TEMPORALISING NATURE: CHRONOLOGIES OF COLONIAL SPECIES TRANSFER AND ECOLOGICAL CHANGE ACROSS THE INDIAN OCEAN IN THE AGE OF EMPIRE¹

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Abstract

The transfer of plants and animals across the Indian Ocean in the second half of the nineteenth and the early twentieth centuries transformed the environments of Australia, South Asia and Africa substantially. This article analyses the temporal dimension of these transfers. It examines the ways Europeans perceived time in the context of the transfers and investigates how timeframes were shifted to explain the ecological change caused by introduced species. This article argues that plants and animals brought their own temporal agency to the transoceanic transfers and examines the discrepancies between non-human life rhythms and human expectations. It highlights that the transfers often developed in ways Europeans could not predict. Furthermore, this article deals with the question of how to periodise the history of species transfer and ecological networking. By examining the timescapes of species transfer across the Indian Ocean, it aims to develop new perspectives on the problem of ecological imperialism.

Keywords: plant transfers, periodisation, Indian Ocean world, environmental history, non-human life

In the second half of the nineteenth and the early twentieth centuries, thousands of plants and animals were transferred between Australia, Asia and Africa. Cattle, horses and sheep were exchanged between the three continents. Australian trees were exported to Africa and Asia. Camels were brought from the Middle East to Australia. Birds from South Asia were taken to Australia and South Africa.²

1 I am grateful to James Beattie for his comments and suggestions on the manuscript and to Brett M. Bennett for his constructive criticism on my research on ecological networks across the Indian Ocean in the last five years.

2 Ian Parsonson, *The Australian Ark. A history of domesticated animals in Australia* (Collingwood, Vic.: CSIRO Publishing, 1998), doi.org/10.1071/9780643100688; Christopher Lever, *They Dined on Eland. The Story of the Acclimatisation Societies* (London: Quiller Press, 1992); Robin W. Doughty, *The Eucalyptus: A Natural and Commercial History of the Gum Tree* (Baltimore, MD: Johns Hopkins University Press, 2000); Tom L. McKnight, *The Camel in Australia* (Melbourne: Melbourne University Press, 1969).

Landowners, foresters, botanists, merchants, politicians and other interest groups formed a broad coalition that keenly acclimatised plants and animals for economic, scientific and aesthetic reasons. In the age of empire, these species transfers reached unprecedented proportions and changed colonial environments substantially.

In recent years, environmental historians have devoted considerable attention to the transfer of biota and ecological knowledge across the Indian Ocean.³ Most of their studies, however, focus on spatial aspects and deal with the ecological, economic and social impact of these transfers. Although they have grown increasingly interested in temporal aspects and in space–time relations,⁴ the most influential texts about the temporal dimension of ecological change remain on a general level. They examine broad issues, such as, for example, the question of how to relate human-centred time with geological time when dealing with the Anthropocene, or how climate change influences the human awareness of time.⁵ The more specific problem of how to structure the history of transoceanic ecological transfer chronologically has been neglected so far.

This article aims to contribute to filling this gap. It has a relatively narrow time frame and does not offer philosophical reflections about the Anthropocene. It concentrates instead on the temporal dimension of species transfers across the Indian Ocean in the second half of the nineteenth and early twentieth centuries. Most historians agree that this was an age of globalisation and modernisation. Contemporaries witnessed processes of acceleration in many areas of their lives, and international politics aimed to standardise the measurement of time on a global level.⁶ It was a time when

3 See, for example, Haripriya Rangan and Christian Kull, 'The Indian Ocean and the making of outback Australia: An ecocultural odyssey', *Indian Ocean Studies: Cultural Social, and Political Perspectives*, ed. S. Moorthy and A. Jamal (New York: Routledge, 2010), 45–72; James Beattie, *Empire and Environmental Anxiety: Health, Science, Art and Conservation in South Asia and Australasia, 1800–1920* (Basingstoke: Palgrave Macmillan, 2011); Ruth A. Morgan, 'Western Australia in the Indian Ocean world—A land looking west?', *Studies in Western Australian History* 28 (2013): 1–11; David Arnold, 'Globalization and Contingent Colonialism: Towards a Transnational History of "British" India', *Journal of Colonialism and Colonial History* 16, no. 2 (2015), doi.org/10.1353/cch.2015.0019; Brett M. Bennett, *Plantations and protected areas: A global history of forest management* (Cambridge, MA: MIT Press, 2015), doi.org/10.7551/mitpress/9780262029933.001.0001.

4 Libby Robin, 'Histories for Changing Times: Entering the Anthropocene?', *Australian Historical Studies* 44 (2013): 329–40, doi.org/10.1080/1031461X.2013.817455; Deborah R. Coen, *Climate in Motion. Science, Empire, and the Problem of Scale* (Chicago and London: University of Chicago Press, 2018); Brett Bennett, 'A Global History of Species Introduction and Invasion: Reconciling Historical and Ecological Paradigms', in *Environments of Empire. Networks and Agents of Ecological Change*, ed. Ulrike Kirchberger and Brett Bennett (Chapel Hill, NC: University of North Carolina Press, 2020), 224–45; Ruth Morgan, 'Prophecy and Prediction, Forecasting Drought and Famine in British India and the Australian Colonies', *Global Environment* 13, no. 1 (2020): 96–133.

5 Dipesh Chakrabarty, 'Anthropocene Time', *History and Theory* 57, no. 1 (2018): 5–32, doi.org/10.1111/hith.12044; Amitav Gosh, *The Great Derangement: Climate Change and the Unthinkable* (Chicago and London: University of Chicago Press, 2016), doi.org/10.7208/chicago/9780226323176.001.0001.

6 Vanessa Ogle, *The Global Transformation of Time: 1870–1950* (Cambridge, MA: Harvard University Press 2015), doi.org/10.4159/9780674915992.

the transoceanic transfer of species increased.⁷ Notions of global condensation and connectivity played an important role in the European initiatives to transfer plants and animals across the Indian Ocean.

These initiatives were part of a global acclimatisation movement that had a strong basis in Australia but also found much support in South Africa and colonial Asia. Participants from different social and ethnic backgrounds took an interest in the transcontinental exchange of plant and animal species. Botanical gardens, acclimatisation societies, agricultural and horticultural societies, forest departments and colonial governments provided the institutional infrastructures for regular transoceanic transfer.⁸

In the second half of the nineteenth century, botanists and foresters in the colonial services in Australia, South Asia and Africa were the most influential protagonists of these transfer processes across the Indian Ocean. Unlike the large numbers of amateur enthusiasts who participated in the acclimatisation movement, they had studied botany and other scientific disciplines at European universities. As a consequence of nineteenth-century professionalisation and specialisation, ‘naturalists’ and ‘gentleman scholars’ were increasingly replaced by experts for specific disciplines such as botany, forestry, zoology and, at the beginning of the twentieth century, ecology. In the colonies surrounding the Indian Ocean, these university-trained scientists explored the flora and fauna of Australia, Asia and Africa, contributed to discussions about the evolution of species and dealt with theories of acclimatisation. They exchanged information about the results of their research in correspondence and publications, and they sent each other plants and animals, dead and alive. They conducted much of their communication via the botanical gardens and other institutions of science in London, but in the second half of the nineteenth century they also corresponded directly across the Indian Ocean.⁹

7 Bennett, ‘A Global History of Species’.

8 Michael Osborne, ‘Acclimatizing the World: A History of the Paradigmatic Colonial Science’, *Osiris* 15 (2000): 135–51, doi.org/10.1086/649323; Lever, *They Dined on Eland*; Donal P. McCracken, *Gardens of Empire: Botanical Institutions of the Victorian British Empire* (London: Leicester University Press, 1997); Lucile Hunt Brockway, *Science and Colonial Expansion: The Role of the British Royal Botanic Gardens* (New Haven, CT, and London: Yale University Press, 2002); Gregory A. Barton, *Empire Forestry and the Origins of Environmentalism* (Cambridge: Cambridge University Press, 2002), doi.org/10.1017/CBO9780511493621; Beattie, *Empire and Environmental Anxiety*; Bennett, *Plantations*.

9 For the problem of the professionalisation of Victorian science, see, for example, Ruth Barton, “‘Men of Science’: Language, Identity and Professionalization in the Mid-Victorian Scientific Community”, *History of Science* 41 (2003): 73–119, doi.org/10.1177/007327530304100103; for a global history of science in the late nineteenth and early twentieth centuries, see Emily S. Rosenberg, ‘Transnational Currents in a Shrinking World’, in *A World Connecting, 1870–1945*, ed. Emily S. Rosenberg (Cambridge, MA, and London: The Belknap Press of Harvard University Press, 2012), 886–945; for transfers of species across the Indian Ocean, see, for example, Pete Minard, *All Things Harmless, Useful, and Ornamental: Environmental Transformation through Species Acclimatization, from Colonial Australia to the World* (Chapel Hill, NC: University of North Carolina Press, 2019), 47–55.

Some of these scientists had German origins, such as, for example, Ferdinand von Mueller, the government botanist of Victoria and director of the botanic gardens in Melbourne, Dietrich Brandis, the inspector-general and a founding member of the Indian Forest Service, and Richard Schomburgk, the director of the botanic gardens in Adelaide and member of the Forest Board of South Australia. Their views on European imperial expansion were ambivalent. As members of the British colonial service, they explored the natural resources of the non-European world and provided the knowledge that facilitated British imperial rule.¹⁰ Together with British-born foresters and garden directors in South Asia, Australia and Africa, they also criticised the environmental destruction caused by settler imperialism.¹¹ At the same time, however, they cultivated ties to their German homelands, communicated with their German peers and took an interest in German colonial initiatives and in the ecological policies in the German colonies after 1884–85.¹²

The article focuses on this transnational group of German and British scientists who communicated their research on the natural world of Asia, Africa and Australia, exchanged plants and animals and were involved in processes of ecological change in the Indian Ocean region in the second half of the nineteenth and early twentieth centuries. The analysis of concepts of time and temporalities in the context of species transfers across the Indian Ocean is based on the sources these foresters and botanists produced: on their correspondence, their publications, the records of the botanical gardens and forest services, the minutes of forest conferences and meetings of acclimatisation societies, and other texts that deal with the species transfers across the Indian Ocean initiated by this group of scientists.

Narratives of acceleration, condensation and progress played an important role in the texts of these scientists. This article, however, aims to demonstrate that the concepts of time that shaped the species transfers across the Indian Ocean were much more complex than the narrative of globalisation allows. It shows that the transfers were characterised by different forms of temporality, and it deals with this problem from several perspectives. It examines chronological structures and situates key trends and

10 Robert A. Stafford, 'Scientific Exploration and Empire', in *The Oxford History of the British Empire*, vol. III: *The Nineteenth Century*, ed. Andrew N. Porter (Oxford and New York: Oxford University Press, 1999), 294–319, doi.org/10.1093/acprof:oso/9780198205654.003.0014.

11 Richard Grove, *Green Imperialism: Colonial Expansion, Tropical Island Edens and the Origins of Environmentalism, 1600–1860* (Cambridge: Cambridge University Press, 1995); Barton, *Empire Forestry*; S. Ravi Rajan, *Modernizing Nature: Forestry and Imperial Eco-Development 1800–1950* (Oxford and New York: Oxford University Press, 2006); Beattie, *Empire and Environmental Anxiety*; Bennett, *Plantations*.

12 For the role of the German scientists in British imperial expansion, see, for example, R. W. Home, *Science as a German export to nineteenth century Australia* (Working Papers in Australian Studies, 104) (London: Sir Robert Menzies Centre for Australian Studies, University of London, 1995); Ulrike Kirchberger, 'Deutsche Naturwissenschaftler im britischen Empire: die Erforschung der außereuropäischen Welt im Spannungsfeld zwischen deutschem und britischem Imperialismus', *Historische Zeitschrift* 271 (2000): 621–60, doi.org/10.1524/hzhz.2000.271.jg.621; Beattie, *Empire and Environmental Anxiety*, 123–49; Moritz von Brescius, *German Science in the Age of Empire: Enterprise, Opportunity and the Schlagintweit Brothers* (Cambridge: Cambridge University Press, 2019), doi.org/10.1017/9781108579568.

developments on a definite set of timescales. It relates continuities in the transfers to temporal categories that identify discontinuities and breaks. Since the main protagonists of the species transfers across the Indian Ocean were also the pioneers of the Indian Forest Service and, at the same time, keen reporters of environmental destruction, the article will, furthermore, discuss the issue in how far 'modern' environmentalism had its origins in the making of colonial forestry and species transfers in the Indian Ocean region.¹³ However, this article not only examines the chronological structures of species transfers, it also investigates perceptions of time. Emotions about the way time passes, about acceleration and progress, about the speed of biological growth and about the life cycles of introduced species, than the narrative of globalisation allows. The transfers were characterised by different forms of temporality, and the article deals with this problem from several perspectives.

To examine how the life rhythms of plants and animals shaped the species transfers across the Indian Ocean, this article applies concepts of non-human agency from multispecies ethnography and Actor–Network Theory.¹⁴ It emphasises that animals and plants brought their own temporal dynamics to transoceanic transfers, and it analyses how the European scientists who initiated the transfers dealt with the temporal agency of plants and animals. It asks how these scientists reacted when the outcome of the transfers did not coincide with their expectations because introduced plants and animals developed in unintended ways. Examining different temporal dimensions such as chronology, perceptions of time and the temporal agency of non-humans contributes to a better understanding of the history of species transfer and ecological change in colonial contexts.

Chronotopes of ecological imperialism

Europeans created specific space–time relations, chronotopes,¹⁵ when they contextualised their own species transfers across the Indian Ocean with the transfers initiated by Africans, Asians and Indigenous Australians. These other, non-European transfers had a long tradition. Long before European colonisation began, the 'monsoon exchange' brought African plants and animals to Asia and introduced Asian species to Africa.¹⁶ Following Fernand Braudel's classic study on

13 See, for example, Grove, *Green Imperialism*; Barton, *Empire Forestry*; Rajan, *Modernizing Nature*.

14 S. Eben Kirksey and Stefan Helmreich, 'The Emergence of Multispecies Ethnography', *Cultural Anthropology* 25, no. 4 (2010): 545–76, doi.org/10.1111/j.1548-1360.2010.01069.x; Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network-Theory* (Oxford: Oxford University Press, 2007).

15 Michail M. Bachtin, *Chronotopos* (Frankfurt: Suhrkamp, 2008).

16 Haripriya Rangan, Judith Carney and Tim Denham, 'Environmental History of Botanical Exchanges in the Indian Ocean World', *Environment and History* 18, no. 3 (2012): 311–42, doi.org/10.3197/096734012X13400389809256; for an older, but still useful, introduction to the monsoon exchange, see William Kirk, 'The N. E. Monsoon and some Aspects of African History', *Journal of African History* 3, no. 2 (1962): 263–7, doi.org/10.1017/S0021853700003091; more recently, Gwyn Campbell, 'The Indian Ocean World Global Economy in the Context of Human–Environment Interaction, c. 300 BCE–1700', *Global Environment* 13, no. 1 (2020): 31–67.

the Mediterranean, Michael Pearson has argued that the monsoon brought 'deep structure' to Indian Ocean history. It regulated transoceanic exchange and created continuity and repetition over a long period of time.¹⁷

In the second half of the nineteenth and the early twentieth centuries, Africans, Asians and Indigenous Australians continued to engage in species transfers independent of European interactions. At the same time, non-Europeans participated in the species transfers initiated by European colonists. In the early 1860s, for example, Raja Rajendra Mullick, an influential merchant in Kolkata, corresponded and exchanged species with the Acclimatisation Society in Melbourne.¹⁸ Non-Europeans also provided ecological knowledge as local intermediaries and as botanical experts who travelled between colonial gardens and research stations such as Buitenzorg (Bogor) in Java and Amani in German East Africa (Tanzania). The camels introduced to Melbourne from Karachi were accompanied by Muslim cameleers who supervised the camels during the voyage. In short, European scientists relied on non-European ecological knowledge in many ways, both on the local and on the transcontinental level.¹⁹

In spite of such dependency, European scientists conceptualised their transfers as part of European time regimes, which gained in significance in the Indian Ocean region in the second half of the nineteenth century.²⁰ They used European calendars to coordinate the transoceanic shipping of plants and animals, and they perceived themselves as pioneers of Western progress. Scientists often referred to the introduction of the telegraph and steamship, which made communication faster and diminished the time it took to travel across the ocean. In 1864, for example, the members of the Acclimatisation Society in Melbourne celebrated the new steamship line between Melbourne and Kolkata as a milestone on the path of progress. It reduced the duration of the voyage to about one month. This meant

17 Michael Pearson, *The Indian Ocean* (London and New York: Routledge, 2003), 13–26, doi.org/10.4324/9780203414132.

18 Acclimatisation Society, Letter Books Outwards, 1862–63, pp. 206, 369, 444, 492, 493, 506, 581, 594, 707. VPRS 2225/P0000/2. Public Record Office Victoria, Melbourne.

19 Haripriya Rangan, 'Elusive Traces: Baobabs and the African Diaspora in South Asia', *Environment and History* 21 (2015): 103–33, doi.org/10.3197/096734015X14183179969827; James Beattie, 'Dragons Abroad: Chinese Migration and Environmental Change in Australasia', *RCC Perspectives* 2 (2017): 59–68; Ulrike Kirchberger, 'Wie entsteht eine imperiale Infrastruktur? Zum Aufbau der Naturschutzbürokratie in Deutsch-Ostafrika', *Historische Zeitschrift* 291, no. 1 (2010): 58, doi.org/10.1524/hzhz.2010.0033; Haripriya Rangan and Christian Kull, 'The Indian Ocean and the Making of Outback Australia: An Ecocultural Odyssey', in *Indian Ocean Studies: Cultural, Social, and Political Perspectives*, ed. Shanti Moorthy and Ashraf Jamal (New York and Abingdon: Routledge, 2010), 45–72; Moritz von Brescius, 'Humboldt'scher Forscherdrang und britische Kolonialinteressen. Die Indien- und Hochasien-Reise der Brüder Schlagintweit (1854–1858)', in *Über den Himalaya. Die Expedition der Brüder Schlagintweit nach Indien und Zentralasien 1854 bis 1858*, ed. Moritz von Brescius et al. (Cologne: Böhlau Verlag, 2015), 31–88.

20 See, for example, Jürgen Osterhammel, *Die Verwandlung der Welt. Eine Geschichte des 19. Jahrhunderts* (Munich: C. H. Beck, 2009), 84–128, doi.org/10.17104/9783406615016-84; Giordano Nanni, *The Colonisation of Time: Ritual, Routine and Resistance in the British Empire* (Manchester: Manchester University Press, 2012), doi.org/10.7228/manchester/9780719082719.001.0001.

that some plant and animal species could now be transported alive.²¹ Another cause for enthusiasm among the acclimatisation societies and botanical gardens of the Indian Ocean region was the building of the Suez Canal, which seemed to offer new possibilities for transporting species to Europe with greater speed.²²

Applying a teleology that was typical for European colonialism, scientists often placed themselves in the present and shifted non-Europeans back into the past in various ways. They presented themselves as well-connected, technologically advanced experts, whereas non-European forms of ecological knowledge, species transfer and ways to integrate introduced species in indigenous agricultural systems were condemned as primitive and locally confined. They were moved backwards to a distant past, usually to an early stage of human development.²³

While creating a temporal distance from non-European species transfers, the scientists emphasised that their own activities rested on the research of their European predecessors. They developed scientific reference systems that referred to their previous achievements. Often, they named species new to them after their mentors and other father figures, and highlighted their merits in various forms of memorial literature.²⁴ In this way, they created generational patterns that structured species transfers and research about ecological change on the timeline. The scientists perceived themselves to be at the top of a dynasty of European explorers who were involved in the species transfers across the Indian Ocean and who were building on each other's work.

Referring to the teleologies of ecological imperialism was, however, only one way of creating chronotopes of species transfer across the Indian Ocean. European scientists established other temporal parameters, which complicate the idea that they completely identified with the time regimes of imperial rule. Although they often ignored non-European transfers that took place simultaneously with their own transfers, they sometimes highlighted long-term continuities of species transfers in the Indian Ocean world and, in this way, defined timelines that diverged from the racial hierarchies of European imperialism.

21 *The Third Annual Report of the Acclimatisation Society of Victoria* (Melbourne: Wilson & Mackinnon, 1864), 42, 43.

22 George H. K. Thwaites to Joseph Dalton Hooker, Peradeniya, Ceylon, 4 March 1870. DC 162/393–394. Royal Botanic Gardens Kew, Archives; for studies on the problem of live plant transportation, see Luke Keogh, 'The Wardian Case: Environmental histories of a box for moving plants', *Environment and History* 25, no. 2 (2019): 219–44, doi.org/10.3197/096734018X15217309861531; Nigel Rigby, 'The Politics and Pragmatics of Seaborne Plant Transportation, 1769–1805', in *Science and Exploration in the Pacific: European Voyages to the Southern Oceans in the 18th Century*, ed. Margarette Lincoln (Woodbridge: Boydell Press, 1998), 81–100; James Beattie, 'Biota Barons, "Neo-Eurasias" and Indian–New Zealand Informal Eco-Cultural Networks, 1830s–1870s', *Global Environment* 13, no. 1 (2020): 134–65.

23 To give just one of many examples, Mueller pointed out that the 'autochthonous Australians' remained in the 'cruel depths of human culture' in a letter to Rudolph Virchow, 26 October 1887: R. W. Home et al., eds, *Regardsfully Yours: Selected Correspondence of Ferdinand von Mueller*, vol. 3: 1876–1896 (Bern: Peter Lang, 2006), 480.

24 See, for example, Joseph Maiden, *Sir Joseph Banks: The 'Father of Australia'* (Sydney: W. A. Gulick; London: Kegan Paul, 1909), doi.org/10.5962/bhl.title.115949.

European scientists constructed deep times when they placed their own transfers in the tradition of precolonial African–Asian exchanges. In his *Forest Flora of North-West and Central India* of 1874, Brandis, for example, pointed out that the vegetation of these regions was characterised by introduced species. Some of them, he argued, were brought to Northern and Central India more recently, whereas others had been introduced in ancient times and had existed in the region since ‘time immemorial’. On his tours, Brandis observed plants from other parts of India, Burma, Ceylon and Western Asia. He noticed a ‘large number of African and Arabian species’, he identified American trees and shrubs, and he referred to eucalypts, albizias and acacias from Australia. He discussed the existence of what he identified as ancient practices of planting, cutting and using trees before and during colonial times. He not only dealt with the regions that had introduced the trees but also included descriptions of how they were cultivated in their countries of origin.²⁵ In this way, he defined a global context that reached beyond the colonial frame in space and time.

By referring to the antiquity of introduced trees, the scientists, furthermore, established chronotopes that legitimised their own transfers across the Indian Ocean. In 1884, in a publication on the acclimatisation of extratropical plants in Australia, Mueller quoted Brandis, who had stated that the Nepal Cypress in northern India would attain an ‘age of 1,000 years’.²⁶ Mueller created transoceanic coherence by relating the Australian colony of Victoria with northern India as extratropical regions. He assumed that trees that were extremely durable in the one region could, once introduced, reach equal permanence in the other.

Foresters often used the temporal category of ‘time immemorial’ when they referred to trees of a very old age. Colonial historians argue that ‘time immemorial’ was a deliberately vague and inaccurate term, describing a very long time without specification. They claim that it was used to stereotype the history of non-European societies as timeless, primitive and pre-modern, whereas the colonial era was associated with modernity and the precise measurement of time by Western calendars. From their point of view, the category ‘time immemorial’ created two separate time spheres, precolonial indigenous versus colonial.²⁷

For the species transfers across the Indian Ocean, this is true in many respects. European scientists indeed referred to non-European ecological customs such as fire cultivation as having been practised since ‘time immemorial’ in a generalising

25 J. Lindsay Stewart and Dietrich Brandis, *The Forest Flora of North-West and Central India: A Handbook of the Indigenous Trees and Shrubs of those Countries* (London: Wm H. Allen & Co., 1874), viii, doi.org/10.5962/bhl.title.54508.

26 Ferdinand von Mueller, *Select Extra-Tropical Plants. Readily Eligible for Industrial Culture or Naturalization* (Detroit, MI: George S. Davis, 1884), 107.

27 Ann McGrath, ‘Deep Histories in Time, or Crossing the Great Divide’, in *Long History, Deep Time. Deepening Histories of Place*, ed. Ann McGrath and Mary Anne Jebb (Canberra: ANU Press, 2015), pp. 7–11, doi.org/10.22459/LHDT.05.2015.01.

and dismissive way. However, they also developed more differentiated perspectives when they used the phrase. The imperial forester David Hutchins, for example, acknowledged the usefulness of the ancient practice of fire cultivation²⁸ or pointed to Indigenous Australian burning of woods in order to criticise the destruction of nature by settler imperialism: the forest ‘has been ravished by the fires of the blacks from time immemorial and recently by the more severe fires of the whites’.²⁹

Creating deep time by describing ancient practices of forestry and by highlighting the mythical age of trees stood in sharp contrast to the fact that nineteenth-century scientific forestry cultivated the discipline of dendrochronology to precisely measure the age of trees. Referring to ‘time immemorial’ served different purposes and had ambiguous meanings with respect to the time regimes of European imperialism. The foresters created chronotopes that bridged the chronological caesura between precolonial and colonial rather than dividing between two time spheres. Trees which were introduced a very long time ago were described as symbols of eternity. Religious connotations played an important role with respect to European and to non-European forests. Mueller, for example, when he argued in a lecture in 1871 that ancient trees and forests should be preserved, explained that the ‘silent grandeur of a dense forest, before the destructive hand of man defaced it[,] conveys to our mind a feeling as if we were brought more closely before Divine Power’.³⁰

In the political arena, such references to the antiquity of trees and forests could be used to underline demands for state intervention to protect tropical forests in British India and the colonies in Australia and Africa. Whereas in Europe the reforestation of areas where trees had been cut was regarded as part of the planning routine of forest administrations, many scientists were convinced that the ancient tropical forests in the Indian Ocean region could not regenerate themselves. For example, in an 1895 handbook on timber in East Africa that was edited by Adolf Engler, the African traveller and director of the botanical gardens in Berlin, it was argued that, once destroyed, tropical forests were gone forever and could never be grown again in their original state.³¹ References to deep time thus had different and sometimes ambivalent functions in the discourses that contextualised species transfers in imperial settings.

28 David E. Hutchins, *A Discussion of Australian Forestry: With Special Reference to Forestry in Western Australia* (Perth: Fred. Wm Simpson, 1916), 42.

29 Hutchins, *A Discussion of Australian Forestry*, 175.

30 Ferdinand von Mueller, ‘Forest Culture in its Relation to Industrial Pursuits’, *Journal of Applied Science* 27 (1872): 234; for David Hutchins, see Barton, *Empire Forestry*, 121; more generally, Ute Jung-Kaiser, ed., *Der Wald als romantischer Topos. 5. Interdisziplinäres Symposium der Hochschule für Musik und Darstellende Kunst Frankfurt am Main, 2007* (Bern: Peter Lang, 2008); Anna Lewington and Edward Parker, *Ancient Trees: Trees that Live for a Thousand Years* (London: Batsford, 2013).

31 E. Gilg, ‘Die Nutzhölzer Ostafrikas und ihre Verwertung’, in Adolf Engler, *Die Pflanzenwelt Ost-Afrikas und der Nachbargebiete, Theil B* (Berlin: D. Reimer, 1895), 286.

Biochronologies

The self-fashioning of European scientists as modernisers, who implemented faster means of transportation and Western ways to measure time, needs to be questioned in the context of species transfers across the Indian Ocean. Although the decades before the First World War witnessed powerful international initiatives to standardise the measurement of time,³² there still was a large variety of different temporalities that shaped the transfers in the Indian Ocean region. Many societies and cultures around the Indian Ocean used their own calendars, be they Hindu, Muslim or those of other backgrounds. The Arab and Malay trade based on dhow and prahu boats continued in the so-called ‘age of the steamship’.³³

Species transfers crossed various time zones and moved between tropical, moderate and dry climates. Shipping calendars were influenced by the monsoon, both in precolonial and colonial times. Different agricultural systems had different planting and harvesting cycles. It was a matter of complex calculation to decide the best time for sending plants and animals across the ocean. For the transport of living plants in Wardian cases from South Africa to Kolkata, for example, the end of the South African winter in the middle of August was considered to be most suitable as departure time from South Africa. The plants would then arrive in Kolkata at the beginning of the Bengal winter, which seemed to be the most favourable season for the cultivation of introduced plants from South Africa.³⁴ Species exchange between Melbourne and Kolkata required the same complicated timing. However, corresponding about ideal timetables did not mean that the plants and animals could actually be sent off at times that would have been perfect for the acclimatisation of newly arrived species. When, for example, the Agricultural and Horticultural Society of India received seed potatoes from Melbourne in 1880, they were reported to be ‘in excellent sprouting condition’, but they had ‘arrived too early in the season for Bengal’ and had to be ‘distributed to residents at Darjeeling and other hill stations’.³⁵

32 Ogle, *The Global Transformation of Time*; Nanni, *The Colonisation of Time*; Lynn Hunt, *Measuring Time, Making History* (Budapest and New York: Central European University Press, 2008), 10 f.

33 Sugata Bose, *A Hundred Horizons: The Indian Ocean in the Age of Global Empire* (Cambridge, MA and London: Harvard University Press, 2006), 28, doi.org/10.4159/9780674028579; Robin A. Butlin, *Geographies of Empire: European Empires and Colonies c.1880–1960* (Cambridge: Cambridge University Press, 2009), 457–9; more generally on periodisation in the Indian Ocean World, see Sujit Sivasundaram, ‘The Indian Ocean’, in *Oceanic Histories*, ed. David Armitage et al. (Cambridge: Cambridge University Press, 2018), 49–52; Milinda Banerjee, ‘Periodization as Dialectic in a Peasant Discourse from Late Colonial India’, *Chronologies. Periodisation in a Global Context*, chronolog.hypotheses.org/355, accessed 5 January 2020.

34 Notes on certain plants, seeds, and roots from South Africa, by Capt. W. H. Lowther, Bengal Army, in *Journal of the Agricultural and Horticultural Society of India* XII (1861): 180–3.

35 Seed potatoes from Melbourne, Monthly Proceedings of the Society, Thursday, the 22nd July, 1880, xix, AgriHorticultural Society of India, Library, Kolkata.

Furthermore, the transfers across the Indian Ocean were determined by the life cycles of the participating plants and animals. Their biological rhythms rarely coincided with the demands of the transfer processes. During the transoceanic passage, animals often received inadequate food and water. Plants were not properly cared for by crews. The risk that plants and animals that were shipped off alive might die during the voyage was considerable. Animals that survived the passage often became sick and died in their new environment. Plant samples and seeds grew too slowly, too fast or not at all, and could not be used for farming.³⁶

The speed with which introduced species naturalised was a key topic in the discourses that accompanied the transfers. Different interest groups had diverging visions about the ideal speed with which introduced species should grow and multiply. Scientists often highlighted the slowness of adaption when they reported progress to colonial audiences that demanded quick results and an immediate promise of economic success. Acclimatisation, the scientists argued, was a 'very slow and delicate process, and much time must obviously be expended before very decided results can be expected'.³⁷

Scientists had different motives in emphasising the *longue durée* of the adaption process of introduced species. First of all, they had to justify why the expensive transfers showed no immediate results. At the same time, however, references to the slowness of adaption were influenced by nineteenth-century discussions about the evolution of species as a long-term process of continuous micro-changes.³⁸ The scientists who transferred plants and animals across the Indian Ocean were important participants in these debates. When they emphasised the long-term continuities of ecological change, they not only reacted to the temporal dynamics of the introduced species and to the economic expectations of their colonial audiences, they also contributed to ongoing research about the evolution and global distribution of species.

The problem of the slowness of growth rates was particularly central to the discourse about the transfer of Australian trees to Asia and Africa and the subsequent reforestation of areas that had suffered from the cutting of woods and desiccation. High-ranking foresters and botanists in Australia, India and South Africa, such as, for example, R. S. Troup, a member of the Indian Forest Service, highlighted that 'the recovery of the forests from the effects of the drought must of necessity

36 See, for example, Ferdinand von Mueller to the Committee of Management of the Zoological Gardens, Report on the Aviary, 3 February 1859, in *Regardsfully Yours*, ed. Home, 3:441.

37 *The Third Annual Report of the Acclimatisation Society of Victoria*, 30; for a discussion of different acclimatisation theories in the French and British context, see Osborne, 'Acclimatizing the World', 136–40; for the reception of acclimatisation theories in Australia, see Pete Minard, *All Things Harmless, Useful, and Ornamental*, 23–42.

38 Penelope Corfield, *Time and the Shape of History* (New Haven, CT, and London: Yale University Press, 2007), 60, 61.

be slow.³⁹ Other prominent foresters and botanists emphasised the discrepancies between the long-term continuities of forest growth and the hectic nervousness of human expectations. ‘The subject of forest management is a long and broad one’, John Ednie Brown, the Conservator of Forests for South Australia, argued in 1881. It would require ‘a considerable number of years to test the results of any experiments that may be made in it’.⁴⁰ Brown’s successor, Walter Gill, complained in 1893 that the settlers’ short-sighted economic greed would result in:

the suicidal policy of cutting timber too young to secure immediate profits, instead of waiting a proper time for fuller returns from larger timber—a practice often followed as a result of external pressure by those who clamor for prompt returns.⁴¹

Joseph Maiden, the director of the botanic gardens in Sydney, dedicated a section of his 1903 study on sand drift in New South Wales to ‘the element of time’. He emphasised that the reforestation of sand dunes took many decades and criticised ‘some people [who] think plantations may be formed in pure sand and produce merchantable timber in a space of time that experts know to be out of the question’.⁴²

Against the background of general criticism of the slowness of reforestation, forest officials and garden directors praised the Australian eucalypts and acacias for growing extremely quickly. They advocated transfers of Australian species to Africa and Asia by claiming that ‘the rapidity of growth of the blue gum exceeds that of any tree indigenous ... and has been the admiration of all forest officers’.⁴³ In this way, the scientists defined several layers of time that worked at different rates of temporal change. The short-term pace of human planning and the expectation of quick economic returns occurred simultaneously with the longer-lasting life cycles of introduced trees. Different temporalities proceeded simultaneously.⁴⁴ These temporal discrepancies played an important role in the transfers across the Indian Ocean.

39 R. S. Troup, ‘A Note on the Causes and Effects of the Drought of 1907 & 1908 on the Sál Forests of the United Provinces’, *Forest Bulletin* 22 (1913): 16. IOR/V/25/560/47 no. 22. India Office Records, British Library, London.

40 John Ednie Brown, *A Practical Treatise on Tree Culture in South Australia* (Adelaide: E. Spiller, 1881), ix, doi.org/10.5962/bhl.title.57507.

41 Walter Gill, ‘Deforestation in South Australia: Its Causes and Probable Results, Read at the Adelaide Meeting of the Australasian Association for the Advancement of Science, held September, 1893’, 2. Pamphlets Forestry, Vol. 1, No. 9. State Library of South Australia, Adelaide.

42 Joseph Maiden, ‘The Sand-Drift Problem in New South Wales’, *Journal and Proceedings of the Royal Society of New South Wales for 1903* 37 (1903): 92.

43 Madras Forest Report of 1868, quoted by Robert Fyfe Zacharin, *Emigrant Eucalypts: Gum Trees as Exotics* (Melbourne: Melbourne University Press, 1978), 79.

44 Reinhart Kosselleck, *Zeitschichten. Studien zur Historik* (Frankfurt: Suhrkamp, 2000), 9.

Scientists often applied generational patterns to structure the *longue durée* of reforestation and to explain why colonial time regimes and biological growth were not in sync. When Brandis opened the Forest Conference in Simla in 1875, he remarked:

our difficulty is that the result of our work does not show at once, and the mistakes we make in the organisation and the treatment of our forests do not, as a rule, manifest themselves until a generation of foresters has passed away, and the work has gone into the hands of new men who had nothing to do with the framing of the original measures. When a railway is built or a canal made it is not generally long before the main defects of plan and construction manifest themselves; but the effect of a wrong treatment of a forest may not show itself for a long series of years.⁴⁵

Brandis highlighted the diachronic dimensions of forest management by introducing generational layers. Whereas the chronologies of human-made infrastructures coincided with human lifespans, the biochronologies and life rhythms of plants could only be explained by taking a much longer perspective. Contemporaries could not judge the success or failure of reforestation in their own lifetimes but had to leave it to future generations.

When Richard Schomburgk gave a lecture at the Chamber of Commerce in Adelaide in 1878, he made the same point by referring to Greek antiquity:

Ulysses, after a ten years' absence from Troy ... found his aged father in the field planting trees. He asked him why, being now so far advanced in years, he put himself to the fatigue and labor of planting that he was never to enjoy the fruits of? The good old man, taking his son for a stranger, gently replied 'I plant for my son, Ulysses, when he comes home.'⁴⁶

Schomburgk moved the time frame from the present to future generations to show that the temporal dynamics of reforestation diverged from human temporalities and life rhythms.

Colonial scientists appreciated the fast growth of introduced Australian trees because it seemed to synchronise human expectations with the rhythms of nature. However, high growth rates could turn into a problem when introduced plants and animals spread faster than expected. If introduced species had no natural enemies in their new environments, they sometimes began to spread rapidly. One of the best-known examples of an introduced species that multiplied so quickly that colonists felt threatened was the opuntia ('prickly pear'). Originating in South America, the opuntia was introduced to South Africa, Australia and British India at the end of

45 'Report of the Proceedings of the Forest Conference, Simla, Oct. 1875' (Calcutta, 1876), 2, 3. IOR/V/27/560/27. India Office Records, British Library.

46 Richard Schomburgk, 'Forest-Tree Planting and its Influence on Climate. A Paper read at a Meeting at the Chambers of Manufactures, Thursday, June 6th, 1878' (Adelaide, 1878), 7. State Library of South Australia.

the eighteenth century. At first, the plant was popular with the settlers. They used it in their gardens and for agricultural fencing. However, the opuntia soon started spreading on its own with the assistance of birds and other animals that carried its seeds over land and water. When from the middle of the nineteenth century the opuntia grew over riverbeds, valleys and farmlands, colonists perceived it as invasive weed and sought measures to eradicate it.⁴⁷

At the Simla forest conference in 1875, the participants discussed the problem of the rapid growth of the opuntia. Some of the forest officials pointed out that its expansion had reached 'unmanageable dimensions' in some regions and that there was a feeling that the opuntia 'has mastered and not served us'.⁴⁸ The temporal agency of plants and animals resulted in discrepancies between biochronologies and human expectations that undermined the narrative of the scientists as powerful re-creators of colonial landscapes.

Spaces of experience and horizons of expectation

The scientists who moved species across the Indian Ocean were themselves often mobile. In the second half of the nineteenth century, many of them had come to the colonies from Europe. When they left their homes, they gave up old certainties about what the future would bring for them. Had they remained in their places of origin, their futures might have been predictable in certain respects. By emigrating, however, the future was no longer regarded as an extension of the present that could have been anticipated from past experiences. The scientists moved into the unknown. They expected the future to be different from what it might have been had they remained in Europe. They were open to new opportunities and excited about making new scientific discoveries. At the same time, however, they were aware of the risks a new beginning in an unknown social and natural environment would bring.⁴⁹

As Europeans in the age of empire, colonial scientists had a clearly defined vision of how an ideal colonial landscape should look in the future. It was a vision shaped by the academic knowledge they had acquired at European universities and by the stereotypes of the civilising mission. The purpose of species transfers was to 'improve' colonial environments, to make them economically profitable and aesthetically

47 See, for example, William Beinart and Luvuyo Wotshela, *Prickly Pear: The Social History of a Plant in the Eastern Cape* (Johannesburg: Wits University Press, 2011), doi.org/10.18772/22011115300.

48 D. Brandis and A. Smythies, eds, 'Report of the Proceedings of the Forest Conference held at Simla, October 1875' (Calcutta, 1876), 108. IOR/V/27/560/27. India Office Records, British Library.

49 For the anxieties Europeans developed when they encountered unknown landscapes and climates in Asia, Australia and New Zealand, see Beattie, *Empire and Environmental Anxiety*, pp. 4–38.

pleasant. The scientists wanted the species transfers to have an outcome that rose to these expectations. If the plants and animals they introduced contributed to an increase in the quality and quantity of agricultural products, the transfer was regarded as a success. If it turned out that introduced species could not be used to augment economic profit or to enhance the lifestyle of colonial elites, the transfer was judged a failure.⁵⁰

At the same time, however, scientists often pointed out that it was one of the most important aspects of the transfers that their results could not be anticipated. The concept of the 'experiment' was central to the history of colonial species transfer across the Indian Ocean in the nineteenth century. To consider the transfer of plants and animals as an experiment implied that the outcome was open. In the context of an experiment, as, for example, the philosopher Elisabeth Pernkopf shows, knowledge is not gained by following a straightforward line towards an envisioned goal. In an experimental system, categories such as surprise, disappointment, repetition and the unintended are important for acquiring insights that can be considered as 'new'.⁵¹

The species transfers were characterised by tensions between an ambition to create the ideal landscape for European settler colonialism and scientific claims that the results of the transfers could not be predicted. When, for example, in the first half of the nineteenth century, Australian and South African merino sheep were introduced to Madras to improve the quality of locally grown wool, the official records to document the outcome were entitled 'Results of the experimental measures adopted for the improvement of the breed of sheep from the merino reported'.⁵² By emphasising the experimental nature of the transfers, the claim to improve colonial agriculture was turned into a scientific hypothesis that had to be tested. Arguing that this exercise was one of experimentation, the scientists justified outcomes that could be perceived as failures if measured against the expectations of improvement and economic profit.

The unpredictability of species transfer often caused difficulties for acclimatisers. When introduced plants and animals behaved in unanticipated ways, scientists had to cope with pressure from many different sides. The export of Australian eucalypts and acacias, for example, was based on the belief that the qualities of these trees would make them contributors to the civilising mission of improving upon nature. They were praised for growing quickly in dry and hot climates, for bringing shadow to the African deserts, for preventing malaria, and for other virtues that would bring progress to Africa and Asia. Against this background, Mueller, one of the main

50 For the connections between acclimatisation and colonisation in Australia, see, most recently, Minard, *All Things Harmless, Useful, and Ornamental*, 9–22.

51 Elisabeth Pernkopf, *Unerwartetes Erwarten. Zur Rolle des Experimentierens in naturwissenschaftlicher Forschung* (Würzburg: Königshausen & Neumann, 2006).

52 Madras Presidency, 'Purchase of Australian and South African Merino rams by the Madras Government'. IOR/F/4/1937 no. 83784. India Office Records, British Library.

protagonists of the nineteenth-century export of Australian trees to other warm regions of the earth, found it somewhat embarrassing when the success story was questioned by recipients who complained that an insect, the *Icerya purchasi* (cottony cushion scale), travelled on the acacia and caused considerable damage to the citrus plantations of Ceylon, California and other regions where acacias were introduced.⁵³

Mueller defended himself against these accusations by referring to the experimental character of the transfers. He offered scientific explanations to his critics and promised to do more research to keep the ‘mischievous’⁵⁴ insect under control. Furthermore, he exculpated himself by pointing out how difficult it was to locate the origins of the *Icerya purchasi*. He emphasised that the *Icerya* was first observed in Ceylon and Brazil and not in Victoria. ‘Whether the *Icerya* was originally an inhabitant of Victoria or merely immigrated, I will endeavour to ascertain’,⁵⁵ he promised a critical enquirer. Mueller differentiated between two kinds of species. The eucalypts and acacias he exported had their origins in Australia. Their transfer was initiated by Mueller and, as government botanist of an Australian colony, he felt responsible for making their acclimatisation a success. Other species, by contrast, did not seem to have their roots in Australia, and their migratory patterns escaped human influence. For them he felt less willing to take the blame.

From a psychological perspective, his remarks about the doubtful origins of the *Icerya* were meant to explain why the expectations of the civilising mission could not be fulfilled. Species that were clearly identified and classified were perceived as ‘desirable animal colonists’⁵⁶ and as partners in the imperial project. Species without classifiable origins that travelled beyond human control and then damaged the plantation economy earned themselves a different status. At the same time, Mueller’s interests in the origins and global distribution of species were part of the scientific debate about the evolution of species. Therefore, his promise to explore the origins of the *Icerya* can also be read as the professional reaction of a scientist who wanted to contribute to ongoing research in his field of study.

Searching for times and places of origin was important both for the self-fashioning of human migrants and for defining and classifying non-human migration. Organising the migration of plants and animals on a timeline was crucial for the scientists to be able to define their transfers as controllable at a time when they became increasingly

53 Ferdinand von Mueller to Charles Riley, 21 May 1887, in *Regardfully Yours*, ed. Home, 3:469, 470; for the *Icerya purchasi*, see Ian Tyrell, ‘Peripheral Visions: Californian–Australian Environmental Contacts, ca.1850s–1910’, *Journal of World History* 8, no. 2 (1997): 287, doi.org/10.1353/jwh.2005.0072; more comprehensively on the anxieties and insecurities that resulted from the unintended transformations of colonial environments as a consequence of settler imperialism, see Beattie, *Empire and Environmental Anxiety*, 16–18.

54 Ferdinand von Mueller to Charles Riley, 21 May 1887, in *Regardfully Yours*, ed. Home, 3:470.

55 *ibid.*

56 Arthur Nicols, *The Acclimatisation of the Salmonide at the Antipodes: Its History and Results* (London: Sampson Low, 1882), 2, doi.org/10.5962/bhl.title.55640.

aware that the species that they were introducing into new environments developed their own unmanageable dynamics and often did not improve but actually endangered existing ecological systems.

The rhythms of ecological networking across the Indian Ocean

The ecological networks that connected the botanical gardens, forest departments and acclimatisation societies of the Indian Ocean region changed over time. It has never been analysed, however, how exactly this process was taking place and how space–time relations within the networks across the Indian Ocean shifted in the age of empire. All we have are general assumptions that the hierarchies between the centre of imperial botany at the Royal Botanic Gardens, Kew, and the botanists in the colonies declined in significance in the course of the nineteenth century and that polycentric networks between the colonial gardens grew more important.⁵⁷ It is therefore necessary to come to more accurate conclusions about how the networks across the Indian Ocean developed chronologically and how the scientists defined and redefined the space–time relations of the Indian Ocean transfer in the age of empire.

A potential approach to dealing with this problem is to look at the networks of important protagonists of the ecological transfers across the Indian Ocean. This would allow a detailed insight into how the geographic and scientific fields of interest changed within a clearly defined time frame. One of the most influential networkers in late nineteenth-century botany was undoubtedly Mueller. After his arrival in Australia in 1847, he developed a world-encompassing communication network that included contacts with colleagues all over the Indian Ocean world.⁵⁸ Mueller had been interested in the floras of Asia and Africa since the beginnings of his academic career at the University of Kiel. Since the 1850s, he had been involved in transfers of species and other scientific exchanges with the botanical gardens in Singapore, Buitenzorg (Bogor), Mauritius, Peradeniya, Kolkata, Ootacamund and Cape Town, with the horticultural and agricultural societies in Natal and Kolkata,

57 Most recently for the gardens in Singapore, Timothy Barnard, *Nature's Colony: Empire, Nation and Environment in the Singapore Botanic Gardens* (Singapore: NUS Press, 2016), 8; for the complexities of this process of increasing direct intercolonial communication and transfer, the sending of duplicates and other problems, see, for example, James Sykes Gamble to W. Thiselton-Dyer, Simla, 16 May 1877; Dietrich Brandis to Thiselton-Dyer, Simla, June 1877. Miscellaneous Reports, Victoria (MR/412), Royal Botanic Gardens Kew, Archives; Dietrich Brandis to Joseph Hooker, Simla, 22 July 1877. Directors' Correspondence DC/153/118, Royal Botanic Gardens Kew, Archives.

58 R. W. Home et al., eds, *Regardfully Yours: Selected Correspondence of Ferdinand von Mueller*, vol. 2: 1860–1875 (Bern: Peter Lang, 2002), 47–50.

and with the officials of the Indian Forest Service and other colonial forest services. Moreover, as a leading member of the acclimatisation society of Melbourne, he engaged in species transfers with partners in South Africa and Asia.

Many of these exchanges were characterised by continuities. Mueller engaged in transfers with garden directors in the Indian Ocean world on a regular basis. As a seed collector for the government of Natal, he sent seeds of eucalypts to South Africa for over 40 years until his death in 1896.⁵⁹ However, the steady regularity could change its pace under certain circumstances. There were moments of condensation, when contacts intensified, and of relaxation, when mutual interest was low and only few letters and plant samples were exchanged. The International Exhibition in Kolkata in 1883, for example, resulted in a general increase of transfers from Australia to Kolkata when government officials, among them Mueller, aimed to display the natural products of their colonies at the exhibition.⁶⁰

Furthermore, Mueller had a continuing interest in the vegetation of New Guinea. Since the mid-1860s, he advertised the potential of the island in correspondence with his colleagues. In 1865, he suggested to August Petermann, the influential cartographer in Gotha, that Germany should found a colony in New Guinea.⁶¹ In the 1870s, he urged Joseph Hooker that more should be done to explore the 'treasures of the wonderland New Guinea'.⁶² However, his initiatives did not meet with much enthusiasm in either Gotha or Kew at that time. By the mid-1880s, by contrast, when German politics began to direct their attention to New Guinea and the region turned into a burning glass of Anglo-German imperial rivalry, Mueller was able to intensify his efforts to explore its flora and gained funding from Australian sources to organise a number of expeditions.⁶³

In the 1880s, Mueller also developed a keen interest in the tropical vegetation of the north of Australia. Important correspondents during these years included Maurice Holtze and his son. Maurice Holtze was the government gardener of the Palmerston Botanical Gardens from 1878 until 1891, and an experienced traveller in South East Asia. In 1891, his son Nicholas succeeded him as curator of what had become the Darwin Botanical Gardens. In his cooperation with the Holtzes, Mueller eagerly

59 Brett M. Bennett, 'Naturalising Australian Trees in South Africa: Climate, Exotics and Experimentation', in *Rethinking Invasion Ecologies from the Environmental Humanities*, ed. Jodi Frawley and Iain McCalman (London and New York: Routledge, 2014), 200.

60 See, for example, Ferdinand von Mueller to Thomas Wilson, 7 May 1883, in *Regardfully Yours*, ed. Home, 3:313, 314; for the colony of South Australia, see 'Calcutta International Exhibition 1883, Copies of Letters sent by the Commissioners'. GRG44/64. State Records of South Australia, Adelaide.

61 Ferdinand von Mueller to August Petermann, 26 September 1865, in *Die Erforschung Australiens. Der Briefwechsel zwischen August Petermann und Ferdinand von Mueller 1861–1878*, ed. Johannes H. Voigt (Gotha: Justus Perthes Verlag, 1996), 74, 75.

62 Ferdinand von Mueller to Joseph Hooker, 1 December 1871. Correspondence of Ferdinand von Mueller Project. Royal Botanic Gardens Victoria, Library. I am grateful to Professor Roderick W. Home and to Dr Sarah Maroske for granting me access to the digitised collection of Ferdinand von Mueller's letters in the library.

63 *Regardfully Yours*, ed. Home, 3:30–3.

accumulated knowledge about the tropical vegetation of northern Australia. Carried by a wave of enthusiasm, he identified, classified and named a large number of species they sent to him. For Mueller, collaborating with Maurice and Nicholas Holtze on the tropical flora in the north was a clearly marked era in his scientific work. He compiled long lists with species he advertised as ‘new’, or ‘*neu*’ when he corresponded with Maurice Holtze in German. Sometimes the words ‘new’/‘*neu*’ were underlined in his handwritten texts. In numerous publications for a variety of scientific and semi-scientific journals and newspapers he announced ‘new’, ‘hitherto unrecorded’ and ‘undescribed’ species to his readers.⁶⁴

Building on his long-standing interests in the vegetation of South and South East Asia, Mueller began, in his correspondence with Maurice Holtze in the 1880s, to relate the ‘newly discovered’ plants of northern Australia with plants known in South Asia, New Guinea, Java and the Pacific islands in a more specific and precise way than before. He aimed to contribute to nineteenth-century research on global plant distribution and evolutionary biology by investigating whether certain species that could be found both in north Australia and in Asia originated from the same families.⁶⁵

Mueller tried to explain how the species could have been transported across the water between northern Australia and the neighbouring Asian regions without European intervention. He occasionally referred to Malaysians who were involved in species transfers between northern Australia and South East Asia. In doing so, he showed a vague knowledge of the contacts indigenous societies in this region had cultivated across the ocean for a long time.⁶⁶ Another explanation Mueller offered was that ‘migratory birds’ transported seeds across the ocean and, therefore, were responsible for Asian–Australian species transfers and distribution.⁶⁷ Again, he connected research on species transfer with questions of origin and tried to categorise species as native or introduced: ‘In 1855 & 1856 *Oryza* could not have reached the places where I saw it through Malayan advents. If migratory water birds brought it, then we have to regard it as indigenous, for that would apply to many places in South Asia as well.’⁶⁸

64 ‘Descriptions of Plants and Correspondence of Dr. Maurice Holtze and Baron Ferdinand von Mueller’. GRG19/391. State Records of South Australia.

65 *ibid.*: see, for example, Mueller to Nicholas Holtze, 29 January 1893; see also Sara Maroske, ‘Australian and Indian Plants: Making Connexions in Nineteenth-Century Botany’, *Historical Records of Australian Science* 23, no. 2 (2012): 107–19, doi.org/10.1071/HR12013.

66 Regina Ganter, ‘Reconnecting with South-East Asia’, in *Indigenous Mobilities: Across and Beyond the Antipodes*, ed. Rachel Stanfield (Canberra: ANU Press, 2018), 255–79, doi.org/10.22459/IM.06.2018.11; Anthony Reid, ‘Crossing the Great Divide: Australia and Eastern Indonesia’, in *Macassan History and Heritage. Journeys, Encounters and Influence*, ed. Marshall Clark and Sally K. May (Canberra: ANU Press, 2013), 41–53, doi.org/10.22459/MHH.06.2013.03.

67 ‘Descriptions of Plants and Correspondence of Dr. Maurice Holtze and Baron Ferdinand von Mueller’, Mueller to Nicholas Holtze, not dated. GRG19/391. State Records of South Australia.

68 ‘Descriptions of Plants and Correspondence of Dr. Maurice Holtze and Baron Ferdinand von Mueller’, Mueller to Nicholas Holtze, 12 January 1892. GRG19/391. State Records of South Australia; the letter is published in *Regardsfully Yours*, ed. Home, 3:592–3.

In his correspondence with the Holtzes in the 1880s and 1890s, Mueller created a transoceanic spatial unit that connected tropical North Australia with South and South East Asia. He defined this unit as ‘new’, as far as his own research was concerned, and emphasised that the question of how to classify the ‘newly discovered’ species was open to discussion.⁶⁹

The way in which the focal points in Mueller’s network shifted shows how ecological transfers across the Indian Ocean changed in the age of empire and how specific space–time constellations were created in the process of the transfers. To explore such transoceanic dynamics, which have been largely overlooked so far, it is necessary to focus on fine layers of time in limited long-distance time frames. These are just as significant to the explanation of ecological change as the long-term perspective of the Anthropocene.

The origins of ‘modern’ environmentalism

The question of origins and of what could be described as ‘new’ in the context of the global distribution of species and ecological knowledge was not only of interest to scientists in the nineteenth century. For some time now, environmental historians in different regions of the globe have dealt with the problem of where and when the roots of the ‘modern’ environmentalism of the twentieth century can be found. They have come to a variety of conclusions. European historians often argue that the origins of ‘modern’ environmentalism have to be located in the nineteenth-century European Enlightenment and romanticism, and were a reaction to industrialisation and urbanisation.⁷⁰ Historians of the British empire associate a new quality of environmental protection with the making of the Indian Forest Service in the second half of the nineteenth century.⁷¹ A new study now locates the ‘roots of biodiversity science’ in the Caribbean in the first half of the twentieth century.⁷² Historians of early modern European overseas expansion highlight the continuing awareness of environmental destruction in colonial contexts dating from the early modern expansionism until the 1860s.⁷³ Historians in different research contexts thus come to different conclusions about the time and place of the origins of environmentalism. They also seem to have different definitions of the term in its changing relations to economic and scientific interests.

69 ‘Descriptions of Plants and Correspondence of Dr. Maurice Holtze and Baron Ferdinand von Mueller’, Ferdinand von Mueller, Descriptions of two new species of *Eugenia*, Extra print from the *Australasian Journal of Pharmacy* (June 1886). GRG19/391. State Records of South Australia.

70 For an overview, see Engelhard Weigl, ‘Wald und Klima: Ein Mythos aus dem 19. Jahrhundert’, *Humboldt im Netz* 5, no. 9 (2004): 1–20.

71 Barton, *Empire Forestry*.

72 Megan Raby, *American Tropics: The Caribbean Roots of Biodiversity Science* (Chapel Hill, NC: University of North Carolina Press, 2017), doi.org/10.5149/northcarolina/9781469635606.001.0001.

73 Grove, *Green Imperialism*.

This article aims to contribute to the rather disparate state of research by highlighting that the scientists who transferred species across the Indian Ocean played an important role in the making of global environmental discourses and practices. As participants in the species transfers across the Indian Ocean, they developed a specific awareness for environmental change and destruction. Their transoceanic communications were informed by a complex set of different ideas about nature and climate. Traditional European perceptions of nature and long-standing ideas and practices of forest conservation were intertwined with new experiences that the scientists made after having arrived in the Indian Ocean region. The scientists witnessed the destruction of nature on the local level, on their journeys, in their forest districts and when they participated in the acclimatisation of species.

The scientists who were involved in species transfers across the Indian Ocean often wrote about the environmental transformations they observed. The transfer of acacias and eucalypts, for example, took place in the context of wider-reaching controversial discussions about deforestation in the colonial forest services surrounding the Indian Ocean. Demands for state intervention to protect the natural environment in the colonies were part of these discussions. The scientists campaigned for forest administrations in the Australian and African colonies, legislation to protect forests and wildlife, and the creation of reservations to protect flora and fauna in specific regions.⁷⁴

The discussions about deforestation, soil erosion, desiccation and climate warming had a strong emotional quality. James Beattie has demonstrated that environmental anxieties about the destruction of nature by settler imperialism, along with concerns about living in hot climates and tropical diseases, played an important role in the exchanges between South Asia and Australasia.⁷⁵ In the correspondence of the scientists who transferred species across the Indian Ocean, we find such anxieties resulting from the personal experiences that were formed on the local level. These experiences and observations were intertwined with references to publications on climate change that were directed to a wider audience and appealed to such concerns. Some of the scientists who transferred species across the Indian Ocean were inspired by George P. Marsh, an influential American polymath. His book, *Man and Nature*, first published in 1864, argued that deforestation would result in a dramatic change of climate. His vision of the future was apocalyptic. He was

74 See, to give just one example out of a large number of comparable publications, Ferdinand von Mueller, 'Forest Culture in its Relations to Industrial Pursuits', *Journal of Applied Science* 27 (1872).

75 Beattie, *Empire and Environmental Anxiety*.

convinced that deforestation and climate change would eventually make the earth uninhabitable for mankind.⁷⁶ Mueller referred to Marsh, and Brandis corresponded with him.⁷⁷

Awareness of environmental destruction in the context of species transfers across the Indian Ocean had its own specific momentum. Although it had European origins, it was based on different preconditions and on different sets of ecological knowledge than the environmentalism that developed in Europe in the nineteenth century. The question that follows this conclusion is how exactly the environmental awareness in the Indian Ocean region can be related to the environmentalism in Europe, and how its protagonists in both world regions influenced each other in the age of empire that is often described as a time of increasing global communication among experts.⁷⁸

Analysing the chronologies of exchange on the macro level contributes to answering this question. To define thin layers of time helps to build a chronological structure of the transfers circulating in the Indian Ocean region, and it provides us with a differentiated picture of the directions the transfers were taking between the Indian Ocean region and Europe. Organising the transfers chronologically can explain where environmentalist ideas originated, and it can shed new light on the causal connections that shaped the transfers across the Indian Ocean and between the Indian Ocean region and Europe.

Since some of the scientists who initiated the transfers across the Indian Ocean had German origins, one way of answering this question is by directing the focus to the circulations between the German scientists in the Indian Ocean region and their colleagues in Germany. In Germany, the colonial movement began to engage in protecting the natural environment in the African and Pacific colonies from the 1890s. Most historians explain these initiatives from a German-centric perspective. By integrating the discourses in the Indian Ocean region and by contextualising them on the timeline, however, it can be demonstrated that an awareness of environmental problems, in particular of the destruction of tropical forests and of climate change and its consequences, developed slightly earlier in the context of species transfer across the Indian Ocean and that it had an impact on the German colonial movement that should not be neglected.

76 George P. Marsh, *Man and Nature; or, Physical Geography as Modified by Human Action* (New York: Charles Scribner, 1864); for the important role of Marsh in nineteenth-century discourse on climate change, see Brett Bennett and Gregory Barton, 'The enduring link between forest cover and rainfall: A historical perspective on science and policy discussions', *Forest Ecosystems* 5 (December 2018): 3, doi.org/10.1186/s40663-017-0124-9.

77 Ferdinand von Mueller to William Branwhite Clarke, 25 December 1876, in *Regardsfully Yours*, ed. Home, 3:84; David Lowenthal, 'Nature and morality from George Perkins Marsh to the millennium', *Journal of Historical Geography* 26, no. 1 (2000): 4, doi.org/10.1006/jhge.1999.0188.

78 Rosenberg, 'Transnational Currents', 919–59.

The German scientists who engaged in species transfer in the Indian Ocean region were leading protagonists of tropical forest conservation.⁷⁹ Mueller, Brandis and others participated in discourses about environmental destruction in the region and were reporting back to Germany their findings from the 1860s. Their correspondents in Germany, most of them influential scientists, propagated the reports they received from the Indian Ocean region in publications that were relevant to the colonial movement in Germany. For example, Mueller had praised the qualities of Australian trees in his correspondence with scientists in Germany since the 1860s and advocated their transfer to the African deserts.⁸⁰ In these letters, he also promoted the foundation of German colonies in Africa, and he wrote that he had participated in building a forest bureaucracy in Australia together with the German-born Australians Richard Schomburgk and Friedrich Krichauff in the 1870s, at a time when political interest in overseas colonisation and, as a consequence, in ecological interventions in Africa and Asia was very limited in Germany.⁸¹

In the 1880s, Mueller and Brandis corresponded with colleagues in Germany and in the newly established German protectorates in Africa about the transfer of species and about forest protection. Brandis, for example, encouraged German officials and wider German audiences to support the cultivation of Indian bamboo in German East Africa.⁸² The planting of Australian trees in the African colonies was discussed by German colonial officials, and Mueller's initiatives played an important role in these discussions.⁸³ Mueller was also a correspondent of Engler, who, in his publications, referred to the destruction of tropical forests in East Africa in the same dramatic style as Marsh.⁸⁴ In his letters to Ferdinand von Krauss at the Museum of Natural History in Stuttgart, Mueller reported that it had become increasingly difficult to acquire samples and skeletons of indigenous Australian animals to send to colleagues, because they were 'mercilessly destroyed and kicked out of god's creation' by the European settlers.⁸⁵

79 Beattie, *Empire and Environmental Anxiety*, 123–49.

80 For some early examples, see Ferdinand von Mueller to Carl von Martius, 27 August 1867, in *Regardfully Yours*, ed. Home, 2:429; Ferdinand von Mueller to August Petermann, 26 November 1865, in *Die Erforschung Australiens*, ed. Voigt, 75.

81 Ferdinand von Mueller to August Petermann, 26 November 1865, 6 November 1870, 28 February 1872, May 1874, in *Die Erforschung Australiens*, ed. Voigt, 75, 98, 99, 109, 121.

82 Dietrich Brandis, 'Anbau der großen Bambusen in Deutschafrika', *Der Tropenpflanzer* 3 (1899): 440; Dietrich Brandis, 'Zur Bambuskultur in Deutschafrika', *Deutsches Kolonialblatt* 11 (1900): 473–6; 'Separat-Abdruck aus den Sitzungsberichten der Niederrhein. Gesellsch[aft] für Natur- und Heilkunde zu Bonn, 1897, Sitzung vom 1. Februar 1897, Prof. Dr. Brandis spricht über die geographische Verbreitung der Bambusen in Ostindien', 2–4. R 1001/7707. Bundesarchiv Berlin-Lichterfelde.

83 See, for example, H. E. Gast to the Kolonialwirtschaftliche Komitee in Berlin, 3 July 1914. R 1001/7736. Bundesarchiv Berlin-Lichterfelde.

84 E. Gilg, 'Die Nutzhölzer Ostafrikas und ihre Verwertung', in Engler, *Die Pflanzenwelt Ost-Afrikas*, 286.

85 Ferdinand von Mueller to Ferdinand von Krauss, 11 June 1887, in *Regardfully Yours*, ed. Home, 3:471.

The awareness of environmental destruction that developed in the context of the transfers across the Indian Ocean thus had an impact on initiatives for environmental protection in the German colonies. It also contributed to the rising sensitivity for the environmental problems in Africa, Asia and the Pacific world and, as a consequence, to the making of colonial bureaucracies for environmental conservation.

The globalisation of periodisation schemes can thus help to develop new chains of causation. If we give up national, long-term teleologies, such as the paradigm that environmentalism in the nineteenth-century German colonial movement was initiated by developments and traditions within Germany alone, and turn towards short-term global perspectives, we can find new dimensions and new explanations for historical problems that have often been analysed from within a European context only. This article, therefore, not only aims to show that European chronologies and time regimes changed when they were contextualised within the temporal dynamics of non-human participants in the transfers, but, more importantly, that we can explain causal connections and questions of 'origin' in innovative ways if we define global horizons of time.

Conclusion

This article has demonstrated that examining the timescapes of species transfer across the Indian Ocean can enhance our understanding of global environmental history in many ways and therefore deserves further scrutiny. Different aspects of measuring and perceiving time, the conceptualising of present activity with respect to the future and the past, the search for origins in processes of migration and mobility, and the defining of long-term continuities and short-term breaks were significant categories of self-fashioning for the participants in the transfers. At the same time, they are important analytical categories for their historians.

European scientists temporalised species transfers they initiated in different ways. They defined themselves as modernisers and identified their transfers as contributions to Western progress. They shifted space–time relations and moved time frames to legitimise their own transfers with respect to non-European exchanges across the Indian Ocean. In the course of the transfers, however, plants and animals developed their own temporal agency. Their life rhythms and speeds of growth did not always coincide with the expectations of colonial audiences. Introduced plants and animals sometimes spread rapidly and damaged rather than improved colonial agriculture. Scientists lost control over the transfers they had initiated and realised that there were limits to their eco-engineering. At the same time, scientists emphasised that species transfers were to be considered as experiments. In contrast to the civilising mission,

which had a clear destiny, the concept of the experiment implied that the future was open and that the outcome of the transfers could not be predicted. Transfers that the colonists regarded as failed, could be justified and appeared manageable.

Furthermore, this article argues for a more nuanced periodisation and detailed space–time analysis to investigate the temporalities of transcontinental species transfer. Defining fine layers of time shows how regional concentrations within the Indian Ocean arena shifted in the decades before the First World War. It helps to relate long-term processes and continuities to discontinuities and condensations and to identify synchronicities and assynchronicities in the networks.

Analysing chronologies in this way also allows historians to relate Indian Ocean transfers to wider-reaching imperial and global networks. If we apply a narrow time frame and establish fine layers of time across long geographical distances rather than taking the long-term perspective of the Anthropocene in the frame of national history, we can create innovative causal connections on the global scale and come to unconventional conclusions about the motivations, impulses and contexts of the transfer of species and ecological knowledge. Although, for example, it has been carefully examined that German Humboldtians brought their own ideas about environmental conservation to the British colonies and India, the transfer of ideas in the other direction, from the German scientists in the Indian Ocean region back to Germany, has been neglected so far. This article suggests that concerns about ecological destruction that were shaped by the preconditions of exploring the Indian Ocean region have influenced discussions about colonialism and ecological destruction in Germany since the 1860s. Examining these transfers on the timescale contributes to a more differentiated approach to the problem of when and where patterns of thinking changed and in how far it is possible to locate the origins of ‘modern’ environmentalism. It is, therefore, important to question the periodisation of national history and to integrate transcontinental and non-human temporalities. In this way, we can make the timescapes of species transfer across the Indian Ocean visible and shed new light on global ecological change in the age of empire.

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