invitations to transfer to the new research service, two-thirds had refused to do so.[58] Officers who had been appointed to work on colonial research during the 1940s were unwilling to transfer to the new CRS as it did not appear to offer conditions of service or financial remuneration that were better than those on offer with the existing technical services. The salaries of members of the CRS were comprised of a number of components. The basic salary of an officer was based on the scales of the Home Civil Service, or for medical researchers, on those of the Medical Research Council. In addition, an officer received an Overseas Research Allowance intended to bring the total emoluments payable to a member of the CRS in line with that of other scientific officers that worked in the technical services in the colonies.[59] Transfer to the CRS, therefore, did not offer obvious financial advantage to specialist officers serving with the Colonial Agricultural, Medical, Forestry or Veterinary Services. The Colonial Office claimed that the CRS offered opportunities for more rapid promotion than the existing technical services, so that young and ambitious researchers could move quickly through the scales from Scientific Officer to Senior and then Principal Scientific Officer with associated increases in salary. In the existing technical services, promotion was more closely tied to age and length of service. For a given time scale, therefore, an officer in the CRS could find themselves in receipt of a higher salary than if they had served in the technical services.[60] The Colonial Office urged that more advantage should be taken by Colonial Governments, and the directors of research organizations in the colonies, of the opportunities for accelerated promotion of able officers.

The factor that appeared to present the most significant deterrent to transfer for officers was pensions. Researchers in the CRS were members of the Colonial Superannuation Scheme and were not in receipt of the more usual Colonial Service pension. The Superannuation Scheme had been contrived to ease the movement of researchers between home institutions, namely the universities and units run by the research councils, and colonial institutions, by producing a pension scheme that could be related to the FSSU, and then later the Civil Service Superannuation Scheme.[61] In practice, the Colonial Superannuation Scheme had proven to have two disadvantages that were thought to make the CRS less attractive to currently serving officers. Pensioners in the Colonial Superannuation Scheme were subject to United Kingdom income tax if they lived abroad, whilst Colonial Service pensioners were only liable to this tax if they retired and lived in the UK. Secondly, the Colonial Superannuation Scheme did not provide additional benefits to officers if they retired on the abolition of their office, as was the case with a Colonial

Service pension. The terms of the pension arrangements for the CRS were, therefore, less favorable than those for officers in other services. Although both the Superannuation scheme and the linking of CRS salaries with those available in the UK had been devised to promote the movement of researchers between British and colonial institutions,[62] the Colonial Office noted ruefully in 1954 that this had not been a frequent occurrence in practice.[63]

Metropolitan scientists who sat on the research committees at the Colonial Office had claimed that specialists would only be persuaded to work on colonial problems if they saw that members of the domestic research councils were overseeing this work; something that could only be achieved through the creation of a new research service. In practice it seems that such relationships with metropolitan research were not necessarily of primary importance for specialists in the colonies. Many of the specialists that had been recruited to carry out research during the 1940s had deployed to one of around 40 new research institutions that had been established using CD and W funding by 1952.[64] These research institutions often operated with a great deal of autonomy from territorial administrations and the staff of these units were removed from the ambit of generalist or non-research members of the technical departments. The result was that specialists such as entomologists found they had a high degree of freedom to devise and carry out their own research programs within new research units.[65] Since the creation of new and separate research institutions during the 1940s addressed one of the key complaints of many specialist officers in the colonies that they were subordinate to non-specialists and restricted in opportunities for research it seems there was little incentive remaining to join the CRS by the time of its creation in 1950.

Conclusion

Lengthy consultation between officials and scientists during the 1940s on the best method of employing greater numbers of British and Dominion researchers led to the decision to create a new branch of the Colonial Service, comprised of officers engaged exclusively to work on research. This Colonial Research Service operated in addition to the existing technical services that carried out duties in the fields of agriculture, medicine, veterinary science and forestry in the colonies as part of the colonial administrations. In contrast to these services that employed agricultural advisers, doctors and veterinary surgeons, the CRS was intended to be a place for scientific specialists such as biochemists, geneticists, parasitologists and entomologists.

The decision to create a new Colonial Research Service by officials at the Colonial Office represented the triumph of the views expressed by the eminent researchers that sat on the new research committees created after 1940. Individuals such as Edward Mellanby of the MRC and W.W.C. Topley of the ARC defined the nature of research and researchers in their arguments in such a way as to make the creation of a new branch of the colonial service appear to be a necessity. Research was largely defined by the conditions said to be necessary for its successful prosecution – freedom for the researcher in defining his or her research program and opportunities for communication with leading scientific centers. It was claimed that these conditions could only be provided if researchers deployed across the colonial empire were placed beyond the day-to-day control of officers of the colonial administrations and were able to move easily between locations. The research committees at the Colonial Office rejected the suggestion that officers currently working in the technical services in the colonies were of sufficient caliber to carry out high quality colonial research. They also claimed that technical officers in the colonies were ignorant of the special requirements of research and could not be allowed to direct researchers, who would anyway reject interference by these officers in their work. In the rhetoric of individuals such as Topley, the only real guarantee of good research work in the colonies was supervision by the domestic research councils of the selection and deployment of research workers. This was justified by the claim that research was an activity that should be differentiated from other modes of science, it enjoyed higher prestige, and it was an activity for which the research councils in Britain were the pre-eminent expert bodies.

Colonial Office officials believed they would not attract high-flying researchers to work on colonial research schemes without the involvement of the domestic research councils and privileged the opinions of the research committees over those of the office's existing technical advisers in discussions over the employment of research staff. As a result, the CRS incorporated many of the features that the research committees had said to be essential to raise the prestige of the service. In practice, however, scientific specialists did not necessarily perceive any advantage in transferring to the CRS on its creation in 1950. By the time the CRS was established, a large number of new research institutions had been created across the British Colonial Empire which served to provide many specialists with the autonomy they had been seeking in matters of research. The majority of scientists with specialist qualifications declined the offer to transfer to the new Colonial Research Service and carried out their research work as members of the existing technical services. For these scientists it seems that the elite status of the CRS, supposedly stemming from its direction by representatives from the domestic research councils in London, was of little significance.

Notes

1 Anthony Kirk-Greene, *On Crown Service: A History of HM Colonial and Overseas Service, 1837–1997* (London: I.B. Tauris, 1999), p. 51.
2 Stephen Constantine, *The Making of British Colonial Development Policy* (London: Maurice Temple Smith, 1984), ch. 7; David Goldsworthy, *Colonial Issues in British Politics, 1945–1961* (Oxford: Oxford University Press, 1971), p. 11; Michael Havinden and David Meredith, *Colonialism and Development: Britain and its Tropical Colonies, 1850–1960* (London and New York: Routledge, 1993), pp. 199–205; J.M. Lee and Martin Petter, *The Colonial Office, War and Development Policy: Organisation and the Planning of a Metropolitan Initiative, 1939–1945* (London: Maurice Temple Smith, 1982); S.R. Ashton and S.E. Stockwell (eds) *Imperial Policy and Colonial Practice, 1925–1945*, British Documents on the End of Empire, ser. A, Vol. 1 (London: HMSO, 1996); Ronald Hyam, *The Labour Government and the End of Empire, 1945–1951* (London: HMSO, 1992).
3 Sabine Clarke, 'A Technocratic Imperial State? The Colonial Office and Scientific Research, 1940–1960', *Twentieth Century British History* 18 (2007), 453–80.
4 Kirk-Greene, *On Crown Service*, p. 35.
5 For the creation of the first medical departments in East Africa see, Ann Beck, *A History of the British Medical Administration of East Africa, 1900–1950* (Cambridge, Mass: Harvard University Press, 1970); on agriculture see G.B. Masefield, *A History of the Colonial Agricultural Service* (Oxford: Clarendon Press, 1972); Joseph Hodge, *The Triumph of the Expert: Agrarian Doctrines of Development and the Legacies of British Imperialism* (Athens, OH: Ohio University Press, 2007).
6 Ralph Furse, *Aucuparius: Recollections of a Recruiting Officer* (Oxford: Oxford University Press, 1962), pp. 134–62.
7 Michael Worboys, 'Science and British Colonial Imperialism' (PhD, University of Sussex, 1979), p. 211.
8 Masefield, *A History of the Colonial Agricultural Service*, pp. 41–2.
9 Masefield, *A History of the Colonial Agricultural Service*, pp. 41–2.
10 Kirk-Greene, *On Crown Service*, p. 28.
11 Kirk-Greene, *On Crown Service*, p. xviii.
12 Worboys, 'Science and British Colonial Imperialism', p. 227.
13 Masefield, *A History of the Colonial Agricultural Service*, p. 131.
14 E.B. Worthington, *Science in Africa* (Oxford: Oxford University Press, 1938), p. 318.
15 Hodge, *The Triumph of the Expert*, ch. 5, and Chapter 10 of this volume; Helen Tilley, 'African Environments and Environmental Sciences: The African Research Survey, Ecological Paradigms and British Colonial Development, 1920–1940', in William Beinart and Joanne McGregor (eds) *Social History and*

African Environments (Oxford: James Currey and Athens: Ohio University Press, 2003), pp. 109–30.

16 Worthington, *Science in Africa*, pp. 479–80.
17 Worthington, *Science in Africa*, pp. 482–7.
18 Worthington, *Science in Africa*, pp. 467–80.
19 Worthington, *Science in Africa*, pp. 182, 261.
20 Worthington, *Science in Africa*, pp. 594–9.
21 Beck, *A History of the British Medical Administration of East Africa*, pp. 185–6.
22 Worthington, *Science in Africa*.
23 Worthington, *Science in Africa,* pp. 17–21.
24 National Archives, Colonial Office [hereafter NA CO] CO 850/180/6.
25 NA CO 913/2.
26 NA CO 900/1.
27 *Colonial Research Committee, Progress Report, 1942–1943*, Cmd 6486.
28 NA CO 900/1; *Colonial Research Committee, Progress Report, 1942–1943*, Cmd 6486.
29 *Colonial Research Committee, 1st Annual Report, 1943–1944*, Cmd 6535.
30 *Colonial Research Committee, Progress Report, 1942–1943*, Cmd 6486.
31 NA CO 900/1.
32 Worthington, *Science in Africa*, pp. 17–18.
33 NA CO 927/88/6.
34 NA CO 877/37/6.
35 NA CO 877/37/6.
36 NA CO 877/37/6.
37 NA CO 927/1/1.
38 This point raises the question of class. It is possible that tensions between doctors and entomologists, biochemists etc, may have been related to differences in social background between these officers.
39 NA CO 900/1.
40 NA CO 900/1.
41 NA CO 900/1.
42 A.V. Hill, *The Ethical Dilemma of Science* (New York: The Rockefeller Institute Press, 1960), p. 50.
43 Hill, *The Ethical Dilemma of Science*, p. 50.
44 Hill, *The Ethical Dilemma of Science*, p. 51. In practice, in the post-war period the majority of researchers that worked in the Home Civil Service were physicists or chemists working on projects concerned with the development of radar or aeronautics and it seems that any movement that did occur between institutions was typically from government departments into industry.
45 David Edgerton, *Warfare State: Britain, 1920–1970* (Cambridge: Cambridge University Press, 2005), Ch. 3.
46 NA CO 927/132/1.
47 NA CO 927/175/1.
48 NA CO 927/14/1.
49 NA CO 927/175/1.
50 NA CO 900/4.
51 NA CO 900/5.
52 Eric Barnard of the DSIR commented to Charles Eastwood of the Colonial Office that entry requirements for the CRS were actually slightly more stringent

than for the Home Civil Service. Whilst entry to the CRS required two years postgraduate training or experience, for the Home Civil Service, postgraduate experience was said to be desirable rather than essential.

53 NA CO 927/132/2, list of posts to be taken by members of the CRS sent by the EAHC, 15 February 1950. The figure is approximate since the numbers of some specialists that would be required was not always specified.

54 NA CO 900/9.

55 *Colonial Research 1951–1952*, Cmd 8665.

56 NA CO 900/9.

57 NA CO 900/9.

58 NA CO 900/12.

59 This complex system resulted in almost continual adjustments to the pay of members of the CRS. Salaries needed to be restructured whenever changes were made to either the salaries of scientists in the Home Civil Service or the Colonial Services. Between the introduction of the CRS in January 1950 and May 1953 the emoluments given to members of the CRS were revised six times. See, NA CO 900/12.

60 NA CO 900/12.

61 The Civil Service Superannuation Scheme was introduced for the research corps of the Home Civil Service on 1st January 1953.

62 NA CO 900/12.

63 NA CO 900/12.

64 Clarke, 'A Technocratic Imperial State?', pp. 453–80.

65 Sabine Clarke, 'Experts, Empire and Development: Fundamental Research for the British Colonies, 1940–1960' (PhD, University of London, 2006).

10
The Hybridity of Colonial Knowledge: British Tropical Agricultural Science and African Farming Practices at the End of Empire

Joseph M. Hodge

This chapter examines the often ambiguous place of British tropical agricultural science and scientists in the late colonial enterprise. I wish to show that British agricultural resource experts – agronomists, soil scientists, plant ecologists, land use planners, entomologists and so forth – held diverse views that were shaped not only by British research traditions and institutional networks, but also by the local colonial contexts in which they worked, and that the differing views they held often led to vigorous policy debates, which could produce significant shifts in thinking about tropical environments and development. Moreover, this chapter suggests that the relationship between British tropical agricultural science and local indigenous knowledge and farming practices was more complex and reciprocal than previously assumed, and that this led over time to a certain level of hybridity, and in some cases to important critiques of previous theoretical assumptions that underpinned the field.

The late colonial and early postcolonial development drive

As Sabine Clarke points out in the previous chapter, a new kind of liberal, paternalist social engineering was espoused by specialist advisers and scientists working for the Colonial Office in the 1940s and 1950s. The new colonial mission took many forms, but perhaps the most definitive were the various land resettlement and agricultural development schemes that were implemented across Sub-Saharan Africa, as well as in other regions of the late colonial world between 1945 and 1965. Over 70 major agricultural development initiatives were in operation throughout the

British colonies by the mid 1950s, including pilot projects for water and soil conservation and food production; numerous land improvement and resettlement schemes; various mechanized cultivation projects for cotton, rice and paddy cultivation; tractor plowing and hiring units; drainage and irrigation schemes; and cooperative and group farming ventures among many others.[1] Augmenting these efforts were numerous infrastructure, health, education and welfare programs, not to mention the mega-projects undertaken by the Colonial Development Corporation (CDC) and Overseas Food Corporation (OFC). Some examples in the case of British colonial Africa include the Gezira Cotton Irrigation Scheme in the Sudan, which began before the war but was substantially expanded in the postwar years, the Anchau Settlement Scheme and the Niger Agricultural Project in Nigeria, the Sukumaland Development Scheme and the various farming settlement schemes that followed the failure of the East Africa Groundnut Scheme in Tanganyika, the Swynnerton Plan and the Mwea and Perkerra Irrigation Schemes in Kenya, the Kigezi Resettlement Scheme in Uganda, the African Farmer's Improvement Scheme and the Peasant Farming Scheme in Northern Rhodesia and the Master Farmer's Scheme in Nyasaland. Like their counterparts in other late colonial empires, these projects are significant less for the originality of their design – the land use planning models and policy concerns on which many of them were based had, in fact, largely been worked out before the war – than for the greater scale and ambitiousness of the development programs of which they were part. This 'Second Colonial Occupation', to use D.A. Low's and John Lonsdale's term,[2] extended beyond the African territories, encompassing the Caribbean and Southeast Asia as well. Nor was Britain alone. In 1946, France established its own *Fonds pour l'Investissement en Développement Economique et Social* (FIDES), which provided metropolitan funds for development initiatives overseas on a much larger scale than previously. Technical personnel, research facilities and new organizational and administrative abilities were also significantly increased, enabling French bureaucratic power to be extended into rural colonial areas as never before.[3]

The greater scale and intensity of the postwar development drive reflected the new imperatives of imperial policy promoted by Sydney Caine, who was appointed Financial Adviser for the Colonial Office in 1943. In Caine's view, the problems of 'natural poverty' and overpopulation were too formidable in many colonies to expect any significant improvement in the standard of living unless there was a dramatic boost in local productivity and output.[4] His assessment of colonial poverty as predominantly 'aboriginal' signaled an important break from the palliative views held by other CO advisers who, in Caine's judgment, placed too much emphasis on the consequences of previous colonial intervention. Providing for social welfare and subsistence needs alone, Caine argued, would only reinforce colonial 'backwardness', instead of directing attention, as he urged, first to increasing output and economic growth.[5] Caine's productionist slant was reinforced further by the postwar economic crisis. There were fears in 1947 that if nothing was done to expand production and consumption both in the 'advanced' countries and the 'undeveloped' regions, the world might find itself in a greater depression than 1929 resulting in millions out of work and unparalleled social unrest.[6] In Britain, there were great shortages of materials, food and other consumption goods, which threatened to lead to lower productivity of the workforce and place a potential brake on the drive to increase production.[7] To these must be added the new Labour government's resolve to counter increasing U.S. domination of the British national economy. Thus, following the war, the imperial government impressed upon governors in the tropical colonies the imperative of increasing production of food and raw materials to meet both British and colonial needs.

Despite the vast influx of financing, expertise and state agency, the results of the new development ventures of the early postwar years were often less than spectacular. The reasons for this have been analyzed elsewhere and need not detain us here except to say that in their haste, colonial regimes resorted to forceful state measures and compulsory legislation to solve rural problems, which in turn generated discontent and anti-colonial resistance in many territories.[8] Such structural crises often ignited bureaucratic tensions and policy debates, not only between metropolitan ministries and local colonial administrations, but within the colonial state itself, between for example administrative and technical departments as well as among personnel within separate departments, creating what often bordered on governmental impasse. Much of the friction and paralysis of late colonialism also reflected the enigmatic and contradictory aims of colonial policy itself, as it strove to balance the imperatives of reasserting order and stability on the one hand, and the demand for intensifying production and productivity on the other; between raising colonial living standards and welfare, while at the same time meeting the pressures of metropolitan needs; between maintaining soil fertility and conservation in the midst of a renewed campaign for the exploitation of colonial resources.

Perhaps even more significant than the schemes themselves, which often failed to achieve their intended outcomes, was the lasting ideological and institutional influence of the late colonial development initiative, with its emphasis on scientific and expert management and state directed solutions. The new, independent governments of the 1960s, as Fred Cooper relates, '…sought to take over the interventionist aspect of the colonial state, and indeed intensify it, in the name of the national interest and (for a time) to demonstrate to voters that the state was improving their lives'.[9] And though the new nationalist governments repudiated many of the former colonial policies, especially conservation measures, in favor of more extensive plans or high profile projects, the principle effect of expanding bureaucratic state power in the name of development was often the same.[10] Indeed, one of the major legacies of the late colonial era, as Christophe Bonneuil has shown, were the large scale, prepackaged land utilization and settlement schemes first initiated by colonial rulers but which continued to hold currency among development practitioners and national elites until the 1970s.[11] Bonneuil argues that these schemes were driven by a number of concerns – planned resettlement schemes aimed at relocating populations due to public health concerns such as sleeping sickness or dam construction; projects that brought previously uninhabited arid regions under irrigation and crop production; the introduction of large scale, mechanized farming; the provision of welfare services and new technologies through integrated rural community development – but at the center to all of them was the growing power of the state and scientific experts over the lives of literally hundreds of thousands of African or other former colonial people. In fact, the early independence years saw a dramatic and bold renewal of large, technocratic programs as the new ruling elites sought to triumph where the old colonial guard had failed, launching huge mechanization schemes and subsidizing the widespread use of artificial fertilizers. These were more than mere showcase or public relations projects. The aim, as Bonneuil relates, was 'to bring agrarian societies under the state's epistemic (and hence political) grasp…to capture the peasantry into stable, legible, and more productive units that would make taxation, conscription, and "enlightened" intervention easier'.[12]

Colonial agricultural policy in the postwar years: the 'modern package' debate

One of the most important modes of intervention in the late colonial period was agricultural science and policy. The years of field trials on improved farming practices, new biometric methods and new crop varieties and seeds that were pioneered in colonial experimental stations and research centers since the 1920s and 1930s, were now widely diffused into pilot settlement and land improvement schemes where literally thousands of farmers became objects of experimentation. By the late 1940s, technical advisers at the Colonial Office in London had come to the conclusion that the maintenance of tropical soil fertility at a level efficient enough for higher standards of living, as well as for production of export crops in competitive world markets, would be impossible without the introduction of mechanization and chemical fertilizers, as well as new forms of cooperative farming.[13] They called for surveys to determine existing supplies of phosphate, potash, lime and nitrogenous fertilizers within the empire, and for properly designed fertilizer trials to be carried out on a whole range of crops and soil types.[14] In the same vein, they recommended properly designed field trials covering both the social and material aspects of mechanized farming, to be coupled with general research carried out at experimental stations in all colonies with the aim of understanding the wider impact mechanization would have not only on production, but on existing systems of land use and tenure.[15]

The Colonial Office's promotion of artificial fertilizers and mechanization corresponded with the more productionist view of development noted above. It could also be felt in the tone set by the CO's new Agricultural Adviser, Geoffrey Clay, who declared at the opening of the second Colonial Service Summer School at Cambridge in September 1948, that the stage was set for a large expansion of colonial production. In the past, Clay noted, colonial efforts aimed at the slow evolution of peasant agriculture, respecting established 'native' practices and encouraging local initiative through community development and mass education, but such methods were slow and could not keep pace with the growth of population or the demands for higher standards of living. In the name of higher yields, the time had come to introduce 'revolutionary changes' in the organization, methods and systems of 'native' agriculture.[16] Drawing on the lessons of Britain's own history of enclosures, Clay called on colonial service officers to be bold in their conceptions and courageous in their experiments. Given the current state of scientific knowledge and modern methods, he believed it was possible to affect an agricultural revolution akin to the eighteenth century but in a fraction of the time.

It was in this climate of unbridled confidence and sense of urgency that the early postwar trials of the new 'modern package' of artificial fertilizers, mechanized plowing and mechanically constructed conservation works began. During the 1940s and even before, extensive fertilizer field trials were initiated both in West and East Africa, which in some cases produced remarkable increases in yields, but in others, the results were less striking and often inconclusive, depending on the fertilizers, soil types and rotation of crops involved. In general it was found that East African soils responded well to phosphates and superphosphates, while in West Africa, sulphate of ammonia proved more valuable.[17] But the real problem with the new fertilizers was their cost, which made them prohibitively expensive for most peasant farmers until heavy state subsidies were introduced in the 1960s. Experiments with mechanization seemed to fare little better. Time and again agricultural officers complained that deep mechanical tillage under hot wet tropical conditions or on lighter soils did more harm than good, speeding up the process of decomposition of organic matter and soil erosion by exposing excessive amounts of soil to the sun.[18] Nor was it very economically practical given the small scale of peasant agriculture and high capital costs due to frequent mechanical breakdowns and expensive replacement parts, fuel and tires.

Despite such uncertain results, the new policy of mechanization and fertilizers went ahead, with the OFC and CDC launching such mammoth, showcase projects as the East Africa Groundnut Scheme in Tanganyika that employed hundreds of bulldozers and reconditioned tractors at every stage of its operations. Other highly touted projects included the Mechanical Cultivation Scheme for the mechanized production of swamp rice in Sierra Leone, and the Niger Agricultural Project at Mokwa, Nigeria, which used Fordson tractors to cultivate oilseeds and guinea corn. All three schemes were disastrous and very costly.[19]

The postwar reorientation of policy was not without its critics however. In Nigeria, for example, the new policy of mechanization introduced after the war, which included large projects planned and funded by the CDC near Iseyin and Abuja as well as Mokwa, stunned many agricultural department staff, since it made the prewar emphasis on contour plowing and ridging for the prevention of soil erosion virtually impossible.[20] Prior to the Second World War, the Nigerian Department of Agriculture had been a strong proponent of extensive research and field trials, directed at developing improved varieties of food crops, the study of intercropping practices and traditional bush fallow systems, and experiments with greening manuring in the south and mixed farming in the north. During the war, under the direction of James Mackie (Director of the Agriculture 1936–45), the Department's emphasis on maintaining soil fertility and improving the colony's self-sufficiency in foodstuffs continued. But not all officials, especially those responsible for Native Administration, were supportive and in fact appear to have actively sought to block such efforts. As the war drew to a close, Mackie found himself increasingly at odds with the new Governor, who initiated a reorganization of administration, giving the senior political officers significant authority over staff appointments in the technical departments. In protest, Mackie resigned in January 1945, complaining that the agricultural department's efforts to develop the country were being obstructed because agricultural staff did not have executive authority and had to take orders from administrative officials, who did not appreciate the importance of continuous research and sound extension work.[21]

Mackie's departure triggered a dramatic shake up of the department with many senior officers following his lead by transferring out to other colonies or seeking retirement themselves. A protracted and often heated debate continued in the late 1940s and early 1950s between those who faithfully adhered to the old organic or 'Humus School' of thought championed by O.T. Faulkner (Director of Agriculture, 1921–36) and Mackie, and those eager to introduce mechanization and the use of chemical fertilizers.[22] Friction between the two camps continued for several years, often dividing along generational lines with older agricultural officers, who had been there since before the war, showing greater awareness of the complexity of many indigenous farming systems and practices and the diversity of local climatic and environmental conditions, while younger officers, many of them hired in the postwar recruitment drive, being more confident in the power of state planning and more taken with the new technocratic approach.

Agricultural staff in Nigeria were not alone in their hostility towards the new policy priorities. Similar frictions occurred in Sierra Leone, where the new policy of introducing mechanical aids to agriculture led to the resignation of H.W. Dougall, an agricultural officer studying indigenous land use practices, and to the early retirement of the Director of Agriculture, R.R. Glanville.[23] Indeed, throughout the colonial empire from Kenya to Malaya to Nyasaland to Tanganyika, the postwar experiment with mechanization proved an abysmal failure, with the possible exception of land clearance, although even then, it was rarely cost effective.[24] In 1949, a mission was sent by the Colonial Office to investigate the problems associated with mechanization in Africa, which concluded that at that moment the use of mechanical power in 'native' agriculture was uneconomic and would require fundamental changes in traditional rights and use of the land.[25] In 1953–4, several tours by the Colonial Agricultural Machinery Advisory Committee found reason to be more optimistic if cheaper and more versatile tractors could be developed, but overall, it concurred that the experiment with mechanized agricultural production, especially in Africa, had been disappointing due largely to the high costs of equipment, supervision and recurrent servicing.[26] Years later, Roger Swynnerton, who served as an agricultural officer in both Tanganyika and Kenya, remarked that the most noteworthy result of the late colonial and early postcolonial penchant for supplying large numbers of tractors to assist peasant farming was 'extensive tractor graveyards'.[27]

Tropical agricultural research on African farming systems

The disappointing track record of postwar, colonial agricultural development had an important bearing on British tropical agricultural science, leading some researchers to question the very wisdom of the 'modern' package. As Anthony John Smyth, a soil scientist and agricultural research officer in Western Nigeria in the 1950s, later confided: 'This experience has made me skeptical of situations in which a failure to persuade farmers is blamed on a lack of extension facilities – lack of a proven product is more likely the cause. People who live close to the bread line are right to be conservative'. In a similar vein, the lesson Donald Chambers, a Senior Research Officer in Tanganyika, was left with was that 'the introduction of unproven or untested "improvements" carries a great responsibility as most farmers have little or no margin for error'.[28]

Such skepticism led a number of agricultural scientists to examine and reassess the efficacy of indigenous methods and practices. In doing so, they drew upon the work of an earlier generation of colonial agriculturists and researchers who, like Faulkner and Mackie, had paid careful attention to local farming systems, climatic conditions and soil types. Faulkner and Mackie were strong believers of looking at problems from the farmer's point of view, and they were often critical of earlier efforts to introduce new and exotic crop varieties or to favor European practices without careful regard for the variability of local climatic and soil conditions and the dynamics of local farming systems. 'In the past' they noted, 'Europeans have recommended, advised, persuaded, almost forced, the farmer to adopt their proposals, often without having first attempted to ascertain whether they were acceptable to him'. The results, more often than not, were complete failures, which '…not only discredit the European in the eyes of the native farmer, but arose in him a justifiable suspicion of all new ideas…'[29] They advised that nothing be recommended to the farmer that wasn't first proven by experiment. Perhaps their most concerted effort was a system of mixed farming for Northern Nigeria that was developed over several years of experimentation beginning in 1922. Extensive trails were conducted, for example, on the effectiveness of pen manure over kraaling, and on devising a suitable type of ridge plow and its effects on yields as a result of changes in ridge spacing. After nearly a decade of field trials, the department launched a pioneering extension campaign to integrate cattle, both as a source of manure and traction, into local crop farming systems to improve efficiency and maintain soil fertility.[30]

Another early advocate of basic examinations of local farming systems was H.L. Shantz, a plant physiologist with the Bureau of Plant Industries at the U.S. Department of Agriculture who was engaged by the 1924 Phelps Stokes Educational Commission to conduct a study of agriculture in East Africa. He found that contrary to popular European conceptions, many of the methods practiced by indigenous communities in the region were remarkably worthy of praise. 'Natives do not cultivate the poor land'. Shantz observed, '[t]hey choose the best. At this they are wonderfully well suited, and the Europeans should have careful studies made of their method. They will select one piece for one crop, another for a different crop…They will pass over easily accessible poor land and choose good land, although it lies at some distance….In general, the natives use excellent judgment in the selection of land and the rotation of crops, and their method of rotation of land insures new, rich soil free from harmful bacteria, fungi, and insects, thereby avoiding the two greatest problems of modern agriculture, the maintenance of soil fertility and physical condition and the avoidance of plant diseases'.[31] Shantz found distinct advantages to using the axe and hoe, with the aid of fire, over the 'tryanny of the plow', which allowed farmers to utilize the rich hillsides rather than being confined to the relatively poor level lands. He saw much merit in the practice found throughout Central Africa of ridging the soil, which protected plants from inundation during heavy downpours and insured better seed beds. Shantz also found the practice of charring grasses to have many positive effects, not only killing fungi and harmful insects, but adding a quantity of mineral fertilizer to the soil and charcoal to improve its physical condition. 'The agriculture of the native is', Shantz concluded, 'as a general rule, admirably adapted to the region he occupies…the 'slogans' of [scientific] agriculture must be questioned very seriously before they are allowed to interfere with the well-established customs of the native. While his practice may not be found to be the best in the end, this conclusion should only be accepted after a thorough and unprejudiced study of his methods and their results'.[32]

This kind of appreciation for local farming practices and environmental factors, led some researchers to produce new and innovative work, which drew upon indigenous ideas and sources of information. One notable example is Geoffrey Milne, a young soil chemist at the East African Agricultural Research Station at Amani, whose study of the basic types of East African soils and development of new units for mapping soils like the 'soil catena' were regarded as landmarks in the development of soil classification for soil surveys, gaining international recognition after the war.[33] In 1935, Milne undertook a soil reconnaissance tour of the Central, Western and Lakes Provinces of Tanganyika which became the basis for much of his Provisional Soil Map of East Africa.[34] What distinguishes Milne's approach most is his argument that simple vegetation or soil surveys did not go deep enough, and that what was needed was a comprehensive 'soil-vegetation complex' or 'land type' classification survey which integrated plant ecology with pedology and addressed the wider questions of proper land use. Milne's soil maps plotted the occurrences of 'natural land types' in a given area, which incorporated not only the soil profile and texture, but qualities such as topographical character, slope, stoniness, soil depth, the nature of plant cover or customary crops, susceptibility to and degree of erosion, wind exposure and river overflow.[35] His work displays a deep sense of the importance and diversity of locality, and of the complex succession of soil types that could be found in any district based on its climate, geomorphology and topography. In the Sukuma region of Western Tanganyika, for example, Milne drew on the help of African agricultural instructors as well as district agricultural officers such as J.G.M. King and B.D. Burtt, to develop a fairly complete and exact soil nomenclature based entirely on indigenous soil names, ranging from the granite rock and shallow dark grey loams of the Kopjes or hillsides known as *Iruguru* or *Luguru*, to the red-brown to bright red *Kikungo* loams on the broad ridges and slopes and well-drained plateaus, to the heavy black fissuring clay *Mbuga* soils found in the seasonally wet lowlands where human habitation was impossible. Local soil types were also closely correlated with the distribution and variation of vegetation types, and their occurrences were carefully mapped into distinctive 'country' or 'land' types. In the Shinyanga administrative district, for example, Milne identified 5–6 distinct types of country, each with its own set of soil conditions.[36] Land types, in turn, were viewed ecologically as distinctive 'habitats', which could be extended to include humans as an environmental factor impacting the land, forming the basis for inquiries into crop-plant behavior, crop yields and qualities, stock-carrying capacity, rates of natural increase, human population densities and types of settlement, human health and standard of living.

Milne's work also involved critically rethinking indigenous land use practices. He found the soil of the so-called 'cultivation steppe' of the Sukuma region of Western Tanganyika, which had been cleared of all woody vegetation so as to be used as common grazing grounds, to be remarkably resilient despite heavy use by local inhabitants and their cattle; its hard level surfaces had resisted trampling and wind and water erosion with the result that the soil over most of the cleared areas was still intact.[37] And in contrast to the common denunciation of Shamba burning as superstitious and destructive of humus, Milne offered an alternative account, noting as Shantz did earlier that low-intensity running fires cleared the land of trash that harbored pests and fungi, partially sterilized the soil and produced mineral residues that were retained on the soil. 'If the native is going to be convinced by our "modern enlightenment"', Milne observed, 'then we must be very sure that the objections we advance do actually hold good'.[38]

Milne was not alone in drawing upon local indigenous knowledge as well as emerging ecological concepts to broaden his understanding of the relationship between vegetation and soils and its bearing on land utilization. On the recommendation of Professor Arthur Tansley, Colin Graham Trapnell was hired by the Colonial Office as a government ecologist in 1930 and after a year's training as a colonial agricultural probationer at the Royal Botanic Gardens, Kew, Rothamsted Experimental Station, Harpenden and the pasture research center at Aberystwyth under Sir George Stapledon, Trapnell was posted to Northern Rhodesia where he and several other colleagues, including J. Neil Clothier, C.E. Johnson, and Peter Greenway, spent the better part of the next decade carrying out the territory's first ecological survey.[39] Trapnell got his first taste of the field as a student in Oxford, where he joined the Oxford University Exploration Club, under Max Nicholson, and helped organize the Club's first expedition to Greenland in 1928. In Northern Rhodesia, he and his colleagues set out on foot on a series of field tours or *ulendo*, initially covering the central and western half of the country, followed later by the north and eastern regions. During these *ulendos*, the team would trek along a series of traverse lines, surveying and recording the geology, topography, vegetation types and soil characteristics at specific intervals of time, as well as spending considerable time documenting the garden sites, agricultural practices, crops and history of the many villages they passed along the way. Out of this extensive touring and observation developed the idea of the vegetation-soil unit – that is a land unit which is uniform both in soil and vegetation type – as a means of land classification. A broad correlation exists, Trapnell noted, between major regional soil types and corresponding types of vegetation. A soil's varying degree of fertility, moreover, could be ascertained through a careful study of vegetation. Different classes of soil associated with specific vegetation types could be assumed to have certain qualities in common, while the same general soil types under different vegetation could be expected to differ in some respects.[40] Similar to the classifications used by Milne in his East African soil map, the vegetation-soil classification methods developed by Trapnell in the 1930s allowed field officers to clearly define and map the different land types of the territory. And again, like Milne, this approach drew upon customary African methods of land selection, which paid close attention to the visible character of soils, preferring red or black earths with a strong or loamy texture, as well as taking careful note of the types of trees and grasses supported by specific soils.[41]

Trapnell's survey reports also contain detailed accounts of the country's main cultivation systems, especially the *Chitemene system* which in one form or another was practiced throughout North Eastern Rhodesia. Chitemene or tree-burning agriculture involves cutting branches from surrounding woodland and stacking and burning them on a circular garden site, thus providing an ash seedbed for planting the main staple, finger millet. Trapnell found such practices to be remarkably diverse and complex, sometimes describing them as highly wasteful and inefficient, such as the small circle method of the *Southern Chitemene system* where sites were largely abandoned after a single year's use, but in many other cases as impressively well-suited to their challenging environments. The larger circle method of the *Northern Chitemene sequence* received much praise for its use of a succession of different crops in different years. Trapnell was especially intrigued by the elaborate extent to which varied crop sequences had been developed, of which he identified four basic types: the groundnut-bean sequence, the groundnut-millet sequence, the millet-bean or double millet sequence and the perennial kaffir corn sequence. In the groundnut-bean sequence, for example, an initial planting of varied catch crops including gourds, pumpkins, maize, cucumbers, cowpeas and castor oil was followed, after the catch crops had sprouted, by a broadcasting of the main millet crop along with perennial kaffir corn. This was followed in the second year by groundnuts, and in the third year by beans planted on mounds with cassava in between. In the forth year beans might be planted on clean mounds, or cassava left to mature. After four or five years the site would be left to regenerate.[42]

Such practices insured a balanced food supply as each household prepared a new millet garden each year while maintaining older sites at different stages in the succession. Even more commendable, according to Trapnell, were the various mound-making methods of the *Northern Grassland system*, which he described as a 'form of semi-permanent millet cultivation in which tree-burning is finally abandoned'.[43] Such methods constituted a different kind of agriculture, by making efficient use of organic matter through the formation of hoe cultivated, top soil mounds of grass sods which were then spread to make seedbeds for millet, and by the re-cultivation of old, abandoned sites once the weed-grass of former cultivation had disappeared and other grasses (*Hyparrhenia filipendula* or Pumpu grass) become dominant.

Trapnell's appreciation of African agriculture should not be overstated. He saw the clear need for improvements throughout the country, and he considered a permanent system of agriculture involving a method a crop rotation, along the lines of European farming, to be the most advanced and preferable. Tree-burning agriculture, especially in its less elaborate forms, was primitive and wasteful and, he believed, would gradually be displaced out of necessity as population grew and natural woodlands were exhausted. But he argued that African agriculture was not static but instead was undergoing a process of slow change as a result of diffusion and intercontact between neighboring tribes. Any modifications that were introduced must be done by carefully studying existing indigenous methods as their inherent possibilities would point the way forward without the importation of alien practices.

During the 'technological turn' of the 1940s and 1950s, as noted earlier, the kind of careful, gradual approach advocated by Faulkner, Mackie, Milne, Trapnell and others, fell out of favor with advisers at the Colonial Office such as Caine and Clay, and with many Colonial Governors, who were eager to get on with the development imperatives of the 'Second Colonial Occupation'. But as doubts began to surface about the efficacy of the 'modern package', some colonial agronomists at least were drawn back to the earlier interest in indigenous practices and methods in an effort to learn from and improve upon them. One of the first important studies was carried out by W.S. Martin, an agricultural research officer in Uganda, who drew attention in the 1940s to the effect of grass leys in binding soil particles into aggregates, which gave scientific validation for shifting cultivation and bush fallow practices as an effective method of restoring soil fertility.[44] 'Native' practices such as mixed or intercropping also received renewed attention in the 1940s and 1950s and were found in some cases to promote higher yields than planting in pure stands.[45] Experiments with mixed planting of crops also found the practice to be highly effective in protecting against insect pests and countering soil erosion.[46] Attention was given to other techniques as well such as mound cultivation, which was found to be a simple and efficient method of conserving the organic matter in the soil that was more beneficial than plowing in grass leys because it acted as a 'compost heap', heating and fermenting the grass under the mound.[47]

Even in the case of such seemingly 'high modernist' campaigns as the Plan to Intensify the Development of African Agriculture in Kenya (better known as the Swynnerton Plan), there is evidence that the thinking behind the scheme developed through what Bienart, Brown and Gilfoyle describe as an 'interpenetration' of scientific and local knowledge.[48] One of the key ideas that underpinned the Swynnerton Plan, and other agricultural programs in Kenya, was the concept of ecological zoning, where areas of cultivation were divided into different 'zones' based on the association of different plant communities with certain kinds of soils and rainfall, and suitable cash or food crops were identified for planting in each zone. The idea of zoning was first introduced in the early 1950s by Leslie Brown, an Provincial Agricultural Officer in Central Province and, later, Nyanza. Brown had been trained as a zoologist, rather than as an agriculturalist, and thus had a natural tendency to look at farming ecologically, but the genesis of his ecological zoning method came not from anything he learned in England or at the Imperial College of Tropical Agriculture (ICTA) in Trinidad, but rather, from Africans themselves. As he later recalled: '[W]hen I say that these policies were not really developed clearly on what I myself had thought of [it is] because I had been taught about this by Africans in Nigeria many years before. I picked up the ideas largely from bush Africans, and then I applied them with my scientific knowledge'.[49]

Prior to serving in Kenya, Brown had spent a great deal of time big game hunting in Northern Nigeria, where he developed a close relationship with one particular Hausa hunter. As Brown explained:

> On one occasion I was endeavouring to shoot a Rowan antelope. I set out with [my Nigerian guide] very early in the morning, and he set off at a terrific clip…we proceeded to walk very fast though the bush for several miles and then at about an hour after dawn or at a little bit before that we came to an area where there were plenty of Rowan antelope tracks, and it was apparent that he knew where he was going…I thought it was worthwhile going into it as to why he knew that the Rowan would be in this particular place. And as he said, it was

> perfectly simple. He said, 'You can see that this is a certain kind of soil (in actual fact the word used was "jigawa" which in Hausa means a certain whitish kind of sandy soil), and on this soil there grows this kind of bush (which was a species of gardenia), and at this time of the year the gardenia is in fruit and the Rowan like to eat the fruits of the gardenia so there will be Rowan here at this time of year'. Well this was a perfectly good example of applied ecology. In actual fact the chap knew exactly what he was looking for, where to find it and also it showed to me that the particular kind of plant could indicate a certain kind of soil with a particular productive capacity.

From these early observations, Brown would later develop tests which confirmed that certain types of soils in certain rainfall conditions could be associated with certain kinds of plant communities. This became the basic principle behind the concept of ecological 'zoning', which provided agricultural officers with a rough-and-ready guide for identifying which areas were more suitable for growing particular crops, such as coffee and tea, than others. Rather than waiting ten years for experimental results, Brown remarked, '…one could in actual fact get a very fair idea of where the areas were which would grow these various crops simply by looking at the plant associations. And I learned these plant associations a) because of my zoological training in the first instance which caused me to look along these lines; and secondly from practical teaching that was given to me by illiterate bush Africans. In fact, a lot of this was very much more useful to me than much of the advance soil science and things like that that I was taught by my professors in Trinidad'.[50]

The work of these British agricultural researchers was corroborated by agronomists and foresters working in other regions of the equatorial belt such as the Belgian Congo, where the failure to devise an effective system of maintaining the fertility of the fragile soils of the Congo Basin rain forest led scientists to belatedly recognize the utility of indigenous multi-cropping and long forest fallowing practices. When experiments with alternating bands of cleared land and forest (the 'corridor system'), and crop rotations using shorter fallowing proved unsuccessful, Belgian colonial managers of the Paysannat Turumba Scheme instructed farmers to return to the traditional Turumba practice of longer fallow periods (in other words, 20 instead of 12 years).[51] Similarly, as Monica van Beusekom's case study of the French Soudan's Office du Niger has recently shown, the failure of earlier efforts to successfully introduce intensive plow agriculture and crop rotations on irrigated plots among African settlers of the scheme, led colonial planners after the Second World War to begin integrating local agricultural practices such as abandoning crop rotations in favor of fallow periods and allowing nomadic pastoralists to graze their cattle on Office lands during the dry season as a way of maintaining soil fertility. And although they still maintained the superiority of European science they began, as Milne and Trapnell had done in the 1930s, to draw heavily on indigenous knowledge such as local soil classification systems to determine which crops and varieties were best suited to which soils.[52]

The greater openness of investigators on the ground towards African ideas and farming practices, did not necessarily translate into revolutionary new thinking at the level of international institutions and global networks. A good example is the case of shifting cultivation, the merits of which were beginning to be reconsidered through the work of researchers like Trapnell and Martin in the 1940s. In the mid 1950s, a Belgian agronomist by the name of Pierre De Schlippe published what is still considered a landmark study, *Shifting Cultivation in Africa: The Zande System of Agriculture*.[53] De Schlippe had worked at the Yambio Experimental Farm in the southern Sudan in the late 1940s and early 1950s, where he undertook a socio-agricultural survey of the area as part of the Zande Development Scheme. His detailed account of almost every aspect of Zande farming, from field and crop associations to harvesting and processing techniques, was written with the intent of showing that African shifting cultivation was a rational and highly adapted system of agriculture, designed to cope with the difficult ecological conditions of the equatorial belt.

Despite such accumulating evidence, however, a definitive study on shifting cultivation published by United Nation's Food and Agricultural Organization in 1957, continued to condemn the practice in the strongest of terms, calling it 'the greatest obstacle not only to the immediate increase in agricultural production, but also to the conservation of the production potential of the future, in the form of the soils and forests [of the humid tropics]'.[54] Such intransigence was also encountered by Peter Nye and Dennis Greenland, two colonial soil scientists at the University College of Ghana in the 1950s, who were carrying out a similar study as De Schlippe's but under experimental conditions on an 800 acre forest reserve. They received very little support from the head of their department at University College, the South African-born ecologist, John Phillips, who looked down on them and did not think what they were doing was very useful. Nor, apparently, did the staff at the Colonial Office, who continued to ignore their research, since it focused on subsistence farming rather than cash crop systems. 'The older scientific community', according to Greenland, 'mostly did not want to know about our study'.[55] Their findings were nevertheless published by the Commonwealth Bureau of Soils (formerly the Imperial Bureau of Soils at the Rothamsted Experimental Station, Harpenden) in 1960, and in them they challenged the FAO's orthodoxy, asserting that '…when not pushed to excess shifting cultivation has for centuries given man his livelihood in the humid tropics; and it is significant that even now, after a quarter of a century of experiment in the African tropics, we have failed to introduce to the forest regions any method of staple food production superior to the system of natural fallowing used in shifting cultivation. On the contrary, failure to appreciate its nice adjustment to the tropical environment has led to many disappointments…The disasters brought on by agricultural methods which have taken no account of the treasures of wisdom and experience accumulated in the old tropical system are a sufficient proof of the latter's value. It can be improved, but only if the reasons for its processes are fully understood'.[56]

Conclusion

What the above examples demonstrate is that there was considerable diversity of opinion and debate among colonial agricultural scientists and administrators, even at the height of the late colonial interventions, and that the transfer of European science was crucially shaped by the colonial context and by its encounter with indigenous knowledge and practices. This led not only to significant shifts in colonial discourse about tropical environments and populations, but also to innovations in tropical agricultural research, such as the rise of ecological perspectives about tropical soils and plant communities and their relation to land use. This was perhaps most evident at the level of practice where the design of colonial agricultural development projects became, out of necessity, a kind of hybridized construct, to use Bonneuil's terms, where 'certain lines of commensurability between expert knowledge and farmers' knowledge' were established.[57] But even on the plane of broad theoretical pronouncements and models, a degree of cross-fertilization began to take place as can be seen in the reappraisal of shifting cultivation noted above.

The work of these scientists and researchers was, in one sense, extremely local, but it was also global in reach. They were part of a network of institutions, careers and ideas that made up what might be termed the British 'school' of tropical agriculture. Most of them were members of the so-called 'Trinidad Mafia', having received their postgraduate training at the ICTA in Trinidad, before being posted to work in agricultural departments and at regional research institutes throughout the Empire.[58] Many also served in several different territories throughout their careers, bringing experience gained from one place to bear on problems they encountered elsewhere, and meeting and exchanging ideas and information with other former ICTA graduates along the way. We know, for example, that Colin Trapnell and Geoffrey Milne corresponded and exchanged ideas with each other during the critical decade of the 1930s.[59] In Kenya, Leslie Brown was certainly aware of the work of Trapnell's colleague, William Allan, at the Rhodes Livingstone Institute. Using the vegetation soil unit as the basis for land use assessment, Allan formulated specific methods for estimating population carrying capacity relative to specific areas and systems of land usage.[60] His methods, in turn, were used in assessing the urgency of land problems in the Native Reserves of Northern Rhodeisa, and similar survey and land-use planning methods were taken up by agricultural staff in other colonies in the 1940s and 1950s.[61] In 1950, Trapnell was recruited by the Colonial Office to train what would become the next generation of African conservation ecologists at the East African Agricultural and Forestry Research Organization at Muguga in Kenya.[62] Peter Nye and Dennis Greenland were also familiar with both Milne's soil investigations and Trapnell's work on Chitimene, as well as De Schlippe's research, as they wrote up their findings in Legon in the late 1950s. Later in his career, Greenland went to work for the International Rice Research Institute (IRRI) in the Philippines, where the director happened to be none other than the son-in-law of W.S. Martin.[63] Martin, it will be recalled, had produced the first experimental evidence of the positive benefits of grass fallow periods for restoring the fertility of tropical soils.

As Greenland's experience suggests, many of the scientists and agricultural experts who began their careers working in the British colonies, were absorbed by the burgeoning new, international scientific networks of the postcolonial period. Many of the pioneering works on indigenous agricultural knowledge and farming systems published in the 1960s and 1970s were, in fact, written by individuals who began their working lives as colonial agronomic scientists and natural resource officers, including John Phillips, William Allan, John Ford and Robert Chambers.[64] Their work was crucial to the development of 'Farming Systems' approaches and 'Farming Systems Research' that became fashionable with the setting up of the Consultative Group on International Agricultural Research

(CGIAR) in the 1970s and 1980s. In turn, the CGIAR's network of international research centers became one of the main sources of employment for these former colonial scientists.

Notes

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9 Frederick Cooper, *Africa Since 1940: The Past of the Present* (Cambridge: Cambridge University Press, 2002), p. 88.
10 James Ferguson, *The Anti-politics machine: 'Development', Depoliticization, and Bureaucratic Power in Lesotho* (Cambridge: Cambridge University Press, 1991), pp. 254–6.
11 Bonneuil, 'Development as Experiment', pp. 260–1.
12 Bonneuil, 'Development as Experiment', p. 269.
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14 Report of the meeting of the committee of agriculture, 31 October 1945, CACAAH&F, Papers 1945, NA CO 996/4; Report of the meeting of the committee of Agriculture, 11 June 1946, CACAAH&F, Papers 1946, NA CO 996/5.
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19 See Alan Wood, *The Groundnut Affair* (London: Bodley Head, 1950); K.D.S. Baldwin, *The Niger Agricultural Project: An Experiment in African Development* (Cambridge, MA: Harvard University Press, 1957); Paul Richards, *Indigenous Agricultural Revolution: Ecology and Food Crops in West Africa* (Boulder: Westview Press, 1985), pp. 19–20.
20 Papers of D.H. Brown, Box 1 (4), BLCAS MSS. Brit. Emp. S. 476.
21 See, J.R. Mackie Papers, 'Colonial Development and Welfare' (1) Papers on Nigerian Agriculture 1939–1945, and 'Letter to S/S/C/ from Mackie explaining his reasons for resigning', Letters 1941–8, BLCAS MSS Afr. s. 2124.
22 Abdul Raufu Mustapha, 'Colonialism and Environmental Perception in Northern Nigeria', *Oxford Development Studies* 31, No. 4 (2003), 409–10.
23 Richards, *Indigenous Agricultural Revolution*, pp. 19–20.
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Minutes of Agricultural Development Schemes Conference, Dodoma, 14–17 March 1951, Tanganyika: Agricultural Policy, 1951, NA CO691/215/14. See also comments by various agricultural officers: Reginald Child, Box 1 (8), Peter Harold Rosher, Box 4 (35), John A. Sandys, Box 4 (37), M.F.H. Selby, Box 4 (40), Anthony John Smyth, Box 7 (45), Robert L. Waddell, Box 7 (57), BLCAS MSS. Brit. Emp. S. 476.

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28 For the above quotations see, Papers of Donald Vincent Chambers, Box 1 (6), and Papers of Anthony John Smyth, Box 7 (45), BLCAS MSS. Brit. Emp. S. 476.

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30 Faulkner and Mackie, *West African Agriculture*, pp. 64–75.

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11

The Science of Decolonization: The Retention of 'Environmental Authority' in the Contest for Antarctic Sovereignty between Britain, Argentina, and Chile, 1939–59

Adrian Howkins

Early in 1955, the British government made a unilateral submission to the International Court of Justice in the Hague requesting adjudication on the sovereignty of the Antarctic Peninsula region, directly to the south of South America. Since 1908, Great Britain had claimed this vast area as part of its colonial empire, administered from Stanley in the Falkland Islands as the Falkland Islands Dependencies. Stretching all the way to the South Pole, the Dependencies were the largest territory under the authority of the Colonial Office. The primary motive for Britain's claim to this region was the desire to tax and regulate the nascent Antarctic whaling industry, and for a while the Dependencies returned a handsome profit. The British claim to the region, however, overlapped significantly with the claims of Argentina and Chile, and since the beginning of the Second World War, the three countries had been involved in a costly sovereignty dispute, which on several occasions threatened to turn violent. Britain's unilateral submission to the International Court of Justice represented an attempt to resolve the dispute honorably and avoid setting a bad precedent for other parts of its colonial empire.

Among the arguments put forward in the British submission to the International Court of Justice was the idea that British scientific research in and around the Antarctic Peninsula, especially in marine biology, gave it a greater legal right to the region.[1] In a discussion of the interwar period, the British legal case noted:

> The Dependencies during this period were covered literally by a network of patrols undertaken by the Discovery Committee. The main

> focus of the Committee's research was on the natural history of whales, the most important economic resource of the Dependencies, and especially intensive observations were made on the whaling grounds of South Georgia, the South Shetlands, and Grahamland… A large and important body of scientific material has been published by the Committee in the 27 volumes of *Discovery Reports*, and its research on the natural history of whales is admitted by expert opinion to have made a vital contribution towards the effective solving of the international problem of the conservation of whale fisheries.[2]

In contrast, the British submission noted, the governments of Argentina and Chile made no effort to understand or regulate the whaling industry, which 'a prudent sovereign would have done, or sought to do'.[3] Such rhetoric can be thought of as an assertion of 'environmental authority', in which the British sought to use their understanding of the natural world both to facilitate and justify imperialism. This connection between imperialism, science, and the environment fits neatly into broader studies of the British Empire, with its seminal idea of 'improvement' as John Gascoigne explores in Chapter 3 of this volume.[4]

Both Argentina and Chile rejected the arbitration of the International Court of Justice claiming the sovereignty of Antarctica to be a purely domestic concern. From the middle of the 1930s, Argentina and Chile had directly challenged British claims to environmental authority in Antarctica. In contrast to Britain's assertions that its scientific research gave it rights to political authority in the region, the two South American countries argued that the Antarctic environment itself demonstrated their 'Natural Rights' to sovereignty. Both countries, for example, highlighted the fact that the Andes Mountains continued under the ocean to reemerge as the 'Antartandes' in the Antarctic Peninsula, providing a geological connection between South America and Antarctica. The Argentines sought to take on British claims to environmental authority directly by asserting the superiority of their own scientific research in the region. The Chileans tended to sidestep this contest by emphasizing the aspects of their case for Antarctic sovereignty that were not specifically 'scientific'. With the outbreak of war in 1939 their claims became more assertive, and Argentina began to send seasonal expeditions to the Peninsula. With these assertions of sovereignty, South American 'Environmental Nationalism' in Antarctica increasingly merged with other nationalist challenges to colonial authority, particularly against Britain's so-called informal empire in Argentina.[5]

Rather than meekly submitting to the South American challenge to their environmental authority in Antarctica, the British redoubled their efforts to assert the superiority of their scientific work in the region. This intransigent response began with the dispatch of the top-secret 'Operation Tabarin' expedition early in 1944.[6] This expedition had a significant, if slightly amateurish, scientific component that conducted research in such fields as meteorology, geology, and marine biology. At the end of the war, Operation Tabarin was renamed the Falkland Islands Dependencies Survey (a forerunner of today's British Antarctic Survey) and British scientific efforts in Antarctica continued at a more professional level with such activities as the establishment of a meteorological service in the Falkland Islands Dependencies. The British increasingly sought to stress that they were conducting 'pure science' in contrast to what they claimed were the obviously political expeditions of Argentina and Chile. One major advantage enjoyed by the British was that British scientists were more closely linked into international scientific networks, such as the International Whaling Commission (IWC), which gave external legitimacy to their assertions of 'environmental authority'.[7]

Science was never purely rhetorical. Over time, and especially with the International Geophysical Year (IGY) of 1957–8, developments in the scientific understanding of Antarctica suggested that the continent itself contained little potential for short-to-medium-term economic gain. Despite widespread scientific research, no easily accessible mineral resources were found. Financial returns from the whaling industry had been declining since the advent of pelagic, factory ship-based, whaling from the 1920s onwards. Combined with the costly dispute with Argentina and Chile, the Falkland Islands Dependencies no longer fulfilled the imperial mantra that empire should pay for itself, and, in fact, the region was becoming a drain on already scarce resources. British officials looked for a way of extricating themselves from their claims to exclusive sovereignty while at the same time retaining political influence. In close alliance with the United States – which had similar ambitions of retaining influence in Antarctica without a formal commitment to sovereignty – the British helped to lay the foundations for the signature of the Antarctic Treaty on 1 December 1959. This treaty effectively brought about the limited internationalization of the Antarctic continent, although it maintained existing sovereignty claims to Antarctica in a state of suspended animation. The internationalization was limited because it deliberately sought to maintain the influence of its signatories and exclude potential 'troublemakers' – meaning soviet satellites and the newly independent states of Asia and Africa – from membership of the Treaty.[8]

The 12 original members of the Antarctic treaty used the conduct of scientific research as a condition for other countries to accede to the Treaty, and as a means of retaining their political influence in the region.

In focusing on the contest for sovereignty between Britain, Argentina, and Chile in the Antarctic Peninsula, this chapter raises the much broader question of what happened to British imperial claims to environmental authority in the region during the period of decolonization? It suggests that, in Antarctica at least, Britain used science as a tool to retain its political influence. Britain's robust response to the anti-colonial assertions of Argentina and Chile and its refusal to relinquish political influence mirrored a similar strategy in many other parts of the colonial empire. In their influential article 'The Imperialism of Decolonization', Wm. Roger Louis and Ronald Robinson argue that in broad alliance with the United States, the British sought to use economic influence as a way of perpetuating their power. Formal empire, they argue, reverted to informal influence, which was often a stronger form of relationship. This chapter follows the argument set out by Louis and Robinson and suggests that in Antarctica the British, in alliance with the United States, used science, and the associated claims to environmental authority, to retain their political influence up to and after the signature of the Antarctic Treaty in 1959. Since the ability to conduct scientific research was in turn tied to a country's financial strength, science itself could be said to have an economic bottom line. But it is interesting to note how central the conduct of science remained in the retention of political influence in Antarctica, and it is very possible that similar strategies were used during the decolonization of other parts of the British colonial empire.

The first section of the chapter looks at British claims to 'environmental authority' in the Antarctic Peninsula from 1908 up to the Second World War. The following section then examines the Argentine and Chilean challenges to these claims, and particularly the use of 'environmental nationalism'. The third section focuses on the British response to this challenge and looks at the ways in which this contest played out between 1939 and 1959. The final section of the chapter will look at British claims to environmental authority alongside Louis and Robinson's argument for an 'imperialism of decolonization', making the argument that British claims to environmental authority survived the supposed decolonization of Antarctica through the 1959 Antarctic Treaty, and that science and scientific prestige became tools for the retention of British influence in the region.

Environmental authority

Great Britain made its first formal territorial claim to the Antarctic Peninsula region in 1908.[9] Its motivation for such a claim was the desire to tax and regulate the nascent whaling industry that was booming in the seas around South Georgia and the Antarctic Peninsula. In making the case for British sovereignty in the late 1940s, Sir Miles Clifford, the Governor of the Falkland Islands, argued:

> The only true wealth that this area contains, so far as we know today, is still as in the past its marine wealth – its whales and seals; these, as we have noted earlier, could readily be exterminated by indiscriminate killing and it was the recognition of this danger which decided His Majesty's Government to bring these industries under control and lead to the establishment of British sovereignty over the area now known as the Falkland Islands Dependencies. *The motive was a purely unselfish one, to conserve the harvest of these seas for the benefit of mankind as a whole.*[10]

Such a claim to environmental authority 'for the good of humanity' – repeated in the 1955 submission to the International Court of Justice – gave legal, practical, and moral support to Britain's case for Antarctic sovereignty. From a legal perspective, the presence of scientists in Antarctica helped to fulfill the legal requirement of 'effective occupation' that would help to demonstrate British rights if ever the dispute should be heard by an international court.[11] Practically, an improved scientific understanding could facilitate an increasing physical penetration and occupation of the region. This was particularly obvious in the case of maps and shipping charts, which provided invaluable aids to navigation. And morally, as in many other parts of its empire, the conduct of scientific research and the imposition of conservation measures aided Britain's claims to be 'improving' and making use of the environment, where otherwise it would simply go to waste.[12]

In order to demonstrate its claims to environmental authority during the interwar period, Britain instituted a program of oceanographic research known as the Discovery Investigations, which was among the first specialist committees set up by the Colonial Office. This enterprise epitomized the connections between science and empire, and it helped to put British scientists, such as N.A. Mackintosh, at the center of international networks of marine biology. Initially making use of Captain Robert Falcon Scott's first Antarctic ship, the *Discovery*, the research program sought an improved understanding of the marine life of the Southern Ocean, in particular of the whale populations. This knowledge, British scientists and officials hoped, could make the whaling industry more productive, efficient, and sustainable. This would in turn increase the profitability of the whaling industry and increase the revenues collected by the Falkland Islands Government. In a neat completion of the circle, the Discovery Investigations were directly financed by taxes on the whaling industry in the Falkland Islands Dependencies. Although the advent of pelagic, factory ship-based, whaling in the early 1920s seriously hampered the British Government's ability to tax and regulate the industry as a whole, revenues from shore-based whaling and associated enterprises ensured that British sovereignty claims to the Falkland Islands Dependencies were largely financially self-supporting up to the Second World War.[13]

Alongside the marine wealth of Antarctica, the British also had a strong emotional attachment to the region, linked to the Heroic Era expeditions of Captain Robert Falcon Scott, Ernest Shackleton, and others.[14] Captain Scott had famously been beaten in the race to the South Pole by the Norwegian Roald Amundsen in the southern summer of 1911–12, and perished along with his four companions on the return journey from the Pole. The dead explorers quickly became lionized as martyrs to the ideals of Edwardian Empire, summed up in the self-sacrificial last words of Titus Oates: 'I'm going outside, I may be some time'.[15] In contrast, Ernest Shakleton, who three years earlier had set the previous record for furthest south by getting to within 112 miles of the South Pole, gained his reputation as a polar survivor. He was perhaps became best known for his epic story of survival following the sinking of his ship the *Endurance* during an expedition to Antarctica between 1914 and 1916. Throughout the so-called Heroic Era of Antarctic exploration, which lasted roughly from 1895–1916, Antarctica offered British adventurers the perfect stage for demonstrations of manly prowess and racial fitness.[16] Certain elements of these expeditions further reinforced British claims to environmental authority. Apologists for Scott, for example, often cite the useful scientific work done by his expedition in contrast to Roald Amundsen's scientifically vacuous 'dash for the pole'. The 35 pounds of rock specimens manhauled from the polar plateau might have contributed to the deaths of Scott and his four companions, so the argument went, but they would later aid the geological understanding of Antarctica.[17]

The connection between Scott's heroic status and his scientific explorations would be enshrined in the creation of the Scott Polar Research Institute (SPRI) in Cambridge, using money raised in the Scott Memorial

Fund. Following its foundation in 1920, SPRI has played a leading role in promoting British imperial interests in the region, as well as being at the forefront of Antarctic scientific research. In 1934, at the official opening of the SPRI building on Lensfield Road in Cambridge, the Prime Minister Stanley Baldwin argued that the university exploring societies of Oxford and Cambridge demonstrated that the 'Elizabethan Spirit of Adventure' was still rampantly alive among the young people of Britain.[18] As British exploration of Antarctica continued into the late 1930s with the Rymill expedition to the Antarctic Peninsula, SPRI continued to play an important coordinating role.

The traces of coal found in Scott's rock specimens also helped to fuel speculation about the potential mineral wealth of Antarctica.[19] This latent belief in Antarctica as a frozen *El Dorado* would prove to be an important incentive for continuing British interest in the region. Having made sovereignty claims to the Falkland Islands Dependencies, the British Government was unwilling to relinquish a territory that might prove to contain significant mineral resources. Before the Second World War, much of continental Antarctica remained, quite literally, a blank space on maps of the world.[20] But the British believed that if minerals were to be found, they would be ideally placed to take advantage of these finds – no doubt once again 'for the good of humanity'. In this way, the vast unknown of the Antarctic environment played a significant role in the history of the impending Antarctic sovereignty dispute.

Environmental nationalism

From the middle of the 1930s, Argentina and Chile actively contested the sovereignty of the Antarctic Peninsula region with Great Britain and with each other. Active South American interest in Antarctica dated back to the sealing industry of the early nineteenth century. Both Argentina and Chile had played a part in the early development of the Antarctic whaling industry in the early twentieth century, and Argentina could boast possession of Base Orcadas, the longest continually occupied station in the region. South American assertions of sovereignty in Antarctica were closely connected to the rise of nationalist movements in both countries, and to the connected belief that Antarctica might prove to contain a treasure trove of mineral wealth.[21] In Argentina this nationalism took a particularly anti-British tone, due mainly to the predominance of British interests within the Argentine economy. In the early 1930s, the aristocratic Foreign Secretary Julio Argentino Roca, son of a famous nineteenth-century president, had incurred the wrath of nationalists by proudly declaring that 'Argentina is an economic part of the British Empire'.[22] Historic grievances against the British 'theft' of the *Islas Malvinas* in 1833 further added to nationalist anger.[23] The Chileans had a slightly more distant, and arguably friendlier, relationship with the British Empire. Many of the Chilean worries focused on the fear of Argentine expansionism rather than hostility towards the British. But even so, as the sovereignty dispute progressed, many Chileans became caught up in the anti-colonial *zeitgeist* of the mid twentieth century.

With the outbreak of the Second World War in 1939, Argentine and Chilean claims to ownership of the Antarctic Peninsula region intensified. Neither South American country declared war on the Axis powers until the final months of the war, when they did so in order to participate in the foundation of the United Nations. With Great Britain distracted and quite possibly heading for defeat, the time looked opportune for advancing the cause of South American Antarctica. The Chileans were unable to do much practically to support their claims owing to their inability to find an appropriate ship to sail to Antarctica, but they did formally announce ownership of 'Chilean Antarctica' in a presidential decree of November 1940. The Argentines were slower to make a formal statement of sovereignty, but they did send naval expeditions to the Antarctic Peninsula in the summers of 1941–2 and 1942–3. These expeditions conducted elaborate ceremonies of possession and erected symbols of Argentine sovereignty, as well as conducting rudimentary scientific research.[24] Although less aggressive than an expedition against the populated Falkland Islands would have been, the Argentine expeditions represented a hostile challenge to British sovereignty in the region.

Despite their mutual rivalry, Argentina and Chile used similar arguments to demonstrate their rights to Antarctica, and these shared arguments pushed them into a loose alliance around the idea of a 'South American Antarctica'. [25] Their claims to possession of the region rested on a combination of rights inherited from the Spanish Empire, historical antecedents, and geographical proximity. Their arguments used the results of biological, meteorological, and glaciological research to make a case for geographical proximity and attachment: this is clearly demonstrated by the idea of the Andes Mountains continuing into Antarctica. In Chile, Captain Enrique Cordovez of the Chilean Antarctic Commission even went as far as suggesting that similarities between the snow and ice of Southern Patagonia and the snow and ice of the Antarctic Peninsula helped to demonstrate Chile's ownership of the region.[26] This challenge to British scientific authority, along with the use of scientific and environmental rhetoric to make their respective cases for sovereignty, can be thought of as a form of 'environmental nationalism', in which the Antarctic environment itself was used rhetorically to support what the Argentines and Chileans saw as an explicitly anti-colonial cause.

In Argentina, the government of President Juan Domingo Perón (that lasted between 1946 and 1955) sought to beat the British at their own imperial game. He believed that Argentina could conduct Antarctic research that was more extensive and of a higher quality than that of Britain.[27] Argentine scientific activity therefore represented a direct challenge to Britain's claims to environmental authority in Antarctica. The conduct of scientific research also conformed to Perón's desire to show the world that Argentina was a modern, forward-thinking country. A leading Peronist newspaper, *Mundo Peronista*, summed up Perón's scientific ambition in an article entitled 'For All the Men of the World'.[28] After explaining the great work that Argentine scientists were doing in the field of cosmic radiation, the article concluded that such research could not take place in anywhere except Argentina because of its privileged geographical situation stretching from Salta in the north to the South Pole. The idea of Argentina justifying its sovereignty through useful scientific research 'for the good of humanity', was not necessarily accepted by the international scientific community more generally. But it resonates with the traditional utilitarian justifications of imperialism used by the British. Perón's Antarctic policy did not seek to challenge the discursive connection between science and empire, rather he sought to take advantage of this connection and exploit it to his own political ends.

In Chile, the challenge to British scientific authority took a less direct form. The Chilean government simply could not afford to compete scientifically with Great Britain and Argentina. Alternative visions of Antarctica continued to flourish in Chile based as much on myths, legends, and poetry as on hard science. Writers such as Francisco Coloane and Miguel Serrano produced accounts of Antarctica in which the mythical creatures of southern Chilean folklore were transferred to the shores of the Antarctic Peninsula. Books like Coloane's enduring classic *The Conquerors of Antarctica* (1945) and Serrano's *Antarctica and Other Myths* (1948) created a literary case for Chilean sovereignty, by creating familiar associations with the frozen south.[29] A number of Chilean scholars of geopolitics used the word 'science' to refer to their geopolitical interpretations of Antarctica, although their writings shared little in common with internationally accepted definitions of the word. These alternative, essentially non-scientific, representations can also be thought of as a contrasting form of 'environmental nationalism' to that of Argentina, that created other sorts of 'natural' connections between Chile and the Antarctic.[30]

Contesting environmental authority

The British responded to South American environmental nationalism in the Antarctic Peninsula, not by surrendering meekly, but by redoubling their efforts to assert their environmental authority in the region. Towards the end of the Second World War, the British dispatched a secret expedition known as Operation Tabarin to assert British rights to Antarctica.[31] The influence of scientists on the planning of this expedition, helped to consummate the relationship between science and sovereignty and the performance of science became a central battleground of the escalating dispute.[32] The principle scientific activities of the Tabarin expeditions were survey and geology, although basic research was also conducted in such fields as glaciology, biology, and meteorology.[33] The British realized that if they could find valuable minerals in Antarctica these could be exploited to fund the British presence in the region. They were also appreciative of the practical benefits of other scientific work in the fields of glaciology and meteorology for tasks such as navigating the icy seas. As in other parts of the colonial empire, claims to environmental authority in Antarctica were never purely rhetorical, and brought important practical benefits.

In the aftermath of the Second World War, the Colonial Office assumed direct responsibility for Operation Tabarin, and it was renamed the Falkland Islands Dependencies Survey.[34] With the creation of this new government organism for Antarctic scientific research the earlier Discovery Investigations became largely redundant, although there was significant continuity in the scientific personnel. In a conversation with Gordon Howkins, the head of the Falkland Islands Meteorological Service, Brian Roberts of SPRI and the Foreign Office Research Department explained the political reasoning behind meteorological work in the Falkland Islands Dependencies:

> It is the wish of HMG to emphasize that the occupation of the Falkland Islands Dependencies should be such as to afford evidence of the exercise of sovereignty and that the programme of research and exploration should keep this in view. An active programme of

> research, which can be justified on scientific grounds alone, is an essential part of the preparation of a case which can be used if necessary to demonstrate to Foreign Governments of a Tribunal that HMG is taking all reasonable steps to develop and exercise sovereignty over the area, and is not merely attempting to prevent foreign encroachments. There is no doubt that both the Chilean and Argentine Governments would like to set up meteorological stations in the Dependencies for political reasons. It is essential therefore that while we have to exclude them from doing so we must take every possible step to ensure that we do not lay ourselves open to the same charge. Whilst FIDS [Falkland Islands Dependencies Survey] was political in origin, it is important to maintain it as far as possible as a normal administrative activity in which motives of research, exploration and development predominate.[35]

A genuine scientific program, Roberts reasoned, set the British apart from their South American rivals, who, he implied, held baser motives for their competing claims. In order to serve these political purposes, Roberts believed that British Antarctic science had to be seen as being non-political.

This focus on objective, rather than obviously politicized, science led to full participation by British scientists in international scientific networks. N.A. Mackintosh, for example, who had been a leading figure in the interwar Discovery Investigations, played a major role in designing the post Second World War International Whaling Commission, in an attempt to create a sustainable whaling industry.[36] Although the Commission's quota system would largely prove to be a failure, it did British Antarctic policy no harm at all to have a British scientist playing a leading role in this international organization.

The involvement of British scientists in a joint Norwegian-British-Swedish expedition to Queen Maud Land (1949–52), provided the British with further evidence for their claim that they valued Antarctic science for its own sake. The fact that this expedition explored an area outside that claimed by Britain added to the idea that this was a 'genuine' scientific project, and further connected participating British scientists, such as the meteorologist Gordon de Q. Robin, into collaborative international scientific networks. Under the guidance of the Swede, Hans Ahlmann, this was certainly one of the most sophisticated scientific expeditions ever to conduct research in Antarctica.[37] But just as the Norwegians and Swedes had clear political motives for participation in this expedition, so too did the British.[38] There was no better way for the British to appear genuinely committed to Antarctic Science than to participate in an expedition outside the territory that they claimed. The Norwegian-British-Swedish expedition, or NBSX as it became known, would provide a model for the international scientific cooperation in Antarctica that would follow. But it also offers a reminder that international cooperation around purely scientific research is often far from politically neutral.

One British official who clearly grasped the connection between science and empire was Sir Miles Clifford, the Governor of the Falkland Islands during the late 1940s and early 1950s. Following a distinguished career in the Colonial Office, Clifford also appreciated the British imperial mantra that empire should pay for itself. Clifford was no great believer that Antarctica would prove to be a frozen *El Dorado*, brimming with mineral wealth, and his disbelief was strengthened by frequent visits to Antarctica. Instead he concentrated his efforts on the region's known wealth: its whale stocks. Towards the end of the 1940s, he put forward plans for a Falkland Islands Dependencies Meteorological Service as an integral part of the Falkland Islands Dependencies Survey, which he hoped could provide accurate weather forecasts of the oceans around Antarctica. With a neat circularity that paralleled the strategy of the earlier Discovery Investigations, Clifford proposed that the meteorological service should be funded by the whaling industry, which already paid most of the Falkland Islands Dependencies taxes anyway. In turn the Met Service would supply useful meteorological information in the form of weather forecasts to the whalers, thereby giving them something in return for their taxes. Clifford reasoned that the Met Service would thereby make the industry more efficient and more profitable, since it would allow more days at sea. This in turn would make the industry more lucrative for the Falkland Islands Dependencies Government, while at the same time bolstering Britain's claims to be conducting useful scientific work in the region. Clifford was successful in establishing a network of meteorological stations at various points around the Antarctic Peninsula, and these produced reasonably accurate short-to-medium-term weather forecasts.[39] But the decline of the whaling industry caused by over fishing, meant that the scheme could never pay for itself and in 1951, the Falkland Islands Dependencies Survey required additional funds from the UK Government.[40]

The South American response to these British initiatives was varied. As noted above, the Argentines tended to compete directly with the British by asserting similar claims to environmental authority, while the Chileans sought alternative, essentially non-scientific, ways to represent the Antarctic environment. One of the most dramatic episodes of the sovereignty dispute took place in February 1952, when Argentine naval personnel fired machine guns over the heads of a group of scientists attempting to reestablish a base at Hope Bay on the tip of the Antarctic Peninsula.[41] After an awkward standoff, the showdown was resolved when Sir Miles Clifford sailed down to the area in a British Navy frigate, and oversaw the reconstruction of the base under the cover of the ship's guns. The Argentine military personnel and the British scientists were then left to spend a tense winter as neighbors in their rival bases at Hope Bay. The following year, the Argentine and Chilean Navies briefly considered mobilization in response to Britain's removal of Argentine and Chilean bases on Deception Island, and the two governments threatened to raise the incident in the Organization of American States as a contravention of the Rio Treaty of Reciprocal Defense.[42] This incident led to serious disagreements in the Chilean cabinet and some desperate diplomacy led by the U.S. Ambassador in Santiago, which prevented a showdown. But these incidents were exceptions to the rule, and at the heart of the dispute lay the day-to-day scientific and survey work, which provided the competing sides with claims to effective occupation and environmental authority.

By the middle of the 1950s, Argentina had arguably taken a lead in the contest for environmental authority in Antarctica, despite being less well-connected in international scientific networks than their British rivals. President Perón had more resources at his disposal than his Chilean neighbors, and had fewer distractions than the British, who found themselves competing with colonial nationalism across their empire. The key player in Argentine Antarctic affairs was General Hernán Pujato, an army officer sympathetic to Perón who became head of the Argentine Antarctic Institute. In 1954, after the purchase of an icebreaker, the *San Martín*, Pujato launched an expedition to the Weddell Sea region, among the least known parts of the contested region. Although Pujato's ultimate plan was to make an attempt to get to the South Pole with a journey that he hoped would make the Argentines only the third party ever to reach this elusive destination by land, after Amundsen and Scott, the expedition had a significant scientific agenda which involved an aerial survey of the region. Unfortunately for Pujato, and for Argentina's Antarctic program more generally, President Perón was overthrown by a military coup in September 1955, leaving the Weddell Sea expedition stranded without the supplies to continue to carry out its scientific program. Although Pujato eventually made it back to Argentina, he was removed from his position as head of the Argentine Antarctic Institute for political reasons, and he never made it to the South Pole. The 1955 military coup proved to be a major distraction from Argentina's scientific research program in Antarctica, and Argentina would never quite recover its leading position in Antarctic science, thereby demonstrating the entanglements between state science and professional science.[43]

The contest for environmental authority in the Antarctic Peninsula climaxed during the International Geophysical Year (IGY) of 1957–8. This was a massive international endeavor to coordinate scientific research into the geophysics of the earth. During this eighteen month period, 12 nations conducted scientific research in or around the Antarctic continent, bringing new players into the contest for prestige and influence. The substantial involvement of both the United States and the Soviet Union in Antarctic research threatened to bring Antarctica into the Cold War, and the question of sovereignty became increasingly international, not least with India's failed attempts to raise 'the Antarctic Question' at the United Nations in 1956 and 1958.[44] However, at least superficially, all 12 countries abided by the 'gentleman's agreement' to keep the scientific work of the IGY politically neutral, and a great deal of first rate scientific research was conducted in Antarctica under the auspices of the IGY.

Among the scientific advances made by the IGY, glaciologists confirmed a 'thick ice' theory, in which the ice was found to be an average of several kilometers thick rather than several hundred meters, as many had previously thought.[45] This finding led to estimates of the world's water budget being revised significantly upwards. Meteorologists filled in many of the holes still remaining in human understanding of Antarctica's weather and climate, which had previously been hampered by a lack of measurements from the continent's interior.[46] Geologists confirmed that East and West Antarctica were indeed attached, meaning that Antarctica was one continent rather than two. Important work was done on the ionosphere, with practical utility for radio communication. In the long term, one of the most important results of the IGY in Antarctica were Charles Keeling's CO2 measurements at the South Pole, which have subsequently been used in making the case for anthropogenic climate change by showing increasing levels of atmospheric greenhouse gases.[47] In summing up the achievements of the IGY, many scientists and policy makers resorted to superlatives: one Russian scientist claimed that 'mankind has learned more about Antarctica in the last three or four years than in all the one hundred thirty years since the day of discovery'.

Antarctic science, as mentioned earlier, was never purely a rhetorical strategy. As scientists learned more about the Antarctic environment, perceptions of the continent began to change. From a political perspective, one of the most important realizations of the late 1950s was a negative discovery: despite the vast quantities of scientific research being conducted in Antarctica, which included geology outside the official remit of the IGY, virtually no exploitable mineral deposits of any worth were found. The concurrent decline of Antarctica's whale populations further contributed to these changing attitudes.[48] British officials in particular wanted their colonial empire to pay for itself, and the growing awareness that Antarctica would not be profitable, at least in the short-to-medium term, helped to reduce their attachment to exclusive sovereignty.

Environmental authority and 'The Imperialism of Decolonization'

In their influential article, 'The Imperialism of Decolonization', Wm. Roger Louis and Ronald Robinson argue that British decolonization around the world in the 1950s and 1960s did not necessarily imply a reduction of British power.[49] Instead they argue that Britain sought to use the transition from 'formal' to 'informal' empire to increase their influence around the world, now as an ally of the United States. Drawing heavily on Ronald Robinson and Jack Gallagher's 'Imperialism of Free Trade', Louis and Robinson argue that 'to see the transformation of an imperial coalition as if it were the collapse of an imperial state is like mistaking the melting tip for the iceberg', adding that 'colonial emancipation is not necessarily a sign of metropolitan weakness'.[50] In particular the British sought to retain and increase their economic influence in their former colonies.

The iceberg metaphor employed by Louis and Robinson (and by Robinson and Gallagher before them) is perhaps appropriate to the Antarctic context. This chapter suggests that a similar argument to that made in 'The Imperialism of Decolonization' can be applied to the 'decolonization' of Antarctica through the 1959 Antarctic Treaty. This Treaty, signed by the 12 countries that participated in IGY Antarctic Research including Britain, Argentina, and Chile , brought about the limited internationalization of the Antarctic continent. The Treaty is often thought to be the end point of imperial claims to Antarctica, and many authors claim that it represented the victory of scientific idealism over political squabbling.[51] But a close examination of the origins of the Treaty suggests that it was less idealistic than has often been assumed. Rather than science trumping politics, policy makers from Britain and other countries exploited science to preserve their political influence in the region.

The results of the IGY – particularly the failure to find any substantial mineral deposits – helped to convince British policy makers that some sort of international agreement would be the best means of preserving British political influence in Antarctica without the costly conflict with Argentina and Chile over the sovereignty of the Antarctic Peninsula. In seeking to achieve this goal, the British Government worked closely with officials from the United States, Australia, and New Zealand. The rhetoric of scientific internationalism provided one of the principal tools for achieving Britain's political goals. Science in general, and the goodwill generated by the IGY in particular, offered a non-threatening way to bring political rivals together to discuss political questions. This use of scientific rhetoric to bring about the internationalization of Antarctica demonstrates the malleability of the relationship between science and politics, as well as the pragmatism of British officials: assertions of environmental authority, which had been used to support Britain's claims to exclusive sovereignty over the Falkland Islands Dependencies would now be used to push for the limited internationalization of the Antarctic continent and the retention of British political interests.

A series of secret meetings between Britain, the United States, Australia and New Zealand in the second half of 1957 and into 1958 set in motion the process that would lead to the signature of the Antarctic Treaty of 1959.[52] The British government was not the only government that had come to favor an international solution to the Antarctic problem, but along with the United States it was among the keenest and most proactive. During the early quadripartite negotiations, British officials took a notably realist position, arguing, for example, that the Soviet Union should be included in the Antarctic conference. In May 1958, the United States issued an invitation to the other 11 nations that had participated in IGY research to a meeting in Washington in order to discuss the political future of Antarctica. The explicit connection between science and sovereignty from the very beginning of the Treaty negotiations offered a neat justification for the exclusion of potential 'troublemakers' from the conference, including both Soviet satellites and the newly independent states of the 'Third World'.[53]

After months of preliminary negotiations, the Washington conference of October–December 1959 led to the signature of the Antarctic Treaty. Article IV of this treaty, suspended all existing sovereignty claims, neither recognizing them nor rejecting them. In many ways this was exactly what Britain had come to want: the signature of the Treaty diffused political tensions, while sovereignty claims remained in a state of suspended animation. The Antarctic Treaty can be seen as a treaty of decolonization: its signatories voluntarily suspended their rights to the normal attributes of sovereignty. But it was a treaty of decolonization that preserved imperial interests through the effective pooling of claims to environmental authority. Science provided the British, and other signatories, with a means of retaining their political influence in Antarctica past the ratification of the Antarctic Treaty in 1961. By the terms of the Antarctic Treaty, only those countries with 'substantial scientific interest' in Antarctica – usually meaning the ownership or maintenance of a scientific station – would have a place at the political negotiating table. With their long history of assertions of environmental authority in Antarctica, the British were well placed to take advantage of this explicit connection between science and politics, and to continue their political influence in Antarctic into the postcolonial present.

Conclusion

In 1985, scientists working at Britain's Halley Base on the Weddell Sea observed a 40 per cent growth in the size of the springtime hole in the ozone layer over Antarctica (compared to 1957).[54] This observation led to rapid international action to ban the CFC chemicals thought to be responsible for causing the growing ozone hole. Among those most satisfied with the rapid action taken to save the ozone layer was the British Prime Minister, Margaret Thatcher, who saw the 'discovery' of the ozone hole as a vindication of Britain's presence in the region in the aftermath of the Falklands War with Argentina of 1982:

> In the aftermath of the Falklands conflict we were able to strengthen Britain's presence in the South Atlantic by increasing our scientific effort. This paid off remarkably quickly in a totally unexpected way with the discovery by the British Antarctic Survey of the ozone 'hole' over Antarctica in the austral spring. This brought home to the whole world the potentially dangerous changes in the environment which mankind's activities are bringing about and led to the first measures to control pollution on a global scale.[55]

The ability of British scientists to understand the Antarctic environment, Thatcher implied, justified Britain's leading position within the Antarctic Treaty System and its continued occupation of the Falkland Islands. This reassertion of environmental authority suggested to the British that they were continuing to conduct Antarctic science for the good of humanity, just as they had done in the heyday of empire.

The history of the Antarctic sovereignty dispute brings into stark relief the question of what happened to imperial claims to dominion over nature during the mid twentieth century decolonization of European colonial empires. In Antarctica, the answer to this question, suggests that the British were able to retain – and even extend – their political influence through continued assertions of environmental authority. During the active phase of the sovereignty dispute, roughly between 1939 and 1959, South American nationalists challenged British claims to environmental authority both directly and indirectly. This challenge provoked a redoubling of British scientific efforts in Antarctica, and the contest for scientific authority came to occupy a central role in the dispute. This was a contest that nobody really 'won', but the important fact is that it took place. Somewhat ironically, the science conducted by Britain in order to strengthen its claim to Antarctica ultimately contributed to a loosening of its attachment to exclusive sovereignty. Scientific research revealed that, at least in the short-to-medium term, Antarctica was not the treasure trove of mineral resources that had been imagined. British officials then led the way in promoting the limited internationalization of the continent, in which assertions of environmental authority would continue to be used to justify political influence.

The history of the Antarctic sovereignty dispute – with its central narrative of nationalism against imperialism – deserves its place alongside the broader history of European decolonization. The Antarctic Treaty can be thought of as a treaty of decolonization, although as in numerous other parts of the world, this paper has argued that imperial influence survived formal decolonization. The central question examined by this chapter – what happened to claims to dominion over nature during the period of decolonization? – could be asked in other colonial situations. The answer to this question would most probably be very different in different places: Antarctica, after all, is a unique environment, and environmental nationalism would almost certainly have been different elsewhere. But, on the broadest level, Britain's attempt to use science to preserve imperial influence, might well have been repeated elsewhere. Such speculation points towards the utility of broader research into the environmental histories of decolonization.

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12
Unexploited Assets: Imperial Imagination, Practical Limitations, and Marine Fisheries Research in East Africa, 1917–53

Christian Jennings

Historical writing about international marine science and the ideology of 'science for development' has followed different trajectories and has rarely intersected.[1] Studies of marine science have focused on northern and southern oceans, while studies of British colonial science generally have favored agriculture, forestry, medicine, and anthropology. On the one hand, this historiographical division makes sense, because the scale and scope of twentieth-century marine research in tropical colonial areas such as the Indian Ocean paled in comparison to both land-based colonial sciences and marine research elsewhere. On the other hand, it is unfortunate that scholars have thus far neglected the intersections between these two fields, because the tropical seas of the empire held a great fascination for British scientists and officials. Twice during the first half of the twentieth century, Colonial Fisheries Advisers crafted comprehensive strategies for research on a global scale that emphasized tropical areas. John Oliver Borley, who served as part-time adviser from 1929 to 1937, did not live to see any serious results from his efforts. Charles Frederick Hickling, the full-time adviser from 1945 to 1961, did oversee the temporary establishment during the waning years of empire of a handful of marine and freshwater research stations around the globe. The longlasting (1951–77) but chronically troubled East African Marine Fisheries Research Organization (EAMFRO), based in Zanzibar, is perhaps the best example of both Hickling's particular genius for unleashing the institution building capacity of the colonial bureaucracy and the serious limitations it faced in realizing such plans in the colonies themselves. But scientists and officials had been trying to launch marine research schemes along the East African coast for several decades before the organization came into existence. Indeed, the long history of failed or frustrated efforts to investigate the marine resources of the East

African coast can be compared usefully with the history of imaginative planning by Borley, Hickling, and their colleagues during the same period. The lesson that emerges from this comparison is one of severe practical limitations to imperial planning.

Despite images of scientific strength and consequential development interventions, this case study of marine fisheries research indicates that for nearly the entire period of British colonial rule in Africa, the empire actually struggled to project science and technology to its colonies. An awareness of this struggle adds depth and balance to recent work on the British Empire such as Alan Lester's account of the shift from core-periphery models of empire to a new focus on dynamic networks linking colonies to other colonies as well as the imperial center. These networks, Lester writes, resemble a kaleidoscope in which patterns are 'provisional and contingent…ephemeral and even fleeting'.[2] In the case of marine fisheries research in East Africa, the pattern was not merely fleeting; indeed, it did not come into focus at all until 1953, after more than three decades of fitful, contentious effort. The present chapter will demonstrate that this blurred image was the result of what Joseph Hodge has described as 'the inadequacies of colonial power in Africa', which resulted in a 'disjuncture between metropolitan discourse and colonial practice'.[3] The efforts of Borley and Hickling to extend marine fisheries research to East Africa stalled at this disjuncture, as did the discussion on fisheries development among colonial officials in Kenya, Tanganyika, and Zanzibar. In the end, their work did lay the foundations for marine science in East Africa, but not in the ways that either party expected.

John Oliver Borley, the imperial imagination, and practical limitations in East Africa

The roots of marine fisheries research in East Africa and other tropical areas of the British Empire can be found in the Falkland Islands and South Georgia, desolate South Atlantic outposts before whaling began in 1904. This turning point coincided roughly with the emergence of marine science and fisheries conservation in the United Kingdom and a trend towards international thinking in the study of the sea.[4] British scientists soon began to express concern about potential overfishing in the South Atlantic, attracting the attention of Ernest Rowland Darnley (1875–1944) of the Colonial Office, who began to push for a comprehensive approach to fisheries research across the empire. Fisheries in general became a higher priority towards the end of the First World War, as British officials worried about a perceived shortage of protein sources for citizens and subjects of the empire, and the Board of Agriculture began to make inquiries about the possibility of boosting production of fish in the colonies. These factors culminated in the formation of several working groups often remembered collectively as the Discovery Committee, which as Adrian Howkins notes in the previous chapter, eventually directed the Discovery Investigations of the 1920s and 1930s. Darnley and his colleagues were keenly interested in learning about both the warmer and colder seas of the empire, but scientific inquiry into the tropical regions could develop only in the shadow of the costly Discovery Investigations, which eventually included three research vessels and a field laboratory at Grytviken on South Georgia.[5] Nonetheless, tropical areas were a crucial part of the global vision and imagination of the scientists who shaped British research priorities and projects during the twentieth century.

John Oliver Borley (1872–1938), the Colonial Office adviser who took the greatest interest in promoting marine research in the tropics during the interwar period, is remembered mostly for his important contributions to the Discovery Committee and fisheries research in the North Sea.[6] A specialist on the North Seas plaice fisheries and their conservation, Borley was appointed in 1903 as an assistant naturalist at the Lowestoft laboratory of the Marine Biological Association, then moved to London in 1910 to become Superintendent Naturalist Inspector for the Board of Agriculture and Fisheries. He was awarded an OBE for his administrative work during the war, and nominated in 1918 for the Discovery Committee. In September 1917, not long before joining the Committee, Borley had circulated a document calling for greater attention to colonial fisheries, noting with dismay 'the wealth of fish unutilised in colonial waters'.[7] In his view, emphasis should be placed on providing opportunities for British fishing firms, but the development of local industries should not be neglected, and he suggested that the cost of employing a research vessel would be justified. Borley's outlook was global and included tropical fisheries. In the Colonial Office's correspondence files, several of Borley's colleagues added comments that reflected his global outlook, suggesting that '[we] should look at the great effort made in St. Helena in or about 1895–7 & the causes of its failure' and, in a less helpful but perhaps prophetic remark, 'I have no observations on behalf of the East Africa Protectorate'.[8] The Board of Agriculture and Fisheries endorsed Borley's ambitious plans, declaring in 1918: 'The time has arrived when the development of the fishery resources of the Empire ought to be considered and taken in hand as a whole'.[9] The Board also agreed with Borley's suggestion of setting up a committee to advise on research vessels, ichthyologists and other scientists, gear and crew.

British scientists already had a vague awareness of the salient facts of marine life in tropical waters and were not working under illusions about the potential productivity of these areas. This is evident in C. Tate Regan's *Report on the Fisheries of the Colonies* (1920), the first comprehensive review of marine research completed after the Board's adoption of Borley's plans. Regan, a specialist on South African fish, presented a clear-eyed view of the prospects for development. East Africa, for example, had a narrow continental shelf with a jagged coral floor, and its warm coastal waters would probably be rich in species diversity but poor in the number of individuals of each species. Preservation and transport of fish to market would present an additional obstacle to profitable exploitation of fisheries in these areas. 'It is evident', Regan concluded, 'that the development of fisheries in many parts of the tropics will not be easy'.[10] Nonetheless, Regan agreed with Borley and others that it would be worth the effort to attempt an increase in productivity. To again use the example of East Africa, Regan pointed out that while the narrow shelf would severely limit the potential for trawling anywhere north of Mozambique, fishing for sawfishes, sharks and rays might be valuable. Regan also advocated research into the migrations and abundance of tuna, mackerel, bonito, sardines and anchovies along the East African coast. This burst of interest in framing fisheries research as a global problem did not translate into action, at least in part owing to the primacy and enormous expense of the Discovery Investigations. Borley returned to Lowestoft in 1921 to direct the new fisheries laboratory set up by Gardiner. He remained a prominent figure within the Discovery team.

During the period between the wars, while Borley and his colleagues were guiding the Discovery Investigations and slowly crafting plans for a centralized fisheries research service, the colonial administrations of Kenya, Tanganyika and Zanzibar had been carrying on a separate conversation about their shared coastal environment. The spark that prodded East African officials into action seems to have been produced in 1928 by John Boyd Orr (1880–1971), the statesman, biologist, founding director of the Food and Agriculture Organization (1945–8) and Nobel laureate (1949). Orr and John L. Gilks, Kenya's Director of Medical and Sanitary Services, carried out an influential study of nutrition among 'natives' in the late 1920s. Before leaving Kenya in March 1928, Orr met with officials in Mombasa who wanted to develop the colony's marine fisheries and had been considering a research scheme. Orr was intrigued by the potential benefit of marine food resources for, as he put it, 'cattle and also for natives in East Africa'.[11] When Orr returned to London, he passed this news on to Major Walter Elliot, Chairman of the Research Grants Committee of the Empire Marketing Board, and Sir William Hardy, the government's Director of Fishery Research.[12] This coincided with a renewed interest from London in colonial fisheries, beyond the scope of the Discovery Investigations. Borley once again stepped into the discussion: he was appointed Fisheries Adviser for the Colonial Office in 1929. From this point forward we can trace the parallel histories of fisheries research from the 'central' vantage point of the Colonial Office and the 'peripheral' research sites in East Africa and other British colonies. Rarely did the two converge harmoniously.

The governments of Kenya, Tanganyika and Zanzibar attempted to follow through with their own plans for fisheries research, but they bumped quickly against the realities of colonial life in East Africa, where the 'thin white line' of administration was more than a cliché. Officials of the three administrations agreed in principle on a shared survey of coastal resources and in 1928 requested the services of Cecil von Bonde, the Director of South Africa's Fisheries and Marine Biological Survey. Kenyan officials had been corresponding with von Bonde since 1925 about the possibility of a sea fisheries survey and expected that Kenya, at the least, would be ready for his arrival. This would not be the case. 'Everyone had forgotten about Dr. von Bonde when he first turned up at Mombasa' on September 20, 1928, recalled one official a few months later. 'Apparently there is no ship on the East Coast which can be used for trawling work'.[13] The ships available in Mombasa were not fit to survey the entire coast, and Tanganyika, lacking a vessel of its own, dropped out of the survey entirely. Von Bonde carried out a limited investigation of the Kenya coastline, focusing by default on African methods of fishing (because of the unavailability of a trawler), and submitted a report in January 1929. He then went to Zanzibar to advise its government on fisheries.[14]

Von Bonde's report produced substantive debate among scientists and officials, some of whom disagreed with his wholesale dismissal of African artisanal fishing as a potential resource to the colonies. During his abbreviated survey, von Bonde had made an effort to learn Swahili names for fish (aided by the Mombasa customs collector) and observed coastal fishermen using lines, nets, and traps. He concluded that not only was there a 'great variety of fish' along Kenya's coast, but that 'some species are caught in large numbers by the primitive methods at present in vogue'. Rather than encouraging and expanding 'native' fishing, however, he recommended that 'present methods of fishing' should be 'revolutionised and developed along modern lines'.[15] The differing responses to von Bonde's report are instructive. Borley, writing in May 1929, noted 'biological reasons' for expecting that tropical seas would not be as productive as colder ones and suggested the study and gradual improvement of 'native' fishing rather than the 'revolutionising' change advocated by von Bonde. Scientists in East Africa could use a 'drifter trawler' rather than one with a motor engine, Borley suggested, doing surveys radiating outward from ports with likely fish markets. Any new species or fishing grounds would then be advertised to the local 'rudimentary fishing population' in the form of a 'gift' of a 'good consignment' of the new item.[16] Kenya, perhaps predictably, went in a different direction.

The sequence of events that unfolded in Kenya provides a good example of the internal tensions that often characterized life in a settler colony. Kenya's Fisheries Survey Committee, led by Coast Province Commissioner, H.R. Montgomery, and perhaps trying to strike a balance between von Bonde and Borley, put forward a plan in August 1929 to purchase a small motorboat to demonstrate 'modern' fishing methods to local fishermen. Kenya's budget committee rejected the idea and instead began negotiations with Mac Fisheries Ltd., a London company, to develop a large-scale fishing operation based at Mombasa. The fisheries committee, dismayed by this turn of events, met again in December and reaffirmed its commitment to 'improving the *native* fishing industry, not only at Mombasa but also along the entire coast', which had existed 'from time immemorial'.[17] The *Times of East Africa* expressed 'very real disappointment' that the budget committee had replaced a government plan for 'encouraging a Native industry' along 'patient but progressive lines' in favor of a plan to 'hand over initial responsibility for the development of the industry to a powerful and wealthy overseas commercial concern'.[18] As it happened, Kenya's negotiations with Mac Fisheries did not get very far. Borley intervened in February 1930 to protest Kenya's actions, and the Secretary of State for the Colonies followed up in March to warn Kenya against negotiations with any private trawling company. Instead, the Colonial Office was considering an alternative proposal from Borley.[19]

Upon his appointment as Fisheries Adviser, Borley had begun to craft a detailed blueprint for comprehensive empire wide fisheries research that in many ways harkened back to his proposals of a decade earlier. The problem with Kenya's plan for a privately owned fishery, to Borley's way of thinking, was that it would advance knowledge of the marine environment of the East African coast in only a piecemeal fashion. Borley felt that any useful survey must include 'the whole marine resources' and should involve cooperation between Kenya, Tanganyika and Zanzibar. He pointed out that similar atomized work was being carried out in several parts of the empire – Ceylon, Malaya, Cyprus, Gambia, the Seychelles – but that nearly all of these schemes had been hindered by a lack of resources and appropriate research vessels. In August 1929 Borley put forward an idea to overcome these limitations. 'A small body of trained men is necessary', he wrote, 'that can be detailed in succession for work in the various colonies – what can shortly be described as a 'flying squad' …managed and paid from the centre'.[20] This 'squad' would specialize in tropical waters and would have the advantage of centrally funded, purpose-built research vessels, one for the open sea and one for inshore work. It would facilitate the sharing of information between different regions of the empire, allowing scientists to build up a comprehensive set of data to facilitate rational conservation measures. Borley assured Kenyan officials that East Africa would be a top priority should his plans come to fruition. Both Tanganyika and Zanzibar responded with enthusiasm to the idea of cooperating in a shared survey with the goal of expanding the existing African artisanal fisheries of the coast.[21]

Once again the Colonial Office backed Borley's ambitious plans; once again those plans were unrealized. A Colonial Office conference in 1930 recommended the establishment of a standing advisory committee on colonial fisheries. The committee would be tasked with compiling a comprehensive review of existing fisheries, developing a five-year research program, supervising the purchase, staffing and equipping of a 'Fishery Research Cruiser', and then publishing and sharing the results of the research. In essence, this would have been a kind of Discovery Committee for tropical areas of the empire, and it would have involved comparable expenses. The purpose-built research cruiser, for example, was to cost roughly £85,000 with an additional £30,000–35,000 annually for maintenance. The cruiser would be in constant use across the empire, staffed by a hydrographic surveyor, three marine biologists (one each for fish, plankton, and invertebrates), and a hydrologist. The Colonial Development Fund would pay for construction of the cruiser, plus half of its annual expenses. The remainder of the costs would be share by the colonial governments that benefited from the research conducted by the cruiser. In return, the cruiser's scientists would advise the colonial governments on the extensions of 'native' inshore fisheries, which would be considered a high priority rather than a poor cousin to trawler-based operations.[22]

The economic downturn of 1931–2 left the British government without the means to realize the plans crafted by Borley and his colleagues. For the next two decades, when colonial officials requested scientific surveys of fisheries, the standard practice was to send out an expert, such as James Hornell, who studied marine fisheries in Sierra Leone, Mauritius, Seychelles, Palestine, Malta, Cyprus and Fiji, or Edgar Barton Worthington, who did the same for freshwater fisheries in Africa. When Borley retired in 1937, no one was appointed to take his place as Fisheries Adviser. For a brief moment in 1938, the Colonial Office revived the idea of a standing committee to advise on colonial fisheries, but was forced to put the plans on hold when the Second World War began. When planning resumed as the war entered its final stages, the vision of comprehensive fisheries research pursued by the Colonial Office was no longer that of Borley's generation.[23]

Marine fisheries as unexploited assets in the second colonial occupation

Historians often view the economic and social pressures of the Second World War as leading to a new attitude in Britain towards its colonies, one that strongly influenced perceptions of the role of science in development. Rather than existing simply to enrich British lives, the colonies and their natural resources were now seen (or at least publicly advertised) as assets that should be harnessed to improve living conditions for the colonial subjects themselves. This increased emphasis on respecting the needs and aspirations of colonized peoples, of course, stemmed at least in part from postwar political realities and the threat of destabilizing unrest in the name of decolonization. Beyond these concerns, the British government realized that agricultural production in the colonies had to increase dramatically in order to help offset massive postwar debts. But regardless of their motives, British officials put serious effort into the implementation of the Colonial Development and Welfare (CD&W) Acts of 1940 and 1945, which provided substantial funding for research and development schemes.

Joseph Hodge has warned against being too impressed by the CD&W acts, in light of the fact that the colonies themselves contributed more to development projects than CD&W funds. Rather, he suggests, the acts signaled an ideological shift towards aggressive state intervention in colonial economies, agriculture, and social life, based on a dramatically increased commitment to and reliance on technical experts.[24] With prominent scientists such as Edgar Barton Worthington emphasizing the lack of basic scientific knowledge about the colonies, CD&W provided a useful venue for thinking creatively about the organization and purposes of colonial research. Scientists, then, took an active role in shaping development schemes that affected everyday life in the colonies in unprecedented ways. These interventions frequently failed – sometimes spectacularly, as in the case of the East African Groundnut scheme. More often, this 'Second Colonial Occupation' left an ambiguous legacy in the colonies and their independent successor states.[25]

The origins of the 'Second Colonial Occupation's' approach to marine research can be found in the Colonial Research Committee, which was established in 1942 to advise the Secretary of State on how to spend CD&W funds intended for research. Although it oversaw a vast range of scientific inquiry (see Chapter 9 by Sabine Clarke in this volume), the CRC was keenly aware of the unfulfilled potential in fisheries production. A CRC memo prepared in September 1942 reviewed von Bonde's report from 1929, noting that nothing had been done in the interim to follow up on his recommendations. 'The fishing which takes place [in warmer seas] is sufficient to show that Colonial fishery resources are in all cases considerable', the author of the memo argued. 'The keynote of the fisheries is that of unexploited assets'.[26] The CRC's emphasis on economic exploitation did not sit well with those marine scientists who had long experience in Colonial Office fisheries research. At a CRC meeting on 26 October 1942, Stanley Wells Kemp, Director of the Plymouth Laboratory of the Marine Biological Association, argued that it would be foolhardy to attempt any development of colonial fisheries without first conducting thorough scientific surveys. Kemp reminded the committee of the 'bitter warning' of recent experiences in Europe, where absence of scientific knowledge and international squabbling had resulted in serious overfishing. Kemp believed that East Africa deserved attention in spite of its narrow continental shelf, and advocated the creation of an East African marine research station.[27]

Also in attendance at the 26 October meeting was Edgar Barton Worthington (1905–2001), an influential voice in shaping colonial science who had previously called attention to the need for fisheries research and had preceded Kemp in advocating a research station in East Africa. Earlier in his career, Worthington had spent two years in East Africa with the Lake Victoria Fishing Survey, working closely with African fishermen and developing an ecological understanding of the lake environment based on complex food chains.[28] When asked to compile information on the current state of scientific research in the African colonies as part of Lord Hailey's monumental *African Survey* (1938), Worthington responded by interviewing roughly 275 scientists and officials, resulting in a separate and equally impressive publication, *Science in Africa* (1938). Worthington's book had advanced a conservationist view of colonial research priorities, including a detailed blueprint for fisheries. 'In view of the enormous seaboard of Africa', Worthington wrote, 'remarkably little has been done for the development of fisheries'.[29] After alluding to Borley's unproductive term as fisheries adviser, Worthington recapped with approval of Borley's plan for a centralized fisheries research organization with 'a few permanent experts ready to be dispatched' across the colonies.[30] Worthington suggested that Kemp's laboratory at Plymouth might serve as the headquarters for such a service. Beyond this, he mused that the 'East African group of colonies have potential fishery resources large enough to warrant a permanent establishment in Africa itself'.[31] The combined presence of Kemp and Worthington at the meeting seems to have been enough to impress the members of the CRC.

By the end of 1943 the CRC had taken action to ensure that marine fisheries research would proceed in a coordinated fashion as soon as the war ended, in the process laying out the general guidelines that would shape policy for the next two decades. In November 1942, following a pattern it had established for other fields of science, the committee proposed the formation of 'regional research institutes' in the West Indies, West Africa, and East Africa (including a separate freshwater organization in East Africa), together with the revival of ailing or closed stations in Ceylon, Malaya, and Hong Kong. Rather than a central 'squad' of researchers to be dispatched as a team to different locations, the committee proposed a Colonial Fisheries Service to provide staff for the different organizations, providing 'interchangeability' between the colonies. The committee recommended the immediate appointment of a new adviser and committee, rather than waiting until after the war. E.S. Russell, the Director of Fishery Investigations in the Ministry of Agriculture and Fisheries, was appointed part-time adviser on colonial fisheries in 1943, and a newly created Colonial Fisheries Advisory Committee (CFAC) began to hold meetings in October 1943.[32] Perhaps the most important decision made in these early stages was Russell's insistence on a 'definite line' between the people hired to work at the proposed research organizations and those who would work in the fisheries departments of the various colonial governments. This meant that scientists in the planned fisheries research service would primarily be charged with investigating the fish and other features of open water areas, while the fisheries officers of the local administrations would be responsible for studying and developing local African and Asian fishing communities.[33]

Charles Frederick Hickling and the imperial imagination

Charles Frederick Hickling (1903–77) replaced Russell as fisheries adviser to the Colonial Office in 1945. Hickling's background closely resembled that of John Oliver Borley, the first person to hold the position. Like Borley, he was a Cambridge graduate who had joined the staff of the Lowestoft Fisheries Laboratory; where Borley had studied plaice, Hickling's specialty was the hake fishery. During the war, he had served as Port Fishery Officer at Milford Haven until his appointment in the Colonial Office. Unlike Russell, his immediate predecessor, Hickling took the position as a full-time job. Part of an elite cadre of postwar government scientists, Hickling not only thought in global terms, but took it for granted that he should spend his time seeing as many far-flung areas of the empire as possible. Perhaps only James Hornell of the earlier generation could match the breadth of Hickling's firsthand knowledge. 'It was a notable experience…to accompany Fred on tour', his colleague Maurice Yonge later wrote. 'He moved from the Governor's residence to the humblest fish landing, advising on scientific and commercial policy and then on the fitting of outboard motors to dug-out canoes'.[34] Hickling took a special interest in the training of fisheries officers and the location and planning of research laboratories, overseeing the formation of marine research organizations in East Africa, West Africa, Southeast Asia, and East Asia. 'Utterly the right man in the right place', according to Yonge, Hickling earned a reputation as a 'one-man FAO'.[35]

The origins of the East African Marine Fisheries Research Organization (EAMFRO) can be traced to Hickling's global view of fisheries research, inherited in part from predecessors like Borley, and to his frequent cajoling of reticent scientists and colonial officials. Hickling toured East Africa in 1946 and recommended, like others before him, that the three colonies should undertake a shared marine research scheme. The first step in making this happen would be a proposal for CD&W funds. Kenya submitted an application on its own in June 1948, but was promptly rejected by the Secretary of State (presumably on advice from Hickling). The task was then handed to Edgar Barton Worthington, who had returned to East Africa after ten years (1937–46) working at Lake Windermere, England, for the Freshwater Biological Association. Worthington's active involvement with the Colonial Research Committee had resulted in his appointment as its Joint Secretary, but he was quickly seconded to the position of Research Secretary for the newly created East African Research Council. The new CD&W application authored by Worthington and submitted in September 1948 proposed the creation of a shared research organization under the direction of the interterritorial East Africa High Commission, which had been created in 1947. We should keep in mind that this proposal was the work of an insider with considerable knowledge of conditions both in the Colonial Office and on the ground in East Africa. Hickling and Worthington did not see eye to eye on the priorities for marine research in East Africa or the nature of the proposed organization, and it is instructive to follow the threads of their arguments as EAMFRO took shape.

Worthington's CD&W application began with a description of the current state of East African fisheries, which were at 'low ebb' owing to the scarcity of fishing gear during the war and fishermen taking other jobs. In Kenya, African fishermen caught about 220 tons per year, but this number appeared to be declining, while the sole European fishing company sold most of its annual 120 tons to ships calling at Mombasa.[36] These numbers were starkly contrasted by the 700 tons of fish that Kenya imported each year from Aden on the Red Sea. During the war, the demand for fish among soldiers and sailors stationed on the coast had far exceeded the catch, and a black market had developed. In an effort to provide servicemen with fish at a reasonable price, the Kenya government had started a fishery, run by Ocean Fisheries Ltd., at Shimoni, a small village 51 miles south of Mombasa near the Tanganyika border. In addition, two European trawling companies were attempting to start operations in Tanganyika, one at Dar es Salaam and the other at Mafia Island. Aside from these small companies, the vast majority of fishing on the East African coast was carried out by African artisanal fishermen working in small village communities. In Kenya and Tanganyika, Worthington reported, these fishermen belonged to 'backward native tribes' using 'primitive and inadequate' methods, but in Zanzibar, 'the native fishermen are on the whole more active and knowledgeable…and provide a more promising foundation on which to build a fishery'.[37]

The application pointed strongly towards the need for investigation and exploitation of offshore pelagic fish. Worthington emphasized that the present fisheries were utterly unable to meet the skyrocketing postwar demand for protein from the European and Asian communities and from the growing numbers of African plantation laborers. Lake Victoria had traditionally been a major source of freshwater fish, but the catch there had been declining of late (one of the main reasons for the establishment of the Jinja research station), and in any case, the growing human population of the area would offset any increase in the lake catch. Given these conditions, there was an obvious need to boost sea fisheries; in Worthington's view, this meant an expansion of offshore motor-powered commercial fishing. Von Bonde's report had concluded that the East African coast was mostly unsuitable for trawling, so the focus would be on pelagic fish, a 'promising field of investigation [which] is at present completely untouched'. This offshore focus would require trials of new fishing methods as well as fundamental taxonomic work, as 'at present only rarely can a precise name be given to any marine fish from East Africa'.[38]

Worthington felt that increasing the production of fish in this way 'would bring prosperity to the coastal fishermen and traders', although it is hard to see how the logic in this statement given that the vast majority of African fishermen used traditional vessels and methods in inshore waters. The proposal set forth by Worthington outlined separate schemes, 'Development Investigations' and 'Research', both to be based at Shimoni and to operate under the EAHC as part of the existing East Africa Fishery Research Organization, which at present consisted of the freshwater research station at Jinja. Both facets of the new Shimoni site would focus on 'practical' research towards the development of large commercial fisheries. The 'Development' scheme would employ fisheries officers to experiment with fishing methods for seagoing motor fishing vessels and processing methods to transport the catch, while the 'Research' scheme would require trained scientists – perhaps at first 'one biologist and a few trained native assistants' – to carry out biological investigations into taxonomy, life histories, and food chains, which would provide the scientific foundation for the trials of new fishing methods.[39]

Worthington and Hickling did not agree on the best way to staff the new organization. Hickling already had his sights set on John Francis George Wheeler (1900–79). In many ways, Wheeler was an obvious choice. He had worked at the Plymouth laboratory in the early 1920s before joining the research staff of the Discovery Investigations. One of his Discovery colleagues, Francis Downes Ommanney, would become a close friend and frequent collaborator. From 1932 to 1941, Wheeler had been the Director of the Bermuda Biological Station, gaining expertise in tropical fishes. In 1943 the Colonial Office, concerned with food shortages caused by the war, hired Wheeler to undertake a survey of the fishing potential of the Western Indian Ocean between Mauritius and the Seychelles aboard the research vessel *Cumulus*. Wheeler had immediately recruited Ommanney, now a successful writer with the British Council, to join him, and they spent the rest of the decade carrying out the survey, checking in frequently with Hickling and the Colonial Office. Hickling strongly endorsed Wheeler as the most knowledgeable scientist in the region. But Worthington worried that waiting for Wheeler and Ommanney to complete the survey, and for the *Cumulus* to be overhauled and refit, would delay the start date for the East African organization until 1951, wasting valuable time. Worthington suggested that in the meantime, a 'young graduate' should be given access to the Indian Ocean fish collection at the British Museum, a few months' training at Plymouth or Lowestoft, and then sent to Shimoni to begin work until Wheeler arrived to take over the organization. The Fishery Section of the Kenya Game Department had already done substantial preparatory work at the Shimoni site, which was adjacent to the headquarters of Ocean Fisheries Ltd. Worthington's application included a detailed map and plan of proposed facilities at Shimoni, including a laboratory and houses for the staff.

Hickling wrote comments on the CD&W proposal while touring Africa in June 1949, endorsing the general division of labor but expressing strong concerns about Shimoni, the proposed site of the marine research organization. The development of inshore African fishing would be left to marine fisheries officers attached to departments of the three colonial governments. Kenya's Game Department already had an officer, T.E. Allfree, stationed at Malindi and equipped with a boat and land facilities for this purpose. Tanganyika intended to appoint one as soon as a worker became available, and Zanzibar was considering doing the same. Hickling hoped that the marine fisheries officer in each of the colonies would be furnished with a sea-going vessel and a master fisherman who could experiment with fishing techniques while the officer worked to develop good relationships with local fishing communities. These officers would have little time for scientific work, which would be left to the interterritorial research scheme, in a fashion similar to marine research schemes under way in West Africa and Malaya. Hickling reiterated his preference for appointing Wheeler to direct the new organization. 'The Shimoni site is still favoured by Worthington', Hickling added, 'but he sees the force of my objections…I feel fairly confident that Zanzibar will have it'.[40] Hickling then traveled to Tanganyika for an important meeting on East African marine fisheries with representatives of the three governments and the EAHC.

Held on July 1, 1949, in the boardroom of the Sisal Growers Association in the northern coastal town of Tanga, the outcome of the meeting would shape the development of marine science in East Africa for decades to come. The two strongest advocates of the Shimoni site were unable to attend: Worthington was delayed on business in the Belgian Congo, and Hugh Copley, the Kenya Fish Warden, was ill. This left the floor mostly open for Hickling, and he delivered a thorough argument for the fulfillment of the global vision of marine research that had been developing in the Colonial Office since 1917. Hickling began by describing the interterritorial marine fisheries research scheme that had recently been approved for West Africa. Based in Sierra Leone, the organization would cover the entire coast of West Africa with a £70,000, hundred-foot steel fishing vessel bought specifically for that purpose and equipped with a freezer, radio, and two 'Icelandic-type' motorboats to be carried on deck. Researchers using this vessel would study the basic productivity of the southeastern Atlantic Ocean including water currents, chemical composition, and plankton, as well as fish. Hickling then briefly described similar efforts under way in Hong Kong, Aden, Mauritius and the Seychelles, and the West Indies. If we think about these comments in the light of Hickling's broader goals, it seems clear that his intent was to challenge the attendees to think beyond local concerns and imagine their new research station as part of a global network of modern scientific organizations. Zanzibar, in this context, simply fit the image better than Shimoni.[41]

Beyond the issue of where to locate the organization, Hickling and Kenyan officials were at odds over some of the basic purposes of the research and development schemes. Hickling appears to have wanted at least a modicum of African scientific involvement in the research organization. In addition to five European scientists and a handful of unskilled laboratory assistants, Hickling suggested the employment of 'four Asian or African' assistants 'preferably of higher certificate educational standard and possibly with biological training'.[42] The officials in attendance protested that finding Africans with appropriate qualifications would be 'difficult', perhaps with some justification given the rudimentary structure of higher education in the East African colonies. Kenya's agriculture secretary, J.H. Ingham, complained that Hickling's vision of the scheme placed too much emphasis on the 'research side', when 'Kenya's original interest had been the start of a fishing industry'.[43] Hickling reassured the meeting that experimenting with new fishing techniques was a fundamental part of the plan, but then went on to insist that the fisheries officers charged with developing local inshore fishing (rather than the kind of commercial fisheries Kenya advocated) be given adequate support. Here one notices that the forcefulness of Hickling's statements lay in part in their striking level of detail. Because the fisheries officers would be responsible for the welfare of African fishermen and the protection of their interests, they would need to spend months of 'shore work' traveling village to village making friends with local people. This would necessitate each fisheries officer being assisted by a master fisherman, Hickling said, 'preferably taken from the East coast of Scotland, the Clyde area, or the West coast of Sussex, where the most knowledgeable seamen were to be found'.[44] Allfree, the Kenyan marine fisheries officer, chimed in appreciatively, explaining that the scope of his work left him 'considerably handicapped' without a master fisherman.

It is easy to imagine that Hickling's comprehensive presentation left little room for dissent, and indeed the meeting ended with the acceptance of his version of the research and development scheme rather than Kenya's. The attendees recommended the establishment of an inter-territorial marine fisheries research organization based in Zanzibar, responsible to the EAHC through a new Inter-Territorial Marine Fisheries Advisory Committee. To meet the demand for fish, each government would have separate fisheries development departments in which a fisheries officer would work together with a European master fisherman to monitor and improve local fishing practices. Hickling exulted in this outcome. A day after the meeting, he worried about the response from Kenya, especially Copley and Worthington, who were 'dead set on Shimoni', but after speaking with officials from Tanganyika and Zanzibar, he felt reassured that 'the days of the tacit ascendancy of Kenya in the East African scene are numbered'.[45] Hickling clearly felt that something important had happened as he prepared to depart for three weeks at sea aboard the *Cumulus* with Wheeler, who was finishing work on the Mauritius-Seychelles survey. 'I feel fit but tired', he wrote, 'and look forward to the peace and good fellowship of the sea'.[46] While in the Seychelles, Hickling received a telegraph from Vincent Glenday, the British resident at Zanzibar, expressing his delight at the outcome of the meeting and inviting Hickling and Wheeler to visit Zanzibar as soon as possible.

Practical limitations and the origins of EAMFRO

By September 1949 the governments of Kenya, Tanganyika and Zanzibar had formally accepted the proposals and funding arrangements suggested at the July meeting, and the EAHC followed suit in early 1950. But Hickling continued to exert a strong influence on the development of the research organization for several more years. In particular, Hickling felt strongly that the organization should have a physical presence in Zanzibar, manifested through a modern laboratory building. During his cruise on the *Cumulus* in 1949, Hickling had already tried to persuade Wheeler that the small surveying vessel would not provide adequate lab space for the comprehensive research to be undertaken by the new organization.

After the organization officially came into existence, Zanzibar's housing authorities went to work creating a luxurious suburb at Mazizini with electric-wired houses for scientific staff and their guests. But Hickling pressed for the rapid completion of the laboratory building in Stone Town. When the EAHC complained in early 1950 about the expansive laboratory designs, which called for a two-story building with 12 offices, a modern laboratory, and two workshops, Hickling shot back, 'these are the minimum requirements for a properly equipped marine laboratory'.[47] During discussions about building a new twin-engine ship to replace *Cumulus*, Hickling took great care to remind all parties that a new ship could not take the place of a complete shore laboratory, citing the example of the Discovery Investigations which had employed much larger research vessels but relied heavily on the Grytviken station and the British Museum as worksites.

The dispute over whether and to what extent the new organization would have a headquarters on land came to a head during the summer of 1951. Wheeler was a somewhat solitary figure, happy at sea and not particularly enamored with the idea of a shore facility. This attitude did not sit well with Hickling, for whom EAMFRO was meant to represent an advance in the institutional – and physical – presence of marine science in the colonies. 'It is perhaps unfortunate', Hickling reported in July, 'that Dr. Wheeler has for so long been a freelance solo worker; he has not yet grasped, I think, the fact that now he has to work with colleagues…and establish a research station of the second magnitude. This can be the only reason for the surprising attitude…that a shore laboratory is, in effect, dispensable if a larger vessel is got'.[48] Hickling's letter apparently caused concern among the members of the East African Marine Fisheries Research Advisory Committee, which Worthington had been working to put together. At the committee's first meeting, held in Zanzibar on August 27–8, 1951, Wheeler read a conciliatory statement from prepared typed notes. 'It may be as well to confess that up to quite recently I had supposed the purpose of this research organization to be different in character from what it now appears', Wheeler's statement read; after Hickling's sharply worded letter, he now realized that 'it is obvious that the lack of laboratory accommodation will hinder the development of the research organization on the lines laid down for some considerable time'.[49]

Even with Hickling, Wheeler, and Worthington temporarily working from the same script, making the new organization (now called by its permanent name of EAMFRO) function effectively was not easy. By September 1951 it was clear that the financial commitments made to the new West African marine and the Northern Rhodesia-Nyasaland freshwater organizations would not leave enough money for a new research vessel to replace *Cumulus*. In December, with the laboratory already behind schedule, rising construction costs forced the designs to be cut to a single-story building. At the same time, it was becoming clear that there were few fisheries scientists available to work in Zanzibar. During the war, the government had carefully controlled access to university science courses. Physical sciences and medicine were top priorities, and very few students were allowed to take advanced courses in biology. This would of course limit the number of candidates available for any new fisheries service. Starting in October 1950, EAMFRO placed advertisements for one biochemist and one marine biologist in the *Times*, *Daily Telegraph*, *Manchester Guardian*, *Scotsman*, and *Nature*. By December, only one candidate had applied for each position: the biochemist candidate was disqualified for a poor recommendation, and the marine biologist candidate, A.J. Prior, was considered a poor fit for the organization because she was a woman. The ads were run again, and as of May 1951, produced only one more applicant.[50]

It is difficult to believe that this flaw in the scheme surprised anyone. As early as 1943, when the Colonial Fisheries Advisory Committee first met to discuss the new fisheries service, officials had predicted that provision of staff would be a serious problem. Most of the new fisheries organizations were hindered by a lack of manpower. 'It was common knowledge', a Colonial Office official recalled in 1952, 'that the finding of experienced scientists to staff our various Colonial Fisheries Research Stations had been one of the most difficult problems since the war'.[51] The government was forced to create a program of Colonial Fisheries Research Studentships in the hope of building a group of young scientists from scratch. Thinking back to Hickling's suggestion that African students be trained to work in a research capacity within the organization, we should perhaps wonder if it would have taken significantly longer to do that than to offset the shortage in Britain itself. In any case, the first Colonial Fisheries Research Student to be assigned to Zanzibar was Frank Williams, a graduate of King's College, Newcastle. 'Mr. Williams is very keen to come out and join you', Hickling wrote to Wheeler in September 1951. 'You will find him a good chap....I suggest you put him on to ichthyological work, as we are training a bio-chemist and a planktologist for you'.[52] Williams sailed for Zanzibar in October and arrived in December, bringing the total research staff of EAMFRO to three.

The inadequacy of its manpower, laboratory space, and research vessel meant that EAMFRO came into existence as merely an approximation of a functioning scientific organization. On paper, EAMFRO was part of an impressive network of colonial research institutes. EAMFRO fit nicely into the new line of British marine and freshwater research stations that ran by 1951 from Sierra Leone to Lake Victoria and Lake Nyasa, through Zanzibar and on to Penang, Singapore, and Hong Kong, largely the result of Hickling's tireless work. At the same time, it answered to the East Africa High Commission, which oversaw separate interterritorial research organizations dedicated to agriculture, cattle, trypanosomiasis, locusts, insecticides, wildlife, freshwater and marine fisheries, secondary industries, medicine, social sciences, and economics. Some of these organizations did in fact run at full capacity, but others, like EAMFRO, struggled to meet their mandate. This was all too clear in the Colonial Office, where officials nervously debated the long lasting question of whether or not colonial research had an ultimate economic purpose. 'There appeared to be a need for a firm directive from here', one Colonial Office supervisor wrote. 'East Africa High Commission had made it clear that…the development of economic resources of that part of the Indian Ocean was the objective'.[53] If the current scheme was not likely to produce practical results, especially given the inadequacy of the *Cumulus* for the scope of the research, it should be stopped. The same official felt that Wheeler simply hadn't performed the duties associated with his position. The EAMFRO director was supposed to exchange quarterly reports with the fisheries officers of Kenya, Tanganyika, and Zanzibar, but this apparently hadn't happened. 'The present Director', the Colonial Office supervisor wrote, 'seems to have far too little consciousness of the need of tying in with what is being done on the mainland coast. He appears to neglect the necessity of maintaining cordial relations with the Kenya Fisheries Service'.[54] The tension between Kenyan officials and EAMFRO did not ease with time; Kenya would later threaten to pull out of the scheme completely unless its headquarters was moved to the Kenya coast.

Conclusion: the legacy of the imperial imagination

Limited by its small staff and unreliable research vessel, EAMFRO nonetheless remained visible in the public life of Zanzibar. EAMFRO's scientists began to make fishing cruises aboard the *Research* in late 1951, and the laboratory building was officially opened on 18 April 1953 at a ceremony attended by the Sultan of Zanzibar and the British Resident. The primary research question – to find out whether 'economically valuable' fish stayed in the area during the southeast monsoon or moved elsewhere for the season – was answered by 1955. The large pelagic fish were indeed there year-round, but they were too strong and violent for the equipment on the *Research*, and more detailed investigations would require an upgrade to a more appropriate ship. The CD&W grant was renewed for the years 1955–60, but the territorial governments increasingly expressed their dissatisfaction with the scheme. Instead of acquiring a new ship, the Colonial Office ordered EAMFRO to help cut costs by taking over an idle research vessel, the ancient but durable *Manihine*. The organization experienced a brief revival with a new group of researchers and a new director, Dennis Norman Frederick Hall, who lasted until the Zanzibar Revolution of 1964, when the organization suddenly became a distasteful relic of colonialism in the eyes of the island's leftist regime. EAMFRO finally collapsed in 1977 with the disintegration of the East African Community, which had taken over supervision of the regional scientific institutions from the EAHC. The University of Dar es Salaam's new Institute for Marine Sciences moved into the laboratory and offices of EAMFRO in Zanzibar and eventually became one of the most prominent marine science organizations in the Western Indian Ocean.

The efforts of Borley and Hickling, then, did eventually result in the creation of a functioning research organization in EAMFRO, which in turn provided the foundations for a late twentieth-century flourishing of marine science in East Africa. By that time, the scientific network that emerged was no longer an imperial one, although it too was fraught with its own political and social complexities and contradictions. Reflecting on the earlier research programs described in this chapter, it is interesting to consider the implications of the failure of colonial officials and scientists to 'develop' African inshore fishing along the coast. As Alan Lester notes, imperial networks usually overlay precolonial ones, which were often 'disrupted and restructured as a result of British interventions'.[55] In the case of marine fisheries research in East Africa, because of British inability to project scientific power, the imperial and indigenous networks did not quite collide in the way Lester describes. Artisanal inshore fishing is still the primary extractive activity on the East African coast, and marine scientists have only recently begun to develop the concepts and vocabulary with which to interact on an equitable basis with its practitioners. While colonial era marine research tended to concentrate on the 'economically valuable' offshore fisheries, it may be that coastal East African fishing communities were the most valuable 'unexploited assets'.

Notes

1 For an overview of the historiography on British colonial science, see the introduction to this volume; for marine science, see Rosalind Marsden,

'Expedition to Investigation: The Work of the Discovery Committee', in Margaret Deacon, Tony Rice and Colin Summerhayes (eds), *Understanding the Oceans* (London: CRC Press, 2001), pp. 69–86; and Helen Rozwadowski, *The Sea Knows No Boundaries: A Century of Marine Science under ICES* (Seattle: ICES and University of Washington Press, 2002).

2 Alan Lester, 'Imperial Circuits and Networks: Geographies of the British Empire', *History Compass* 4 (2006), 135.

3 Joseph M. Hodge, *Triumph of the Expert: Agrarian Doctrines of Development and the Legacies of British Colonialism* (Athens: Ohio University Press, 2007), p. 12.

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13
Thomas Adeoye Lambo and the Decolonization of Psychiatry in Nigeria

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Too often, the history of science in European empires is told solely as the story of how Europeans applied 'modern' science to 'primitive' environments. It is a story of the goals, actions, and outcomes, good or bad, of European efforts to order, control and exploit the territories that came under their domain. In other words, it is a history *about* colonized people and places but rarely *of* colonized people and places. To the extent that indigenous actors are integrated into histories of colonial science, it is usually either as enthusiastic converts to European knowledge systems[1] or, following Frantz Fanon, as quintessential resisters of alien rule and the knowledge regimes that sustained it.[2] A small, but growing, body of literature is recognizing the important role that non-Europeans played in developing and interpreting scientific knowledge in European empires. As Kapil Raj has noted, the time has come to move away from viewing European science and indigenous knowledge systems as diametrically opposed constructions whereby Europeans either imposed European science on 'unscientific' populations or appropriated indigenous knowledge and put it to 'scientific' use. Rather it is important to see colonial settings as 'contact zones' in an 'emerging world order of knowledge' that is not, and never was, wholly European.[3] By examining the work of Thomas Adeoye Lambo (1923–2004), Nigeria's first European trained psychiatrist of indigenous background, this chapter argues that a more comprehensive understanding of the complex negotiations involved in producing, circulating and implementing scientific knowledge can be obtained by recognizing the active, purposeful and engaged contributions that non-European scientists have made to imperial and global scientific networks.

T.A. Lambo oversaw the transformation of Nigeria's psychiatric services in the 1950s, from European controlled institutions practicing highly racialized psychiatry to Nigerian controlled institutions functioning on more culturally sensitive models of diagnosis and treatment. Lambo's breakthrough developments in outpatient and community treatment as the chief psychiatrist at Aro Mental Hospital in Abeokuta in the 1950s and 1960s made him an intellectual hero within Nigeria and an influential figure in international psychiatric research and global health governance. As such, he lived at the intersection of clinical psychiatric science and the politics of decolonization, at both a national and international level.

Lambo's transformation of Nigeria's psychiatric services had clinical and political implications both in Nigeria and internationally. Clinically, Lambo's insistence on cultural sensitivity in treating Nigerian mental patients – focusing on understanding the cultural masking agents of mental illness in Nigerians and the importance of traditional medical practice in treating Nigerian patients – allowed for dramatic improvements in the recognition and diagnosis of mental illness in Nigerians and resulted in higher recovery rates for patients than had been obtainable in colonial asylums.[4] Politically, Lambo's success highlighted to Nigerians the inadequacies of colonial psychiatry and the inability of racist and alien colonial rule to bring 'progress' to disadvantaged Nigerians while suggesting that Nigerians might govern themselves better than did the British. Lambo's efforts to decolonize Nigerian psychiatry also received significant international acclaim. Under Lambo, Aro Mental Hospital became a major node in international networks of research in cross-cultural psychiatry, including as a catchment area for the World Health Organization's (WHO) *International Pilot Study of Schizophrenia*.[5] Lambo himself was always very interested in international health issues and became heavily involved in the WHO later in his career, serving as the Deputy Director General of the WHO from 1973–88.[6]

Lambo's engagement in crosscultural psychiatric experiments and international health governance contributed not only in decolonizing the practice of psychiatry in Nigeria, but also in 'decolonizing' the mindset of psychiatric professionals the world over, helping to frame a new cross-cultural perspective for a postcolonial world. Lambo's influential career therefore illustrates the extent to which both local and global consciousnesses were important to the production and interpretation of psychiatric knowledge in the era of decolonization. It is also an example of the important role that networks of scientific knowledge played in the discourse on decolonization both locally and globally.[7] Finally, T.A. Lambo provides a strong example of a colonial subject who straddled the line between 'western' science and 'indigenous knowledge systems', and, in so doing, represents a complex, nuanced example of the non-European contribution to 'modern' science.

Nationalism and the decolonization of psychiatry in Nigeria

Lambo's ideas and professional path were intrinsically linked to political and economic developments in postwar Nigeria. In the years after 1945, Nigeria moved incrementally towards independence from British rule through a series of reforms and concessions on the part of colonial officials instigated by both nationalist movements in Nigeria and imperial ennui in Britain. Nigerian officials drafted constitutions in 1947, 1951, and 1954 that increased the participation of Nigerian subjects in government at each turn, grooming Nigeria for independence while simultaneously entrenching regional divisions in the country that would have permanent and dire consequences. The decade succeeding the Second World War also saw a dramatic increase in government expenditure through a ten-year development plan instituted in 1945 that pumped millions of pounds sterling into infrastructure and agricultural improvements, as well as social services. The ten-year plan allocated 10.4 million pounds for growth in medical and health services, including leprosy and malaria treatment facilities, and, most importantly for our purposes, the construction of Aro Mental Hospital in Abeokuta, which had begun admitting patients by the early 1950s.[8] The plan also provided 7.7 million pounds for expansion of education facilities in Nigeria. This expansion of education services focused mainly on secondary and normal schools. It also resulted in the establishment of the University College at Ibadan in 1948, appended to the University of London and the first facility through which students could earn university degrees in Nigeria.[9] The expansion of education facilities was meant to provide the manpower to realize the 'Nigerianization' campaign that accompanied the transition to independence whereby high level positions in government and civil service held by British colonial officers would be taken over by Nigerians for the first time. It was within this context of expanding social services in health and education attendant to the overall process of 'Nigerianization' that Lambo returned to Nigeria from the UK, where he had earned his medical degrees, and took up the position as chief psychiatrist at Aro in 1954. Lambo was himself a part of the transition to independence and, as such, was keen for both personal and patriotic reasons to illustrate the effectiveness of indigenous leadership in psychiatric services. By the time Nigeria achieved independence in 1960, Lambo was already an important symbol of the progress made possible by the end of colonial rule.

The main emphasis of Lambo's clinical psychiatric research in Nigeria centered on the relationship between culture and human psychology. Most important to Lambo was the recognition that the forms and symptoms of mental disorder in patients often manifested themselves within specific cultural contexts and could only be understood within the terms of those contexts. The link between the practice of clinical psychiatry and the social sciences was paramount to Lambo, who consistently urged for more data to be compiled on the sociocultural makeup of Nigeria in particular and African societies in general. Understanding indigenous African cultures was not only important in terms of diagnosing mental illness in African patients. Lambo also believed that cultural sensitivity could go a long way towards improving the treatment regimes available to mental patients in Nigeria. The more European-trained psychiatrists appeared to understand patients' own conceptions of their illnesses and how they should be treated, the more comfortable patients would be around European-trained psychiatrists, and the more receptive they were likely to be to psychiatric treatment. Lambo also believed that patients' disorders were more likely to improve from treatment if that treatment was geared towards the cultural environment that the patient would face upon reintegration into society.

Lambo's ideas of a culturally sensitive diagnosis and treatment of mental disorder may seem entirely intuitive today, but in many ways they were starkly different from the way that mental health services had been approached in colonial regimes in Africa in the first half of the twentieth century. Prior to the 1950s, European doctors dominated psychiatric facilities in African colonies, including Nigeria. These doctors often had neither professional psychiatric training nor any detailed understanding of the cultures that they encountered in Africa. They tended to see African psychology in racial terms, in no small part inspired by the 'civilizing mission' of European colonialism.[10] Many Europeans working in African colonies in the first half of the twentieth century saw the colonial project as one of a culturally and intellectually superior white, European race bestowing 'civilization' on a morally and intellectually inferior black, African race.[11] The rhetoric of colonial psychiatry tended to fit within this racial model of the 'civilizing mission', suggesting a strong connection to Foucault's critique of psychiatry as a tool of the state to define normality and marginalize threats to the stability of the political order by declaring them abnormal, dangerous, and insane.[12]

Colonial psychiatrists developed a concept of the universal 'African mind' that applied to all Africans by virtue of their race, regardless of differences in cultural background. Furthermore, the 'African mind' was defined primarily in pejorative terminology and strictly in terms of deviation from 'normal' European characteristics. As late as 1953, just a year before Lambo began work at Aro, famed colonial psychiatrist J.C. Carothers (who himself had taken no professional psychiatric training before becoming chief psychiatrist at Mathari Hospital in Nairobi in 1938) summarized the definition of the 'African mind' as most colonial psychiatrists understood it in a major publication commissioned by the World Health Organization. According to Carothers, the African was

> …conventional, highly dependent on physical and emotional stimulation; lacking in spontaneity, foresight, tenacity, judgment, and humility, inapt for sound abstraction and for logic, given to phantasy and fabrication, and, in general, unstable, impulsive, unreliable, irresponsible, and living in the present without reflection or ambition, or regard for the rights of people outside his own circle. To counteract these ruderies, he has also been described as cheerful, stoical, self-confident, sociable, loyal, emotionally intuitive, and eloquent, and as bearing grudges and having an excellent memory, a large vocabulary, and an aptitude for music and dance.[13]

In a previous study, Carothers had infamously purported that the fully formed 'African mind' was similar to the lobotomized European. As evidence, Carothers noted that 'at least one of the few Europeans leucotomized in Kenya has, since his operation, consorted much more happily with Africans than with Europeans, in marked distinction from his previous behavior and to the great embarrassment of his relations'.[14] Although Carothers' study was conducted only amongst the Kikuyu in Kenya, he referred to his subjects simply as 'Africans', and generally assumed that his findings applied to all Africans. This practice was common amongst colonial psychiatrists of the time. Racial categorizations trumped cultural divergences for most colonial psychiatrists throughout the first half of the twentieth century.[15]

Clinical observations tended to be of mere academic interest to Europeans psychiatrists and government officials in African colonies. Modern, European-styled psychiatric treatment was simply not available to African subjects.[16] This was nowhere more the case than in Nigeria, where colonial mental asylums were chronically overcrowded, underfunded, and poorly staffed.[17] For the most part, colonial asylums in Nigeria were custodial in nature, designed to house only the most violent and criminal 'lunatics' – to use the parlance of the times – and lacking in treatment options. In fact, other than the main government-run asylums in Yaba, Calabar, and, later, Lantoro, most local asylums were physically and administratively the responsibility of the Department of Prisons.

Conditions in Nigeria's asylums were regularly criticized as deplorable by colonial officials, visiting psychiatrists and Nigerians themselves, but very little was done during the first half of the twentieth century to improve them. For example, visiting psychiatrist R. Cunyngham Brown conducted a survey of Nigeria's psychiatric services in 1936. Brown's report criticized the overcrowding of Nigeria's asylums generally and the government-run asylums in the South specifically.[18] The report also repudiated the use of prisons to house lunatics and lamented the paucity of staff and lack of curative or therapeutic treatment.[19] Seventeen years later, when J.C. Carothers performed another survey of Nigeria's psychiatric services, many of the same criticisms reappeared. Reporting on Yaba asylum, Carothers noted that Brown's assessment continued to apply, 'except that it is now more crowded and much more dilapidated'.[20] Overall, Carothers lamented 'it is sad to reflect that, if Dr. Brown's excellent advice could have been followed at that time, there might have been no need for the present commission of enquiry'.[21] The asylum system in Nigeria clearly left much to be desired.

The problem was ultimately quite simple: the colonial government in Nigeria was not willing to appropriate the necessary expenditure to improve the asylums despite the embarrassment that they caused. For example, when a proposal to build a new asylum in Abeokuta was floated in 1926, the government declared its position on the matter thusly:

> If government proposes to make itself responsible for the care and maintenance of all persons who are useless to their friends and relations, and whom an alienist might classify as 'lunatics', considerably more than a million pounds a year would probably be required for the erection and maintenance of the necessary institutions. His Honour is not therefore entirely convinced of the desirability of contemplating action on a large scale.[22]

A similar argument was made 30 years later, after the Carothers report suggested expanding psychiatric facilities. At that time, the Acting Secretary to the Government at Lagos proclaimed:

> We discussed the cost of a Lunatic Asylum and you have mentioned figures from 750,000 downwards. I should say that there is not the

> faintest hope of getting any sum of this order....We will never get a vast sum of money for a lunatic asylum....[T]o think in terms of 750,000 for 300 lunatics is merely baying for the moon....[23]

As a result, Nigerian mental asylums remained deplorable throughout the colonial era.

The poor conditions of the asylums themselves contributed to the underdevelopment of 'modern' psychiatric services in Nigeria. Most Nigerians distrusted and avoided European styled psychiatric treatment whenever possible, preferring instead to rely on traditional indigenous healers. Colonial officials and psychiatrists recognized that under existing conditions, every effort should be made to avoid sending Nigerians to the asylums so as not to contribute to the chaos of the existing order, especially since there was little motivation ever to improve conditions there. Psychiatry was a moribund profession in Nigeria at the time that Lambo emerged on the scene in 1954.

When Lambo took up his post at Aro Mental Hospital he immediately began to confront the problems of colonial psychiatry by asking research questions based on very different assumptions than those of colonial psychiatrists. Rather than starting from the assumption that African psyches were inherently different from European psyches and attempting to explain *why* this difference was so pronounced, Lambo reoriented psychiatric research in Nigeria by asking the question of *whether* African minds were, in fact, so different from other peoples, even allowing for the possibility of inherent similarities across space and between races. Lambo blasted the racist generalizations of colonial psychiatrists like Carothers, declaring that existing research on mental disorder among Africans was 'extremely inadequate' because too often 'the clinical conclusions were founded on the treacherous sands of unscientific methodology'.[24] He lambasted colonial psychiatrists for declaring their work to be scientifically objective when, in fact, Lambo believed:

> [A]t their worst they have been but glorified pseudo-scientific novels or anecdotes with a subtle racial bias; at their best, they are abridged encyclopedias of misleading information and ingenious systems of working hypotheses, useful for the guidance of research, but containing so many obvious gaps and inconsistencies, giving rise to so many unanswerable questions, that they can no longer be seriously presented as valid observations of scientific merit.[25]

These unscientific assumptions and conclusions about African mentality had led to a situation in which the advancement of the field was not hampered so much by ignorance of African cultures, but 'by knowing so much that is not strictly true'.[26] Lambo took the greatest offense to Carothers' equation of the 'African mind' with simplicity and immorality, particularly the suggestion that the African brain corresponded generally to the lobotomized European brain, calling such exaggerations 'a good example of one of those attempts by some authors who, confronted with the baffling problems of the incomprehensible, adopt the popular procedure of making sweeping generalizations behind a veritable smokescreen of technical terms, involved abstractions and semantic confusion'.[27] Lambo's research sought to ameliorate some of the most heinous injustices that he observed in colonial psychiatry.

Convinced that cultural difference, not racial difference, was the key to understanding and treating mental illness in Africans (indeed all people), Lambo dedicated his research to understanding African psyches, not as they supposedly related to European 'norms', but within the cultural norms of individual African societies. Lambo published many articles detailing the ways that culture affected the form and content of psychiatric disorders particularly among the Yoruba ethnic group, who make up the vast majority of the population in southwestern Nigeria where Aro was located. In so doing, Lambo was able to challenge some of the most prevalent myths of colonial psychiatry.

One such myth that Lambo confronted was the widely held belief that mental illness was far more prevalent in 'detribalized', literate, and urban Africans than in 'traditional' illiterate, rural Africans. Fear of the political, economic and cultural impact of 'detribalization' permeated social scientific discourses in colonial African settings. As increasing numbers of Africans moved from rural to urban environments, adopted and adapted European religious and cultural norms, and, in so doing, demanded more active and participatory forms of government, 'traditional' and presumably historically static social structures were being significantly undermined and along with it the stability of British indirect rule reliant on the indigenous leadership of primarily rural, agrarian communities.[28] This preoccupation with the perils of 'detribalization' trickled down to colonial psychiatry, where colonial psychiatrists determined 'detribalization' to be the greatest existing threat to African sanity. African minds were stable, according to colonial psychiatrists, because of their primitiveness: Africans were well adjusted to their simple, rural lives. Colonial psychiatrists believed that primitive 'African minds' became so stressed by contact with modern, sophisticated, European cultures, most commonly through Western education in urban environments, that they were much more likely to develop mental illness than if they had remained in their 'traditional' surroundings.[29] In studies on paranoid psychoses and schizophrenia among the Yoruba, Lambo was able to illustrate that this belief was not true and that it stemmed primarily from the ability of colonial psychiatrists to recognize mental illness in Africans only when it resembled mental illness in Europeans. Lambo found, for example, that paranoid delusions among non-literate, rural Yoruba were common and 'often centered around the concepts of supernaturalism and ancestral cults'.[30] Colonial psychiatrists saw such preoccupation with the supernatural as a normal function of 'African culture' and, according to Lambo did not have the cultural understanding or sensitivity to recognize when obsessions with such phenomena cross the line between normal and psychotic. On the other hand, amongst literate, urban Yoruba 'hypochondriacal delusions, especially in the early stages, seem to dominate the picture', as they did with Europeans.[31] Only psychoses precipitated by organic illness took similar forms in the literate, urban and non-literate, rural groups. Overall, Lambo determined that 'the same diagnostic criteria and assessment of prognostic possibilities which hold in Western culture are equally applicable to the Yoruba patients who have been in contact with Western culture. These, however, do not seem to hold with patients whose cultural background is as different as that of the non-literate (rural) Yoruba tribe', whose disorders were masked by pathoplastic features specific to their cultural backgrounds.[32] This is just one of many possible examples of the culturally-oriented research that Lambo conducted on the nature and presentation of mental illness in Nigerians.[33]

Lambo's belief that cultural sensitivity was necessary in the diagnosis of mental illness carried over into a belief in the need for cultural sensitivity in treatment as well. The application of this theory led to Lambo's most famous experiment: the Aro Village scheme. Opened in 1954, Aro Village was a direct attempt to decolonize the practice of psychiatry in Nigeria, moving away from a colonial mindset of forced committal and isolated, in-patient, primarily custodial, care to one of voluntary admission, outpatient, community-oriented therapeutic care. Four villages surrounding Aro Hospital served as the basis for the treatment regime. Patients arrived with a family member – usually a mother, aunt, or sister – who would keep watch over the patient during their stay. The patients lived with villagers during their stay, attending the hospital for regularly scheduled treatments, which sometimes included such 'modern', up-to-date psychotherapeutic methods as ECT and insulin coma therapy. Patients and villagers engaged in community projects and activities together, including church services, films, plays, dances, and eventually in agricultural activities designed to make the hospital and villages self-sufficient while simultaneously providing a sense of normality and responsibility designed to help patients with the process of reintegration into their cultures and societies when they returned home.

If the environment was designed to be culturally sensitive and community oriented, so were the treatments. Not only did Aro Hospital provide 'modern' treatment options but it also incorporated traditional medical practitioners with expertise in mental disorders. Although 'indefensible by Western standards', Lambo argued that indigenous 'witch doctors' had been invaluable in the success of Aro. As Lambo put it:

> Through their participation we have enriched our scientific knowledge of the psychopathology and psychodynamics of the major psychiatric disorders occurring in these exotic societies. We have also been able to accumulate a mass of data on the natural history and prevalence of many psychiatric disorders, in terms of cultural and social variables (variables that are ill defined and remain resistant to Western forms of categorization). Without the help of the 'witch doctors' we would not have known how and where to look and what obstacles to skirt in searching for simple disorders like obsessional neurosis in the indigenous population of Africa. Most of these traditional healers who are employed by us and are participating in this scheme have considerable experience in the management of African patients. They supervise and direct the social and group activities of our patients in the villages under our guidance.[34]

The incorporation of indigenous medical practitioners served two purposes. In the first place, they helped the European trained psychiatric staff understand the cultural factors that might be affecting the presentation of mental illness, therefore allowing for more complete and effective diagnosis. On the other hand, they also allowed for patients to be treated within cultural frameworks with which they were familiar and comfortable, thereby engendering trust in the therapeutic process and improving the likelihood of eventual recovery.

The perceived successes of Aro Village quickly vaunted Lambo into the limelight in Nigeria. Lambo was able to declare that African patients treated within a culturally familiar community environment showed lower levels of chronicity and higher levels of permanent recovery than those treated in modern, Western mental hospitals in Europe or the United States.[35] Just as importantly, Lambo had overseen the decolonization of Nigerian psychiatry – its transference from European to Nigerian leadership, and its transition from a race-based theory of mental illness in Africans to a crosscultural model of research, diagnosis and treatment. The value of this revolution was evidenced in the results: where colonial mental asylums were easily cast as dismal failures, Aro Hospital and the Village scheme were, by comparison, monumental successes. Lambo's professional agenda, rooted in a cultural nationalism that sought to restore dignity to the 'African mind' and to provide more effective care for it, coincided neatly with the advance of nationalist movements and the decolonization of Nigeria in general. Lambo's contributions to nationalism and decolonization had become so recognized by the time of Nigeria's independence in 1960, that he was rubbing elbows with some of the most distinguished nationalist academics in Africa. In 1962, he contributed to the *Proceedings of the First International Congress of Africanists*, an organization whose officers included the likes of Kenneth Onwuka Dike, Alioune Diop, Aimé Césaire, James Ojo Coleman, and Michael Crowder, among others.[36] Lambo's leadership role in Nigeria quickly expanded beyond the reach of Aro. In 1964, he was appointed Professor of Psychiatry at University College Hospital in Ibadan. Two years later, he became Dean of Medicine at the University of Ibadan and, in 1968, Vice Chancellor of the University.[37] Lambo's accomplishments made him an important personality in Nigerian national history.

International scientific networks in an age of cross-cultural psychiatry

Lambo's efforts at decolonizing psychiatric knowledge and practice necessarily utilized networks of knowledge production and circulation that had been developed under British rule in Nigeria and which linked Nigeria to other parts of the British Empire and, indeed, the world at large. Jock McCulloch has argued that the highly racialized psychiatry that emerged throughout the British Empire in the late nineteenth and early twentieth centuries was ideologically similar across space despite the fact that it developed largely independently in different places, with very little evidence of the direct influence of colonies on each other.[38] While this may be true in regards to the origins of colonial psychiatry in different environments, by the 1950s, there were very clear channels through which psychiatric knowledge from the colonies circulated to Britain and, by extension to other parts of the world as well. Increasingly, colonial psychiatrists published their findings not only in regional scholarly journals like the *East African Medical Journal*, but also in Euro-American journals like the *British Journal of Psychiatry*, and the *Journal of Mental Science*.

Carothers' WHO-sponsored synthesis on African psychiatry published in 1953 is a good example of the extent to which psychiatric knowledge produced in diverse colonial environments could be compiled and disseminated by an important international organization by this time. Carothers' compendium synthesized published sources from across British and French Africa, as well as the United States and, to a lesser extent, the Caribbean, in order to provide the most up-to-date perspective available on the nature of the 'African mind' wherever it might be found.[39]

The ability of imperial circuits to disseminate knowledge across space itself contributed to the construction and utilization of race-based psychiatric principles to define and control blacks not only in Africa but in other parts of the world. For example, psychiatrists in Britain in the 1950s often spoke of their immigrant Nigerian patients' maladies in terms of the 'detribalization' problem.[40] Because of this, Lambo needed to address the ills of colonial psychiatry not only in Nigeria, but internationally as well. Lambo did this both by working within existing imperial knowledge networks and by developing new networks for purposes of experimentation and knowledge dissemination.[41] Like colonial psychiatrists before him, Lambo published his findings broadly in international journals. He also conducted studies on the psychological issues facing migrant Nigerians in Britain, for example, in order that both the UK and Nigerian governments might be better able to work together to improve conditions and outcomes for Nigerians attempting to cope in alien surroundings. [42] Lambo also reached out to other nationalist psychiatrists in Africa to share their research findings by hosting the First Pan-African Psychiatric Conference in Abeokuta in 1961.[43]

Perhaps the most significant way in which Lambo contributed to the growth and development of networks of psychiatric knowledge circulation was through the promotion of Aro Mental Hospital as an important node for international experiments in crosscultural psychiatry. The unique, and apparently successful, approach to patient care developed by Lambo had brought international attention to Aro by the late 1950s. In 1960, the United Nations filmed a documentary in Nigeria lauding the accomplishments of Lambo and his staff called *The Healers of Aro*.[44] From the early 1960s, Lambo himself became increasingly involved in experiments in crosscultural psychiatry in which results at Aro were compared with results from similar studies performed at other mental hospitals around the world. In essence, the goals of Lambo's crosscultural studies grew out of his nationalist approach to decolonizing the psychiatric services of Nigeria, but recognized that the best way to achieve nationalist ends was through international engagement.

The preoccupation of crosscultural psychiatry continued to be on the relationship between culture and mental health, particularly on the forms, manifestations, diagnoses and treatments of mental disorder in different cultural environments. Recognizing that culture is a major factor in the form and process of mental illness was only part of the equation, however. The question that still perplexed psychiatrists was whether culture *determines* those forms and processes, or merely serves as one of many *influences* on them. In other words, is mental illness diagnosable and treatable *only* within a *specific* cultural context, or are there *patterns* of mental disorder that can be recognized, diagnosed and treated *across cultures*?

Data on this question would have been desirable to someone like Lambo from both a global and a nationalist perspective. From a nationalist perspective, it would either prove that cultures were so psychologically divergent that only indigenous leadership in either psychiatric or governmental affairs would be reasonable, or that psychologically human beings, despite their cultural differences, were essentially similar in terms of brain function (and dysfunction), thereby effectively illustrating the innate equality of man, something that nationalists in Africa had been fighting to prove for generations. The projects also integrated Aro Hospital, and by extension Nigeria, into the global dialogue on mental health, serving as a source of national pride. From a global perspective, even conducting such large projects over such a vast space in any kind of coherent way and with any kind of valuable results would go a long way towards demonstrating the value of a global perspective and the capacity for collaboration and cooperation on a global scale. Lambo's research agenda therefore became simultaneously nationalist and global in outlook.

Two crosscultural psychiatric studies involving Lambo and Aro Hospital were particularly influential. The first was a joint project between Cornell University and Aro Hospital titled *Psychiatric Disorder among the Yoruba,* which compared trends in psychiatric disorder in southwestern Nigeria in 1961 with an identical study conducted in rural Canada in the United States thirteen years earlier.[45] The second was the WHO's *International Pilot Study of Schizophrenia* (*IPSS*), the first volume of which was published in 1971, in which Aro had served as one of nine catchment areas for the collection of data regarding worldwide diagnostic patterns for schizophrenia.[46] The crosscultural projects involving Lambo and Aro Hospital were very successful and, overall, provided data illustrating that human psychology was largely similar across cultures, provided that the variables for the determination of mental order and disorder were properly calibrated. The findings suggested that large, international projects were instrumental in providing essential data on human psychology and in systematizing research methods that could be utilized in a broad variety of cultural circumstances.

In *Psychiatric Disorder among the Yoruba,* Lambo and his co-authors determined that the primary indicator for increased rates of mental disorder amongst the Yoruba was not necessarily the distinction between rural and urban or between literate and illiterate, as colonial psychiatrists concerned with the 'detribalization' hypothesis had suggested, but rather the level of integration or disintegration of a community overall. The authors defined 'disintegration' as 'the breakdown or disruption of the inter-relationship' of established patterns of sociocultural interaction between people. Both integrative and disintegrative processes are constantly underway in any community, however:

> [a]t a point in time when the social network undergoes change, there is likely to be a disruption of the previous forms of interaction, and it is appropriate to say that the community is in a state of re-orientation, in which a preponderance of either integrative or disintegrative processes may come to the fore. Changes that occur in such a manner as to permit substitutions and adaptations while the functioning of the system of relationships continues with effectiveness will not involve disintegration to any significant degree.[47]

Lambo and his co-authors selected 15 different Yoruba communities representing different degrees of urbanization, cultural change, and general socioeconomic status and evaluated these communities' levels of integration and disintegration. They then performed experiments to determine the relative levels of psychiatric disorder among the communities.

The authors concluded, firstly, that the levels of urbanization, cultural change and socioeconomic status were not directly proportional to the level of integration or disintegration. A rural community could be significantly disintegrated, and a poverty-stricken community could be significantly integrated. Furthermore, according to the authors, '[d]isintegration…is a common but not a necessary accompaniment of cultural change and modernization. In the Yoruba villages we received the impression that prevalence of psychiatric disorder is associated with disintegration rather than with cultural change as such'.[48] The belief of colonial psychiatrists that contact with European culture necessarily increased risks for mental illness was therefore directly refuted.

In global terms, the results of the study showed a great deal of similarity with the results of an identical study performed in rural Canada. According to the authors, '[b]y and large…the similarity in the two samples is much more impressive than the differences. In view of the life situations, this is truly remarkable. The similarity applies both to pattern quality (anxiety, depression, etc.) and to prevalence in most of the categories tabulated'.[49] The similarities were significant because, 'many people have emphasized that cultural differences must mean major difference in psychiatric disorder, an expectation that is doubtless due in part to theories of personality and culture'.[50] It also provided data on mental illness in African communities outside of the hospitals, whose statistics typically placed 'much emphasis [on] differences – the prevalence of excitement and violence and the absence of depression'.[51] The comparability of prevalence of many psychiatric disorders between Yorubas and Pennsylvanians suggested that large-scale comparative experiments in crosscultural psychiatry might go a long way towards eradicating persistent ideas of a cultural superiority – inferiority dichotomy between Westerners and Africans and allow for the development of more sophisticated methods of diagnosis and treatment of mental illness in both groups.

Similar findings came out of the *IPSS*. Ibadan, Nigeria, served as a catchment area along with Aarhus, Denmark; Agra, India, Cali, Colombia, London, Moscow, Taipei, Prague, and Washington, DC. The goal of the study was to answer the following questions: '(a) In what sense can it be said that schizophrenic disorders exist in different parts of the world? Do they differ in form or content? Does the clinical course differ? (b) Can other functional psychoses also be recognized and do they run a recognizably different course? (c) Can techniques be developed for recording and classifying symptomatology, psychiatric history data, and social data, reliably? (d) Can teams of research workers be trained to use these techniques so that comparable observations can be made in both developed and developing countries?'[52]

The results of the *IPSS* indicated that, at a general level, the methodology worked, and that all nine areas showed a remarkable consistency in differentiating schizophrenia from manic and depressive states. The study concluded that this, in itself, was a great success and that

> genetic, etiological, epidemiological, therapeutic, and prognostic studies should benefit by the increased comparability that this implies. Above all, however, the status of psychiatry within the expanding public health programmes being developed by WHO and

> national governments depends upon its having a solid clinical groundwork on which planning and evaluation can be based.[53]

Basic human prevalence of schizophrenia was therefore proved.

The results of the *IPSS* raised many questions about the capacity for crosscultural analysis as well, however. Although differentiation between schizophrenia and other mental disorders was uniform enough, the study found that differentiation between subtypes of schizophrenia (hebephrenic, catatonic, acute, latent, and so on) were much less similar. Indeed, Moscow and Washington, DC added an addendum of 'extra' cases of schizophrenia that fell outside of the *IPSS* rubric. Beyond this, the prevalence of certain types of schizophrenia and other disorders varied significantly across regions. The Aarhus group showed a higher incidence of mania than the rest, while in Agra catatonic and unspecified schizophrenia were diagnosed at higher than normal rates.[54] The findings actually corroborated findings that Lambo had made about the difficulties of diagnosing schizophrenia within Nigeria 15 years earlier, although the report makes no mention of this.[55]

Overall, however, the *IPSS* provided yet another example of the capacity to conduct crosscultural research in psychiatry and illustrated the value in understanding how, why and on what level culture impacted the diagnosis of various kinds of mental illness in different places. It also helped to cement Aro Hospital and Nigeria firmly within the established network of international, crosscultural psychiatric research. Lambo himself dedicated his energies to international health issues from the early 1970s, resigning his Vice Chancellorship at the University of Ibadan in 1971 to become the Assistant Director General of the WHO with responsibility over the Divisions of Mental Health Non-communicable Diseases, Therapeutics and Prophylactic Substances and Health Manpower Development. From 1973 to 1988 he served as Deputy Director General of the WHO, overseeing the development and implementation of projects not only in global mental health, but global health in general. Just as colonial scientists moved from positions in imperial service to positions in international organizations during the era of decolonization, Lambo moved from a primarily national position to one of international emphasis as his career progressed.[56] The moves to the international arena were organic for both colonial and nationalist scientists. For British colonial scientists whose wide geographical experience and concern with trans- and supra-national issues like the environment, food production, and global health, no doubt continuing their work in international scientific and development aid agencies was a more attractive prospect than returning to the relatively provincial confines of the motherland. For Lambo, the move to the international arena made perfect sense considering the extent to which his nationalistic approach to psychiatric practice in Nigeria had always contained an intrinsic and necessary engagement with international networks of knowledge production and dissemination.

Lambo therefore contributed to the 'decolonization' of global psychiatry much as he had overseen the 'decolonization' of Nigerian psychiatric services. By providing research detailing the effects of culture on psychology, Lambo promoted a worldview that stressed understanding cultural differences between peoples in order to recognize the basic similarity, equality and dignity of human beings as the foundation of any effective therapeutic practice. The result has been a replacement of a colonial psychiatry that divided the world into racial categories with a much more complex, crosscultural understanding of human psychology that is simultaneously universal and diverse, but rooted, at least in Lambo's case, in a nationalist agenda brought to fruition during the decolonization process in Nigeria.

Conclusion: psychiatry and imperial science in the age of decolonization

Whereas other chapters in this volume have stressed the continuities between imperial and postcolonial science, this chapter seems to have stressed the discontinuities between colonial psychiatry and the nationalist inspired crosscultural psychiatry of Lambo and others. To a certain extent, this is true. Lambo and other Nigerian psychiatrists who followed in his footsteps were intent on distancing themselves from a colonial psychiatry that had been more or less universally recognized as unbeneficial to the populations it was supposed to have served. The knowledge that Nigerian psychiatrists constructed and disseminated was therefore directed both at improving conditions and outcomes for the afflicted and at explicitly discrediting the colonial regime. In this sense, an ideological discontinuity between colonial and postcolonial psychiatry in terms of knowledge production and interpretation was practical and necessary. Part of recognizing this discontinuity, however, is the result of concentrating on non-European contributions to international knowledge networks, both imperial and postcolonial. Indeed, the critique of the inequities and iniquities of colonial psychiatry were not new in the 1950s. There was a strong continuity between Lambo's position on mental health services in Nigeria and those of the Nigerian population at large which had long avoided contact with Nigeria's colonial asylums. It was only when Lambo engaged directly with the existing imperial knowledge networks as a result of changing circumstances attendant to the decolonization process in the 1950s that this indigenous perspective began to create a rupture between a very racist, Eurocentric body of knowledge and a more egalitarian, crosscultural theory and practice of psychiatry both in Nigeria and globally.

The discontinuities between colonial and postcolonial psychiatry seen in this chapter are therefore mostly associated with the ideology informing the production and interpretation of scientific knowledge. However, there are major continuities between colonial and postcolonial psychiatry that are also evident in Lambo's approach to professional psychiatry. Although the knowledge produced led to different conclusions than that which had preceded it, Lambo used the same set of structures and processes to produce his knowledge that Carothers and other colonial psychiatrists had used before him. Lambo's explication of mental illness in Nigerians, even with its cultural peculiarities, was explained wholly in terms of the Euro-American psychiatric definitions, nosologies, and diagnoses enshrined in the *Diagnostic and Statistical Manual of Mental Diagnoses (DSM),* which has provided the normative language for professional psychiatrists the world over since the early twentieth century. This adherence to established terminology reflects Livingstone's point that international science needs a universal language and set of symbols in order to make knowledge relatable and comparable across space and time.[57] Lambo's tendency to classify mental illnesses amongst Nigerians in terms of 'depression', 'schizophrenia' and so on, reflects the historical reality that the West had established hegemony over the language and symbols used in psychiatric research by the 1950s. Lambo also conducted most of his experiments within the confines of the 'modern' Aro Mental Hospital, designed to provide a clinical and therapeutic experience similar to that obtained in Euro-American settings, although Lambo himself adapted this experience with the development of Aro Village. Finally, Lambo very much utilized the networks of scientific knowledge dissemination constructed by European imperial power, even as he strove to expand on them and create new, parallel networks. The rupture between colonial and postcolonial knowledge production and interpretation was therefore brought about primarily from within established imperial structures and processes.

Lambo's career therefore reflects the tension between 'colonial' and 'postcolonial' psychiatric science in ways that mirror the cultural 'tensions of empire' that Frederick Cooper and Ann Laura Stoler have famously highlighted, particularly their contestation of the notion of distinct and uniform categorizations of 'colonial' and 'postcolonial' that miss 'much of the dynamics of colonial history, including the circuits of ideas and people, colonizers and colonized, within and among empires'.[58] The career of T.A. Lambo brings focus to the complex blending and overlapping of elements of colonialism, nationalism, decolonization, and international scientific networks that colonial subjects had to negotiate. Lambo's professional identity was shaped in the context of colonial nationalism and gradual decolonization in Nigeria. His nationalistic approach, centered on understanding and working within Nigerian cultural frameworks, brought international recognition and led him towards crosscultural research that incorporated his findings into a global body of psychiatric knowledge increasingly concerned with the more complex and variegated effects of culture on human psychology within and across racial groups, but nevertheless reliant on and constrained by European discursive frameworks. Lambo's success in such endeavors resulted in him gaining positions of great responsibility nationally in Nigeria and in global health governance through his work at the WHO. Lambo's career illustrates the extent to which colonial nationalisms and decolonization processes had the potential to influence, even transform, international scientific agendas, as well as the extent to which international scientific networks had the capacity to reinforce nationalist positions much as they had previously reinforced imperial structures and ideologies. This realization suggests the need for more and deeper research on the historical role that colonial subjects have played in constructing scientific knowledge and networks, both within and beyond imperial contexts, and at various levels: local, national and international.

Notes

1 See, for example, George Basalla, 'The Spread of Western Science', *Science* 15 (1967), 611–21, which provides a model that did for science studies what modernization theory did for development studies. Although Basalla's model has been roundly criticized as oversimplified and deterministic by historians of science, some of its basic tenets are still very discernible in mainstream science studies. For example, David Wade Chambers and Richard Gillespie, 'Locality in the History of Science: Colonial Science, Technoscience, and Indigenous Knowledge', *Osiris* 2 (2001), 221–40, critiques Basalla for his failure to recognize that negotiations of western science with indigenous knowledge systems will be different across space because of local political, economic, and cultural dynamics. The article nevertheless sees 'western' science as something very distinct from 'indigenous knowledge' and, while it recognizes that indigenous

populations appropriate 'western' science for specific, local purposes, it does not allow for indigenous actors to contribute to or influence 'western' scientific knowledge itself.

2 Frantz Fanon, *The Wretched of the Earth*, trans. Constance Farrington (New York: Grove Press, 1978).

3 Kapil Raj, *Relocating Modern Science: Circulation and the Construction of Knowledge in South Asia and Europe, 1650–1900* (Basingstoke, Hamps.: Palgrave Macmillan, 2007), p. 13.

4 At least according to Lambo himself. See T. Adeoye Lambo, 'Further Neuropsychiatric Observations in Nigeria', *British Medical Journal* 2 (1960), 1697.

5 World Health Organization, *Report of the International Pilot Study of Schizophrenia*, Vol. I [hereafter *IPSS*] (Geneva: World Health Organization, 1973).

6 Femi Oyebode, 'Obituary: Thomas Adeoye Lambo, O.B.E.', *Psychiatric Bulletin* 28 (2004), 469.

7 For more on the geographies of science, see David N. Livingstone, *Putting Science in Its Place* (Chicago: University of Chicago Press, 2003).

8 Toyin Falola, *Development Planning and Decolonization in Nigeria* (Gainesville: University of Florida Press, 1996), p. 87.

9 Toyin Falola and Matthew M. Heaton, *A History of Nigeria* (Cambridge: Cambridge University Press, 2008), pp. 146–8.

10 For more on colonial psychiatry as an intellectual endeavor, see Jock McCulloch, *Colonial Psychiatry and 'The African Mind'* (Cambridge: Cambridge University Press, 1995).

11 McCulloch, *Colonial Psychiatry and 'The African Mind'*.

12 Michel Foucault, *Madness and Civilization,* trans. Richard Howard (New York: Vintage Books, 1965).

13 J.C. Carothers, *The African Mind in Health and Disease: A Study in Ethnopsychiatry* (Geneva: World Health Organization, 1953), p. 87.

14 J.C. Carothers, 'Frontal Lobe Function and the African', *Journal of Mental Science* 97 (1951), 46.

15 As discussed in McCulloch, *Colonial Psychiatry*.

16 On colonial asylums in African colonies, see Jonathan Sadowsky, *Imperial Bedlam: Institutions of Madness in Colonial Southwest Nigeria* (Berkeley, CA: University of California Press, 1999); Megan Vaughan, *Curing Their Ills: Colonial Power and African Illness* (Stanford, Calif.: Stanford University Press, 1991), pp. 218–38; Leland V. Bell, *Mental and Social Disorder in Sub-Saharan Africa: The Case of Sierra Leone, 1787–1990* (Westport, Conn.: Greenwood Press, 1991); Julie Parle, 'The Fools on the Hill: The Natal Government Asylum and the Institutionalisation of Insanity in Colonial Natal', *Journal of Natal and Zulu History* 19 (2001), 1–40; Lynette Jackson, *Surfacing Up: Psychiatry and Social Order in Colonial Zimbabwe, 1908–1968* (Ithaca, N.Y.: Cornell University Press, 2005); Richard C. Keller, *Colonial Madness: Psychiatry in French North Africa* (Chicago: University of Chicago Press, 2007); Jean-Michel Begué, 'French Psychiatry in Algeria (1830–1962): From Colonial to Transcultural', *History of Psychiatry* VII (1996), 533–48.

17 For more on colonial asylums in Nigeria, see Sadowsky, *Imperial Bedlam*.

18 Dr. R. Cunyngham Brown, C.B.E., *Report III on the Care and Treatment of Lunatics in the British West African Colonies: Nigeria* (Letchworth, UK: Garden City Press, Ltd., 1938), pp. 47, 49–53.

19 Brown, *Report III on the Care and Treatment of Lunatics in the British West African Colonies*, pp. 54–5.
20 J.C. Carothers, 'A Report on the Psychiatric Services of Nigeria' (1955) Nigerian National Archives, Ibadan, Nigeria [hereafter NNAI] Ministry of Health files [hereafter MH] 59/S.9, p. 18.
21 Carothers, 'A Report on the Psychiatric Services of Nigeria', p. 4.
22 Secretariat, Northern Provinces, Kaduna, to Director of Medical and Sanitary Services, Lagos, 26 August, 1926, NNAI, MH 59, Vol. I, 202.
23 A.M. Gerrard, Acting Permanent Secretary, to Southern Acting Secretary, 27 December 1957, NNAI MH 59/S.11, 113–14.
24 T. Adeoye Lambo, 'The Role of Cultural Factors in Paranoid Psychosis among the Yoruba Tribe', *Journal of Mental Science* 101 (1955), 241.
25 Lambo, 'The Role of Cultural Factors in Paranoid Psychosis among the Yoruba Tribe'.
26 Lambo, 'The Role of Cultural Factors in Paranoid Psychosis among the Yoruba Tribe'.
27 Lambo, 'The Role of Cultural Factors in Paranoid Psychosis among the Yoruba Tribe', p. 245.
28 Joseph M. Hodge, *Triumph of the Expert: Agrarian Doctrines of Development and the Legacies of British Colonialism* (Athens, OH: Ohio University Press, 2007), pp. 126–43.
29 See, for example, Carothers, *The African Mind*, p. 130.
30 Lambo, 'Cultural Factors', p. 251.
31 Lambo, 'Cultural Factors'.
32 Lambo, 'Cultural Factors', p. 260.
33 See also, T. Adeoye Lambo, 'Early Childhood Experience and Adult Personality', in S.H. Irvine and J.T. Sanders (eds) *Cultural Adaptation within Modern Africa* (New York: Teachers College Press, 1972); *idem.*, 'Further Neuropsychiatric Observations'; *idem.*, 'Malignant Anxiety: A Syndrome Associated with Criminal Conduct in Africans', *Journal of Mental Science* 108 (1962), 256–62; *idem.*, 'Neuropsychiatric Observations in the Western Region of Nigeria', *British Medical Journal* 15 (1956), 1388–94; *idem.*, 'Psychiatric Syndromes Associated with Cerebrovascular Disorders in the African', *Journal of Mental Science* 104 (1958), 133–43; *idem.*, 'Schizophrenic and Borderline States', in A.V.S. de Reuck and Ruth Porter (eds) *Transcultural Psychiatry* (Boston: Little Brown, 1965); *idem.*, 'Socioeconomic Changes in Africa and their Implications for Mental Health', in Gordon Wolsteholme and Maeve O'Connor (eds) *Man in Africa* (Boston: Little Brown, 1965); *idem.*, 'Some Unusual Features of Schizophrenia among Primitive Peoples', *West African Medical Journal* 1 (1957), 147–52.
34 T. Adeoye Lambo, 'Patterns of Psychiatric Care in Developing African Countries', in Ari Kiev (ed.) *Magic, Faith, and Healing: Studies in Primitive Psychiatry Today* (New York: Free Press of Glencoe, 1964), pp. 449–50. For more on Aro Village, see T. Adeoye Lambo, 'A Form of Social Psychiatry in Africa', *World Mental Health* 13 (1960), 190–203; *idem.*, 'Afuko and Ibarapa', *Lancet* 1 (1965), 307–8; *idem.*, 'The Village of Aro', *Lancet* 2 (1964), 513–14; T. Asuni, 'Aro Hospital in Perspective', *American Journal of Psychiatry* 124, No. 6 (1967), 763–70.
35 Although he gives no figures for this. See Lambo, 'Further Neuropsychiatric Observations', p. 1697.

36 T. Adeoye Lambo, 'Important Areas of Ignorance and Doubt in the Psychology of the African', in Lalage Bown and Michael Crowder (eds) *The Proceedings of the First International Congress of Africanists* (Evanston, IL: Northwestern University Press, 1964).
37 Oyebode, 'Obituary'.
38 McCulloch, *Colonial Psychiatry*.
39 Carothers, *African Mind*.
40 Matthew M. Heaton, 'Stark Roving Mad: The Repatriation of Nigerian Mental Patients and the Global Construction of Mental Illness, 1906–1960' (PhD diss., University of Texas at Austin, 2008).
41 For more on the construction, expansion, and tensions between networks in the British Empire, see Alan Lester, 'Imperial Circuits and Networks: Geographies of the British Empire', *History Compass* 4, 1 (2006), 124–41.
42 T.A. Lambo, *A Study of Social and Health Problems of Nigerian Students in Great Britain* (unpublished, 1957).
43 T.A. Lambo (ed.) *First Pan-African Psychiatric Conference, Abeokuta, Nigeria* (Ibadan: Government Printer, 1961).
44 Ben Park, *The Healers of Aro,* 16mm film (New York: United Nations, 1960), cited in Sadowsky, *Imperial Bedlam*.
45 Alexander H. Leighton, T. Adeoye Lambo, Charles C. Hughes, Dorothea C. Leighton, Jane M. Murphy, and David B. Macklin, *Psychiatric Disorder among the Yoruba* (Ithaca, NY: Cornell University Press, 1963).
46 WHO, *IPSS*.
47 Leighton et al., *Psychiatric Disorder,* p. 177.
48 Leighton et al., *Psychiatric Disorder,* p. 279.
49 Leighton et al., *Psychiatric Disorder,* p. 274.
50 Leighton et al., *Psychiatric Disorder*.
51 Leighton et al., *Psychiatric Disorder*.
52 WHO, *IPSS*, pp. 3–4.
53 WHO, *IPSS*, p. 396.
54 WHO, *IPSS*.
55 Lambo, 'Some Unusual Features'.
56 See, Hodge, *Triumph of the Expert*, pp. 256–62; and Jennifer Gold's chapter in this volume.
57 Livingstone, *Putting Science in its Place*, pp. 135–78.
58 Frederick Cooper and Ann Laura Stoler (eds) *Tensions of Empire: Colonial Cultures in a Bourgeois World* (Berkeley: University of California Press, 1997), pp. 1–56.

14
The Reconfiguration of Scientific Career Networks in the Late Colonial Period: The Case of the Food and Agriculture Organization and the British Colonial Forestry Service

Jennifer Gold

> Sir.–Your article of September 5 appears to reveal a paradox. Your Correspondent refers to the relative difficulties of readaptation on their return to England of tropical specialists such as doctors, nurses, engineers, agricultural and forestry experts. But it is just these skills which are most needed in the newly independent countries.
>
> ('Letter to the Editor', *The Times,* 10 September 1963)[1]

D.A. Low's and John Lonsdale's depiction of late imperial reform as marking a 'Second Colonial Occupation' has been recurrently invoked to describe – indeed has become shorthand for – the expansion and technocratic focus of H.M. Overseas Civil Service (HMOCS) in the late 1940s and 1950s.[2] Moreover, scholars now talk of a 'third colonial occupation' to denote the subsequent influx into newly independent states of 'a new team of technocrats in the form of consultants' employed within the international development industry.[3] Far from constituting a discrete transition, however, the administrative and intellectual continuities that traversed these phases have spawned a number of recent theoretical and prosopographical studies focusing on individuals whose careers encompassed both colonial service and international development work.[4] Whereas these studies provide valuable insight into the institutional and scientific legacies of empire, this chapter inverts this historical frame of analysis, examining the way in which the nominal 'third colonial occupation' was deeply embedded in a distinctive and highly politicized reconfiguration of professional networks during the late colonial period.

In this chapter I argue that the career trajectories of British colonial scientists were entwined in complex issues of sovereignty, governance and international geopolitics, even before the end of formal empire. Specifically, I scrutinize the fears articulated by Colonial Office officials in the 1950s regarding the potential loss of HMOCS scientists to the staff of international organizations. In a decade characterized by the 'proliferation of multilateralism as the basic form of institutional development',[5] there was not only a significant increase in the interaction between United Nations agencies and crown colony technical departments, but also, as a result of severe shortages of natural resource specialists, considerable inter-institutional friction concerning the mobility and alleged 'poaching' of colonial scientists.

The deliberate focus here is on tensions between the Colonial Office and the Food and Agriculture Organization of the United Nations (FAO) in relation to British colonial foresters. Postwar forestry networks, as Peter Vandergeest and Nancy Peluso have observed, were being 'reconstituted even while colonial empires were dissolved' through a growing international nexus of forestry activities coordinated by the FAO.[6] Of all the UN agencies, it was the FAO that maintained the closest working ties with British colonial territories. The Organization's region-based approach to implementing its international mandate entailed the establishment of regional offices, commissions and conferences that incorporated or liaised with nearby colonies.[7] The FAO also received the largest share of centralized UN technical assistance funds during the 1950s – funds to which colonial administrations were eligible to apply.[8]

It was against this background that the Colonial Forest Service (CFS) – the branch of HMOCS concerned with the scientific management and utilization of crown colony timber resources – became a locus of governmental concern over the sustainability of the 'Second Colonial Occupation'. Whilst it was not uncommon for CFS personnel to be loaned to the FAO on secondment or indeed to undertake consultancy work for the agency upon retirement, Colonial Office bureaucrats expressed increasing anxieties during the 1950s over the premature loss of CFS officers to the FAO.[9] It was deemed that growing inter-institutional contact was exposing serving forest officers to the Organization's recruitment network in problematic ways. As Colonial Office Assistant Secretary, James W. Vernon, reflected in 1956:

> F.A.O. has many people travelling around these days and many of our technical people go to F.A.O. conferences so that the opportunities for an informal discussion about the possibilities of employment are

> legion. It would, therefore, in practice be very difficult to stop F.A.O.'s own technical experts making such informal approaches when they see a U.K. expert likely to be suitable for an F.A.O. vacancy.[10]

This chapter interweaves complimentary 'top-down' and 'bottom-up' perspectives as a means of understanding the implications of this late colonial reconfiguration of career networks. After outlining the nature of growing postwar contact between FAO and CFS personnel, I analyze the discursive framing of Colonial Office protests to the FAO over alleged attempts at 'poaching' serving forest officers. The remainder of the chapter juxtaposes this framing with the lived experiences of practitioners involved. As such, the ensuing two sections provide a dual institutional perspective, examining the way in which the mechanics of the FAO's recruitment operations inadvertently exacerbated Colonial Office anxieties over British manpower shortages. The penultimate section demonstrates that colonial bureaucrats laid undue emphasis on the need to contain FAO recruitment networks, attributing insufficient agency to the extensive networking activities of CFS scientists themselves. The final part of this chapter offers a microlevel perspective, drawing together the complex mechanisms underpinning alleged instances of 'poaching'. It focuses on the two most substantive forums for postwar inter-institutional contact, namely conferences and technical assistance projects and offers a grassroots perspective on the way in which this interaction shaped career trajectories. I wish to demonstrate here, that while Colonial Office complaints concerning the loss of manpower to the FAO over-inflated both the extent of the problem and the degree to which the FAO was at fault, they serve as an index of wider anxieties over imperial decline.

The nature of postwar interaction

The need for British governmental cooperation with international agencies in the development of colonial territories was prescribed by Article 73(d) of the UN Charter. The external intervention in colonial affairs this entailed was, however, by no means the 'unqualified nuisance' sometimes posited by scholars.[11] As John McCracken and Lawrence Dritsas have shown, the postwar period witnessed a substantial increase in colonial administrations receiving technical expert assistance from external agencies.[12] By the mid 1950s the FAO was offering significant assistance through funds supplied by the UN Expanded Program of Technical Assistance. Whilst the Colonial Office resisted suspected attempts by territories to use FAO experts as a means of alleviating general manpower shortages,[13] applications were encouraged where the specialist skills required were unobtainable from either the UK or another colony.[14] In the case of forestry, this was overwhelmingly in the areas of forest economics and timber utilization.

Extra-imperial contact was also extended through the proliferation of international, regional and specialist forestry meetings organized or sponsored by the FAO. As problems such as watershed management, soil erosion and tree disease transcended political boundaries, forestry departments sent representatives to international and regional policy coordination meetings, albeit with factors such as geographical distance and local finances mediating the extent of participation. Colonial territories also utilized the FAO's specialist forestry workshops and study tours in support of their expanding research activities and the drive towards scientific specialization in CFS posts.[15]

Aside from instrumentalism, the symbolism of such international agency assistance was seized upon as a means of legitimizing colonial policy. Domestically, publicizing the FAO's contribution to the development of overseas territories was judged to be a convenient way of boosting public support and ameliorating humanitarian criticism. As a Whitehall report on British-based publicity on the FAO concluded in 1954:

> Through the U.K.'s membership of F.A.O. the Colonial Territories receive much valuable technical assistance. Criticism in this country of the U.K.'s alleged lack of help to these territories can be effectively countered by publicity about the Expanded Technical Assistance Programme, in which F.A.O. plays a large part.[16]

Moreover, with FAO staff comprising part of an international civil service under the UN system, their cosmopolitan identities stood at least partially detached from the impedimenta of colonial self-interest. Even early discussions on the so-called 'Second Colonial Occupation' were shaped by the belief that utilizing extra-imperial assistance both offered the appearance of impartiality and underscored imperial benevolence. 'I cannot sufficiently often repeat', stressed a Colonial Office official in 1947, 'that if we really mean what we say about developing the Colonies for their own good, we ought to be willing to call on technical skill from any part of the world which may be available to help in the process. Otherwise we are in grave danger of it being thought that our enthusiasm arises only from the prospect of more jobs for British people'.[17]

Postwar British imperialism, therefore, derived considerable practical and symbolic benefit from contact with the FAO. The Organization's international mandate did not constitute a challenge to imperial governance *per se*. Indeed, the FAO accommodated the status quo of international geopolitics through attributing to imperial powers the responsibility for colonial development. Yet despite these assurances, the FAO's ties with colonial territories heightened governmental concerns over the sustainability of staffing late colonial administrations.

The scalar politics of colonial manpower

The 1950s were repeatedly punctuated by Colonial Office complaints to the FAO that the Organization had attempted to poach serving British officers. Such protests largely focused on informal inquiries made to HMOCS personnel by FAO staff with whom they had forged connections through officially sanctioned work. One of the earliest of these complaints concerned an approach made to William Gordon of the British Guiana Forest Department in 1953. In the following protest note sent via the Foreign Office, officials chided:

> Her Majesty's Government are disturbed at this direct approach by the Organisation to a serving officer. As has been made clear unofficially on several occasions, Her Majesty's Government are perfectly ready to consider requests for the services of members of the Colonial Service provided that such requests are channelled through the Secretary of State for the Colonies.[18]

This rhetoric elicits the extent to which the Colonial Office's view was inflected by particular geographical conceptions of sovereignty. British policy during the early 1950s, as David Goldsworthy has noted, consistently sought to designate colonial affairs a matter of '*domestic jurisdiction*, from which the UN was excluded under Article 2(7)' of its Charter.[19] In this instance, direct approaches to Service personnel by FAO were charted as a violation of British imperial sovereignty. Officials made discursive recourse to the jurisdictional boundaries of international law, asserting the exclusive territorial sovereignty of colonial administrations and a hierarchical structure of communications that international agencies should follow. 'The strict position in international law', as Colonial Office Assistant Secretary, J.W. Vernon concluded, 'is that F.A.O., as an international organisation, may only contact our dependent territories officially through H.M.G. […] we must be consistent about this and ask in all cases about employing colonial government officials they should come through us'.[20]

The deployment of this scalar defense of imperial sovereignty resonates with recent critiques of the 'new imperial history' that challenge the valorization of networks over the epistemological realities of scale.[21] While a networked understanding of imperial spatiality helps unsettle reified distinctions of metropole – periphery and international – national, there remains a tendency to marginalize the extent to which scale, 'as a way of seeing, thinking, and organizing knowledge about the world', provided a powerful framing device for imperial actors.[22] Scalar thought, as political theorist Engin Isin notes, 'arises from the will to regulate, control, govern and thus capture the infinite varieties of flow through space'.[23] It was precisely this determination to delimit the flow of networks of personal connection through imperial space that structured Colonial Office discourse.

Formally, FAO recruitment protocol adhered to this scalar imaginary. Section 8.6 of the Organization's in-house *Correspondence Directory* detailed the bureaucratic procedure concerning 'the recruitment of officials of dependent territories of the U.K'. Attributing exclusive territorial sovereignty to colonial administrations, it prescribed that approach letters to serving expatriates be routed through the Chief Secretary of the colonial government concerned, with facsimiles sent to London. Only once official clearance was obtained could a formal approach be made to a potential recruit.[24]

However, it was over the FAO's more opaque practice of making direct but *informal* inquiries to serving British officers that tensions arose with the Colonial Office. Effectively amounting to the clarification of availability and interest from potential candidates, such inquiries were sanctioned by the FAO's directorate on the basis of administrative efficiency and the proviso 'that they represent in no way an offer of employment'.[25] Within the Colonial Office such inquiries were tantamount to 'poaching' as officials extended arguments of imperial sovereignty to the private correspondence of Service employees. The approach made to William Gordon was a case in point. A specialist in forest law, he was contacted by the FAO's Forestry Division in 1953, inquiring: 'Although we have at present no definite assignment to offer you, an occasion may arise when your experience in this and connected fields would be of great help to us, and I am glad to understand that you would be willing to cooperate with our Organisation, whether in Technical Assistance or as a temporary consultant'.[26] To Colonial Office bureaucrats such an approach 'even when, as in this case, the request is of a preliminary kind' violated international law.[27]

While ‘poaching’ remained a persistent concern of Colonial Office officials during the 1950s, there was a distinctive shift in the discursive framing of these concerns towards the end of the decade. The specter of accelerated decolonization across British Africa increasingly rendered appeals to respect imperial sovereignty both practically and morally redundant. In its place, developmentalism provided an alternative, politically expedient rhetorical framework – a platform on which to project the common purpose of imperialism and international development, pointing to the futility, even recklessness, of the FAO’s actions. Crown colonies were posited as emergent nation-states in a world of interdependence, assisted towards self-government through the technical assistance efforts of HMOCS personnel. Thus, rather than violating international law, unsanctioned approaches to serving personnel were represented as a form of futile, ‘zero-sum competition’ that was counterintuitive to the developmentalist imperatives of global maximization enshrined in the FAO constitution.[28] ‘British officers serving in under-developed countries, whether dependent or independent’, a Colonial Office official reasoned in 1961,

> are already engaged in a form of technical assistance. Their services are required by the countries concerned. If the United Nations induces them to leave in order to go to some other under-developed country there will be no net gain to under-developed countries generally. It will simply be a case of filling a hole by creating one elsewhere.[29]

This reframing of expatriate forest officers from sovereign subjects to global technical assistance specialists allowed for the continued insistence that the FAO use official channels of communication when contacting serving personnel. Observing these communication channels was now posited as a means of ensuring the most efficient allocation of a finite global resource. Yet despite the power of this discursive strategy, tensions over recruitment would continue throughout this period. The following two sections provide a dual institutional perspective, analyzing the mechanics of the FAO’s recruitment operations and the extent to which inter-institutional tension was a particular consequence of *mutual* concerns regarding the availability of technical specialists. Crucially, I show that while the FAO’s recruitment operations inadvertently exacerbated governmental anxieties of imperial decline, Colonial Office complaints over-inflated both the degree of manpower loss and the extent to which the FAO was at fault.

FAO recruitment operations

Problems of procurement constituted 'a handicap of impressive proportions' to the FAO, fundamentally shaping its recruitment operations.[30] By the early 1960s, its field program had expanded to become the central focus of the Organization's work – growing under receipt of resources from the UN's Expanded Program of Technical Assistance (1950) and the United Nations Special Fund (1960).[31] The consequent pressure this demand for specialists exerted upon the agency's recruitment machinery was exacerbated by limitations in available sources of supply. As Karl Olsen, Chief of the FAO's Field Operations and Liaison Service, summed up the difficult recruitment climate in 1958:

> Apart from an early retirement age in some countries bringing technicians on to the market, and apart from former employees of colonial services continuing to be available, the [field] program must continue to operate largely with men 'borrowed' from universities, national civil services and from the business world. [...] The facts are that we recruit in a world market under highly competitive conditions. The number of experts available to us is small.[32]

These problems help explain the decentralized, networked-based system of recruitment adopted by the FAO that so aggrieved the Colonial Office. Thus, while mediums such as advertising were used to a limited extent, recruitment procedure largely reflected a strategy of locating experts through the socio-cognitive networks of FAO employees.[33] 'The number of experts needed', stated a senior FAO official in 1960, 'makes it necessary that we should take advantage of the knowledge and experience of the entire technical staff'.[34] Technical divisions and departments at headquarters in Rome were consequently afforded considerable autonomy in the granting of appointments – the assumption being that those most familiar with the technical requirements of a vacancy might personally know potential candidates or could utilize professional connections in locating suitably qualified individuals. Similarly, although formal approaches to potential recruits were restricted to headquarters staff, all staff – whether stationed in the secretariat or field – were authorized to conduct informal inquiries or 'soundings out'.[35]

It was this decentralized approach that jarred with the scalar thinking of Colonial Office officials. Not only did it leave the FAO with little means of regulating breaches in recruitment protocol – 'the effective and the ineffective are left to their own conscience and device', Karl

Olsen conceded in 1958 – but it constituted the antithesis of the hierarchical approach to recruitment promoted by colonial bureaucrats.[36] It also bypassed the centralized recruitment services offered to international organizations by the International Recruitment Unit of the UK Ministry of Labour. Designed to centrally coordinate and thereby help regulate the appointment of British citizens to international posts, Ministry representatives complained in a 1959 internal report that while there were 'great possibilities of co-operation', the FAO did 'not circulate their job descriptions as in the case with the United Nations and UNESCO, and it is at times difficult to avoid the conviction that when recruiting in this country they are prepared to approach any source except the organisation established for the purpose'.[37]

Rather than utilize the International Recruitment Unit, FAO forestry staff tended to draw instead on the Colonial Office Forestry Adviser and British contacts within a matrix of professional and pedagogic institutions, such as the Commonwealth Forestry Association, Forestry Commission, Commonwealth Forestry Institute, and Forest Products Research Laboratory. Christopher Hankey, Director of the International Recruitment Unit, expressed his frustration in 1961 at the 'constant tendency [...] to recruit on the 'old boy' basis without any reference to us at all'.[38] Yet despite suggestions of nepotism, Egon Glesinger, Director of the FAO Forestry Division from 1959–63 defended the meritocratic credentials of this strategy at a meeting with the Department of Technical Co-operation: 'the F.A.O. did not favour 'blind' recruitment, since it could not afford to appoint junior or second-rate experts, and wherever possible preferred to make personal informal approaches to potential candidates'.[39]

CFS manpower shortages

The nature of FAO's recruitment operations, however, only partially account for the extent of Colonial Office concern over the 'poaching' of colonial scientists. As chapters by Sabine Clarke and Christian Jennings in this volume also indicate, the Colonial Office was facing its own difficulties in recruiting scientists during the latter part of the 1950s. The CFS was no less immune than other branches of HMOCS to these problems. Figure 14.1 illustrates the extent to which forestry vacancies consistently outpaced recruitment between 1955 and 1959. These years were marked by declining application rates that recruitment officials largely attributed to deteriorating career prospects. The shift towards appointment on short-term contract, constitutional change in West Africa and growing political uncertainties in East and Central Africa – historically the most attractive region amongst prospective candidates – were seen to be amongst the contributing deterrents.[40] The resultant shortfall in forest department staffing exacerbated Colonial Office concerns over FAO recruitment. As J.W. Vernon urged the FAO in 1956:

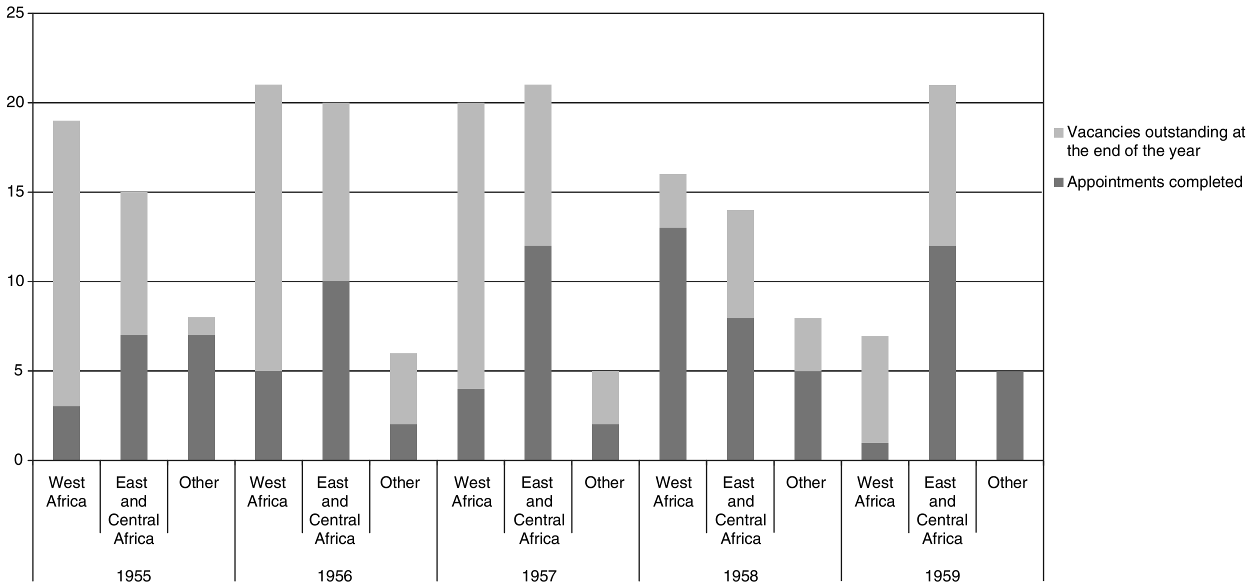
> We do feel it would be wrong for F.A.O. at the best of times to go direct to Government servants about their release and not through Government channels, and it becomes particularly important that this should not be done when Governments are understaffed, as so many of our colonial governments are today in respect of Forestry and Agricultural people.[41]

This somewhat precarious staffing situation fueled a diplomatic flashpoint in 1956 following the Colonial Office discovery of direct communications between FAO staff and R.J. Streets, Conservator of Forests in Cyprus. The corresponding reprimand sent to the FAO reflected a growing unease at the impact of recruitment inquiries on the morale of an already overstretched Service. Specific stress was placed on the likelihood of considerable and unnecessary 'disappointment to the officer' of having his request for contractual release without financial penalty subsequently refused by a colonial government at pains to retain experienced staff.[42]

The R.J. Streets case also reflects anxiety over the type of forest officer normally being targeted. FAO technical assistance projects almost exclusively required candidates with extensive field experience or specialist expertise – individuals who were typically in the shortest supply and represented the greatest human capital investment to colonial administrations. The lack of recruitment due to financial stringency in the 1930s followed by its cessation during the Second World War meant forest departments such as that of Cyprus were in a 'jam for senior staff' comparable to R.J. Streets.[43]

Colonial Office concerns regarding the 'poaching' of serving personnel, therefore, were as much a product of heightened anxieties over shortages of colonial manpower as they were over the nature of the FAO's recruitment operations. What is more, difficulties in gathering empirical evidence of 'poaching' fueled a sense of hysteria over the extent of the problem. Officials were continually frustrated in their attempts to uncover the scale of the FAO's direct approaches to HMOCS personnel. A brief internal investigation launched in response to the R.J. Streets case turned up only seven possible cases of 'poaching' indicated through perusal of personal files and recourse to staff memories. The futility of

Figure 14.1 Vacancies and Appointments within the Colonial Forest Service, 1955–9



Source: Compiled from statistics in Oxford University Archives, FR 1/4: Colonial Office report entitled 'Recruitment to the Forestry Branch of the Overseas Civil Service', submitted to the Commonwealth Forestry Institute Advisory Committee for Forestry, 24 May 1960.

drawing any conclusions was patently clear to its lead investigator: 'There may be cases of FAO approaching an officer informally and obtaining a refusal of services. We should not know of these unless the officer concerned happened to mention it to e.g. an Adviser on tour'.[44] Equally, detection of successful approaches principally relied on formal approach letters from the FAO making ad hoc reference to existing knowledge of a serving officer's interest in a post. These investigative constraints contributed to a sense of paranoia that those direct approaches detected were merely the tip of the iceberg. The very nature of such investigations also laid undue emphasis on the need to contain FAO recruitment networks while rarely attributing sufficient agency to HMOCS scientists themselves.

Personal networks

Although often overlooked by Colonial Office bureaucrats, alleged instances of 'poaching' were not always initiated by FAO staff. CFS members frequently utilized personal networks as a means of facilitating their transfer to an international civil service. Indeed upon investigation, the R.J. Streets case was concluded to be the outcome of inquires the officer himself had initiated with personal contacts at the FAO.[45] In a rare omission of the role of HMOCS networking, a Colonial Office official concluded in 1956: 'I think that F.A.O.'s direct approach to serving forest officers is most objectionable. It will be difficult to stop, however, for the fault may not be entirely on F.A.O.'s side. I suspect there is a good deal of discreet enquiry by forest officers for their prospects in Colonies which are approaching self-government are uncertain'.[46]

Whilst impending constitutional change rarely spelt immediate redundancy for technical branch officers – and indeed from 1960 compensation schemes were actively designed to discourage resignations – many still set about finding alternative employment: 'I could see that one was going to have to change horses some time or other in the next few years and it seemed to me that aged 40 it was going to be easier for me to change sooner rather than later'.[47] With formal bureaucratic channels of assistance essentially restricted to those with agreed terms for departure, personnel wishing to secure postcolonial service appointments prior to offering their resignation were reliant on informal networks of personal connection as their principal investigative outlet.[48] Distance from job markets rendered perusing advertisements, corresponding with potential employers and attending interviews logistically difficult unless it could be combined with periods of home leave. In addition, the securing of references and testimonials constituted a further problem exacerbated by the conditions of colonial employment. As commentary carried in the HMOCS in-house journal, *Corona* surmised:

> Testimonials are rather a problem. [...] Most Colonial Governments have, in their General Orders, some provision for giving them, but the value of these outside the territory may not be very great. It is certainly worth trying to find a way round this difficulty, as a really first class testimonial can be worth a lot in breaking the ice and showing an employer that your application is worth following up.[49]

Networking, therefore, provided a crucial means of acquiring such testimonials, alongside job information and personal introductions or referrals: 'One was aware that one would want another job at times and my father-in-law was very worldly wise and said 'keep up your contacts' [...] I wrote to people [that I considered influential] and said if I need a reference would they give it to me and could they send me any notices of jobs that came their way'.[50]

For those Service members seeking to enter the international development sector, this attention to networking was also a partial function of specific labor market conditions. The predominantly temporary basis of development project work coupled with the institutionalization of network-based recruitment by agencies such as the FAO, necessitated individual commitment to network formation and renewal. This degree of personal responsibility for career management is symptomatic of what has been termed the 'boundaryless' nature of contemporary careers within international development.[51] In contrast to linear career paths through organizational hierarchies (so-called 'bounded careers'), this term denotes career identities independent of specific employers and marked by their peripatetic, non-hierarchical and network-oriented character. With employment prospects in the forestry sector severely limited in the UK during the 1950s and 1960s,[52] the FAO provided a high status, comparatively well paid employment option to pursue, and one with a particular reputation for network-based recruitment: 'FAO was an old-boy outfit and if you knew somebody [...] they'd probably sign you on and it was thus in my case'.[53]

Of course undue emphasis should not be placed on personal networks as equitably shared and progressive assets.[54] The specific composition of social connections, particularly the existence of contacts at FAO's Rome headquarters, had both facilitative and disabling outcomes for individual career trajectories. On the one hand, headquarters contacts represented a range of potential resources, including vacancy information, supporting references and even the capacity to appoint or exert influence on the hiring process. The exclusionary effect of an absence of connections with headquarters staff is palpable in the private correspondence of Jack Thirgood, a research silviculturalist in the Cyprus Forest Department:

> [U]nfortunately although I have several friends in field posts I know no-one on the staff at Rome who could push an application forward. I am afraid I have seen too much of UN personnel to have any illusions as to how the recruiting process operates. [...] In the absence of influential contacts any idea of joining the FAO staff must remain in abeyance although I once had hopes in that direction.[55]

The surviving personal correspondence of staff at Rome headquarters also allows some insight into the assistance they provided to extant and retired HMOCS officers. The records of Fergus Wilson, Chief of the Agricultural Education, Extension and Rural Youth Service at FAO, provide a case in point. Wilson received numerous requests for vacancy information, testimonials and support for forthcoming applications, particularly from officers whose postings in East Africa had overlapped with his previous employment at the University College of East Africa, Makerere. Ex-Uganda officer, R.G. Hampson, for instance, inquired whether Wilson could place him 'in touch with the appointments section of F.A.O.' and 'put a good word in the right quarter'. In response, Wilson took it upon himself to ensure Hampson's Personal History form was 'duly registered, circulated to the appropriate units, and duly filed for future reference in the Personnel Division'.[56]

On the other hand, there was no straightforward relationship between personal contacts in FAO headquarters and assistance with job acquisition. The personal correspondence of Fergus Wilson is also testament to the judgment exercised in responding to employment inquiries from personal contacts – many of whom were simply redirected to more formal channels of inquiry such as the International Recruitment Unit in London.[57] Influenced perhaps by a variety of possible factors including heavy work schedules and knowledge of the specific expertise and professional reputation of inquirers, the provision of assistance by contacts at headquarters was highly contingent.

The socio-cognitive networks of CFS members, therefore, unsettled the hierarchical channels of communication between the FAO and colonial administrations insisted upon by the Colonial Office. Neither colonial governments nor the Colonial Office itself could prevent CFS personnel from utilizing networks as a means of facilitating their transfer to an international civil service, despite guidelines and financial penalties for breaking contracts. The final section of this chapter draws together the various mechanisms underpinning the transfer of CFS personnel to FAO employment discussed above. It offers a microlevel perspective on the reconfiguration of career networks through the insights of practitioners involved, focusing on the two most formative modes of contact between the FAO and CFS personnel, namely FAO technical assistance projects and forestry conferences.

Negotiating career outcomes: technical assistance visits and conferences

1. Technical assistance

The social exigencies that inflect fieldwork have generated sustained interdisciplinary dialogue. Alongside illustrating the complex assemblage of accommodation, transportation and supplies required to negotiate the logistics of expeditionary and field science,[58] studies have focused on recovering the collaborative input of a network of 'invisible technicians'.[59] Imperial expeditionary accounts, as Kuklick and Kohler note, are 'replete with anecdotes of colonial figures offering hospitality and practical assistance', that supplement the less accessible contributions of their indigenous counterparts.[60] These support mechanisms similarly structured HMOCS interactions with FAO technical assistance experts. Indeed, in submitting technical assistance requests to the FAO, colonial administrations were required to provide a detailed account of the infrastructural support they would provide visiting experts.

The East Africa Wood Consumption Survey (1959–61) constitutes a case in point. Conducted by three FAO forest economists, the project involved surveying wood consumption trends and the appraisal of future requirements for Uganda, Tanganyika and Kenya. The household and institutional surveys involved required the assistance of expatriate and local staff across the three colonies. J.E.M. Arnold, the only FAO forest economist to work on the survey across all three East African colonies recalled the survey team's reliance on forest department staff:

> [A]n important part of it was making sure the people in the area that were going to be visited understood why they were going to be visited – a lot were instinctively suspicious. So once everything was

> agreed, forestry department staff would then supervise the actual field visits to make sure nothing went wrong at the field visit stage.[61]

This type of in-situ face-to-face contact opened up employment opportunities for CFS personnel. Firstly, visiting experts were able to directly observe promising candidates for FAO posts. J.E.M. Arnold recalled convincing the Timber Marketing Officer in Tanganyika to join the FAO: 'he was so good that I persuaded him when I went back to FAO [...to come and] do the next timber trends study'.[62] Secondly, field projects often received supervisory and technical support visits from FAO headquarters staff – a practice referred to as 'backstopping' within the Organization.[63] Such visits brought headquarters staff responsible for recruitment into direct contact with the local support network surrounding field projects. As Jack Westoby, Chief of the Forest Economics Branch, recorded of his visit to the East Africa Survey: 'I have just returned from a tour of East Africa and North Africa, where I had the opportunity of discussing the project with Pringle and Arnold, our experts in the field, [...] and with other local personnel who are according advice and assistance in this project'.[64] As early as 1952, FAO officials recognized the recruitment opportunity afforded by this type of visit: 'On occasion a senior official, usually in connexion with other assignments, visits a particular country or countries with a view to discovering other sources of expert personnel'.[65] Finally, for other forest officers, visiting experts offered a means of obtaining personal introductions at FAO headquarters, as in the case of a forest officer from Sarawak whose leave coincided with the FAO expert's debrief period in Rome: 'I had a great lunch with him [and he urged me] to speak to Mr Kennitz. So I did. We talked about inventory work and what it costs and the kind of areas that are covered and then he said, 'would you like to go to Western Samoa?'[66]

2. Conferences

Conferences and meetings constituted a second, albeit highly temporary, forum for cross-institutional interaction. Geographical distance was not synonymous with isolation for colonial foresters, for even within the same forest department, opportunities for conference participation varied significantly with seniority of post and the extent of engagement in active research.[67] As Table 14.1 indicates, participation was largely split between the principally biennial meetings of FAO's regional commissions, which were attended by senior departmental staff, and specialist forestry meetings, attended by research officers.

Table 14.1 Summary of FAO Conferences and Workshops Attended by CFS Members

Year	FAO Conference	Colony
1948	FAO European Conference on Soil Conservation	Cyprus
	Sub-Commission Conference on Mediterranean Forestry	Cyprus
1950	(1st) Asia-Pacific Forestry Commission	N. Borneo, Malaya
	FAO Land Use Meeting (Cyprus)	Cyprus
	FAO Conference on Land & Water Utilisation & Conservation (Amsterdam)	Cyprus
1951	Regional Meeting on Land Utilisation, Asia & Far East	North Borneo
	FAO Near East Regional Conference (Syria)	Cyprus
1952	Asia-Pacific Forestry Commission	Malaya, N. Borneo, Sarawak
	Eucalyptus Study Tour (Australia)	Malaya, Nigeria
	Third session of the Mediterranean Sub-Commission (Istanbul)	Cyprus
	FAO Meeting on Torrent Control & Protection of Avalanches (France)	Cyprus
	Near East Forestry Conference (Jordan)	Cyprus
1954	FAO World Forestry Congress (India)	Fiji, Malaya, Nigeria, Tanganyika, Uganda
	Third Conference on Mechanical Wood Technology	Uganda
	FAO Seminar on Forest Policy for Near East Countries	Cyprus
1955	Asia-Pacific Forestry Commission	Malaya, Sarawak
	Seminar for Forest Research Workers (Dehra Dun)	Malaya
	Latin American Forestry Commission	Trinidad
	Near East Forestry Commission (Iran)	Cyprus
1956	FAO-ECAFE Conference on railway sleeper specifications & supplies	Malaya
	World Eucalyptus Conference	Cyprus
1957	Asia-Pacific Forestry Commission	Sarawak, N. Borneo

Table 14.1 Summary of FAO Conferences and Workshops Attended by CFS Members – *continued*

Year	FAO Conference	Colony
1958	Near East Forestry Commission	Cyprus
1959	European Forestry Commission	Cyprus
	Working Party of Afforestation & Reforestation of the European Forestry Commission (Istanbul)	Cyprus
	Near East Forestry Commission Regional Committee on Forest Research	Cyprus
1960	Forestry Commission for Africa	Nyasaland, Uganda, Tanganyika
	Fifth World Forestry Congress (Seattle)	Cyprus, N. Rhodesia
	Latin America Conifer Seminar and Study Tour (Mexico)	Nyasaland, Uganda, Kenya
1961	Second Eucalypt Conference (Brazil)	Nyasaland
1962	Wood industries Study Tour (Czechoslovakia)	Nyasaland
1963	World Consultation in Tree Breeding and Forest Genetics (Sweden)	N. Rhodesia
1964	FAO Seminar on Tropical Forestry (West Germany)	Mauritius
1965	FAO Regional Conference	N. Rhodesia
1966	World Forestry Congress	British Honduras

Source: Compiled from annual reports of crown colony forest departments. Please note that alongside uneven participation, colonies varied in the degree to which they included listings of conference participation in their annual reports.

Colonies particularly used FAO workshops and study tours to support trials of fast growing exotics, notably eucalyptus and pine.

As sites of momentary co-presence, conferences have been extensively examined for their social networking potential.[68] The capacity for such events to facilitate career opportunities is illustrated by the following testimony from a CFS member from Northern Rhodesia:

> The other person who had been aware of what we were doing in Zambia and liked the look of it was Oscar Fugali in FAO Rome. And I had a note from him saying we are recruiting now and if you're interested in a job in FAO, let me know. [...] That happened at an international conference [...] I had presented a paper or two and had a few things to say.[69]

Whilst the mobility of rank and file personnel engaged in forest management was more confined, many still had some access to conference networking. Opportunities for face-to-face contact were provided through colonial forest departments hosting both FAO sponsored technical meetings and regional forestry commission gatherings. Examples include the Cyprus department hosting a FAO conference on land use in 1950 and the meeting of the Asia-Pacific Forestry Commission in Malaya in 1952.

FAO also sent staff representatives to a number of imperial forestry conferences. One such event stands apart in the extent to which it shaped career outcomes: the 1962 British Commonwealth Forestry Conference in East Africa. Constituting the eighth in a series of largely quinquennial conferences, this 'parliament of imperial forestry' was a forum for Commonwealth wide policy coordination.[70] In their respective surveys of these conferences, environmental historians Ravi Rajan and Joe Powell stress the opportunity these events presented for personal network cultivation.[71] Yet, as Powell concedes, in the absence of 'more detailed research it is only possible to note the chances [these conferences] provided for the initiation and consolidation of influential networking'.[72] By supplementing this analysis with oral historical testimony, however, traces of these networks begin to emerge.

Hosted jointly by the forest departments of Kenya, Uganda and newly independent Tanzania, FAO sent four observers to the 1962 conference. Whilst FAO staff made an open plea during conference proceedings for greater cooperation in providing forest officers on secondment, the conference largely functioned as an informal recruiting ground.[73] As a former CFS officer from Tanzania noted of the conference: 'it was because the Colonial Service was gradually winding down that [...staff from FAO headquarters] knew that there were going to be quite a number of forest officers with tropical experience that would be looking for jobs. So FAO did a little bit of recruiting of which I was one result'.[74]

Beyond the plenary sessions in Nairobi, organizers ran official tours of all three territories conducted both prior to, and as part of, the main conference. These tours provided an opportunity for FAO staff to meet rank and file CFS personnel, evaluate their work in-situ and make recruitment inquiries. Equally, CFS members actively sought to meet touring FAO staff. Michael Philip, for instance, recalled the conference tours around Uganda providing 'a wonderful opportunity to show ourselves off' to FAO delegates.[75] Similarly, Jack Holmes, Head of the Arusha Forest School in Tanzania, recalled British forest officers traveling to intersect the tour party at Arusha after hearing that FAO officials were 'looking and recruiting'.[76] Finally, even for forest department staff who had not previously considered their positions, these tours provided a sudden confrontation with the uncertain realities of impending constitutional change – 'an opportunity for people to face the facts' – and raised awareness of the Organization as a potential employer.[77]

Conclusion: legacy

The socio-cognitive networks forged through interaction between CFS members and FAO staff in the late colonial period jarred with the Colonial Office's desire to delimit the flow of networks of personal connection that traversed imperial space. FAO assistance to British crown colonies simultaneously helped strengthen the 'Second Colonial Occupation' and generated fears of its demise. In an era of progressive decolonization, global shortages of natural resource specialists resulted in the career trajectories of colonial scientists becoming highly politicized. Yet while colonial bureaucrats railed against the FAO for the potentially corrosive impact of their recruitment networks on the staffing of colonial administrations, the lived experiences of rank and file practitioners who personally negotiated the material realities of late imperialism elicit the extent to which serving officers initiated extra-imperial communications. The flow of colonial foresters into FAO employment would only increase with constitutional change. Yet – with Whitehall accusations of the FAO 'poaching' serving personnel resurfacing in the UK's bilateral aid program – the end of formal empire was by no means the end of the inter-institutional frictions generated by recruitment. Continued shortages in the availability of natural resource specialists did nothing to alleviate these tensions.[78] Where once, FAO recruitment practice had played upon Colonial Office anxieties of imperial decline, it continued to serve well into the late 1960s as an index of Britain's waning international political influence.

Notes

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2 D.A. Low and John Lonsdale, 'Towards the New Order, 1945', in D.A. Low and A. Smith (eds) *History of East Africa*, Vol. III (Oxford: Clarendon Press, 1976), pp. 1–63. For a history of the use of this phrase, see Sabine Clarke, 'A Technocratic Imperial State? The Colonial Office and Scientific Research, 1940–1960', *Twentieth Century History* 18 (2007), p. 455, n. 8.
3 This term first appears in Dani W. Nabudere, 'Globalisation, the African Post-Colonial State, Post-Traditionalism, and the New World Order', in Dani W. Nabudere (ed.) *Globalisation and The Post-African State* (Harare: Aaps Books, 2000), p. 36. See also, M. Power, 'The Commonwealth, "Development" and Post-colonial Responsibility', *Geoforum* 40 (2009), 16.
4 See, for example, Uma Kothari, 'From Colonialism to Development: Reflections of Former Colonial Officers', *Commonwealth & Comparative Politics* 44 (2006), 118–36; Joseph M. Hodge 'British Colonial Expertise, Post-Colonial Careering and the Early History of International Development', *Journal of Modern European History* 8, 1 (2010), 24–46.
5 C.A. Miller, 'Democratization, International Knowledge Institutions, and Global Governance', *Governance: An International Journal of Policy, Administration, and Institutions* 20 (2007), 329.
6 P. Vandergeest and N.L. Peluso, 'Empires of Forestry: Professional Forestry and State Power in Southeast Asia, Part 2', *Environment and History* 12 (2006), 369.
7 J.M. Lee, *Colonial Development and Good Government: A Study of the Ideas Expressed by the British Official Classes in Planning Decolonization, 1939–1964* (Oxford: Clarendon Press, 1967), p. 192.
8 Amy L.S. Staples, *The Birth of Development* (Kent: Kent State University Press, 2006), p. 99.
9 See for example, J. Pitt, 'From Africa to Brazil in Forestry', *Corona* (1959), 32–4.
10 J.W. Vernon, Colonial Office, to W.D. Sweaney, Colonial Office, correspondence minute, 4 April 1956, the National Archives, Kew, Colonial Office [hereafter NA CO] 1029/95.
11 See, for example, Ronald Hyam and Wm. Roger Louis, 'Introduction', in Ronald Hyam and Wm. Roger Louis (eds) *The Conservative Government and the End of Empire 1957–1964*, British Documents on the End of Empire, Series A, Vol. 4 (London: HMSO, 2000), p. lxx.
12 John McCracken, 'Experts and Expertise in Colonial Malawi', *African Affairs* 81 (1982), 101–16; Lawrence Dritsas, 'Ecological Reconnaissance: Experts Visit the Central African Federation' (paper presented to the Cabinet of Natural History Seminar Series, Cambridge University, 2007).

13 For example, see rejection of request by the Cyprus Forest Department for a forest management expert and a silviculturist, NA CO/852/1285/6.
14 A.W. Smith, correspondence minute, 16 August 1960, NA CO/1017/611.
15 For accounts of the shift towards specialization in late-colonial science, see the chapter in this volume by Sabine Clarke and Sabine Clarke, 'Experts, Empire and Development: Fundamental Research for the British Colonies, 1940–60' (PhD thesis, University of London, 2005). See also Joseph M. Hodge, *Triumph of the Expert: Agrarian Doctrines of Development and the Legacies of British Colonialism* (Athens: Ohio University Press, 2007).
16 'Report of the Working Party on F.A.O. Publicity in the UK', F.A.O. National Committee for the U.K., October 1954, NA MAF/197/48.
17 Correspondence minute, 1947, author unknown, NA CO/877/31/5.
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22 R. Kaiser and E. Nikiforova, 'The Performativity of Scale: The Social Construction of Scale Effects in Narva, Estonia', *Environment and Planning D: Society and Space* 26 (2008), 538. For an examination of the historically contingent 'scalar debates' that structured interaction between the government of British India and the League of Nations, see S. Legg, 'Of Scales, Networks and Assemblages'.
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31 Food and Agriculture Organization, *FAO: The First 40 Years* (Rome: FAO, 1985), p. 120.

32 Olsen to F.T. Whalen (Deputy Director-General), 30 October 1958, FAO EX/2/2(1).
33 See, for example, FAO advertisement, *Commonwealth Forestry Review* 44 (1965), 255.
34 Internal memorandum by A.H. Boerma (Assistant Director-General, FAO), 22 November 1960, FAO EX/2(1).
35 Internal memorandum by A.H. Boerma (Assistant Director-General, FAO), 22 November 1960, FAO EX/2(1).
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38 C.A. Hankey (DTC) correspondence minute, 13 December 1961, NA OD/8/3.
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41 Letter from J.W. Vernon to K. Olsen, 6 July 1956, NA CO/1029/95.
42 Letter from J.W. Vernon to K. Olsen, 6 July 1956, NA CO/1029/95.
43 R.A. Whittle to J.W. Vernon, correspondence minute, 14 February 1956, NA CO/1029/95.
44 Cornelius (Colonial Office), correspondence minute, 13 March 1956, NA CO/1029/95.
45 Cornelius (Colonial Office), correspondence minute, 13 March 1956, NA CO/1029/95.
46 Correspondence minute, F.S. Collier (Forestry Adviser), 19 April 1956, NA CO/1029/95.
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52 For a review of the UK employment situation for forestry, see R.D.H. Rowe, 'Professional Foresters: Supply and Demand', *Empire Forestry Review* 40 (1961), 210–16.
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54 See for example, M. Gray et al., 'Networks of Exclusion: Job Segmentation and Social Networks in the Knowledge Economy', *Equal Opportunities International* 26 (2007), 144–61. David Lambert and Alan Lester also warn against progressive conceptions of networks in David Lambert and Alan Lester, 'Imperial Spaces, Imperial Subjects', in David Lambert and Alan Lester (eds) *Colonial Lives Across the British Empire* (Cambridge: Cambridge University Press, 2006), pp. 11–12.

55 Letter from J.V. Thirgood to T. Gill, 13 May 1966, Box 9, ITSF Records, Forest History Society Archives.
56 Letter from Hampson to Wilson, 15 June 1970; Letter from Wilson to Hampson, 23 June 1970, RCMS 162/4/1/7.
57 'Food and Agriculture Organisation, Correspondence: Candidates' 1969–70, RCMS 192/4/1/10.
58 K. Richards, 'The Field', in John Agnew and David N. Livingstone (eds) *The Sage Handbook of Geographical Knowledge* (London: Sage, 2010). See also Bruno Latour, *Pandora's Hope: An Essay on the Reality of Science Studies* (Cambridge, MA: Harvard University Press, 1999); Felix Driver, 'Editorial: Field-work in Geography', *Transactions of the Institute of British Geographers* 25 (2000), 267–8.
59 See, for example, Felix Driver, *Geography Militant: Cultures of Exploration* (Oxford: Blackwell, 2001). Steven Shapin first uses the phrase 'invisible technician' in Steven Shapin 'The Invisible Technician', *American Scientist* 77 (1989), 554–62.
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61 Interview with J.E.M. Arnold, Oxford, 12 August 2008.
62 Interview with J.E.M. Arnold, Oxford, 12 August 2008.
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68 See for example, J. Urry 'Social Networks, Travel and Talk', *British Journal of Sociology* 54 (2003), 155–75; H. Bathelt and N.A. Schult, 'Between Luminaries and Meat Grinders: International Trade Fairs as Temporary Clusters', *Regional Studies* 42 (2008), 853–68.
69 Interview with N. Cooling, Bampton, 13 February 2007.
70 Ravi Rajan, *Modernizing Nature: Forestry and Imperial Eco-Development 1800–1950* (Oxford: Oxford University Press, 2006), p. 18.
71 Rajan, *Modernizing Nature*; J.M. Powell, 'Dominion over Palm and Pine: The British Empire Forestry Conferences, 1920–47', *Journal of Historical Geography* 33 (2007), 852–77.
72 Powell, 'Dominion over Palm and Pine', p. 855
73 Commonwealth Forestry Conference Proceedings, 14th Plenary session.
74 Interview with R. Willan, Oxford, 25 July 2006.
75 Interview with Michael Philip, Aboyne, 24 July 2007.
76 Interview with Jack Holmes, Ardrossan, 14 December 2007.
77 Interview Robert Dewar (CFS Nyasaland), Crieff, Scotland, 22 July 2007.
78 See, for example, discussion in Minutes of the 24th meeting of the Advisory Committee for Forestry, 7 July 1966, OUA FR1/11/2.

Epilogue

Michael Worboys

It is great pleasure to reflect on the essays in this collection and to congratulate Joe Hodge and Brett Bennett on bringing together such a high quality and varied set of papers. As someone who is now in their fifth decade of working in the field, I am once again struck by the methodological sophistication and empirical strength of work on science and Empire. Indeed, I want to take as my theme the fact that work in the field has been very much at the cutting-edge historiographically and that this is still too little appreciated within the history of science, technology and medicine community. An inventory of new approaches and methods in the last half century would include, amongst the most important themes, work on: 'sites', 'the practice turn', how knowledge travels, and 'big pictures'. With each of these historians of science and Empire were ahead of the game. However, they did not have much impact on the wider field, nor have they enjoyed recognition. This seems to be for three main reasons. Firstly, they were empirically focused, not least as they were often opening up new research areas and defining subjects and issues. As a consequence, they did not broadcast the innovative character of their work and often it was not set in fashionable Edinburgh School or Latourian terms. Secondly, their work was clearly regarded as marginal by mainstream historians of science, where the 'social turn', for a while at least, led them to focus on the 'society of science', rather than the 'science in society' concerns of most historians of science and Empire. Thirdly, historians of science and Empire have not worked much on the classical natural science disciplines that still dominate the history of science. Indeed, the hierarchy of 'pure' science, down through 'applied' disciplines that has, and still pervades, the scientific community seems to be replicated in the history of science, where there has been little interest in the hybrid knowledges and practices that characterized science in the

Empire. Yet, the potential of work on science and Empire was evident at the Melbourne Conference on 'Scientific Colonialism' in 1981, though its proceedings were not published until 1987.[1] What is interesting in hindsight was, and perhaps still is, the insularity of Anglo-American historians and their lack of awareness of the innovative work of their colleagues in Australia and India, along with their reluctance to acknowledge fully the international, neigh global, character of science in the modern era.

The great shift in the historiography of science in the last quarter of the twentieth century, informed above all by the sociology of scientific knowledge, was the rise of 'context' and the attention given to specific local sites of knowledge production, stabilization, validation and use. A useful summation of these developments is presented in Crosbie Smith's and Jon Agar's collection *Making Space for Science: Territorial Themes in the Shaping of Knowledge*, published in 1998, but emanating from a meeting in 1994.[2] What is surprising given the subject matter and approach is the near absence of discussion of science and Empire, when histories of colonial science were obviously and necessarily about specific sites and spatial relations. There is only one contribution in the Smith and Agar collection that is extra-Euro-American and this makes only cursory reference to the 'large and growing' literature on imperialism and science.[3] Yet, as Hodge and Bennett demonstrate in their introductory essays to this collection, there was already a rich and varied literature on place and space in histories of science and Empire. Moreover, this was not just about single sites, but changing relations between places, and had moved from center-periphery models to thinking in terms of multimodal networks of interactions between sites. An excellent summary and exemplary use of such approaches is Chamber's and Gillespie's article on 'Locality in the History of Science: Colonial Science, Technoscience, and Indigenous Knowledge', which also demonstrates the necessity of locating specific sites in connected networks and of being open to different knowledges.[4] In this volume, John Gascoigne shows how we need to be sensitive to the nature of relations, as the private patronage networks that had dominated colonial science to the mid nineteenth century were displaced by those shaped by the state and professional institutions. Gregory Barton's essay on the development of Albert Howard's methods shows how they were shaped by the specific scientific, technical and cultural context of his location, which was in turn set in the geographies and histories of the Indian independence movement. Similarly, Joseph Hodge's account of late colonial agricultural policy shows the decisive importance of place in the fate of particular schemes, and also illustrates another key area where historians of science and Empire have been particularly innovative, namely, their interest in the physical as well as the social environment. For them, the 'tropics' has not just been a rhetorical and metaphorical category, but also a set of changing physical conditions and material forces. Finally, Tamson Pietsch's essay on J.T. Wilson's develops the notion of a 'sub-imperial space…somewhere between the nation and the world' to characterize the professional networks in which he operated.

Amongst the best works on science and Empire remains Richard Grove's *Green Imperialism*, which as well as making the argument for the colonial origins of modern environmentalism, is also a thoroughly materialist history of interactions between humans and the environment.[5] In detailing how early colonial 'scientists' responded to problems such as deforestation and local climate change, Grove inevitably discussed not just ideas but practices, and in doing so detailed the non-disciplinary or hybrid forms of knowledge and the eclectic practices developed to respond to environmental changes. An early and influential example of this work was Elizabeth Whitcombe's study of irrigation in north-west India published in 1972, where she argued that the material consequences for Indian farmers were at best mixed, and that the work produced by what Rohan de Souza has recently termed 'colonial hydrology', showed signs of hybridity with regard to fields of knowledge, both in theory and practice.[6] The essays by Brett Bennett and Christian Jennings on forestry and fisheries respectively, show these activities to have been hybrids of disciplines and of sciences and technologies. The general lesson here for historians of science is that more attention needs to be given to knowledges and practices beyond the classic natural science disciplines of physics, chemistry and biology; indeed, it is likely that most past science in most of the world, including Europe, involved syntheses of knowledge from different fields and combined theory and practice.[7]

In his Keynote Address to the Three Societies Meeting in Halifax in 2004, James Secord stated that although the central question in the history of science was 'how and why does knowledge circulate?', it was still a topic that was under-studied and under-theorized.[8] In reviewing what has been and might be done, Secord states that 'More promising has been the outpouring of work on imperial and postcolonial science', but the point is unreferenced and undeveloped.[9] Again, and of course, how knowledge circulates and how it spreads and is understood and used have been central to histories of science and Empire. Some of the best examples of this work has been in natural history. Indeed, the greater maturity and sophistication of the field is evident in comparing two studies of Kew Gardens; namely, Lucille Brockway's pioneering study published in 1979, with Richard Drayton's monograph two decades on which was able to draw upon and extend a wider range of theoretical and empirical resources.[10] How knowledge travels is necessarily central to most of the contributions to this volume.

Arguably the first modern 'big picture' history of science was George Basalla's model of the spread of Western science published in 1965. Although usually cited nowadays as a relic of abandoned historiographies, the model was an attempt to say something about science on the global stage and, for a while at least, encouraged others of think 'big' as well. The most enduring alternative has been Roy MacLeod's 'Moving Metropolis', which while putatively an attempt to characterize the successive phases of British imperial and colonial science, encouraged historians of science and Empire to think about nodes and networks, and to be sensitive to the changing character of the natural knowledges and practices over time and across cultures.[11] Work on the development of science, technology and medicine in the Pacific basin in the 1980s was similarly ambitious.[12] You will not be surprised to learn that when Anglo-American historians began to work on big pictures in the early 1990s, their canvases rarely included Empires, the *internationale* of science or global developments.[13] The focus was on long durée histories or revisionist interpretations of key moments in the traditional Eurocentric narrative. Surprisingly, or may be not, when the place of science in the world was mentioned it was often in a Basallaian, diffusionist frame. For example, the Introduction to the special edition of the *British Journal for the History of Science* on 'The Big Picture' in 1994, noted that many authors in the collection pointed to 'the central importance of the decades around 1800 for the sciences, both in Europe and in terms of *their export to other parts of the world*'.[14]

There are no 'big picture' contributions as such in this volume, though many demonstrate the need to consider the 'internationale' of science even in a volume devoted to the British Empire. Sabine Clarke's essay explores how the notion of a cadre of research in fundamental science would develop knowledge and expertise that would be useful across different environments and different colonies.[15] Adrian Howkins and Jennifer Gold both show that at the end of Empire, the history of British colonial science has to considered in a global framework, both with other nation states and the new post-Second World War international organizations.

My charge overall has been that historians of science have largely neglected the historiographical innovations of work on science and Empire, to their detriment and ours, however, the situation with historians of medicine and historians of the social sciences is quite different. Work on colonial, imperial and tropical medicine has been mainstream in the history of medicine since the 1980s and work on race in particular has had a major impact on new genres such as the history of the body.[16] Thus, Matthew Heaton's essay both draws upon and contributes to a rich literature on colonial psychiatry.[17] With the social sciences, it is almost certainly the case that the history of anthropology is more developed, both theoretically and empirically, than any other discipline.[18] That said, histories of science and Empire do mirror mainstream history of science in still largely focusing on the natural sciences. Thus, one area where more work is needed is studies of the social science enterprise that was developed in, and for, the British Empire, and its linkages with the natural science, medicine and technology.

Notes

1 Nathan Reingold and Marc Rothenberg (eds) *Scientific Colonialism: A Cross-cultural Comparison* (Washington, D.C.: Smithsonian Institution Press, 1987).
2 Crosbie Smith and Jon Agar (eds) *Making Space for Science: Territorial Themes in the Shaping of Knowledge* (Basingstoke: Macmillan, 1998).
3 Alix Cooper, 'From the Alps to Egypt (and back again): Dolomieu, Scientific Voyaging, and the Construction of the Field in the Eighteenth Century Natural History', in Smith and Agar, *Making Space*, p. 63.
4 David Wade Chambers and Richard Gillespie, 'Locality in the History of Science: Colonial Science, Technoscience, and Indigenous Knowledge', *Osiris* 15 (2000), 221–40.
5 Richard Grove, *Green Imperialism: Colonial Expansion, Tropical Island Edens, and the Origins of Environmentalism, 1600–1860* (Cambridge: Cambridge University Press, 1995).
6 Elizabeth Whitcombe, *Agrarian Conditions in Northern India: The United Provinces Under British Rule, 1860–1900* (Berkeley: California University Press, 1972); Rohan D'Souza, 'Water in British India: The Making of a "Colonial Hydrology"', *History Compass* 4, 4 (2006), 621–8.
7 John V. Pickstone 'Working Knowledges Before and After circa 1800: Practices and Disciplines in the History of Science, Technology and Medicine', *Isis* 98 (2007), 489–516; *idem., Ways of Knowing A New History of Science, Technology and Medicine* (Manchester: Manchester University Press, 2000).
8 James A. Secord, 'Knowledge in Transit', *Isis* 95 (2004), 654–72.
9 Secord, 'Knowledge in Transit', p. 669.
10 Lucille H. Brockway, *Science and Colonial Expansion* (New York: Academic Press, 1979); Richard Drayton, *Nature's Government: Science, Imperial Britain, and the 'Improvement' of the World* (New Haven: Yale University Press, 2000).
11 Roy MacLeod, 'On Visiting the Moving Metropolis: Reflections on the Architecture of Imperial Science', *Scientific Colonialism: A Cross-Cultural Comparison* 5, 3 (1987), 1–16. Also see, Roy Macleod, 'Passages in Imperial Science: From Empire to Commonwealth', *Journal of World History* 4 (1993), 117–50.

12 Roy MacLeod and Philip F. Rehbock (eds) *Nature in its Greatest Extent: Western Science in the Pacific* (Honolulu: University of Hawai'i Press, 1988).
13 'The Big Picture', *British Journal for the History of Science* 26, No. 4 (December 1993), pp. 26, 387–9.
14 'The Big Picture', p. 388.
15 Also see, Sabine Clarke, 'Pure Science with a Practical Aim: The Meanings of Fundamental Research in Britain, circa 1916–1950', *Isis* 101 (2010), 285–311.
16 Roy MacLeod and Milton Lewis (eds) *Disease, Medicine and Empire: Perspectives on Western Medicine and the Experience of European Expansion* (London, Routledge, 1988); David Arnold (ed.) *Imperial Medicine and Indigenous Societies* (Manchester, Manchester University Press, 1988); Nancy Stepan, *The Idea of Race in Science: Great Britain 1800–1960* (Basingstoke: Macmillan, 1982).
17 Jonathan Sadowsky, *Imperial Bedlam: institutions of Madness in Colonial Southwest Nigeria* (Berkeley: University of California Press, 1999); Sloan Mahone and Megan Vaughan (eds) *Psychiatry and Empire* (Basingstoke: Palgrave Macmillan, 2007); Waltraud Ernst and Bernard Harris (eds) *Race, Science and Medicine* (London: Routledge, 1999).
18 George W. Stocking, Jr., *Victorian Anthropology* (New York: Free Press, 1987); Henrika Kuklick, *The Savage Within: The Social History of British Anthropology, 1885–1945* (Cambridge: Cambridge University Press, 1991); George W. Stocking, Jr. (ed.) *Colonial Situations: Essays in the Contextualization of Ethnographic Knowledge* (Madison, WI: University of Wisconsin Press, 1991); Helen Tilley and Robert J. Gordon (eds) *Ordering Africa: Anthropology, European Imperialism and the Politics of Knowledge* (Manchester: Manchester University Press, 2007).

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