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Diagnosing crisis: The East India Company medical services and the emergence of state conservationism in India, 1760–1857

In some respects the history of the response to colonially induced ecological change in India before 1857 followed the pattern which had developed on Mauritius, St Helena and St Vincent. In this way the experience gained in these island colonies exercised an important formative influence over the way in which environmental ideas were conceptualised and state conservation came to be developed in India. While the scale of the physical context was quite different and it took much longer for ecological changes to make an impact on European policy in India, the manner of response and the intellectual constraints upon it were essentially very similar. However, the way in which information about the environment was gathered, communicated and coordinated became much more critical to the formulation of scientific and state environmental policy.

From the point of view of the historian concerned with the broader picture of the economic and social changes contingent on East India Company rule, the ecological consequences of western penetration and the development of state responses to such changes are of considerable interest. Deforestation in particular, and the controls involved in the colonial response to it, had a direct and far-reaching impact on agricultural production and population movements. Other consequences of company rule have been much studied, and at first sight it may seem surprising that the ecological consequences of colonial rule in India and the environmental policies of the EIC have, until recently, received relatively little attention.[1] The principal difficulty to date relates to

1 For an important exception, see Richard Tucker, 'The depletion of India's forests under British imperialism: Planters, foresters and peasants in Assam and Kerala', in D. Worster, ed., *The ends of the earth: Essays in environmental history*, Cambridge, 1988, pp. 118–41. See also Michael Mann, *Britische Herrschaft auf Indische Boden: Landwirtschaftlichen Transformation und ökologische Destruktion des Central Doab, 1801–1854*, Stuttgart, 1992 (and University of Heidelberg 1991 Ph.D. diss. of the same title), and Mahesh Rangarajan, 'Production, desiccation and forest management in the Central Provinces' and other essays in R. H. Grove and V. Damodaran, eds., *Essays on the environmental history of South and South-East Asia*, Oxford University Press, New Delhi, in press.

the absence of accurate information on ecological change, so that the generalisations which have been made have normally been based on little more than guesswork.[2] While some reference has to be made here to the speed of ecological change under company rule, a very detailed assessment of it is at this point neither possible nor an essential part of this analysis.[3] Furthermore, under company rule the broader impact of environmental degradation on agricultural change, colonial production, migration and social change is a largely unexplored, although important, field and is necessarily and advisedly largely beyond the scope of this book.[4] Instead, the objectives of this chapter are confined to exploring early colonial anxieties about the Indian environment and the way in which an interventionist state response first developed in response to those anxieties. The chain of intellectual events principally involved the elaboration of arguments linking deforestation with rainfall and climatic alteration and the propagandising of such desiccationist arguments by specialists. As in the island colonies, the development of a distinctive group of professional scientists as environmental commentators took place, involving not only the canvassing of new scientific insights but also the often disguised

2 Currently the only systematic attempts to survey the history of land-use change under colonial rule in India are those being conducted by John Richards, Elizabeth Flint and colleagues under the auspices of Duke University; see J. F. Richards, E. S. Haynes and J. R. Hagen, 'Changing land use in Bihar, Punjab and Haryana, 1850–1970', *Modern Asian Studies*, 19 (1985), 699–732. Unfortunately, for the earlier period of British rule, the basic data (anyway scanty) is far less easily used than for the period covered by the Duke University project. The same applies, of course, to the late seventeenth and the early eighteenth century. This is important, since the period before 1857, during which the conservation ideas discussed in this chapter emerged, probably experienced more radical vegetal changes than the period after the Mutiny.

3 In fact, in any future analysis of rates of ecological change in the period 1650–1850 a prime task will be to determine to what extent the changes caused by 'western' economic penetration under colonial rule were really new in scale. It seems particularly likely that vigorous economic transitions in some of the successor states to Mughal rule, especially in South-West India during the late seventeenth and the eighteenth century, were accompanied by corresponding changes in rates of deforestation, expansion of arable land and the assertion of monopolistic land-use practices and rights.

4 Some recent regional studies, however, are helpful in indicating the disruption caused to forest 'tribal' as well as agrarian societies by early-nineteenth-century forest felling, neglect of irrigation, expansion of arable land and revenue collection; see e.g. R. K. Gupta, *The economic life of a Bengal district: Birbhum, 1770–1857*, Burdwan, 1984, pp. 117–19, 296–307; E. Whitcombe, *Agrarian conditions in Northern India*, vol. 1, *The United Provinces under British rule, 1860–1869*, Berkeley, Calif., 1972, pp. 61–119; V. Damodaran, *Broken promises: Popular protest, Indian nationalism and the Congress Party in Bihara, 1935–1946*, Oxford, 1992; and Michael Mann, 'Ecological change in North India: Deforestation in the Ganga-Jumna Doab 1800–1850', in Grove and Damodaran, *Essays*, in press.

mediation of new or distinctive and sympathetic attitudes to nature in the tropical world. In India too the botanical garden, in close alliance with metropolitan botany, emerged as the focus for such professionalisation.[5] The founding of scientific societies and their journals also helped to stimulate the diffusion of environmental ideas. Lastly, an identification between moral or reformist sympathies and environmental concern became as characteristic among scientists in India as it had been in the island colonies.

By contrast, the Hippocratic analysis of environmental change, important on the islands and in physiocracy, was developed in a much more specific and influential way in India. However, the influence of long-established indigenous Indian conservation and tree-planting practices, critical to the thinking of van Reede at the Cape and Poivre on Mauritius, was also elaborated much further in colonial India under company rule. We have already seen how the Ezhava epistemologies of Malabar affected European constructions of nature in India and elsewhere. In a similar fashion, Hindu, Muslim and Zoroastrian concepts of man–environment relations formed an essential stimulus to colonial arboriculture and to the adoption of the Humboldtian environmental ideology which so much influenced EIC scientists.[6] In a more immediate sense the permeation of indigenous Indian knowledge about the consequences of deforestation was directly instrumental at a number of stages in the formation of colonial perceptions of rates and mechanisms of environmental change. In fact, it would probably be true to say that, on balance, indigenous knowledge, management and afforestation methods were more important to the evolution of company environmental policy than any set of ideas imported from outside India. After the end of company rule, this equation changed, and externally derived, especially German, formulations held greater sway. Possibly as a direct corollary of this shift, local resistance to state forestry and conservation policy became far more developed after the end of company rule.[7]

The role of universalist scientific arguments also came to be more significant than it had been in the island colonies. In India the relative influence of scientists, and especially medical surgeons, in their relations with the colonial state became far more developed and the conservation propaganda they wielded more sophisticated. As experts consulted by government, the surgeons were incorporated in an entirely new kind of scientific civil service, in a structure that guaranteed some continuity in analysis and ensured that forest conservation was taken on by the state in India as an accepted part of the role of colonial government. Indeed, in their emerging capacity as scientific advisers to government, the staff of the EIC Medical Service acquired a quite unprecedented institutional role as the source of local and international environmental expertise.[8] In its emphasis on the extent to which environmental degradation constituted a threat to the social fabric, the Hippocratic analysis of environmental change formed the basis for an important variety of thinking about the reasons for famine and food crises in India; it both argued for an interventionist instead of laissez-faire approach to land use and was unsatisfied with Malthusian analyses of famine.[9]

Part of the object of this chapter, then, is to trace the increasing degree of direct involvement by the EIC Medical Service in formulating a diagnosis of the ecological transition taking place in India under colonial rule. The sophistication of this diagnosis helps to explain the direct part played by EIC surgeons and other actors in evolving an interventionist response to the threats to human health and economic stability posed by deforestation and land degradation in India. The methods adopted by the medical service in lobbying government to adopt interventionist controls on environmental change thus emerge as a particular focus of interest.

A secondary intention here is to indicate how the emergence of conservation policies can help shed some light on changing notions of the responsibility

5 See Chapter 4 for the beginnings of this process in India.

6 See Chapter 7 for details of the Indic elements in Humboldt's thinking.

7 The pioneering essay in this area is R. Tucker, 'Forest management and imperial politics: Thana district, Bombay, 1823–1827', *Indian Economic and Social History Review*, 16 (1979), 273–300; for a development of this, see I. M. Saldanha, 'Colonial forest regulations and collective resistance: nineteenth century Thana district', in Grove and Damodaran, *Essays*, in press. For a useful small-scale study of resistance at a later period, see R. Guha, 'Forestry and social protest in British Kumaon, 1893–1921', *Subaltern Studies*, 4 (1985), 54–101.

8 It should be noted that an earlier authority on the subject does not perceive local scientific expertise as being significant in India until about 1900; see R. M. Macleod, 'Scientific advice for British India: Imperial perceptions and administrative goals, 1898–1923', *Modern Asian Studies*, 3 (1975), 345–84. This view needs to be drastically revised.

9 To date, analyses of the ecological factors connecting deforestation, water supply and climate have rarely entered into accounts of the history and causes of famine in India in the context of colonial rule. See e.g. D. Arnold, *Famine: Social crisis and historical change*, Oxford, 1988; B. M. Bhatia, *Famines in India*, London, 1967; S. Ambirajan, 'Malthusian population theory and Indian famine policy in the nineteenth century', *Population Studies*, 30 (1976), 5–14; J. Dreze, 'Famine prevention in India', paper presented at a meeting of the World Institute for Development Research, Helsinki, July 1986; and A. Sen, *Poverty and famine: An essay on entitlement and deprivation*, Oxford, 1982. However, for an important recent exception, see V. Damodaran 'Famine in a forest tract', in Grove and Damodaran, *Essays*, in press. Apart from the latter, none of these works (in common with almost all other studies of famine in India) consider the very prominent part contemporary propagandists of the connections between ecological change and famine played in the formation of policies on famine prevention, in which forest reservation was an important constituent after 1847. A great deal of this distorted emphasis may have originated in the way in which the report of the Famine Commission of 1880 in its conclusions played down the strength of those arguments favouring large-scale forest and watershed protection as preventive measures, stressing instead less interventionist, short-term and more laissez-faire prescriptions; see Government of India, *Report of the Famine Commission*, 4 vols., Calcutta, 1880.

and role of the colonial state in India during the first half of the nineteenth century and particularly on the shifting strength of laissez-faire versus utilitarian and interventionist policies and the interest groups advocating them. Fears grew during the period that the unleashed and uncontrolled forces of local and European capitalism might actually threaten the survival of peasant agriculture and, in turn, endanger the security of the colonial state. Conservation thinking represented a stark contradiction and an impediment to short-term capital interests, so that its successful advent raises some awkward questions about the ideological stance adopted by the colonial state in relation to the control of destructive and capitalist economic forces.[10] The environmental ideas propagandised by the EIC surgeons, most of whom were trained at German or Scottish universities, had radical and influential implications which were not always appreciated by the governments of the time.[11] Colonial governments did, nevertheless, soon come to appreciate the full political advantage to be gained from the kinds of land-use control which forest protection implied, despite the hostility to state land control articulated by contemporary capital interests.

While the direct role of the surgeons as effective administrative innovators in land-use decision making dates, in the main, from the late 1830s, their role as providers of scientific expertise dates from a much earlier period. The employment of J. G. Koenig as a state naturalist by the Nawab of Arcot prior to his employment by the East India Company at Madras constitutes one of the earliest instances of a surgeon's being employed specifically as a non-medical state scientist.[12] There had always been a close association between surgeons and botanical science, and this was a connection that was actively fostered and utilised by Sir Joseph Banks.[13] It became much more specific with the appointment of William Roxburgh and Nathaniel Wallich as superintendents of the Calcutta Botanic Garden and John Berry as superintendent of the Madras Garden and the Madras Nopalry.[14] After 1792 their involvement in the problems posed by deforestation gradually developed in the context of the government's recognition of their botanical expertise, a recognition which was often actively sought out by the surgeons.

10 See in particular Washbrook, 'Law, state and agrarian society in colonial India', pp. 684–7, for a useful discussion of the hostility of the post-Mutiny government of India to many of the objectives of private capital.

11 For an account of the very close connections (in comparison with English medical schools) between the traditions of medical training in the Scottish universities in the early part of the nineteenth century and the French and German Enlightenment, see A. Chitnis, *The Scottish Enlightenment*, London, 1976, pp. 124–87.

12 A well-documented instance of such employment a little later by an indigenous Indian ruler involved the employment of J. M. Hönigsberger (a German surgeon from Kronstadt, Transylvania) at the Court of Lahore: Hönigsberger, *Thirty-five years in the East: Adventures, discoveries, experiments and historical sketches relating to the Punjab and Cashmere*, London, 1835. Further insights into the employment of surgeons as non-medical scientific experts are provided throughout the text of Crawford, *A history of the Indian Medical Service*.

13 See Chapter 8.

14 See King, 'Brief memoir on William Roxburgh', and M. Vicziany, 'Imperialism' botany and statistics: The surveys of Francis Buchanan', *Modern Asian Studies*, 20 (1986), 625–60, on the competition between Buchanan-Hamilton and Wallich to acquire the superintendency of the Calcutta Botanic Garden. King's memoir is useful in revealing the significance of the occupancy of the post of Madras government botanist/naturalist in establishing the EIC Medical Service in the superintendency of the Calcutta garden. Koenig, Russell and Roxburgh all occupied the Madras post, which had itself arisen from company interest in the botanical and horticultural work carried out by Koenig for the Nawab of Arcot. The Dutch East India Company at the Cape had also generally employed surgeons as superintendents of the VOC company garden; see Karsten, *The Old Company's garden at the Cape*, pp. 1–45. However, there is no clear reason for believing that this constituted the basis of the practice at Calcutta. Recognition of the work of Koenig and Roxburgh by the company (with the encouragement of Sir Joseph Banks) was more significant.

Beginning as a successor state among others, the East India Company had by 1818 succeeded in assuming and consolidating political leadership of the Indian sub-continent. The process had been complicated, since it involved the close cooperation and alliance of a variety of social and indigenous service groups (especially Bania bankers and Parsi merchants) and the specific interests of the British private traders.[15]

The fact of company success and the assertion of British corporate and private commercial interests generated important and identifiable changes in the Indian economy.[16] These related to the rise of new urban centres along the coast (e.g. Bombay, Madras and Calcutta) and inland (e.g. Kanpur, Mirzapur, Benares, Baroda and Hyderabad). Rapid economic changes were also associated with new patterns of trade, as was the acceleration in shipbuilding activity that followed expansion of the Calcutta and Bombay commercial fleets and the marine force of the EIC so essential to the patrolling and policing of the seas.[17] Conversely, the decay and dislocation of the traditional manufacturing sector, especially that dealing with cotton textiles, exercised its own impact. Parallel to this major overhaul of the economic system was the creation of major land-revenue systems to support the company raj: the *ryotwari*, *zamindary* and *malguzari*, which were the outcome of much deliberation and experimentation. The cumulative effects of these changes and policy decisions on the indigenous population have been studied in some detail and at many

15 D. Kumar and M. Desai, eds., *The Cambridge economic history of India*, vol. 2, Cambridge, 1983, pp. 3–352; L. S. Subramanian, 'The Banias and the British: The role of indigenous credit in Western India in the second half of the eighteenth century', *Modern Asian Studies*, 20 (1987), 473–511.

16 C. A. Bayly, *Rulers, townsmen and bazaars: North India in the age of British expansion*, Cambridge, 1983, pp. 229–309.

17 R. A. Wadia, *The Bombay dockyard and the Wadia masterbuilders*, Bombay, 1955; P. Nightingale, *Trade and empire in Western India, 1784–1800*, Cambridge, 1970.

levels in the social structure. However, the ecological impact which the company system produced has not received the same detailed attention.

This is in part because our knowledge of the speed and character of ecological change in pre-British India, particularly of deforestation, is still very limited and patchy, and our insights into changes in the first crucial decades of colonial rule are also very sketchy. However, those studies of deforestation that do exist for the period 500 B.C. to A.D. 1760 (and particularly for the period 1500–1760) indicate that periods of relatively rapid change did take place in pre-colonial times, particularly in connection with periods of military expansion by aspiring new state builders. Above all, very extensive early deforestation took place at a variety of dates in the Indus and Ganges river basins and in the semi-arid zones.[18]

A growing awareness of such pronounced pre-colonial deforestation episodes leads one seriously to question the objectivity of some recent historical essays that have tended to characterise the pre-British period as an ecological and pre-capitalist golden age of common property rights and sustainable resource use.[19] In some of these essays the caste system has even been characterised as an effective ecological adaptation to different habitats.[20] Such accounts would seem inherently Orientalist in the Saidian sense and are based on belief in a kind of pre-colonial 'Merrie India' that is closely akin to the romantic constructions of 'Merrie Africa' that have long been discarded by scholars.[21] In fact, far from being a paradise of so-called common property, the nonarable Indian environment has, from a very early date, been subject to attempts at management and control by both states and dominant groups, some of a geographically very extensive nature.[22]

18 See esp. Jean Filiozat, 'Ecologie historique en Inde du Sud: le pays des Kallar', *Revue des Etudes d'Extrème Orient*, 1980 (2), pp. 22–46; George Erdosy, 'Deforestation in pre- and proto-historic South Asia', in Grove and Damodaran, *Essays*, in press; Makhan Lal, 'Iron tools, forest clearance and urbanisation in the Gangetic plains', *Man and Environment*, 10 (1985), 83–90; Chetan Singh, 'Forests, pastoralists and agrarian society in North India', paper presented at Conference on Environment and History in India, Bellagio, Italy, March 1992; Irfan Habib, *Atlas of the Mughal empire*, Aligarh, 1982, pls. 10 and 10a.

19 See e.g. M. Gadgil and R. Guha, *This fissured land: An ecological history of India*, New Delhi, 1992, and 'State forestry and social conflict in British India', *Past and Present*, no. 123 (1989), 141–77.

20 See M. Gadgil, 'Towards an ecological history of India', *Economic and Political Weekly*, 20 (1985), 1909–18.

21 Said, *Orientalism*. For critiques of the 'Merrie Africa' hypothesis, see J. Lonsdale, 'Introduction', in D. Anderson and R. H. Grove, eds., *Conservation in Africa: People, policies and practices*, Cambridge, 1987, pp. 271–7; and P. Coquery-Vidrovich, *Afrique noire: Permanences et ruptures?* Paris, 1985.

22 Some idea of the early stages of this process is contained in D. Das, *Economic history of the Deccan*, New Delhi, 1976, pp. 105–15. For a more specific example of Maratha pre-colonial forest control, see H. B. Vashishta, *Land revenue and public finance in Maratha administration*, Delhi, 1975, pp. 138–46; see also accounts of Maratha forest reserves in *Report of the Bombay Forest Commission*, vols. 1–2, Bombay, 1887.

These attempts to introduce state control became much more frequent towards the end of the seventeenth century and often involved plantation projects to safeguard timber for the construction of increasingly large navies. As Mughal control collapsed, the ascendancy of successor states and their attendant commercial elites caused dramatic rises in timber demand and the growing commoditisation of forests for revenue and state needs long before the East India Company became a significant power in the land. For example, until the end of the eighteenth century the forests of Cochin were under the control of the feudal chiefs of the Nadivazlis, who owed allegiance to the Rajah of Cochin.[23] These processes of forest annexation by pre-colonial states frequently involved the forced removal of peasant populations and the destruction of pre-existing customary forest-utilisation arrangements. Moreover, when the EIC did acquire forested territory, the management methods of the conquered states were often imitated and co-opted. The case of Sind provides an instructive example of the way in which an extensive 'pre-colonial' state-forest and hunting-reserve system could be taken over by the company and run with few changes. Between about 1690 and 1830 the Amirs of Sind were responsible for the reafforestation of over a million acres of the Indus flood plain with up to eighty-seven *shikargah*, or hunting and forest reserves, whose forest products were sold to the peasantry, many of whose villages had previously been forcibly removed to establish the reserves.[24] As Eastwick tells us, the shikargahs 'answer the double purpose of preserving game and supplying the whole country with timber of excellent quality, as well for the construction of boats and houses as for firing and every other useful purpose'.[25] The extent and revenue production of the shikargahs in pre-colonial times was remarkable. In Karachi district alone, for example, in the 1840s twenty-four forests covered an area of over 95,000 acres. By 1870 these forests were producing revenue for the British of 39,000 rupees per annum.[26] These figures indicate that the shikargahs had become a very important source of revenue to the amirs and in some sense substituted for land revenue, since the forest reserves occupied the best irrigated areas and the best soils.[27] Similar revenue consid-

23 Then in 1813 a forest department was set up under a *mellei melviharappan* ('mountain superintendent'); see H. Vishwanath, ed., *Working plan for Chakakuan*, Forest Department, Trivandrum, 1958, pp. 12–13 (Bodleian Library, Oxford, Indian Institute Archives, Trav. 0.3). For details of similar pre-colonial arrangments in Travancore, see F. Bourdillon, ed., *Report on the Travancore forests*, Trivandrum, 1886, pp. 15–16.

24 See E. H. Aitken, ed., *Gazetteer of Sind*, Lahore, 1907, p. 40, for estimates of individual forest areas; this estimate covered the full 87 government shikargah forests.

25 E. B. Eastwick, *Dry leaves from young Egypt*, London, 1849, p. 24.

26 *Gazetteer of Sind*, Lahore, 1874, p. 321.

27 This was why the planting of a shikargah tended to involve village removal. Napier noted in

erations applied to the pre-colonial state forest policy farther south. Thus, after the 1730s the heavy resource and financial demands of the Maratha armies compelled the Maratha state builders to extract high revenues from the forests under their control. The forest reserves designated to perform this function were eventually (after 1805), as in Sind, taken over and run by the EIC as the initial infrastructure of the Bombay forest-conservancy system. In other words, the onset of British colonial control seems likely to emerge as a less significant episode in Indian forest history than the phase in which the successor states to the Mughal empire started to exercise a new economic and political dispensation.

Discussions in the Governor's Council at Fort William, Calcutta, from the beginning of the 1760s indicate that timber shortage was already an important matter and had been for some decades before the company acquired full territorial control of Bengal and adjacent regions. As early as 1761 fears were being expressed that timber, as an expensive commodity needed for house and ship construction, was being misused. This anxiety lessened only temporarily when new supplies of softwood timbers were discovered by Richard Becker, a company agent, in the Morangs region of Southern Nepal; this timber could be floated down to Calcutta by river.[28] The same fears were expressed very explicitly on the west coast by the early 1780s. On one occasion company agents reported that 'timber which abounds in the interior parts of this country is an article of such important consideration that we cannot but recommend your honours attention of this object, and propose that indiscriminate lease of cutting be not granted, as it has occasioned great abuse'. For this reason they recommended that 'forests which used to supply the Mahratta Circar be now appropriated to the Revenue of the Company'.[29]

In both the Bengal and Bombay presidencies between 1760 and 1790, chronic difficulties in obtaining timber and controlling indigenous sources of supply encouraged company military plans and local adventurism. Above all, expansion by the company northwards and eastwards to the Nepal border and into the Maratha territories on the west coast was much encouraged by the

1843 that 'they occupy all the best land in Scinde; wherever good land was found a shikargah was at once planted, and the inhabitants driven away . . . it therefore became a matter for consideration whether they should be maintained': PRO 30/12/61, letter from Napier to Ellenborough, 22 May.

28 National Archives of India, New Delhi [henceforth NAI], Home Public Consultations, Foreign and Political Select Committee Proceedings, vol. 12 (6 Jan. – 29 Dec. 1767), committee meeting at Fort William, 14 July 1767, p. 232.

29 NAI, Home Public Consultations, noted 24 Sept. 1781: Letter from James Sibbald et al. in Bassein to William Hornby, President, Bombay, 2 May 1781 (letter no. 9). 'The revenue arises, it was noted, from the taxes and customs respecting the latter . . . it is necessary to observe that the whole revenue was farmed out, but those of Bassein cannot be.'

threat of a timber shortage. In fact, it may even be appropriate to argue that company expansionism was *normally* associated with timber shortage, much as the desire to control strategic timber supplies lay behind earlier episodes of British expansionism in North America and contemporary ones at the Cape. Despite this, the ambitions of private traders to gain control over forested areas were frequently thwarted by lack of political and territorial control and deliberate company reluctance to become involved in harvesting activities that might provoke conflict and confrontation with indigenous states and commercial interests. This was the case initially in Bengal in the 1760s and, more specifically, in the Godavery delta north of Madras. There, for example, in 1785 a proposal was made to the company by one Andrew Parkinson, a private trader, that it should establish a superintendent of woods in the forests of the Rajahmundry Circar alongside the Godavery River. In this case the Council at Masulipatam, adjacent to the forests, turned down this suggestion on the ground that the company simply did not control the relevant territory of the Bhadrachalam region.[30] Such debates and disputes within the company tended to underline the connections between ambitions for territorial and political control and access to forest resources. Where forest timber was needed to build and maintain the ships of the company marine, the search for timber emerged as a motive to expand and engage in the wars of neighbouring Indian states. As the Parkinson case shows, where the supply of shipbuilding timber was not a major political imperative, further expansion of controls over forests was rarely encouraged. Nevertheless, serious tensions sometimes arose between the presidencies through varying perceptions of the need to wage war in order to gain timber supplies. On several occasions, for example, Warren Hastings found cause to criticise the Bombay authorities for involvement in the Maratha wars when control of particular forest areas was the only reason given by Bombay for interventions unlicensed by the governor-general in Calcutta. On one occasion the agent of the Bombay government caused great irritation when he told Hastings that an unlicensed campaign was justified, since 'before we had the trade, but now we have the country where the articles [teak] of that trade are produced'.[31]

From the 1770s until about 1860 fluctuating demand for naval and military (plus some urban construction) timber represented the main significant commercial and demand factor in British forest policy in India. Urban demand for firewood expanded far more steadily until the 1840s. This position was

30 Madras, Tamil Nadu State Archives, Consultations, vol. XXXI: Letter, 1787: 'Mr Parkinson . . . addressed us . . . in regard to the situation of the port and river of Bandermalanka and the advantage of encouraging the trade in teak timber and clearing the woods bordering the Godavery.'

31 NAI, Secret Political Files, vol. 16: Proceedings of Council (letter of 23 Aug. 1875 from President, Bombay, considered): Bombay's agent questioned over attack by Bombay on Broach.

quickly changed when the need for railway sleepers suddenly became significant – indeed, dominant – at the beginning of the 1860s. The resulting and increasingly extensive search for timber after 1800 in remote, especially mountain, districts bestowed a double benefit on the company, since the need to acquire control over timber resources facilitated the control of unruly tribal groups. This was the case, for example, with the Dangs Bhils in the Western Ghats, the Paharia of the Rajmahal Hills of Bihar and the Rampa tribal groups in North Arcot near Madras.[32] Resistance by these and other groups to company incursions, though periodically violent and effective, could ultimately be controlled by direct suppression or by co-option of hill tribes into local police and army forces, so that timber could then be removed without further difficulty.

Even before the Napoleonic wars, political competition for the forests of India had been closely connected with the rise in demand for raw materials. But these new demands were not all externally created. In fact, there is evidence of an increasing integration of internal trade and commercial demands connected with the growing dominance of new states in Western India towards the end of the eighteenth century.[33] This was increasingly reflected in a growing requirement for shipbuilding timber on the Malabar Coast by both the company and other successor states of the Mughal empire.[34] However, these developments were soon overshadowed by the material demands of the global conflict between Britain and France. This was reflected in a rapid growth in demand for shipbuilding timber, which by 1810 had developed into a timber 'crisis' which was accompanied by a concerted and worldwide search for new timber resources.[35] One may represent this, as Rodger does, as the pioneering

32 H. D. Love, *Vestiges of Old Madras*, vol. 1, London, 1913.

33 C. A. Bayly, 'The Middle East and Asia during the age of Revolutions 1760–1830', *Itinerario*, 2 (1986), 80–1; L. S. Subramanian, 'Bombay and the west coast in the 1740s', *Indian Economic and Social History Review*, 8 (1981), 215–16.

34 Extensive references to this increase in demand can be found in the first two chapters of Wadia, *The Bombay dockyard and the Wadia masterbuilders*. The increasing interest of the EIC in the consequences of this rise in demand are documented in BL, Home Misc. IOL, (102) F/4/39: papers regarding the timber trade in Malabar Province, April 1795 – Jan. 1798; also in Home Misc. E/4/1014, draft 23 (1798–9), pp. 266–9.

35 R. Pering, 'A brief inquiry into the causes of the premature decay in our wooden bulwarks with an examination of the means best calculated to prolong their duration', *Quarterly Review*, 8 (1812), 28–41; Albion, *Forests and sea power*, pp. 346–69 (chapter entitled 'Searching the World for timber'). Albion's treatment is useful in drawing attention to the connections in the search for timber in the Cape, Madagascar and Malabar. Essentially it was the failure to establish reliable timber supplies at the Cape that focussed attention on Malabar. In both places the concerted searches and surveys of 1810 led to the development of more sophisticated ways of analysing and then managing timber reserves and towards more rigorous management by the state of forest reserves; see papers regarding the survey of forests in the Bombay Presidency in BL, IOL, F/4/347 and F/4/348, dealing respectively with reduction of the

growth of a kind of industrial consumption pattern.[36] It served for the first time to focus attention on the global strategic value of a raw material and on a deciding factor in the Franco-British contest. It also sharpened appreciation of the long-term value of the Western Indian and Burmese forests and can be seen, with hindsight, as the point of departure for the gradual sharpening and sophistication of environmental concerns on the part of both the British government and Indian landholders between 1790 and 1850. This was a phased development which took place with many regional variations, the phases reflecting both shifts in the influence of scientists and changes in the political priorities and sensitivities of the colonial state in India.[37]

The outbreak of the long naval conflict with the French, however, shifted the focus of incipient environmental concern away from Bengal and towards the Malabar Coast. At a relatively early date, the cumulative effect of early commercial deforestation began to be observed with some anxiety by British officials on the west coast. The Malabar forests, particularly after the loss of the American sources of supply after 1776, had come to be heavily drawn upon by both indigenous Indian merchants and the Royal Navy for shipbuilding purposes. Much local naval shipbuilding, especially of the Bombay Marine, was actually carried out by Parsi enterprises.[38] The defeat of Tipu Sultan enormously increased shipbuilding activity and, more important in terms of Indian forest history, for the first time allowed unimpeded access to the forests of Malabar and Mysore and thus to a steady supply of teak.[39]

The ease of access permitted to both British and Indian entrepreneurs under the East India Company as a consequence of the political demise of the old west-coast princedoms was a critical factor in accelerating deforestation. Political division and traditional controls had had the effect of cushioning Indian forests from the increasing pressures imposed by external markets and

Ramnagar Forest establishment and statistical survey returns, including an 1811 account of the Bhil forest tribes, by Captain Morier Williams, all in pp. 67–73; F/4/427 (10478), Reports on the teak plantations at Rampur (Boalia, or Bauleah), by George Ballard and Surgeon William Roxburgh, of July 1812; and two sets of papers on the 1810 surveys of the Malabar forests: F/4/427 (10507), pp. 271–97, and F/4/432 (10543). Further papers regarding the survey and supply of timber for shipbuilding: BL, IOL, Bombay Public Consultations, March 1813 – April 1814, Bom. Pub., 9 March 1815, draft 104, pp. 450–9. Exactly the same process was taking place in the United States, where naval forest reserves were again declared in 1816 after their earlier abandonment at independence; see Hough, 'Preservation of forests', p. 37.

36 Rodger, *Wooden Walls*.

37 For details of the latter, see Bayly, *Rulers, townsmen and Bazaars*, pp. 197–229.

38 Wadia, *The Bombay dockyard and the Wadia masterbuilders*, chaps. 1–2.

39 Rear-Admiral Sir Thomas Trowbridge noted in a letter to Jamsetjee Bomanjee, master shipbuilder at Bombay, on 14 June 1802, 'Timber, I presume, can now be had in abundance from Tippoo's country'; quoted in A. Siddiqi, 'The business world of Jamsedjee Jeejeebhoy', *Indian Economic and Social History Review*, 19 (1983), 302.

small private enterprises. As a single political and colonial entity, India then became much more vulnerable to both externally and internally generated economic and ecological pressures. Perhaps foremost among the latter was the financial stake exerted by Parsis in banking, shipbuilding and internal river traffic. By the late eighteenth century the Parsis were increasingly organising themselves as a body of collaborators working in close association with the agency houses of Bombay and exploiting new opportunities generated by English private and mercantile initiatives. Prominent among these was the collaboration between Jamsedjee and Jardine Matheson. The Pestonji Brothers and Pahis and Company based at Hyderabad also assumed a key role in 1807–20 in opening up the Godavery River for navigation and the adjacent forests for timber cutting.[40]

To some extent the situation in India in 1800 was analogous to that which prevailed in mid-seventeenth-century England as the land market became more fluid and large-scale felling took place.[41] Nevertheless, the English precedent of the Crown forest system, not conspicuously successful at home, was to be even less so at first in India, in part because of the sheer scale and geography of the problem and the power of the economic pressure groups anxious to secure a toehold in previously little-exploited Indian forests, where the ownership status was more nebulous and forests were therefore less protected than in Europe.

The first major European response in Western India to the fear of a naval timber shortage was the foundation of a timber syndicate on the Malabar Coast by surgeon William Maconochie in 1796. This first syndicate soon collapsed.[42] Maconochie's activities, it should be said, were commercial rather than scientific or medical. His initiative was followed, however, by attempts to start other agencies connected purely with the supply of timber for the Navy. These opened, closed and reopened from time to time in largely unsuccessful attempts to conserve the supply of teak from the coast and Ghat uplands of South-Western India.[43] The early history of British management of the teak

40 On this, see Siddiqi, 'The business world of Jamsedjee Jeejeebhoy', pp. 301–7.

41 Grove, 'Cressey Dymock and the draining of the Great Level'.

42 B. Ribbentrop, *Forestry in British India*, Calcutta, 1899, p. 62, and E. P. Stebbing, *The forests of India*, vol. 1, Edinburgh, 1922, p. 68.

43 Some of these efforts involved some interesting early species-selective measures to protect young teak trees. For example, in a proclamation of 9 June 1799 issued at Calicut it was noted that 'the government has much at heart to put an end to the very ruinous and wanton practice that prevails in every tract of forests in Malabar of cutting down the young teak trees for domestic and other purposes, but for which there are many other species equally well applicable . . . the Commissioners have come to the resolution of prohibiting this practice in future, and to direct that no young teak trees . . . under 24 inches in girth are to be cut down after the first of Karcadagom [the rainy season] . . . this prohibition is not meant to extend to the cutting of the other species of timbers of whatever size or growth in the said forests all of which may be cut down and carried away as usual': Diary of Mr Law, assistant in Ernaad taluk, 14 June 1799, quoted in W. Logan, ed., *A collection of treaties, engagements and other papers of importance relating to British affairs in Malabar*, Madras, 1891, p. 318.

forests of Tenasserim in Burma followed roughly the same pattern.[44] During the late eighteenth and the early nineteenth century a series of timber-working leases were formalised by the East India Company which were to become 'a thorn in the side of' later administrations bent on public control.[45] First attempts to control cutting more specifically than by syndicate control were made by the Bengal–Bombay Joint Commission of the EIC in 1800, which attempted to impose regulations prohibiting the felling of teak below twenty-one inches in girth.[46] This measure, aimed at preventing wholesale clear-felling of forest, imposed virtually no formalised structure specifically to administer the regulations and therefore had little chance of success.[47]

After 1800 the state of the Indian forests became a matter for frequent and detailed strategic discussions in London. Viscount Melville, for example, in a letter to Marquis Wellesley on 4 July 1804 stated his 'conviction that with a view both to military and commercial purposes, this country must one day avail itself of the valuable resources to be had for ship-building in the ports of India'.[48] The state of oak timber, he went on, 'has rendered it a matter of indispensable necessity to look to India for material assistance'. Wellesley, replying from Bombay, asserted that that city remained the best site for shipbuilding.[49] The best crooked timber for the purpose came 'from Mahratta country between Surat and Bombay, where it is floated down the rivers'. However, Wellesley warned that 'it has . . . of late years become more scarce from the great consumption and dearer, as further away from rivers, and consequently incurring the charge of land carriage'. Straight timber was procured from Malabar through the port of Cochin. But here too exhaustion threatened. 'For my part', Wellesley says, 'I have great doubts if any great quantity of timber large enough for ships of the line is to be expected from Malabar.' He feared that 'consumption of late years (in Hyder's and Tippoo's time), was greater than the means of the country could afford'. One engineer

44 Ribbentrop, *Forestry*, p. 62.

45 Ibid.

46 Ribbentrop, *Forestry*, p. 64.

47 Ibid.

48 Cambridge University Library, East India Papers, 10/719/40; sect. entitled 'Prince of Wales Island and the building of ships in India', p. 723. Melville noted that Andrew Tate, a shipbuilder, had favoured construction in Rangoon, where, he said, 'the country seems to be wonderfully intersected by rivers, which of course must be highly useful in bringing wood to the coast'.

49 The largest ship constructed there, the letter says, was of 1,360 tons.

who surveyed a part of Malabar province 'had never seen the forests' but had 'seen the remains of large trees formerly cut down, and of course some still remaining at the greatest distance from the rivers'.[50]

On these grounds Wellesley suggested that 'several professional men should be sent to ensure a due survey' of the remaining forests, while warning that the 'climate is highly unhealthy and deaths must be expected'. The difficulties involved in extracting desperately needed sources of teak from areas not under company control were constantly referred to in correspondence during 1804. Wellesley pointed out, for example, that there would be 'some difficulty in getting permission from the Mahrattas to introduce European workmen into that part of the country'.[51] Particular difficulty was anticipated in getting hold of crooked teak 'of sufficient dimensions for ships of war'.[52] Philip Dundas, like Wellesley, concluded that 'the forests of Malabar have been nearly exhausted' but that 'the timber trade in Travancore' and Cochin was 'much better'. In fact, Dundas thought that the Travancore forests were 'inexhaustible', an impression probably brought about by the fact that they were intensively managed by the indigenous ruler on a sustainable-yield basis. Morever, as 'Cochin is not likely to fall into the hands of the Dutch, this place is advantageously situated as a general mart of teak timber'. More teak might also, he thought, be 'brought down the Piniary river from the Annamally [Annamalai] woods and the forests in the vicinity of Palghaut which abounds in timber trees'. But Dundas was also considering areas further afield. He noted that 'should it be deemed expedient to establish dock yards at Rangoon or its vicinity our dependence on the north of Europe for maritime stores and timber would be diminished; and we should hope that it would ultimately operate as a preventative to our [British] forests being entirely exhausted'. A shortage of teak, then, increased the political attraction involved in acquiring routes and territory in areas previously uncontrolled by the East India Company. It was this factor, and the possibility of military expansion in 'virgin areas' once exploited by, for example, Hyder Ali, which may have discouraged any embryonic ideas about intensive management of the forests of the west coast at a time when such management was already in place under the Dutch colonial government in Java.[53]

In 1805, the year of Trafalgar, the EIC Court of Directors set up a Forest Committee to consider how far the Navy could depend on its newly acquired supplies of Malabar teak, now highly valued as a raw material for building ships of the line. The committee, as a first step, enquired into proprietary

50 Ibid.

51 Ibid.: Letters, Philip Dundas to Viscount Melville, 21 and 28 June 1804.

52 Ibid., 'Enclosure 1', in Dundas letter of 28 June 1804.

53 See Peluso, 'The history of state forest management in colonial Java'.

rights in the forests. Its reports showed that the capacity of the Malabar Coast forests had been much overrated and that all accessible forest had already been heavily cut through. Further extensive extraction, it was felt, would entail expensive road construction, which would, however, be repaid in terms of an increased asset value for proprietors. In the same year, 1805, it was decided to issue a proclamation vesting in the East India Company itself all royalty rights once claimed by indigenous governments.[54] All further unlicensed felling was to be prohibited. The Forest Committee's findings were based on a memoir drawn up at the request of the governor of Bombay by one Francis Wrede, 'a gentleman from Germany long resident in Malabar'. In this memoir Wrede had argued that 'we are now brought to a crisis'. The company, he said,

> has for these thirteen years past been in possession of Malabar and during that period considerable progress has been made towards improving the administration and exploring the resources of that valuable province . . . the great importance of the teak forests known to exist in the interior part of the province was early a concern and pointed out by the first commissioner and has since been a favourite theme of speculation both in India and at home.[55]

By 1805, Wrede continued, the forests had become a subject of general interest not only to the Court of Directors and the Board of Control, but also to the 'British public at large'. He recommended that a new survey of the Malabar forests be attempted and suggested that the surveyors be accompanied by a surgeon, for health and other reasons. He also suggested that 'since Mr Maconochie [surgeon] had not taken up his post as Naval Architect in the United Kingdom . . . he should be invited to assist'.[56] In fact, it was not until 1810 that a surgeon actually participated in forest surveys. This occurred when surgeon Thomas Palmer was appointed conservator of Malabar during 1810–13 and was made responsible for completing the Malabar surveys.[57] Thus, even at this early stage, German expertise and that of the company medical

54 Ribbentrop, *Forestry*, p. 64.

55 BL, IOL, Home Misc. 1/493, L111, pp. 1051–7, extract from Bombay Public Consultations, 19 Feb. 1805: Report of Herr Wrede, p. 1057.

56 Ibid., pp. 1093–6.

57 BL, IOL, Home Misc. F/4/429 (10507)(1): Paper regarding the survey of the Malabar forests (10508) 1810–13: In this paper surgeon Thomas Palmer is mentioned as 'acting Conservator of Malabar during this period'. Palmer encountered difficulty in having his services fully recompensed, a problem probably arising out of bureaucratic unwillingness to recognise the plurality of the medical and non-medical skills offered by the surgeon. See F/4/429: 'Memorial of Surgeon Thomas Palmer requesting some remuneration for his services as Surgeon to the Department of the Conservator of Forests from August 1804 to October 1813'.

service had proved indispensable to government in forest-conservation matters.

The Forest Committee of 1805 had recognised that regulation would fail without proper enforcement. Under pressure from the Court of Directors, therefore, Captain Watson of the EIC Police Service was appointed 'Conservator of Forests in India', the first holder of any such formalised position under the EIC. Watson was invested with wide-ranging powers, which he used with 'great energy and less discretion'.[58] Within two years he had established an EIC timber monopoly throughout Malabar and part of Travancore, and in so doing disregarded, as Wrede had suggested, all previously existing rights. Wrede had reasoned that

> the dominion of proprietary right of the jungles and every other part of the unoccupied land [*sic*] and appropriated land found in the province belongs to the Company just as it was possessed by Tippoo and transferred to us, and as in like manner all forests are unquestionably the royalty or property of the Circar in the Travancore and Cochin countries . . . at any rate their presupposition of there being a royalty militates for the Company as Sovereign and the *onus probandi* that any part of it is private property lies with the claimants and hitherto none of them has been able to make out his claim in a satisfactory manner nor probably ever will. (p. 1057)

This opinion is useful in demonstrating the degree to which the company was able to rely on indigenous princely precedent in alienating any customary use made of forests. This policy had a dual effect: 'The government had a plentiful and cheap timber supply during his reign and . . . a general discontent amongst proprietors as well as traders rose to a [high] pitch.'[59] The early opposition mounted by commercial interests against Watson was a first instance of the kind of strong political lobby which was to be mounted against state conservation efforts by private timber as well as state revenue interests in India throughout the nineteenth century. A fine distinction has to be drawn between the claims supported by Wrede and Maconochie on the part of the company (which were essentially monopolistic and very close to ideas of state control) and those made more successfully between 1815 and 1840 which involved the claims of independent mercantile interests with priorities very different from the company's. In fact, at root four types of claims were extant: those of the company itself; purchased private (Indian and British) claims; those of further concession claimants, mainly based on claims to old indigenous holdings; and those of the rajahs, which were themselves often based on the unilateral arrogation of older common rights for monopoly reasons – that

58 Ribbentrop, *Forestry*, p. 65.
59 Ibid.

is, the first and last claims were essentially of the same variety, as Wrede's report makes clear. All these types of claims ignored the activities of customary forest users, most of whom were poor and possessed no paper rights at all.

The exigencies of the wars with the French prevented the early political success of private and commercial claimants to the forests. However, after 1815 the conservationist position became more vulnerable, and the pioneering timber conservancies came to an end in 1823.[60] In that year the west-coast conservatorship was abolished by the EIC largely as a result of the private views of Sir Thomas Munro and public pressure put upon his office; he recommended to the Supreme Government that forest regulation was more trouble politically than it was worth. Munro himself, as architect of the southern 'Settlement',[61] a scheme designed at the very least to ensure maximum rent returns even in famine years, was certainly not a man to be easily persuaded of the value of forest protection. Besides, carefully documented evidence of forest destruction was not available during the first conservatorship in the way that it came to be during the 1830s. As a result, private timber interests were at an immediate advantage in lobbying.

There is some irony in Munro's role in the dismantling of the early conservancy, even though it was, as Ribbentrop pointed out, a 'probably unjustifiable monopoly'.[62] Munro had closed the conservancy at least partly in the belief that it was fundamentally inequitable, particularly in its trampling of indigenous 'property rights'.[63] In holding an idealised and highly inaccurate view of indigenous landholding, Munro remained blind to the already transforming influx of private timber interests and land grabbers, who had little in common with the pre-1792 dispensation and were ready to take quick advantage of the dismantling of controls and the growth of the market since 1823. Thus Munro wrote in 1823 that the owners of forest rights in Malabar were

> too proud traders not to cultivate teak or whatever wood is likely to yield a profit . . . they are so fond of planting . . . that to encourage them no regulation is wanted, but a free market . . . to restore the liberty of trade in private wood; let the public be guarded by its ancient protector; not a stranger but the Collector or Magistrate of the country, and we shall get all the wood the country can yield more certainly than by any restriction measures. Private timber will be increased by good prices and trade and agriculture be free from vexation.[64]

60 Ibid.
61 Munro was governor of Madras from 1823, the same year in which Elphinstone became governor of Bombay.
62 Ribbentrop, *Forestry*, p. 65.
63 See Thomas Munro, 'Timber monopoly in Malabar and Canara', in A. J. Arbuthnot, ed., *Major-General Sir Thomas Munro: Selections from his official minutes and other writings*,, vol. 1, London, 1881, pp. 178–87.
64 Ribbentrop, *Forestry*, p. 65.

The problem with this romanticist view was that it assumed that the forests were illimitable and that the dictates of capital and the market would encourage economy. That neither proposition was true was psychologically difficult for the anti-monopolist to accept in a continental situation. At any rate, Munro's view at this period was arguably responsible for increasing the rate of deforestation after 1823. Indeed, the dismantling of the early conservancies facilitated, for the first time, the widespread felling of teak forests far inland in Mysore. Ironically, this was an area which had fired Munro's Romantic and lyrical tastes during his first visits to the region, as he made clear in letters to his sister. In one of them he wrote that he spent

> many of my leisure hours on the highest summit of the rock on which the fort stands, under the shady bastion, built by Hyder. The spot has for me a certain charm, which I always feel but cannot easily describe . . . while seated on the rock, I am, or fancy that I am, more thoughtful than when below. The extent and grandeur of the scene raises my mind and the solitude and the silence make me think 'I am conversing with nature here.' To the East I see a romantic, well-cultivated valley leading to the wide plains of the Carnatic. To the south a continuation of the same valley, running as far as the eye can reach, into Mysore. All the rest, on every side, is a vast assemblage of hills and naked rocks, wildly heaped one above the other.[65]

Munro was strongly committed to the continuation of what he construed as an ancient Indian tradition of 'personal government'. At a stroke, nevertheless, he managed to destroy the basics of a conservancy system which, however inequitable, was inherited in all its essentials from the kinds of forest control practised by the coastal rajahs and which he might have been expected to approve of. Certainly in his remarkable essay on the timber monopoly there is no doubt that he accurately foresaw the kinds of popular peasant resistance which strong state forest controls and annexation would be likely to – and did – provoke later in the century. However, he left nothing at all in place of the pre-colonial or 1806 controls, and in so doing laid the groundwork for the unprecedented rates of deforestation which took place in Western India during the next two decades.

In the opening years of this period, an inherent contradiction developed between a naval timber policy which had seen the need for conservation even before 1800, and which continued to advocate one, and the newly emerged priorities of a settled occupying colonial government. The latter set great store by a high and increasing level of agricultural production and the extraction of

65 Munro in Ambore to his sister, March 1795: G. R. Gleig, *Life of Sir Thomas Munro*, vol. 1, London, 1830, pp. 86–7, quoted in E. Stokes, *The English Utilitarians and India*, Oxford, 1959, p. 12.

the maximum possible level of peasant land revenue and was unsympathetic at first to the influence of climatic or environmental variables on peasant producers and their working environment. The shift away from an interest in maintaining a firm grip on coastal trading, merchant, banking and timber-extraction concerns towards a position in which the EIC became dominantly concerned with maintaining agrarian land revenues was still a new and significant one in the 1820s. The social and economic consequences of this transition, especially in relation to the destruction of traditional buffers against and responses to crop failure did not emerge fully until later on. Meanwhile, in the 1820s, the likely environmental consequences of deforestation were simply not appreciated by the majority of European observers in India.[66] Thus, although the naval timber-conservation interest on the west coast continued to make its protests during the 1820s, these fell on deaf ears.

The end of the west-coast conservancies spelt the end of conservation attempts based solely on an interest in assuring a supply of timber for state needs. Instead, after 1823, most of the successful conservation initiatives were based primarily on arguments relating to matters other than simple timber depletion. Furthermore, the opinions of scientists gradually became more influential and were more willingly heard than the pleadings of the military and naval boards. After 1823 the focus of concerns about climate and deforestation and timber shortage shifted once more to Bengal. This was primarily an outcome of a localised company interest in the dynamics of climate and famine that had been nurtured by William Roxburgh, first in Madras and then, after 1793, in Bengal. This resulted less in an early interest in conservancy than in a state enthusiasm for tree planting that did not develop in the Bombay Presidency until the 1840s. In order to understand the development of state tree-planting efforts in Madras and Bengal, some appreciation is needed of the evolution of the environmental interests and activities of Roxburgh himself.

Early Scottish Hippocratic responses to ecological crisis in India: William Roxburgh and the study of climate and famine in Madras and Bengal, 1776–1825

A more sophisticated and intellectual response to evidence of deforestation and drought had in fact been developing simultaneously to the worries about naval and other timber shortages which we have already observed in the successor states of the Mughal empire. This had begun in 1776 with the arrival

66 Bishop Heber was a rare exception to this rule: R. Heber, *Narrative of a journey through the Upper Provinces of India from Calcutta to Bombay, 1824–5*, London, 1828, p. 274.

of William Roxburgh in Madras after a period spent as a surgeon on company ships. During the ensuing thirty-seven years, until his death in 1813, Roxburgh developed a series of analyses and diagnoses of the dynamics of climate and ecological change in India. All of these were contingent, and even marginal, to his main role as company surgeon, botanist and 'naturalist'. However, Roxburgh was by no means a marginal 'colonial scientist' simply articulating the narrow material interests of the company or colonialism. Instead he can be seen far more accurately as a product of a late Enlightenment interest in meteorology. In this sense he should rightly be placed in a category along with such colonial environmentalists and climate enthusiasts as Alexander Anderson and Pierre Poivre. But he also occupied a place in a scientific mainstream closely connected with such major contemporary figures in the Royal Society as Sir John Pringle and Joseph Banks, as well as other early Linnaeans working in the tropics. Roxburgh identified himself with the strongly dissenting and investigative Warrington Academy school of Joseph Priestley and Johann Reinhold Forster, two men whom he admired and imitated. More specifically, Roxburgh allied himself with the Priestleyite interest in the measurement of atmospheric 'virtue', with all that that implied in terms of attitudes to social and scientific reform and of dissent. In other words, Roxburgh linked the quality and 'virtue' of the atmosphere with the quality of a society. Through his training under John Hope, the Linnaean experimental plant physiologist and curator of the Edinburgh botanical garden, Roxburgh also became a direct inheritor of the ideological agendas of Stephen Hales and Duhamel du Monceau, the two men who had most influenced Hope and about whose theories he lectured in Edinburgh to Roxburgh and his fellow students in the early 1770s.[67] Hope brought Roxburgh, as his star student, into contact with two important networks; those of the Royal Society and the Society of Arts. From the Royal Society Roxburgh took up the contemporary enthusiasm for systematic meteorology, while from Hope and the Society of Arts he adopted a related and life-long interest in tree planting.[68]

As a company surgeon, Roxburgh integrated these meteorological and arboricultural programmes into a more specifically medical discourse and made them part of a programme of interventionist interaction with the tropical environment which he developed after 1776. Finally, he became a pioneer in the collection of tropical meteorological data, to an extent unrivalled elsewhere until the 1820s except among indigenous Chinese observers. It was detailed measurements over many years that facilitated his diagnosis of climate change

67 H. R. Fletcher and W. H. Brown, *The Royal Botanic Garden, Edinburgh, 1670–1970*, Edinburgh, 1970.

68 Later recognised by the Society with the award of a medal.

and famine incidence, the basis for his more generalised critique of the colonial impact on the Indian environment.[69]

A major 'centre of calculation' encouraging the collection of meteorological data was the Royal Society itself. The Society's connections with systematic meteorology dated back to 1723 and were in origin closely connected to the discoveries of Hales and the publication of *Vegetable Staticks*. In 1724 Junius Jurin, a close colleague of Isaac Newton, had published *Invitatio ad observationis meteorologicas communi consilio instituendes* in London. This appeal for data resulted in the submission of temperature and rainfall records from places as far apart as St Petersburg, the state of Massachusetts and, not least, Bengal, where some company servants had been directly involved. While important for the Royal Society as an exercise in initiating a data-collection network, these pioneering efforts were effectively disrupted by the wars of the mid eighteenth century.[70] However, after about 1770 an interest in meteorology and meteorological networks quite abruptly arose again. This time the motivation behind them was more directly connected with a widespread shift in Europe towards the collection of systematic data as a part of wider state policy, and it was more medically oriented. In essence, medical and agricultural climatology became institutionalised as European states increasingly intervened in matters of public and health welfare. In France, for example, a national network of observers was established in 1778 under the auspices of the Société Royale de Médecine, and contemporaries spoke of meteorology as 'a new science'.[71]

The work of two researchers contributed to the revival of meteorology after 1770: Jean Deluc's 1772 *Recherches sur les modifications de l'atmosphère* and Joseph Priestley's 'Observations on different kinds of air', also published in 1772. The dissenting and reformist connotations of Priestley's work meant that from 1772 onwards British meteorology involved a radical set of agendas at least as strong as the climatic 'moral economy' implicit in the ideas of Poivre and his physiocratic colleagues in Paris. Roxburgh could not have avoided the social messages of this meteorological radicalism and, indeed, seems to have embraced them with enthusiasm in a tropical region where meteorological fluctuations were so much more extreme than in Europe (and often fatal in their consequences) and where they therefore might be interpreted as signi-

69 Note that neither Poivre nor Anderson collected discrete and systematic meteorological data, while Banks and Beatson commenced collection of rainfall data on St Helena only after 1811.

70 Feldman, 'Late Enlightenment meteorology', in T. Frangsmyr, J. L. Heilbronn, and R. E. Rider, eds., *The quantifying spirit in the eighteenth century*, Berkeley and Los Angeles, 1990, p. 147.

71 Ibid. As far as methods were concerned, this revival in meteorology was based on the botanico-meteorological work of Duhamel du Monceau, whose influence on Mauritius and on John Hope has already been noted.

fying far more important social lessons. Roxburgh, like his compatriot on St Vincent Alexander Anderson, also became sharply aware of the new moral significance ascribed by their joint mentor, Sir John Pringle, to the atmospheric function of vegetation as it could now be interpreted in the light of Priestley's findings. Pringle, as we have seen, placed Priestley's pneumatics in the context of the aerial system of fevers and also linked it with the model of a benevolent economy which Priestley had begun to map. 'From these [Priestley's] discoveries we are assured that . . . every individual plant is serviceable to mankind, if not always distinguished by some private virtue, yet making a part of the whole which cleanses and purifies our atmosphere.' Storms and tempests (i.e. extreme meteorological events) would shake the 'waters and the air together to bury in the deep those putrid and pestilential effluvia which the vegetables upon the face of the earth have been insufficient to consume'.[72] The importance of this line of thinking to the later development of climatic environmentalism can hardly be overemphasised, as it became an essential part of the link made between environment and reformist notions of moral economy among Scottish surgeons in the Indian medical services.

While on St Vincent, Anderson eventually followed the implications of Pringle's sweeping environmentalist dictums (as relayed by Edward Long) by seeking to protect existing natural forests. Roxburgh, for his part, intended to go one significant stage further in India by cultivating new plantations and implicitly thereby serving mankind by purifying the atmosphere and increasing the social 'virtues' represented by the survival or renewal of vegetation. The gradual unfolding of Roxburgh's Priestleyite environmental programme (among many other activities, mainly botanical) can be identified almost from the date of his arrival in Madras in 1776. In that year he began a series of meteorological observations for the Coromandel Coast (using a Nairne thermometer and Ramsden barometer) which remained unbroken until his posting to Calcutta in 1793. Logic dictated that Roxburgh should send his observations back to the Royal Society, and he duly sent his records for 1777–9 to Sir John Pringle, thereby reaffirming the theoretical and ideological basis for the observations and incorporating the Indian environment into the ambit of the dissenting and reformist networks of Priestley and his associates. There were in fact great practical difficulties of time and space involved, and a letter from Roxburgh to Banks in 1782 indicates that many of the records which he sent to Pringle in London were lost en route.[73] However, Pringle ensured that

72 Sir John Pringle, quoted in Douglas McKie, 'Joseph Priestley and the Copley Medal', *Ambix*, 9 (1961), 1–22. See also Priestley, 'On the noxious quality of the effluvia of putrid marshes'.

73 Roxburgh to Banks, letter, 10 Dec. 1782, in *Banks letters*, p. 714. Roxburgh asked if Surgeon Sharpe could be commissioned to carry copies of weather records to John Pringle in London after the loss of earlier copies. Roxburgh had begun a correspondence with Banks in 1779, informing him of the research journey to the Malacca Strait and Siam being undertaken by Johann Koenig for the EIC.

Roxburgh's first sets of weather records from the Madras Presidency were prominently published in *Philosophical Transactions of the Royal Society* in 1778 and then much later in 1790.

During his first few years of residence in the Madras Presidency, Roxburgh spent much of his time as a surgeon at Nagore and in supervising the construction of an acclimatisation and botanical garden at Samulcottah, north of Madras.[74] Here he embarked on a long run of plant-transfer and tree-planting experiments, very much on physiocratic lines.[75] It was while resident at Nagore between 1778 and 1780 that Roxburgh first became interested in the interconnections between drought and famine. In times of scarcity, he noted, the supply of coconuts (a major food item) from Ceylon quickly dried up. He therefore advocated company sponsorship of food-tree planting along canal banks and village streets to secure supplies from coconut, sago, date, and palmyra palms as well as from plantain, jackfruit, breadfruit and opuntia trees.

Meanwhile Roxburgh's meticulous record keeping meant that he obtained a very detailed empirical view of the local impact of the globally occurring droughts that took place in 1787–92 and that particularly affected semi-arid zones in India, West Africa and the Caribbean. These drought episodes were almost certainly caused by an unusually strong El Niño phase in the current off the west coast of South America. This current is now believed to be the single most effective variable in controlling annual fluctuations in global atmospheric circulation and in particular the strength and incidence of the Indian Ocean monsoon.[76] In 1791 the world experienced one of its strongest known El Niño episodes.[77] Already devastated by a famine in 1780, the Circars of the Madras Presidency were again very badly affected in 1789–92, and many villages in the Godavery delta were entirely depopulated. The famine was much discussed in Europe; Edmund Burke referred to it. Roxburgh made a particular point of praising pre-colonial irrigation methods and, like Burke, believed that the EIC was largely responsible for the decline in artificial irrigation and for the increased vulnerability to famine that resulted from periods of drought. While there is no proof that Roxburgh was actually aware of Burke's critique of the company in this respect, there is no question that both

74 Samulcottah is a small station about seven miles from Coconada and twenty-seven miles from the mouth of the Godavery River.

75 According to George King, he introduced coffee, cinnamon, nutmeg, arnotto and sappan wood as well as the breadfruit tree, the mulberry tree and various kinds of pepper vines. He also experimented with sugar cane.

76 Quinn and Neal, 'El Niño occurrences over the past four and a half centuries'.

77 The strength of the 1791 El Niño was recorded by, among other authorities, J. H. Unanue, in *El clima de Lima*, Madrid, 1815.

men belonged to the same party in this case.[78] In fact, since 1782, according to Buchanan, rainfall levels had deteriorated steadily in South-East India. This decline had been noticed by Roxburgh and had in fact led him to speculate on the periodicity of drought events and to compare the severity of the late 1780s rainfall deficit with that of earlier periods. The results of these investigations were reported to the company in 1793.[79] 'There are but few, if any', Roxburgh wrote, 'of the lower Maritime Provinces of India that are not subject to (I dare scarce venture to say periodical, because our knowledge of meteorological facts is but as yet very imperfect) visitations of drought, more or less according to unknown circumstances.' In recent years, he added, 'we have seen and heard of the dreadful effects of such droughts prevailing over many parts of Asia'. It was sufficient, he carried on, 'for my purpose to take notice of that which has taken place in the Circars for no less than three years successively, to the dreadful effects of which I have been a constant Eye-witness'. As noted in Chapter 7 the seriousness of the drought in Southern India was communicated by James Anderson, the curator of the Madras Nopalry garden, to Robert Kyd in Calcutta, in a communication which came to the notice of Alexander Beatson on St Helena some years later.[80] However, while this networking was important (particularly in its effect on Beatson's thinking), Roxburgh's response was far more practically significant. In essence it fell into three parts. First, he became interested in placing the 1789–93 droughts in an historical and chronological context. Secondly, he sought to blame the nature of zamindari landlordship as it had been reconstructed by the company for the seriousness of the famine that resulted from the drought. Thirdly, the famine increased his interest in planting trees both to provide famine foods and to try to increase the incidence of rainfall. This last concern would have been further stimulated as knowledge of the passing on St Vincent of the King's Hill Forest Act of 1791 started to get around among East India Company officials.

By taking an interest in the history of Indian droughts, a logical outcome of his meteorological interests, Roxburgh soon became aware of a comparable drought period one hundred years earlier, in the period 1685–8.[81] He actively

78 See Edmund Burke, 'Speech on the Nabob of Arcot's debts', 28 Feb. 1785, reprinted in P. Marshall, ed., *The writings and speeches of Edmund Burke*, vol. 5, Oxford, 1981.

79 William Roxburgh, 'Suggestions on the introduction of such useful trees, shrubs and other plants as are deemed the most likely to yield sustenance to the poorer classes of natives of these provinces during times of scarcity', report to President's Council, Tamil Nadu State Archives, Public Consultations, vol. CLXXX1, 8 Feb. 1793.

80 Beatson, *Tracts*, p. 15. See Chapter 7.

81 This drought, too, appears to correlate with a strong El Niño episode. See Quinn and Neal, 'El Niño'. On this occasion, according to Roxburgh, the climatic perturbation involved three exceptionally wet years followed by three very dry years.

sought out documentary and oral evidence of these earlier droughts, finding a rich source of material in an informant whom he refers to as 'the Rajah of Pittenpore's family Brahmen'.[82] This informant had found among 'the records of his grandfather an account of a most dreadful famine which prevailed over the northern provinces' during the years 1685 to 1687. During the last year 'only one shower fell', and 'very few people survived these three years'. Roxburgh noted, too, the incidence of lesser famines in other years, especially in 1737. But the severity of famine in the 1680s and 1780s seems to have made a deep impression on him, much as the 1770 famine had on Robert Kyd. The scale of mortality involved meant, he thought, that the government would have to address the issue by reforming land ownership and by tree planting. 'I fear', he commented, 'that no great deal of good can be done while the present system of renting the lands of these provinces prevails, viz., that the Sower scarcely knows whether he will reap or not, and if he mends the Bank of a water course or digs a well, he knows not but it may be for the benefit of another.' Government would have to restore permanent title to the ryots (peasants), he thought, 'that we may hope soonest to see resources for the Poor, hitherto unknown in these parts, springing up'.[83] In fact, on paper the Madras government approved these suggestions, resolving to 'procure cocoanuts from Colombo, sago-palms from Travancore and bread-fruit from the Nicobars for sowing and planting'.[84]

Shortly after submitting his famine report to the Madras government, Roxburgh was transferred to Calcutta as director of the botanical garden upon the death of Kyd. This meant that his policy initiatives for food security, land reform and tree planting on the Coromandel Coast were interrupted. Nevertheless, there were plenty of opportunities to develop such physiocratic policies in Bengal. In particular Roxburgh set about improving on Kyd's teak-planting experiments and expanding them into a fully developed plantation programme in Bengal, Bihar and Orissa. To aid him in this, he brought with him large supplies of teak seeds from Rajahmundry.[85] Between 1793 and 1813 (when Roxburgh died) the plantation programme was steadily expanded, and it continued to be enlarged by Nathaniel Wallich after Roxburgh's death. As the first planted trees started to mature, after about 1805, Roxburgh began to write papers dealing with their growth and comparing it with that characteristic of natural teak stands.[86] At least one of these papers was reprinted in

82 'Note' in Roxburgh, 'Suggestions' (see n. 79).

83 For further details of this, see Roxburgh correspondence quoted in Love, *Vestiges of Old Madras*, II, p. 410.

84 Ibid.

85 NAI, Fort William–India House Correspondence, p. 230: Letter from Roxburgh to Court of Directors, 7 Mar. 1796.

86 'A table of the growth of trees in the botanic garden at Calcutta', *Nicholson's Journal*, 17

Transactions of the Royal Society of Arts and is indicative of the close relationship which Roxburgh maintained with this society, its tree-planting campaigns and its environmentalist personalities. Roxburgh did not, in fact, drop his meteorological interests during this period, becoming particularly concerned with the provenance of the seasonal drying winds which caused so much agrarian havoc in deforested landscapes. Significantly, he published the results of these researches in medical journals.[87]

There are two main points to be made about Roxburgh's Bengal plantation initiatives. While undoubtedly additionally stimulated by the general ship and urban timber shortage in Bengal, the climatic and medical motivations for tree-planting activity which had first affected Roxburgh in Coromandel were still important. Secondly, the plantation methods he adopted were developed by him in India and were not derived from German or other European precedents. Indeed, Roxburgh's plantation methods predate most comparable German methods and owed nothing to them. Georg Hartig's standard German texts on forestry science, for example, postdate Roxburgh's first methodically organised plantations in Bengal by more than ten years.[88] This is not surprising, since the soil and weather conditions in Bengal could hardly have been more different from those of Central Europe. Instead Roxburgh relied heavily on indigenous skills and advice to develop the plantations, and the extant records reveal the considerable difficulties experienced before plantings were successful.[89] The most important of these experiments took place in the large forest reserves at Bauleah in Bengal.[90] By 1812 the experimental area was large, being some 715 bighas in size.[91] Roxburgh's early experiments must have been a success, since as early as 1798 he had decided to extend teak planting to Bihar, a development which the Calcutta authorities were quick to boast about

(1807), 110–11, 'Letters on various productions of the East Indies', ibid., 27 (1810), 69–76, and 'Some account of the teak tree of the East Indies', ibid., 33 (1812), 348–54 (the last paper was reprinted in *Transactions of the Royal Society of Arts*, vol. 30).

87 See, for example, 'Remarks on the land winds and their causes', *Transactions of the London Medical Society*, 1 (1810), 189–211.

88 Georg Ludwig Hartig, *Grundsätze der Forst-Direction*, Weimar, 1803. See also Henry E. Lowood, 'The calculating forester: Quantification, cameral science and the emergence of scientific forestry management in Germany', in Frangsmyr, Heilbronn, and Rider, *The quantifying spirit in the eighteenth century*, pp. 315–42.

89 NAI, Fort William–India House Correspondence, vol. 13, p. 31: 'Letter transmitting report of Dr Roxburgh on the teak tree with his request to be furnished annually with certain plants and seeds'.

90 BL, IOL, F/4/427 (10478): Reports on teak plantations at Bauleah by George Ballard and William Roxburgh, 1812.

91 For details of Roxburgh's experiments in plantation methods at Bauleah, see NAI, Home Public Consultation Letters, letter, 23 Oct. 1812: E. Barnett (Acting Collector of Bauleah) to Richard Rocke, Acting President and member of the Board of Revenue, Fort William, Calcutta. A bigha is about two-thirds of an acre.

to the Directors in London.[92] By 1813 further plantations had been established at Cuttack in Orissa and in outlying districts of North-West Bengal and Bihar.[93] Sometimes the police service was used as a convenient conduit for the supply of seeds and trees.[94] At other times in the period 1812–17 seed was provided direct to selected zamindars to make plantations at their own discretion, an idea that seems to have been taken up in several parts of Bengal. Other supplies of seeds and saplings were sent to the botanical gardens at Saharunpore and Agra, to 'Mr Gardner at Khatmandu', to the 'Vizier' at Lucknow and to stations as far off as the Ceded Provinces.[95] By 1817 some of the plantations set up by Roxburgh were being supplied with large allocations of convict labour, a development which he might not have approved of.

By the time Nathaniel Wallich took over as superintendent of the Calcutta Botanic Garden in 1816, a very extensive tree-supply and arboricultural information network had been set up based in Calcutta and stretching between Delhi in the East, Kathmandu in the North and Cuttack in the South. The Plantation Committee set up in 1823 by Wallich and the Marquis of Hastings was predicated on this network and provided the basis for an arboricultural role in government at a time when forest conservancy had been almost entirely abandoned on the west coast of India. However, the limitations of the plantation arboriculture established by Roxburgh need to be appreciated. Although convinced of a relationship between trees and the atmosphere, Roxburgh does not seem to have been able to conceive of climatic variation taking place on a *regional* basis, even though he could appreciate and apparently measure climatic changes in terms of observations at single geographical points. The critical transition to apprehending the possibility of actually measuring regional change probably required the kind of approach described in 1817 by Humboldt in his advocacy of the isotherm as a means to describe continental climates.[96]

92 NAI, Home Public Consultations: Letter, 31 Jan. 1798, Fort William, to Court of Directors: 'Considerable quantities of [teak] seeds have been sent to parts of Bengal and Berar.'

93 Ibid., External Revenue Dept: letter, 22 May 1813 (received 23 June), telling the Botanic Garden superintendent to take measures for disseminating the cultivation of the teak tree in the district of Cuttack; see also letter, 2 Oct. 1813 (received 11 Oct.), 'relative to cultivation of the teak tree in various districts'.

94 NAI, Home Public Consultations: letter of 14 Feb. 1817: 'Reply to orders, has selected and forwarded to the Superintendent of Police in the Western Provinces a quantity of teak seeds, with a copy of directions to forward the object contemplated.'

95 Ibid., Botanic Garden Letters, 1816–17. Supplies of trees were sometimes used as diplomatic presents by the company, as in 1811, when the Royal Gardens in Delhi were supplied with trees from Calcutta (letter, received 21 June, from External Political Dept to Supt, Botanic Garden, Calcutta).

96 Alexander von Humboldt, 'Sur les line isothermes et la distribution de la chaleur sur le globe',

By the time of his death in 1813, Roxburgh had formulated a Hippocratic and Priestleyite response to famine, timber shortages and deforestation, converting it to his own very unusual arboricultural strategy. While the strategy was widely accepted in company circles, which were apparently easily persuaded of the validity of Roxburgh's ideas, a philosophy which connected tree cover with atmospheric and medical 'virtue' actually ran counter to emerging currents in the medical and epidemiological thinking of the time – although such thinking was, admittedly, highly ambivalent with regard to the health benefits of forests. In 1807, for example, James Johnson (like Roxburgh an ex-naval surgeon), the most popular medical writer on climate and disease in India before 1850, remarked approvingly of the efforts being made on St Helena 'to spread vegetation and plant trees' to increase the availability of moisture.[97] But by 1818 Johnson had entirely changed his tune and warned unequivocally that 'mountain countries with trees give rise to fevers' and that miasmic poisons adhered to 'lofty umbrageous trees'.[98] Precisely at the time when the extensions of plantations were being planned by Roxburgh and company authorities near Calcutta, Johnson warned that 'all forests around Calcutta should be cleared'.[99] Similarly, the Western and Eastern Ghauts [mountains] of India, he said, were 'the origins of miasmata'. As the inheritor of Roxburgh's policy, Nathaniel Wallich ignored the Johnsonian theories of forest miasmata. Moreover, he had powerful political allies who also took the Roxburgh line on the benefits of trees, not least of these being Bishop Heber, a close friend of Roxburgh's and a devotee of his atmospheric philosophy. Heber it was who composed the eulogy to Roxburgh on the monument at the foot of the great banyan tree in the Calcutta Botanical Garden.[100]

A few years later, in 1824, Heber followed Roxburgh by criticising the reckless speed of deforestation in Kumaon and the Siwalik tracts for aesthetic and agricultural reasons, and on grounds which Wallich had not himself cared to utilise with government. 'Great devastations', Heber believed,

> are made in these woods, partly by the increased population, building and agriculture, partly by the wasteful habits of travellers, who cut down multitudes of young trees to make temporary huts, and for fuel, while the cattle and goats which browse on the mountains prevent a great part of the seedlings from rising. Unless some precautions are taken, the uninhabited parts of Kumaon will soon be wretchedly bare of wood and the country, already too arid, will not only lose its beauty, but its small space of fertility.[101]

Mémoires de la Société d'Arcueil, 3 (1817), 462–602, quoted in Feldman, 'Late Enlightenment meteorology', p. 177.

97 J. Johnson, *The Oriental voyager*, London, 1807, pp. 380–2.

98 J. Johnson, *The influence of tropical climates on European constitutions*, London, 1813 (repr. 1818, 1827), p. 93.

99 Ibid., p. 71.

100 King, 'Memoir on William Roxburgh'.

The complex scientific and symbolic loading of the botanical garden as an institution, which in India had distinctive Mughal antecedents, provided the practical infrastructure for a new-found appreciation of the vulnerability of the environment to human action. This new appreciation was guided, as it had been on Mauritius and St Vincent, by a strong medical preoccupation with the workings and interdependence of environmental factors and human health, underpinned by a growing awareness of the pharmacological significance of tropical plant species.[102] While encouraged by the state, ostensibly for economic and commercial reasons, the botanical garden continued to encompass less openly expressed notions of the tropical environment as a paradise, botanical or otherwise, which most professional botanists were keen to protect. It is true that the connections between paradisal ideas and botanical or experimental gardens had actually been more pronounced in the Mughal period. Indeed, the ancient Farsi term for an ornamental garden was 'paradaeza'. However, many EIC gardens were, in fact, founded on the sites of older Mughal imperial gardens. The garden at Saharanpur, revivified by the Marquis of Hastings and J. Forbes-Royle, was an early example. Furthermore, paradisal notions continued into the company period, albeit entirely Europeanised in conception. Thus Heber had written of the Calcutta Botanic Garden at Sibpur that it was

> a very beautiful and well managed institution, enriched besides the noblest trees and most beautiful plants of India, with a vast collection of exotics, chiefly collected by Dr Wallich himself in Nepaul, Sumatra and Java and increased by contributions from the Cape, Brazil, and many different parts of Africa and America, as well as Australasia, and the South Sea Islands. It is not only a curious but a picturesque and most beautiful scene, and more perfectly answers Milton's idea of Paradise except that it is on a dead flat instead of a hill, than anything which I ever saw.

101 Heber, *Narrative*, p. 274. The reference to the 'beauty' of the country, as well as its physical state, is noteworthy here; according to Charlton, *New images of the natural*, p. 80, Heber was a pioneering inheritor of those French writers (especially Bernardin de Saint-Pierre) who appealed to nature's creativity as evidence of the existence of God as a loving, providing father. Such notions helped to increase the sensitivity of Europeans to landscape change.

102 A recognition of the pharmacological potential of tropical forest species in undisturbed forest is an extension of this idea and is especially apparent in H. Cleghorn, F. Royle, R. Baird-Smith and R. Strachey, 'Report of the committee appointed by the British Association to consider the probable effects in an economical and physical point of view of the destruction of tropical forests', *Report of the Proceedings of the British Association for the Advancement of Science*, 1852, pp. 78–102.

One can see here that, with Heber, the notion of the creation of an earthly paradise made up of plants derived from the 'four quarters of the world' was still very much alive.[103] It is no coincidence, perhaps, that it was Heber who had first clearly articulated anxieties about the rates of deforestation and possible aridification in Northern India during the 1820s.[104] However, the paradisal connotations of the botanical garden and its historical and textual connections with both Mughal and western Edenic discourses are not sufficient to explain the emerging environmentalism of the company medical service. It required an acquaintance both with Priestley's atmospheric theories and with the holistic conceptions of German Romantic science (and Humboldtian ideas in particular – themselves strongly connected with an emergent Orientalist 'Indic' knowledge) to give the Scottish surgeons of the EIC Medical Service the powerful arguments they needed to solicit state protection of the environment.

The career of Nathaniel Wallich well exemplifies these connections.[105] Once he was firmly established as superintendent of the Calcutta garden in 1817, the mere longevity of Wallich in office assured him the ear of the authorities.[106] Wallich was particularly impressed by Roxburgh's plantation efforts and moved quickly to replicate and institutionalise them, bringing about the formation of a Plantation Committee, chaired by the governor-general, in 1823. This method of formalising plantation activities seems to have been stimulated

103 Heber, *Narrative*, pp. 39–40. See also N. M. Titley, *Plants and gardens in Persian, Mughal and Turkish art*, London, 1979.

104 It should be recalled that the Calcutta Botanic Garden had also exercised a powerful formative impression in Humboldt's mind. See Chapter 4.

105 Nathaniel Wallich (1786–1854) was thirty years old when he assumed control of the Calcutta Botanic Garden, and he remained in charge until 1846, when he was succeeded by Hugh Falconer. Vicziany states that 'it never occurred to the Company that Wallich be asked to complete Buchanan's survey of Bengal because he simply lacked the talent for such a complex task' ('Imperialism, botany and statistics', p. 55 n. 127). Sir William Hooker, however, wrote that 'this gentleman, a pupil of the celebrated Hornemann of Copenhagen, entered upon the duties of office with an ardour which has rarely been excelled in any country and which has certainly never been equalled in a tropical climate': Review of *Illustrations of Indian botany*, *Hooker's Botanical Miscellany*, 1831, pp. 90–7. Heber, for his part, reported that Wallich was 'the epitome of all frankness . . . and creative zeal for the source of science, the last enriched by a greater source of curious information relating to India and the neighbouring countries than any which I have met with': *Narrative*, p. 40.

106 The relationship between the botanical-garden system in India and the EIC Medical Service had become formalised in 1793 with the appointment of Roxburgh as director of the Calcutta Botanic Garden in succession to Kyd. By 1814 the Sibpur/Calcutta garden contained 3,500 specimens. In 1831 Hooker wrote, 'The circumstances of Dr Wallich being appointed as successor to Dr Hamilton [Buchanan-Hamilton] to the Superintendence of the Calcutta Botanic Garden constitutes a new era in the Botany of India': *Hooker's Botanical Miscellany*, 1831, pp. i–ix (editorial).

by a run of correspondence in 1819 between the Marine Board at Calcutta and the Bombay government. These letters indicate the scale of difficulty involved in transporting coir and timber from the west coast to Bengal for particular shipbuilding projects, so that any state activity to encourage the timber supply must have seemed attractive.[107]

Wallich also intended the Plantation Committee to cope with a severe shortage of sissoo (*Dalbergia Sissoo*) and bamboo in rural areas of Bengal, a shortage which he considered a 'formidable evil', as 'bamboo is the universal building material for the lower orders of the natives of India', and 'a good sized bamboo has not been for many years procurable in Bengal'.[108] According to Wallich, Calcutta's construction and firewood needs had long been supplied from the Moorshedabad area. However, in 1815–16 the bamboo jungle had been 'cut down as it was supposed to be the cause of local epidemics'. Wallich clearly scorned this apparently Johnsonian forest clearing and pointed out that 'in the first place the sickness was not remedied'. It would be far better, he believed, to follow the example of the judicious 'Rajahs of Rampore and Rohilcund', who had carefully protected bamboo forests and plantations to cater for local needs. Otherwise, he thought, it would be necessary to import bamboo from the Mattaban coast of Burma. By articulating these views, Wallich brought about a distinctive 'social forestry' based on indigenous precedents and apparently concerned for the basic needs of the poorer rural communities. His ideas were taken up by government, although without a great deal of enthusiasm. In 1822 the Bengal Public Works Department took over Roxburgh's old plantations at Bauleah, Sylhet and the Jungle Mahals (in Eastern Chotanagpur) to continue planting teak, while adding sissoo and saul (*Shorea robusta*) species to the plantations.[109] A year later Wallich formed the Plantation Committee to further develop the concept and provide assured finance for plantation staff. One immediate result of its proceedings was that Wallich's expertise in all matters relating to botany, forests and arboriculture was now recognised at the highest level.[110] This, along with the government's direct

107 NAI, Home Public Consultations, 1819, letters, 12 March (on despatch of coir and timber from Mangalore to Calcutta) and 20 July (from Marine Board on timber for Bengal for buoys and light vessels).

108 Nathaniel Wallich in House of Commons Select East India Committee cross-examination, 14 Aug. 1832, by T. H. Villiers, in *Parliamentary papers relating to the East Indies*, X, pt 1, pp. 193ff, esp. paras. 2335–43.

109 Ibid., 10/719/40, p. 771, 'Appendix'.

110 Dr H. F. C. Cleghorn noted in 1852: 'Three MS volumes of proceedings and reports, with two original maps of the route taken by Dr Wallich and Capt. Satchwell were placed by the Supreme Government with the Agricultural and Horticultural Society "for information and deposit". These volumes contain the labours of a body of public officers which, under the denomination of the "Plantation Committee", originated under the Marquis of Hastings and continued in existence six years. The records of its proceedings, as contained in these vol-

involvement in plantations, ensured that the superintendent's opinions were eagerly sought as the timber shortage became more serious throughout India in the late 1820s and early 1830s.

Before this, however, one early significant outcome of the Plantation Committee's work was the stimulus it gave to efforts to incorporate tree-planting schemes in the canal-building projects which Hastings had encouraged. Here plantations served a dual purpose: in bank stabilisation and in provision of firewood. More important, tree cover came at this stage to be associated in the official mind, even if only loosely, with the retention of water in local water-tables.[111]

Wallich's consultative role was developed further in 1825 when he was appointed to make a survey and report on the submontane forests of Oudh, which were said to be undergoing extensive depredation.[112] This had caused some anxiety in Calcutta, where shortages of firewood and construction timber in the environs of this rapidly growing colonial capital had been a matter of official concern since the 1760s. Wallich's consultancy was the first of a series

umes, extend over 1070 pages of manuscript. They contain much and most valuable, indeed generally unknown information bearing on the great practical measure of forest cultivation . . . the Sissoo localities in particular, and every effort should be made to preserve this information from destruction. The late Dr Spry [the author of *Modern India*,] Secretary of the Agricultural and Horticultural Society, was desired to undertake the examination of these records and favour the society with a report upon their contents.' Unfortunately, this was never done, owing to Spry's untimely death, and I have not to date traced the Plantation Committee records. Nevertheless, their contents were instrumental in persuading Dr Ryan, Spry's successor as secretary, to campaign for forest conservation on the basis of an imminent firewood crisis during 1841 (the same year as J. F. Royle, surgeon and later superintendent of the Saharanpur Botanic Gardens, was advocating state forest protection in his *Productive Resources of India*), thus aiding Alexander Gibson in his similar efforts. See Cleghorn et al., 'Report of the committee', and Royle, *Essay on the productive resources of India*, London, 1840, pp. 98–104.

111 There is an important, although tenuous, connection through the Marquis of Hastings among canal reconstruction, the early fostering of botanical gardens and later advocates of conservation. In 1821 Hastings visited the North-West Province. The reconstructed canal carrying water to Delhi was the primary interest of the expedition, and Hastings visited Saharanpur at its head. Here his attention was drawn to a neglected 'fruit-garden' which had been founded by Zabita Khan, the son of Najib ud-Daula, with the revenue of seven villages for its maintenance. This had been reduced by the Marathas, who were less interested in botanical gardens (an interest of Persian origin in the case of Zabita Khan); the function of the garden had been the encouragement of economic plants, especially fruit trees. Hastings decided to restore it and appointed George Govan, the EIC civil surgeon at Saharanpur, as superintendent, to be succeeded by J. F. Royle in 1823. Royle, incidentally, had deliberately chosen the medical profession for the purpose of pursuing his botanical interests. Saharanpur was then used by Wallich as the forward base for his extensive surveys of Oudh, the Himalaya foothills and the Terai. See Burkill, *Chapters*, pp. 31–3.

112 Stebbing, *Forests*, p. 126.

of assignments he fulfilled between 1825 and 1827 in Oudh and then further afield in Burma. In 1826 he was required to make an ascent of the Irrawaddy and report on the state of forests there, while in 1827 he had to travel up the Salween and Ataran rivers to their headwaters.[113] The recommendations made by Wallich after his Oudh expeditions are worthy of special attention, although their full implications were ignored by government at the time. In essence Wallich argued for extensive state intervention to save the forests in areas he had visited. Many of the forests of the Himalayan foothills were open to 'wanton destruction' and 'in every way deserving of being preserved for the exclusive use of government', which, Wallich thought, should 'interfere in the management of the forests'.[114] In this way a project that had been intended by government essentially as an auditing exercise after the attainment of (or the contemplation of, in the case of Oudh) full political control was converted by Wallich into an exercise in the advocacy of interventionism. The time was not yet ripe for interventionist prescriptions, however, and Wallich's ideas were ignored, so that, insofar as policy was concerned, he remained for a long time a conservationist voice crying in the wilderness.

From hindsight, part of the reason for this impasse lay in Wallich's apparent decision not to utilise arguments other than those concerning prospective timber shortages, irrespective of his own motives for advocating forest protection, which undoubtedly were far wider than considerations of the state timber supply and which were largely inherited from Roxburgh. Furthermore, Wallich apparently thought he lacked any credible scientific basis or statistical data to question government policy with respect to forests. This is perhaps surprising, since the Bengal government itself had experienced great difficulty in obtaining timber supplies in Bengal. However, the colonial state still appeared to think it might import timber from further afield.

But there was another factor. After the departure of the Marquis of Hastings, the EIC had become far less disposed than before to believe that the kind of scientific botany of which the Calcutta Botanic Garden was a symbol was really being of any substantial economic benefit. To this extent, Banks's successful and, arguably, dishonest advocacy of economic arguments with government had begun to fall flat. Thus in 1830 an EIC Retrenchment Committee

113 Burkill, *Chapters*, p. 34.

114 Reported in Royle, *Productive resources of India*, p. 189. Royle also noted: 'In his visit to the Terai . . . he particularly recommends a vast extent of forest-land in Oude, situated in the east side of the Kaureola river, and holding out the prospect of very valuable supplies, provided that means are adopted for preventing wanton depredation, and of allowing the young plants to grow up and take the place of those cut down.' While little notice was taken of Wallich's conservationist ideas during the 1820s, Royle's publication of part of his report in 1840 in a book widely read in official circles undoubtedly assisted Alexander Gibson in his later propagandisation of conservationist ideas as a servant of the Bombay government.

actually recommended that funding for the Botanic Garden should be heavily reduced. Similar moves were made in connection with the Dapoorie garden at Bombay a few years later.[115] It has, of course, been argued by Lucille Brockway that local colonial aims and policy on botanical gardens were firmly linked in objectives and ideology.[116] The successive attempts made by the EIC to reduce funding for the botanical gardens, or to eliminate it altogether, lead one to question the adequacy of this assumption. Both William and Joseph Hooker, for example, as successive directors of Kew Gardens found it necessary to ingratiate themselves with the company to an extraordinary extent simply because by the late 1820s the company had become almost entirely disillusioned with the economic potential and original promise of the botanical gardens. This made them early targets during periods of retrenchment, and it was only through the energetic efforts of the Hookers in the scientific community in Britain that the gardens in India survived this period at all.[117]

The early 1830s, therefore, were a period in which the company itself largely lost interest in both forest regulation and economic botany, despite the increasing preoccupation of contemporary metropolitan botanical science with Indian botany in a more academic sense. In the long run, however, it was the academic preoccupation, coordinated by William Hooker, professor of botany at Glasgow since 1820 and the future director of Kew Gardens, which enabled the botanical gardens in India and the role of the medical service in them to survive. Above all, Hooker saw the enormous scientific advantages in terms of plant collection and information co-ordination to be gained from the gardens and from the elaborate and growing network of surgeons stationed conveniently around India. It was his active encouragement of this institutional infrastructure, despite all the efforts of the EIC, which was to provide the basis for the development of a new kind of environmental critique and conservation policy in India.[118]

115 Burkill, *Chapters*, p. 109.

116 Brockway, *Science and colonial expansion.*

117 The same was true of the botanical gardens on St Helena and at the Cape during the 1830s. They suffered from much more serious neglect; see Grove, 'Early themes in African conservation', p.24.

118 Useful and comprehensive details of staffing, location and numbers of surgeons in the medical service are found in J. Macpherson, 'Notes on the condition of the Indian Medical Service', *Calcutta Review*, 1854, pp. 217–54; Spry, *Modern India;* and Crawford, *History of the Indian Medical Service* and *Roll of the Indian Medical Service.* Spry records that by 1838 there were at least 800 EIC surgeons based in mainland India. Burkhill (*Chapters*, p. 25) assembled the 'names of men who had studied the vegetation of India up to the year 1840' and found among them 28 surgeons, 7 army officers, 4 missionaries (not also surgeons) and 3 administrators in senior posts. The Edinburgh Medical School was the chief recruiting ground for the company's medical service. The efficiency and enthusiasm of the professor of botany determined the quality and research interests of the botanists produced. Roxburgh, Buchanan-Hamilton and Gibson were all ex-pupils of Professor John Hope at Edinburgh, who had annually awarded a gold medal to the student who produced the best dried plant collection.

Part of the basis for the strength of the botanical garden system as an institutional basis for environmental thinking and lobbying derived from the high reputation which company surgeons enjoyed in government circles in England. For example, in 1831 and 1832 Wallich was interviewed on several occasions by House of Commons committees on a variety of Indian agrarian and economic matters. He took advantage of these cross-examinations, which appeared on the official record, to press home his own opinions on what now appeared to him an Indian forest crisis. Wallich's interest in state forest control seems likely to have been awoken by a four-month sojourn on Mauritius, where he had particularly approved of the intensive land-use methods and rigorous land-use planning inherited from the French.[119] His observations on Mauritius, his experiences with the Plantation Committee and the severe timber shortages in Bengal and Malabar all influenced him in his statements to an 1832 Commons committee. Unless 'speedy provision' was made for the renewal of these forests for the supply of timber, 'we shall', he said,

> within a very short time, find a most painful falling off, that the present means, speaking of Hindostan, would be so inadequate as I mentioned yesterday, that even in such an article as bamboo (which I would compare to nothing less than the seacoal of England as one of the indispensable necessities of life) there would also be a great falling off.

Even if the forests were to be 'properly managed', he told the committee, 'they should be sufficient for local wants, but not for exportation'. Finally, he recommended, 'it is quite time that means should be resorted to, to preserve those forests which are remaining and new plantations should be made'.[120]

While Wallich was clearly precocious and well informed, he was by no means the only influential individual to be thinking on these lines at the time or to be affected by what was known of pre-colonial practices in forest protection. The naturalist leanings of Bishop Heber have already been noted. However, in influencing forest policy in the long term, the ideas of W. H. Sleeman were actually much more important, since he initiated a fashion for roadside and firewood tree planting in Northern India during the 1820s that was taken up and expanded by Governor-General Lord Dalhousie and others after 1850 in a move that laid the groundwork for Dalhousie's more comprehensive forest-policy initiatives. Despite his better-known role as a suppressor of thuggee, Sleeman emerges in his writings and in his policies in North-West India as a person deeply interested in the history of the Indian landscape and

119 Evidence to House of Commons committee, in *Parliamentary Papers relating to the East Indies*, X, Paper 735 (II), 1831–2, para. 2335, pp. 198–9.

120 Ibid., para 2303, p. 198.

an appreciator of the tree-planting inclinations of rulers and ruled during the pre-colonial period. Of course, it would be possible to link his interest in eliminating the 'criminal' groups in society to an interest in maintaining 'virtue' in the atmosphere and in the landscape by preserving the tree cover and eliminating 'vitiated' air.[121] But this might be a far-fetched thesis, not least because forest *clearance* tended to be a greater preoccupation with those interested in controlling 'thugs' and dacoits. Instead it is probably better to explore other reasons for Sleeman's environmentalism, not least in the areas of 'Oriental' scholarship and aesthetics. In a letter of 1844 Sleeman himself described the avenue of trees which he had planted along the road 'from Maihar to Jubbulpore' in 1829 and 1830, and another, eighty-six miles long, from Jhansi Ghat on the Narmada River to Chaka. The trees planted were banyan (Ficus *bengalensis*), pipal (*Ficus religiosa*), mango (*Magnifera inelica*), tamarind (*Tamarindus indica*) and jaman (*Eugenia jambolana*). These trees, Sleeman asserted with a self-confessed interest in posterity, would 'last for centuries'.[122]

According to his own writings, Sleeman's motives for encouraging tree planting seem to have been much affected by his readings of Shaikh Sadi and other early Islamic poets. For example, he quoted approvingly Sadi's couplet which argued that 'every leaf of the foliage of a green tree is, in the eye of a wise man, a library to teach him the wisdom of his Creator'.[123] Sleeman was similarly affected by what he knew of the connections between Hindu mythology and the 'sacredness' of kalpa briksha (*Erythrina arborescens*), in a system that effectively contributed to forest protection in, for example, the Jabera and Hardwar parts of the Northern United Provinces.[124]

Sleeman stands out as one of the few men who were *not* members of the medical service vigorously to promote forest protection for other than straightforward strategic and timber-deficit reasons. This is undoubtedly because his official duties gave him unrivalled opportunities to travel throughout Northern India and gain access to regions not generally reached by Europeans. As a result, he was able to form an impression of the very rapid and geographically extensive deforestation that was taking place in the 1820s,

121 W. H. Sleeman, *Rambles and recollections of an Indian official* (1844), London, 1914, pp. 73–7, 433–52 (chapter entitled 'Tree Cultivation').

122 Ibid., p. 451, note added by Vincent A. Smith, Sleeman's 1914 editor.

123 'Sadi' was the nom-de-plume of the Persian poet whose name is supposed to have been Shaikh Maslah ud-Din, who lived ca. 1194–1292. His best works are *Gulistan* and *Bustan*. Sadi says in *Gulistan*, ii.26, 'That heart which has an ear is full of divine mystery. It is not the nightingale that alone serenades his rose; for every thorn on the rose-bush is a tongue in his or God's praise'; see editor's note in the 1914 ed. of Sleeman's *Rambles and recollections*, p. 75.

124 Ibid., p. 74.

especially in the Ganga–Jumna Doab (confluence) and in the foothills of the Himalayas in present-day Uttar Pradesh and Himachal Pradesh. This episode of deforestation had begun in about 1800 and lasted until at least the mid 1840s, by which time very large areas had been rendered treeless and salinated. Sleeman documented this process of degradation in great detail and recorded the dismal impact of British revenue policy on traditional forest and planting practices. He rightly took note of an initial period of rapid deforestation in the Ganga basin under the Mughal empire during the seventeenth and the early eighteenth century. The disappearance of many woodlands, he said, had taken place when 'the Sikhs, Marathas, the Jats and the Pathans destroyed them all during the disorders attending the decline of the Muhammedan empire'. However, the greatest damage, he found, had been done by the East India Company itself through excessive revenue levies. For example, the upkeep of mango groves, very important to the welfare of almost every North Indian village, had been made impossible because 'our government has, in effect, during the thirty-five years that it has held the dominion of the North-West Provinces, prohibited the planting of mango groves, while the old ones are every year disappearing . . . the government is not aware of the irreparable mischief they do the country when they govern by such measures'.[125] These were prophetic words, for the damage done to the Doab by deforestation was indeed irreparable. It led to steadily eroding soils, declining crop yields, a change in the local climate and the impoverishment and immiseration of the population on a grand scale.[126] Later the great North Indian irrigation schemes further exacerbated these problems through wide-scale salinisation of the now unprotected soils.[127]

Similar rates of deforestation were characterising Western India. The dismantling of the early forest conservancies by Thomas Munro on ideological grounds meant that deforestation proceeded apace throughout the late 1820s and the 1830s.[128] In areas under direct EIC control, the protection of private property rights in preference to the protection of pre-existing public or common rights meant that all government sanctions on the removal of timber by increasingly vigorous private timber interests had been removed. In those areas that remained notionally outside company control, particularly in Travancore

125 Ibid., p. 434.

126 For a more extensive study of the degradation of the region, see Michael Mann, 'Ecological change in North India: Deforestation and agrarian distress in the Ganga–Jumna Doab 1800–1850', in Grove and Damodaran, *Essays on the environmental history of South and South-East Asia*, in press.

127 See Elizabeth Whitcombe, *Agrarian conditions in Northern India*, vol. 1, *The United Provinces under British rule, 1860–1869*, Berkeley, Calif., 1972.

128 To date, however, it is not possible to make any very accurate assessment of this period of rapid deforestation; more research is needed.

as well as in some parts of Mysore and Malabar, the situation remained more as it was during the first conservancy period. That is, elements of indigenous forest control remained. During the 1830s, nevertheless, the Bombay and Madras governments came under first intermittent and then, after 1837, persistent pressure to alter their approach to forest management. In the Bombay Presidency this led eventually to the highly interventionist conservation approach of the late 1840s.

Strong practical pressure came, surprisingly, from those areas left under indigenous control. In 1830, not long before Wallich made his effectively futile attempts to secure government intervention in areas of unrestricted deforestation, the Nilumbur rajah had made an urgent approach to the government of Bombay.[129] He pointed out that if conditions were left as they were prices would continue to rise and the extraction of under-age timber would continue, so that complete disappearance of the forests would soon follow. This advice was taken seriously at the time, although the Bombay government seems to have been uncertain in its response, deciding on 20 April 1830 to send the observations of the rajah on to the Indian Navy Board. The Navy Board concurred with the rajah and strongly advised the restoration of the old conservancy, but to no immediate avail.[130] The government of Madras was then brought into the matter and the Nilumbur initiative communicated to the Madras Board of Revenue for comments on 22 April 1831.[131] At this point the initiative ran deep into the institutional sand of the Madras Revenue Board, which throughout the 1830s remained implacably hostile to any real form of government forest control. Between 1831 and 1837, therefore, the activities of the timber merchants expanded without any serious check on their activities, effectively defended as they were by the sympathetic stance of the revenue boards and the effective impotence of the navy and military boards. Concerned as the latter were about the deforestation rate, they remained without allies in government prepared to back their wish for new controls. Moreover, even though Wallich sought to raise the long-term strategic implications of deforestation with a House of Commons Select Committee in 1832, his efforts came to nothing, and the Revenue Board view prevailed against all conservationist arguments.[132]

This situation might have continued considerably longer, even though it is clear that in several parts of India the speed of deforestation was causing increasing disquiet among EIC officials and collectors away from the main

129 Stebbing, *Forests*, p. 72.
130 Ibid.
131 Ibid.
132 Wallich evidence before Select Committee, 1831–2, Q. 2365, quoted in Siddiqi, 'The business world of Jamshedjee Jeejeebhoy', p. 302.

cities. In 1837, however, the situation changed, once more as the result of an initiative from an area outside company control. In September of that year the Madras government received a report from the resident in Travancore on the forests of that province, and the subject was once more reopened.[133] Once again, when approached for its view the Madras Board of Revenue denigrated the report, which was concerned principally with illegal inroads being made by timber merchants who had previously operated, legally, outside Travancore. The Madras government then asked the board to reconsider the Nilumbur rajah's old report in the light of the complaints now being made from Travancore, which had arisen essentially because the rajah's advice had been ignored. More directly, the revenue authorities were asked to consider new measures for the protection and management of forests in their charge. The board attempted to stonewall this direction of thought, first by indicating that it 'would institute enquiries' in the matter and secondly by furnishing the government with a copy of a report received from the collector in Malabar, Mr Clementson, in 1834.[134] Unlike many reports received from collectors during 1837, this one, in response to the Nilumbur initiative and the 1831 recommendations of the Indian Navy Board, considered the notion of resuming government interference in timber cutting as an infringement of private property rights.[135] It is clear that the Revenue Board considered that Clementson's laissez-faire views, wrapped up as they were in legal arguments, would easily put paid to the Travancore report. During 1838, however, this confidence was betrayed, ironically enough, by Clementson himself, who submitted a new report in May 1838 commenting on the indiscriminate cutting of teak, irrespective of age, by all landowners, with the single exception of the Nilumbur rajah.[136]

Clementson suggested no solution to this apart from imposing a high duty

133 Stebbing, *Forests*, p. 73. The Travancore report had originally been submitted by one Mr Munro, a Scottish forester and conservator of the Travancore forests, to the resident, Colonel Fraser. Munro had written: 'The system of throwing open the teak forests to all who wish to cut, or giving them to contractors, is in the highest degree ruinous. They cut indiscriminately all that comes in their way; any range of forest, however extensive, would be destroyed if left to their tender mercies. They never think of planting and all that such speculators calculate on is present profit or loss, without troubling their heads about depriving future generations of the benefit they now enjoy. The teak forests of Malabar are, I am told, in this predicament, and if the British government do not oblige them to plant and also leave some large trees here and there for seed, this valuable tree will be extinct [*sic*]. There are two ranges of hills in our forests that were formerly rented to a Parsee, and if the contract had not been taken from him, before it was too late, he would not have left a teak tree standing. It will take 40 or 50 years before the forests recover from the effect of this avarice.'
134 Stebbing, *Forests*, p. 72.
135 Ibid.
136 Ibid., p. 75.

on young timber. This would have been an unenforceable policy under the best of conditions. Significantly, Clementson commented on the contrasting state of the Travancore forests, averring that the 'easier' conditions there were due to the fact that the forests belonged to the government and that restrictions on timber cutting that could be imposed there would be impossible in Malabar because of the preponderance of private ownership.

Pressure on the Madras Revenue Board as, for the time being, the arbiter of these problems continued to be built up by further unsolicited reports during 1838 from the collectors in Canara and Rajahmundry. The report made on Canara by Collector Blane roundly condemned the inability of the revenue authorities to control deforestation. It specifically raised the issue, for the first time, of the depredations made by *coomri,* or shifting cultivation, suggesting that the revenue authorities should make an attempt to control this separately. This was a somewhat far-fetched suggestion in the circumstances. The principal difficulty, the collector pointed out, was lack of anyone in the province with technical knowledge of either this issue or forest management in general.

The report from Rajahmundry in August 1838 was far more alarmist.[137] The collector, G. A. Smith, made the point that timber merchants based outside his province operated without hindrance in Rajahmundry and were entirely outside his control or surveillance. It was this report, in fact, which finally persuaded the Board of Revenue to send all the collectors' reports on deforestation to the Madras government for its perusal during September 1838. Along with the reports, they sent the extraordinary recommendation that no new independent action needed to be taken apart from prohibiting the felling of small timber. The government response on this occasion already differed significantly from the pattern earlier in the decade, and the whole problem came before the Madras Military Board as part of a government attempt to secure a new initiative in the matter. The extreme institutional reluctance to attempt any other intervention still limited the Military Board in its role, although it appointed an officer in Canara in November 1838 to report on available timber resources, while the resident in Travancore and the collector in Malabar were asked to report further on the status of timber other than teak. Effectively, then, any further action was delayed by the Madras government, as much from institutional inertia and lack of expertise in the face of an unprecedented problem as from any deliberate policy.[138] An institutional impasse had been reached.

137 Ibid., p. 77.

138 Ibid., p. 78. The Madras Military Board despatched Lieutenant Miller of the Ordnance at Canara in November 1838 to examine the forests 'with reference to the resources in Saul timber as well as teak'. The significance of this lay in the fact that saul (or sal), unlike teak, was a timber for general rather than Navy use and held the premier place in the timber markets of Central, North-East and North India.

Meanwhile in Bombay, as in Madras, the military authorities also became closely involved in the forest problem during 1838, also to no immediate effect. Essentially this new involvement of the military represented a third pressure exerted upon the government, following on that already applied by the indigenous interests and the three collectors, all requesting a new initiative. In Bombay it was the Indian Navy Board that became concerned with the specific issue of whether naval timber supplies should be secured by individual contract or through an agency. This was a direct consequence of a decision having been taken to recommence Navy shipbuilding in the Bombay yards.[139]

The Bombay government permitted the Navy to take its own action in the matter on this occasion, and the superintendent of the Navy, Admiral Sir C. Malcolm, appointed Captain John Harris to report on the state of the Malabar forests. Harris had been Navy timber agent in Malabar in 1828–9 and was therefore one of the few men qualified to carry out this task. He was unequivocal in his findings, reporting that almost all accessible forests available for water carriage had already been felled. Furthermore, he commented favourably on the views expressed by the Nilumbur rajah in his letter to the Bombay government in 1830, thus adding the weight of his approval of the rajah to Clementson's.[140] The Navy Board at this stage aligned itself firmly with the idea of conservancy, envisaging full powers being exercised to control cutting operations. In so doing, it found itself in complete contradiction to the views and indeed the interests of the Madras Revenue Board, which, even when confronted with evidence of wholesale deforestation in Malabar, still refused to countenance further controls. Instead the board talked, in procrastinating fashion, of the 'great diversity of opinion on the subject of the timber contained in the Malabar forests'.[141]

139 Stebbing, *Forests,* p. 78; T. Cruickshank, *The practical planter,* Edinburgh, 1830, p. 14. This decision was, in fact, probably related to the increasing difficulty experienced by the Navy in securing timber from Northern Europe, that is from forests closed to the British until 1815 which had in the years intervening between then and 1838 become overworked and the timber thus overpriced; hence the resurgence of the Malabar forests in strategic importance at the end of the 1830s. The perception of a renewed crisis in timber supply is recorded in Cruickshank, p. 14: 'Our foreign trade in timber must soon be attended with great depletion. The principal sources for which we are furnished with this article at present are Canada and the northern part of . . . Europe . . . in the course of the next 40 or 50 years it may be as uncommon to import wood from the British settlements in N. America as at present it is to bring the same commodity from the United States . . . the methods being pursued in North America, for the purpose of clearing land . . . often affect areas far beyond the limits intended by those who practise it. Whether the dreadful conflagration which took place at Miramichi in 1815 proceeded from this or some other cause does not seem to be well ascertained; but it furnishes a striking example of the mischief that may be done . . . and may be so quoted as a warning.'

140 Stebbing, *Forests,* pp. 78–9.

141 Ibid., p. 60. Nevertheless, the board recognised that 'no time should be lost in taking steps

When in January 1839 the Navy Board again requested information on the future of timber supplies and the likelihood of further controls, it received an embarrassed response from the Madras government, relayed through Bombay, that 'nothing decisive had been done'.[142] On this occasion the Navy decided, unilaterally, to station an agent, Lieutenant Williams, on the Malabar Coast, seeking Bombay government approval after the event. By this stage, then, the Madras Revenue Board had simply lost all credibility with government and Navy interests on the west coast. In the face of continuing criticism from the Navy Board and, for example, from the collector in Canara (who had complained about the lack of technical expertise available to him), the Bombay government found itself suffering from its failure to locate appropriate expertise to restore some order to what had developed, in practical and political terms, into a full-scale deforestation and timber-supply crisis. This crisis had been allowed to develop almost entirely through the intransigence of the revenue boards and inability on the part of government to grasp the implications of allowing full rein to private property rights. Earlier failures to monitor the physical facts of deforestation effectively contributed to the sense of crisis.

It is worth noting at this stage the extent to which the political initiative had passed not only from the Madras Revenue Board but also from the Madras government itself with regard to decisions about land use in its own territory. During 1838 and 1839, however, the Bombay government was better apprised of the situation, largely through the direct pressure put upon it by the Indian Navy Board and through the presence of the Bombay dockyards, with the direct interest this implied in the Malabar forests and even in forests farther away.

In fact, it seems clear that by 1838 the opinions of Alexander Gibson, superintendent of the Dapoori Botanic Garden at Poona, were already making themselves felt in government circles.[143] Stebbing notes that 'the government

to reform a system which must ultimately prove so injurious to the interests of the Province, in the destruction of one of its most valuable products'. Preoccupation with the commercial timber value of the forests was to remain a characteristic of Revenue Department policies even after 1857, and until the end of the century, at a stage when other departments of government were fully cognisant of the non-accountable economic and social benefit of forest reservation; see, for example, F. A. Pressler, 'Panchayat forestry in Madras', paper presented at World Environmental History Conference, Duke University, Durham, N.C., April 1987, and Government of India, *Famine Commission*, IV, pp. 39–53 (minutes of evidence of Sir Richard Temple).

142 Stebbing, *Forests*, p. 81.

143 Alexander Gibson (1800–67), botanist and surgeon, was born at Laurencekirk, Kincardineshire, on 24 Oct. 1800. He took his degree in medicine at Edinburgh, where he was taught by Professor John Hope, the botanist, who had also taught Roxburgh and Buchanan-Hamilton. In Jan. 1825 he was appointed assistant surgeon in the EIC Medical Service and served at least two years in the Indian Navy, a normal requirement for surgeons starting out in company service. During this time he studied several Indian languages and became proficient in Hindustani, Marathi and Gujerati, later becoming acquainted with Konkani and Kannada. By 1836 he had been appointed a vaccinator for Deccan and Khandesh, and acquired in the course of this task a widespread field knowledge of the biota of the region and an unusually close knowledge of the rural economies of the area. At this time he also grew familiar with the rapid ecological changes taking place in the Deccan. There is some dispute about the date of his appointment to the superintendency of the Dapoori Botanic Garden. Burkill gives it as 1836, while Crawford (*Roll of the Indian Medical Service*) and the *DNB* (quoting his obituary in *Proceedings of the Linnaean Society*, 1867, p. 33) give it as 1838. His report on teak deforestation submitted to the Bombay government in 1840 led directly to his appointment as conservator of forests in the presidency. At Dapoori his successful efforts to produce drugs for the use of the medical service won him special commendations from the Court of Directors, leading it later to take his warnings about the precipitational effects of deforestation much more seriously than might otherwise have been the case. He was elected a Fellow of the Linnaean Society on 19 April 1853 and died in India on 16 Jan. 1867. His works are listed in the bibliography.

had been carrying out an enquiry of its own'.[144] The 'enquirer' here was almost certainly Gibson. In 1838 he had published his first major report on the natural resources of Western India, and subsequently the government seems to have become aware through his researches that royalties in the Deccan and Konkan from teak and blackwood could be considered the prerogative of government 'except in those villages where the right to timber had been specifically granted to the Mandaris by the terms of their *Sanad*.'[145] It does seem likely that this information came from Gibson, keen to encourage the government to assume direct control of the forests. In fact the issue of Mandari rights may have come to Gibson's knowledge during his travels as official vaccinator in the region in the early 1830s.

By 1839 a fourth pressure had also started to act on both governments in the circumstances of the forest crisis. In a sense, this pressure had begun with the way in which the reports of the collectors in Malabar, Canara and Rajahmundry reinforced the more extensive critique despatched by the resident in Travancore. These were reports which in essence questioned the ability of government to manage important strategic and human resources at all. This initially low-level official discontent surfaced fully, especially in Madras, in the aftermath of the serious famines of 1837–9 and resulted in mounting internal criticism of governmental attitudes to famine management. A notable example of this kind of criticism came in 1838 from J. E. Thomas, a Madras government civil servant, in an issue of the new *Madras Journal of Literature and Science*.[146] Thomas's main theme in two articles he published in consec-

144 *Forests*, p. 28.

145 See A. Gibson, 'A general sketch of the province of Guzerat, from Deesa to Daman', *Transactions of the Medical and Physical Society of Bombay*, I (1838), 1–77.

146 'Notes on ryotwar or permanent money rents in South India, and on the duty of government in periods of famine', pp. 53–78, 200–21.

utive issues of the journal was that 'the followers of Adam Smith' had misinterpreted and mistakenly applied his theories to India when they were intended to apply only to European conditions. Thomas believed that they did not take into account the vagaries and character of the Indian land-tenure systems or the variability and harshness of the climate. He quoted specific instances of famines which he believed had been exacerbated by mistaken government policy. Thus at 'Nagpur in 1830 it is reported to have instantly converted scarcity into absolute famine', and 'it is not easy to conceive a wise course even in a financial point of view'. Positive rather than negative intervention was far preferable in the context of famine. 'A Government Commissariat', he felt, 'should be forced to input its supplies from places where grain was relatively abundant' rather than be allowed to rely on some notional kind of market mechanism to assure grain supplies. Thomas then urged a complete reassessment of government policy, noting:

> The object of these remarks is not so much to advocate particular measures of relief, but rather to induce a full examination of the doctrine laid down in government orders; and to endeavour to ascertain whether it be an indisputable truth to be taught to all our native servants that injury must inevitably follow from any interference of government in seasons of dearth . . . in this country.[147]

Other influential commentators in and outside India were at work in a similar vein in the last years of the 1830s. Howitt, for example, in an openly anti-colonial tract entitled *Colonization and Christianity,* drew attention to Abbé Guillaume Raynal's allusions to the Bengal famine of 1770, which had so alarmed Robert Kyd and 'which [had] throughout Europe excited so much horror of the English'. In fact, Raynal had summarised a body of travel literature and used it as the basis for a wide and slashing indictment of the Europeans as destroyers of whole peoples, in a veritable chronicle of genocide.[148] When applied to the Indian situation, these kinds of criticism of government policy in forest, revenue and famine management found a common feature in their critique of the long-term implications of what were essentially laissez-faire policies. These, it was felt by many of the commentators, held out disastrous possibilities, which the famines of 1837–9 tended only to confirm. It was this situation which propelled both the Madras and Bombay governments, assailed by conflicting evidence from diametrically opposed interest groups within government, to seek out the expertise of the medical service. Thus in 1840 assistant surgeon Alexander Gibson, superintendent of

147 Ibid., p. 54.

148 W. Howitt, *Colonization and Christianity: A popular history of the treatment of natives by the Europeans in all their colonies,* London, 1838, pp. 268–70; G. Raynal, *Histoire philosophique et politique des deux Indes,* vol. 5, Amsterdam, 1764.

the Dapoori Botanic Garden, was appointed to inspect and report on the forest 'problem', as it was now known. This was consistent with a pattern already better established in Bengal, where surgeons Buchanan-Hamilton, Wallich and Helfer had all served in comparable consultancy roles.[149]

Precisely as in Bengal, Gibson's position as superintendent of the botanical garden at Dapoori constituted the key to his selection on the grounds of professional expertise. By choosing to rely on the somewhat unknown quantity of a physician such as Gibson, the Bombay government had, largely unwittingly, exposed itself to the influence of a scientific community which during the 1830s had undergone some important changes in its character and integration. It was a community characterised by an academic, medical and ideological agenda quite distinct from that to which government had been accustomed earlier in the century. The main features of these changes are worth considering, since they determined the new parameters within which the forest problem was increasingly dealt with in the period 1840–60.

Whereas Roxburgh, Buchanan-Hamilton and Wallich had operated for much of the time in relative professional isolation, the surgeons employed as consultants and experts on natural resources from the late 1830s operated in a more complex intellectual context and one far more integrated with the world of science outside India. Internally, the growth of the medical service had been accompanied by the emergence of provincial medical and scientific societies, each with its scientific journal. Both these developments served to accelerate and enrich the diffusion of scientific ideas of all kinds amongst the European intellectual elite, not least amongst those for whom new thinking about the natural environment had become directly relevant. Specifically, they served to provide a wealth of empirical material on forests and deforestation and to offer what were in effect early ecological ideas, for which the newness of the Indian environment in scientific terms provided theoretical stimulus.

A new elite of scientists, most of them within the medical establishment, constituted a specialist intellectual renaissance that produced a stream of articles and papers on the medicine, natural history and ethnology of India.[150]

149 See Vicziany, 'Imperialism, botany and statistics', pp. 625–60, for details of Buchanan-Hamilton's employment by the EIC as a consultant.

150 The *Madras Journal of Literature and Science* commenced in 1831 under the editorship of John Cole, a surgeon in the EIC Medical Service. Other important journals making their appearance at this time that contributed to the emerging environmental debate were *Transactions of the Bombay Medical and Physical Society,* commencing in 1838; the *Indian Journal of Medical and Physical Science* (1834); the *Quarterly Medical and Surgical Journal of the North-West Provinces* (1848); the *Indian Annals of Medical Science* (1833); the *Calcutta Journal of Natural History* (1841), edited by Surgeon McClelland (ceased in 1847). The last journal is a useful exemplar of the close links between the scientific journals and the employment of EIC surgeons as EIC consultants. McClelland, who had arrived in India in 1830, had been employed by the company to study soils in the Kumaon Hills with a view to possible tea

While this was a development which had earlier foundations, the founding of the new scientific societies in the early 1830s, especially in the South of India, together with the expansion of the medical service, gave it an entirely new vigour. The external relations of this community with scientific developments in the centres of European science were characterised by the increasing preoccupation of British botanists with Indian flora and fauna. This was a development assured of continuity and potency by the appointment of Sir William Hooker as director of Kew in 1841. Hooker had trained many of the surgeons in the EIC Medical Service. Throughout the 1830s and 1840s he deliberately reinforced the network of contacts and scientific channels that had been developed by Sir Joseph Banks between Kew Gardens and surgeons stationed in different parts of India. The developing infrastructure of the medical service provided a ready-made information-gathering network for Hooker, and one in large part staffed by individuals who owed allegiance to him and his Kew establishment as much as they did to the medical service itself.[151] After 1847 this connection was strengthened still further by the arrival in India of Hooker's son, J. D. Hooker, as an influential member of Lord Dalhousie's entourage.[152]

The chief implication of these developments for the Bombay government and, a little later, for the Madras government was that, with reliance on the medical service, the whole issue of deforestation came to be defined much less in terms of timber depletion and much more in terms of the environmental, species-extinction, social and even aesthetic consequences of deforestation. Empirical evidence of the effects of deforestation was gradually accumulating

cultivation. In 1835 he went to Assam with Nathaniel Wallich and William Griffith and in 1852 produced a report on the Pegu forests which was decisive in encouraging Dalhousie to promote state forest control on an all-India basis.

151 The way in which Sir William Hooker built up the system of patronage essential to his information and plant-gathering network is well described in an obituary in the *Journal of the Royal Geographical Society* (1866): 'Hooker obituary', pp. 197–8. Written by Sir Roderick Murchison with the assistance of J. D. Hooker, it instructs us: 'In 1820 he went to Glasgow as Professor of Botany, where he remained for twenty years. During that period he was an admirable teacher, exciting in his pupils the highest enthusiasm by the animating style and clearness of his lectures, and still more by the annual excursions to the highlands, in the course of which he never failed to convey to those who accompanied him . . . his own love of Nature and her works . . . numbers entered the army, navy and Indian Medical Service or sought other positions in foreign countries. To all of these Sir William Hooker was ready to lend a helping hand, guiding their studies while pupils, and furthering their interests afterwards, well satisfied to be repaid by a share of their collections . . . thus zealous botanists of his own training were spread almost broadcast over the face of the globe . . . indefatigable as a letter writer, and strictly punctual in reply, he attended to all who applied to him for information and thus knew everything which was done in his favourite science all over the world.'

152 Leonard Huxley, *Life and Letters of Sir J. D. Hooker*, 2 vols., London, 1918, I, p. 235.

and being disseminated through the new scientific journals. Of central significance was the gradual diffusion of a single predominating scientific argument, that is, the critique of the effects of deforestation based on the writings of Priestley, Humboldt and Boussingault. This analysis, which guided the thinking of the whole medical service by the early 1840s, was one which made its impact by stages. It relied for its acceptability not only on its predictive power but on a framework of thinking, not often made explicit, which valued the natural environment of India in terms much wider than the purely commercial. Indeed, for many of the surgeon-botanists, commercial argument can be said to have counted for little. Central to the Humboldtian analysis of environmental change as propounded by the medical service was the prospect that widespread deforestation could cause fundamental climatic and therefore agrarian and economic change. The most influential propagandists and exponents of this view after 1840 were Alexander Gibson himself in Bombay, and assistant surgeon Hugh Cleghorn and assistant surgeon Edward Balfour, the latter two active in the Madras Presidency. Other surgeons, such as Donald Butter, Robert Wight, Hugh Falconer and John Ellerton Stocks, also played a significant part in the propagandising of Humboldtian views within the company apparatus.

An analysis of the development of this kind of thinking between 1837 and the late 1840s presents some special problems. In general, however, the desiccationist argument became prominent in direct proportion to the growing political influence of the medical service in government decision making. An early product of the close association of the Bombay and Madras governments with the expertise of Gibson and his colleagues was a growing disarticulation between the increasingly sophisticated perception of deforestation at presidency level and the much less developed attitudes espoused by the government of India and the EIC Court of Directors. The main bone of contention involved an increasing divergence of views about the primacy of private property rights vis-à-vis government revenue interests in forested areas.

By the early 1840s both presidency governments had become much more inclined to question the sanctity of such rights and increasingly to consider the economic and social disbenefits of the kind of activity which the full exercise of property rights might imply. The far less evolved outlook of the Court of Directors, on the other hand, was clearly shown in February 1840 in the review it undertook of the development of forest policy between 1800 (the date of the Bengal–Bombay Joint Commission) and April 1839. First of all, the Court even questioned the need to resurvey the Malabar forests (which the Bombay government had proposed on the advice of the Navy Board), on the ground that surveys had already been carried out in 1805 and 1806![153] The

153 Stebbing, *Forests*, p. 86.

complete inability of the Court to appreciate the dynamics of land-use change and the limitability of natural resources in India was much in evidence at this time. While grudgingly admitting that land might be purchased to serve the immediate needs of government, the Court also stipulated, astonishingly in view of the events of the late 1830s, their neo-Munrovian and 'anxious wish that in the prosecution of a survey, if such a measure should appear necessary, the utmost care may be taken to avoid any infringement of the rights of or any inconvenience to . . . private persons'.[154]

Lobbying for the new conservation, 1840–7

After about 1840, an increasing divergence of views developed between levels of the EIC apparatus about the most appropriate response to the deforestation issue. At presidency level, Alexander Gibson and other surgeons were able to indicate to the Bombay and Madras governments the complexity and scale of the consequences that might follow from further deforestation. By and large, Gibson's knowledge was based (apart from the basic publications by Humboldt and Boussingault) on material which does not appear to have made an impact on either the Court of Directors or the government of India, to whom expertise comparable to that offered to the presidency governments was not immediately available. Nevertheless, a considerable amount of evidence on the consequences of deforestation was freely available in scientific circles. An understanding of the way government conservation policy evolved and the significance of the part which Gibson played in stimulating it involves an analysis of the way in which he selected appropriate information to use in lobbying government. Thus a survey of the kind of literature Gibson would have been familiar with is useful.

In 1838 Boussingault published his major paper on the effects of forest clearance and run-off in the *Edinburgh New Philosophical Journal,* in a translation of his original Paris lecture published in the *Annales de Chimie* in 1837.[155] This transfer of ideas between French and Scottish academic communities was a familiar one. It was built on the tradition of close contact between the two communities established as early as the mid eighteenth century. The *Edinburgh New Philosophical Journal* was a journal widely read among surgeons trained at the Scottish universities, as the majority of surgeons working in India were by the late 1830s. The implications of this paper were realised relatively quickly by surgeons working in India, mainly because of their professional and Hippocratic preoccupations with water supply and atmosphere, issues which Humboldt and Boussingault linked to forest cover. Within a year of the English translation's appearing, Boussingault's warnings made their appearance in direct and indirect form in scientific publications in India. Among the first of these was a paper published by Captain T. J. Newbold in 1839 in the recently founded *Madras Journal of Literature and Science.*[156] This was an important paper for several reasons, not least because it helped alert assistant surgeon Edward Balfour to the potential impact of deforestation on rural food supplies and local climates. Drawing on the results of interviews with villagers in the Hoogri River valley between Bellary and Bangalore, Newbold was able to make a connection between the appearance in recent memory of sand dunes, the submerging of arable fields by alluvium, flooding and recent deforestation. Newbold was the first in a line of commentators on this sort of connection, all drawing their material and field examples from the Arcot, Bellary, Ceded Districts and Bangalore areas, in a region peculiarly susceptible to periodic drought and soil erosion.[157]

The receptiveness of the surgeons of the medical service to Boussingault's paper was due principally to a growing interest within the medical profession in epidemiology and public health, particularly with regard to water-borne diseases. This was an interest which had its main origins in the context of European urbanisation. Increasing doubt was also being cast on older theories of the 'miasmic' origin of tropical diseases.[158]

Since the 1760s, Scottish medical teaching in particular had been characterised by an emphasis on the environmental context of disease. It was this new approach, as well as earlier French methods, which eventually culminated in surgeon Ranald Martin's suggestion of 1835 that officers in the medical service should be called upon to compile medico-topographical reports about the hinterlands of their stations.[159] Of these, surgeon Donald Butter's report

154 Ibid.

155 Boussingault, 'Mémoire sur l'influence des défrichements dans la diminution des cours-d'eau'.

156 T. J. Newbold, 'Notice of river dunes on the banks of the Hoogri and Pennaur rivers', *Madras Journal of Literature and Science,* 1839, pp. 309–10. Newbold, later made a Fellow of the Royal Society, was a prolific writer in the natural sciences of India and Malaya, his outstanding book being *A political and statistical account of the British settlements in the Straits of Malacca,* London, 1839. Like Balfour, he was much interested in and knowledgeable about the hill tribes of the Eastern and Western Ghats; see e.g. 'The Chenchars: A wild tribe inhabiting the Eastern Ghauts', *Journal of the Royal Asiatic Society,* 8 (1846), 271–83.

157 F. C. Danvers, for example, in his pioneering essay on the causes of famine, entitled 'A Century of Famines', quotes at length from the writings of Sir Richard Temple on the connections between deforestation and famine in North Arcot and Chingleput: Danvers, 'A century of famines', unpublished paper, Edinburgh University Library, India Papers, category X, pp. 6–11.

158 For the traditional 'miasmic' view, see Spry, *Modern India,* pp. 184–96. Spry, a surgeon, considered forests to be fertile breeding grounds for disease, a view disputed in 1849 by Edward Balfour.

159 Crawford, *History of the Indian Medical Service,* p. 247: 'The [Medical] Board at first threw

on Awadh (Oudh) stands out as being clearly derived from Boussingault in its discourse on local forests and climate.[160] Like Sleeman, Butter warned that the imminent imposition of the 'strictly enforced revenue system' would have the almost immediate effect of 'destroying the remnants of the sylvan verdure' of Oudh, thus

> emphasising the slow, but certain process by which India, like all other semi-tropical countries, (such as Central Spain, Southern Italy and the Western territory of the United States), has its green plains – no longer capable of entangling and detaining water in the meshes of a herbaceous covering, – ploughed into barren ravines, by its sudden and violent though now short-lived rains – its mean temperature and its daily and annual range of temperature augmented – its springs and perennial streamlets dried up – and its rainfall and the volume of its rivers diminished.[161]

cold water on the scheme, whereupon Martin laid his suggestion before government, which approved; and the Board then called for reports.' Several were published; the best-known are Martin's report on Calcutta published in 1837 and Taylor's on Dakka published in 1840. Other reports published in the scheme were D. Butter on Oudh and Sultanpur, 1839; W. Dollard on Kumaon, 1840; R. H. Irvine on Ajmir, 1841; W. Jacob on Jessore, 1837; McCosh on Assam, 1837; D. A. Macleod on Bishnath, Assam, 1837; R. Rankine on Saran, 1839; F. P. Strong on Calcutta, 1844. Spry explained in *Modern India* (p. 184) that 'medical topography embraces a wide range of inquiry, and requires on the part of the medical scientist an aptitude for observation which only few men possess, while a knowledge of the subject is of such paramount importance to the well-being of a state that no-one can contemplate it without being impressed by its magnitude'. Spry added perceptively: 'Happiness is ever attendant upon health. Without the one, we can never hope to enjoy the other – so firmly fixed was this truth in the minds of men in the earliest ages that we find Homer paying the highest compliment it perhaps ever received: "A wise physician skilled in words to heal, is more than armies to the public weal". (*Iliad*, 13,xi,630) Much of what fairly comes under the name of topography has already been glanced at in the following pages, such is the natural character of the country . . . its elevations and formations, the chief productions of the soil, as well as the constitutional and characteristic peculiarities of the people . . . one fruitful source of disease in Central India is the variability of the climate . . . the experience I have had of the climate of the Saugar and Nerbudda territories convinces me that, at least among the European community, much sickness might be avoided if more consideration was given to this subject.'

160 Butter, *Outlines of the topography and statistics of the southern districts of Oudh and the cantonment of Sultanpur, Oudh*, Benares, 1839. Butter's own comments in the introduction to his work are helpful in explaining the extent to which such surveys, essential to any serious assessment of contemporary land-use change, were previously lacking: 'I have to my knowledge endeavoured to give a fruitful and unbiased description of the Southern Districts of Oudh, but the total absence of official . . . information, has rendered the attempt more arduous than, in the commencement of my task, I had expected.' Nevertheless, the report became widely distributed, and Sir Henry Laurence commented in 1844 that 'Dr Butter's "Outline" is a very creditable piece of work': H. M. Lawrence, *Essays, military and political, written in India*, London, 1859, pp. 375–427.

161 Butter, *Topography of Oudh*, p. 9.

Measures could be taken to ameliorate this process, Butter thought. However, 'artificial planting', he pointed out, 'which might if carried on systematically arrest the current deterioration of climate, is on the decline'.

This was a comprehensive statement of the desiccationist argument. Butter's belief that the climate had already started to deteriorate is an important indicator of the potency which desiccation fears had already acquired in India and of their potential as an intellectual weapon with which government might be persuaded to carry out the kinds of land-use prescriptions which the medical conservation lobby was soon to recommend. However, in 1840 this was a psychological weapon which Alexander Gibson, although certainly well aware of the arguments, did not choose to use immediately. This was partly because in 1840 he was as yet in only a consultative position and had anyway been assigned a very specific task, that is, 'to visit the forests and report on their resources and on the best means to be adopted for their preservation and improvement'.[162]

Though trained as a surgeon, Gibson had become first and foremost a botanist, and his early response to deforestation reflects the priorities of the botanical enthusiasts of the period. Soon after his appointment as a consultant to the Bombay government, he entered into correspondence with Sir William Hooker. This connection encouraged him to take steps to promote state conservation initiatives. An early letter to Hooker, written very soon after the latter was appointed director of Kew, gives a useful impression of Gibson's attitude in the early 1840s. 'The Deccan', he wrote, 'is more bare than Gujerat and the clefts of the Ghat mountains are the only situation where trees are to be found in any quantity and even there they are disappearing fast under the increased demand for land for spade husbandry . . . they are too steep for the plough.' It is a matter 'for regret', he continued, '*for the naturalist, perhaps also for the economist,* that the woods are in such rapid progress of destruction'.[163]

The text of this letter indicates that both personal scientific and public economic motives were being articulated in connection with the new advocacy of conservation in the Bombay Presidency in the early 1840s. The first kind of motive, much the more important in compelling the actions of Gibson, was not at this period put forward by the surgeons as an argument to persuade governments to take a long-term environmental view. A third set of overlap-

162 Stebbing, *Forests*, p. 78.

163 Royal Botanic Gardens Archives, Kew, India Letters: Alexander Gibson to J. D. Hooker, 24 March 1841 (letter no. 211) (my italics). This correspondence reflects the direct involvement of the Hookers, father and son, in the deforestation issue, one reinforced by the visits of J. D. Hooker to St Helena and Ascension in 1843 and to India in 1847–50. Their simultaneous involvement in early conservation in the Cape Colony should be noted: Grove, 'Early themes in African conservation', pp. 23–24, 31.

ping motives also started to make an explicit appearance in the 1840s. These related to the maintenance of social stability in the countryside and to the maintenance of public health and the prevention of famine. It was this last set of motives that became most prominent during the decade after Gibson's appointment as a consultant, both because they were associated most closely with the anxieties of government at the time (it was beginning to recognise the threat which the consequences of deforestation might present to social as well as economic stability) and because they were at the heart of the Hippocratic and specifically public-health ethos espoused by the surgeons.

In 1841 Gibson made an inspection of the forest tracts near the coast in the Northern and Southern Conkan, and in 1842 undertook an experimental thinning of teak forests in the Rutnagherry Collectorate. During the same period as his early survey work, two further significant reports were submitted on the Bombay forests: by the government timber agent at Surat, Mr Boyce, in 1841 and by Colonel Jervis, the chief engineer in Bombay, in his capacity as a member of the Military Board in 1843.[164] Thus at this period agents of three groups, the government of India, the military authorities at Bombay and the government of Bombay, were concerned with the deforestation problem. Boyce's report recommended the leasing of particular forests to the government by 'tribes' (especially the Dangs Bhils of the Western Ghats) and private owners, and in June 1842 the government of India was minuted to this effect by Bombay. Both reports were far wider in scope than previous surveys, and the recommendations they made bear the imprint of Gibson's opinions. Thus Boyce was particularly concerned with the medicinal products of the Bombay forests and canvassed the possibility that 'a careful examination of the forests would disclose other productions of value from a commercial as well as a scientific point of view and at the same time allow of a large quantity of land within this limit being brought into cultivation'.[165]

Colonel Jervis's 1843 report is noteworthy in that much of the material was devoted to arguing that conservation might have a very positive influence on the way of life of the agrarian population. He noted, for example, that 'the plantations south of Songhur, scattered and of little account for external commercial purposes', were 'capable of being turned to profitable use if conserved, so as to secure a succession of cuttings, all of which are applicable to increase the comfort of the dwellings of the people, and this is of the more consequence here as the country is otherwise bare of wood'.[166]

It is clear from Jervis's report that the appointment of Gibson had resulted in some efforts to protect forests, especially those nominally in government

164 Stebbing, *Forests*, p. 111.
165 Ibid., p. 110.
166 Ibid., p. 111.

ownership. Moreover, the reports of Jervis and Boyce both stressed the social benefits that might be derived from protection. It was even proposed in 1842 that Boyce, who had unusual insights into traditional forest use, should assume a form of conservatorship of the newly leased forests in the Dangs region of the Western Ghat mountains.[167] This idea was not followed up, and it seems clear that funding was not allocated. Instead responsibility for the forests remained in the hands of separate Bombay government departments – the Military Department, the Political Department and the Board of Revenue – none of which exerted any real executive function. Jervis's report prompted the Military Board to suggest that it be invested with absolute control over the Bombay forests to provide timber for all government departments. The Bombay government in 1843 remained equivocal on this point. Instead, and here the hand of Gibson himself is evident, the Military Board was asked to submit a scheme for the establishment of a conservancy under Gibson.[168] The Military Board complied and recommended that he be appointed conservator while retaining the post of superintendent of the botanical garden. Moreover, it was suggested that as 'interim Conservator' he might also be made responsible for the administration of forests in Madras. This suggestion, not surprisingly, did not meet with the approval of the Madras government.

By 1845 the Bombay government had become fully convinced, entirely on the strength of Gibson's promptings, that an independent department should be established free of any interference by, for example, the Military Board. The arguments that seem most to have convinced the Bombay government were those relating to the serious decrease in the supply of firewood and building timber throughout the presidency. By 1845 these shortages had reached crisis point in the perception of the government. Thus in 1846 it was reported by Gibson that in the neighbourhood of Mangalore 'the article of firewood, formerly so abundant, is now one of the chief items of expense to the poorer classes of people, and is a deprivation severely felt by them'.[169] The cause of this scarcity, Gibson suggested, was 'the improvidence with which the wood was treated, every tree and bush being felled at first, and the shoots and saplings which would have grown up and supplied their places being cut down every year until the roots die off, leaving nothing but the bare laterite hills which will remain for ever afterwards utterly sterile and useless'.[170]

In November 1845 the Bombay government submitted the entire correspondence with the Military Board and Gibson to the government of India, detailing its intentions with regard to formally setting up a conservancy. The

167 Ibid., p. 114 (minute of the chief engineer, 9 Dec. 1843).
168 Stebbing, *Forests*, p. 117.
169 Ibid., p. 120.
170 Ibid., pp. 120–1.

urgency of the matter was emphasised and the sanction of the supreme government requested for establishment purposes. An optimistic forecast was made that the cost might be defrayed by the sale of thinnings from the forest.[171]

This last suggestion was presumably made in the belief that no establishment would be sanctioned unless a reasonable return on expenses could be demonstrated. An interest in 'social forestry' was clearly not expected of the government in Calcutta by the now relatively enlightened Bombay authorities. But the urgent firewood problems faced by the Bombay government do not appear to have been found convincing in Calcutta. Instead the government of India delayed any decision and made enquiries of Bombay concerning the possible inclusion of Madras in the scheme, and also enquired as to whether forests outside government ownership would be subject to government sanction from the proposed conservancy.[172]

Throughout this period a consistent campaign of lobbying for forest protection emanated from the lowest levels of the EIC up through the Bombay government to the government of India. From above, the government of India, reluctant to fund conservancy schemes in either Madras or Bombay, started to come under pressure from the members of the Court of Directors, themselves still largely ignorant of the urgency of the Indian forestry problem as it was perceived by the medical service. The response of the supreme government in March 1846 to the Bombay submission on conservancy promised yet another period of procrastination by the authorities, and it was at this stage that Gibson took matters into his own hands through scientific publication and by bypassing the company authorities in India altogether. By early 1846 he had exploited arguments about shortages of firewood to a considerable extent but without any clear success in his campaign to secure government sanction for conservancy. Now he decided to turn to quite a different strategy and emphasise the climatic dangers of deforestation. It is hard to understand why this line of argument had lain dormant so long. The medical service had been made aware of Boussingault's reasoning of over eight years before.[173] One hypothesis may be that Gibson did not feel confident from a scientific point of view in extending the line of Boussingault's reasoning too far. Specifically, he was reluctant to go beyond discussion of the impact of deforestation on catchment run-off (which Boussingault considered verifiable) to treat the relationship between forest cover and climate or precipitation, a much less verifiable matter.[174] His mind seems to have been finally changed, however, by

171 Ibid., p. 118.
172 Ibid.
173 See Butter, *Topography of Oudh*, p. 9.
174 For recent authoritative contributions to this debate in the Indian context, see V. M. Meher-Homji, 'The link between rainfall and forest clearance: Case studies from Western Karnataka', *Transactions of the Institute of Indian Geographers*, 2:1 (1980), 59–65, and 'Probable impact of deforestation on hydrological processes', *Climatic Change*, 19 (1991), 163–73. In general it is now considered by forest meteorologists that deforestation exercises a profound impact on rainfall and climate at micro and macro levels, both directly and through the effect of increased albedo (reflectivity of the denuded land surface). The subject is still a matter of vehement debate; see letter to the *Times* by Sir Charles Pereira on trees and rainfall, 3 Aug. 1992.

his receipt of a letter from a correspondent in Mahabaleshwar dated 21 February 1846 'in which the writer mentions the common belief in the Konkan that with the removal of wood, the small streams had more or less dried up'. The correspondent also mentioned that it was generally held by Parsi merchants resident in the Nilgiri Hills that declines in rainfall had followed local deforestation. Other reports were also quoted, all of them notable for originating with indigenous rather than European authorities.[175] By 6 March 1846, only a few days after receiving this letter, Gibson had finished compiling a manuscript report on the destruction of the forests of the Konkan in which he made specific mention of the climatic and economic consequences of deforestation. 'A change of climate', he wrote 'is by no means limited to the mere district in which the clearing has taken place, but its influence extends far inland.'[176] Deforestation in the Western Ghats, that is in the headwaters of rivers watering the fertile western coastal lowlands of the presidency, would clearly be affected by such changes, or so Gibson thought. It is important to stress that these were regions to which the company at the time attached a great deal of economic importance, particularly for large-scale cotton growing. Unlike Roxburgh before him, Gibson now saw for the first time the dangers of regional rather than just local climate change.[177] The potentially formidable indirect economic disbenefits of deforestation detailed in the report were unmistakable. Having finished it on 6 March 1846, Gibson sent the report in letter form directly to the Court of Directors in London without approaching the Bombay government with it at all. Instead he used material from the report as the basis of a short but prominent paper to be published in *Transactions of the Bombay Medical and Physical Society*,[178] a journal which enjoyed widespread readership among medical-service and other officials throughout India. The article was published later in the year. The symbolism of these actions cannot have been lost on the Bombay government; Gibson had appealed over the heads of both the Bombay authorities and the government of India directly to the Court of Directors and the Indian scientific community. This was an

175 IOL, Boards Collections; V/27/560/107, incomplete letter to A. Gibson, p. 21.
176 Gibson, 'Report on the forests of the S. Conkan', unpublished MS and letter to Court of Directors, 9 March 1846, quoted in Cleghorn et al., 'Report of the committee'.
177 Ibid., p. 102.
178 'Report on deforestation in South Conkan', pp. 37–41.

indicator, if one were needed, of the weight and status which his professional medical status lent him. Nevertheless, the action was a gamble; but it was one which quickly paid off by breaking at a stroke the administrative logjam among scientific advisers, presidency governments and the government of India. Moreover, Gibson had backed the gamble by documenting his findings among his own peers in an academic forum. As a result, on 17 December 1846 the government of India authorised 'the employment of an establishment for the management of the forests under the Bombay Presidency, at a monthly charge of 295 Rupees'. This enabled the Bombay government on 22 March 1847 to add 'Conservator of Forests' to Alexander Gibson's appointment as superintendent of the Dapoori Botanic Garden; and authorised him 'to entertain the establishment which had been sanctioned' by the government of Bombay and for which Gibson had long campaigned.[179]

Implications of the formation of the Bombay Forest Department and its later consequences

The formation of a new conservancy in the Bombay Presidency in 1847 and the establishment of Gibson as its first conservator constituted a major turning point in the development of British colonial policy towards the environment and its degradation, not only in India but in a much wider context. It was important, above all, because the central rationale for establishing the conservancy was based not simply on the prospect of rapid timber depletion (as the 1805–23 conservancy under Watson and Palmer had been) but on acceptance by the East India Company of a set of much wider and longer-term environmental considerations and risks. Whilst the underpinnings of this new approach were based on a distinctively Humboldtian and ecological approach to the environment, and one which recognised the essential interdependence of its elements, this did not necessarily mean that the state had accepted a new ideology in any wholesale fashion. Instead the key factor in the decision taken by the Bombay government related to the emergence of a political situation in which a new economic balance was struck between the short-term priority of land revenue and much longer-term priorities relating to sustainability in patterns of resource use and to social stability. These were now seen as being threatened by the kind of reckless deforestation which had taken place since the 1820s. Without a doubt, the conservancy decision represented an enormous shift by the colonial government in response to a new 'scientific' and medical assessment of economic risks.

At the very least, as Sir George Arthur commented in 1848, short-term

179 Stebbing, *Forests*, p. 118.

forest-revenue interests would now have to be sacrificed, and the object of government would be

> to secure these general resources of the state, for the deficits of which no amount of revenue will compensate, and for the foundation of a system to be perfected hereafter which shall secure an adequate permanent supply of timber, future regularity being in no case risked for an excessive profit at the outset.[180]

An equally radical and possibly even more surprising transition in attitude had occurred on the part of the Court of Directors as a direct result of Gibson's communication with them in March 1846. While even in the short term this initiative was undoubtedly decisive in securing funding from the government of India for the formal establishment of the Bombay Forest Department, his intervention also had more significant long-term consequences, for in July 1847 the Court of Directors issued a highly unusual circular letter, Despatch no. 21 of 7 July 1847. This stated that a knowledge of the relationship between deforestation and climate had

> a strong practical bearing on the welfare of mankind, and we are anxious to obtain extensive and accurate information in regard to it. We desire, therefore, that you will furnish us with any that you may possess, and that you will institute enquiries in such quarters as may be likely to lead to the acquisition of particular facts bearing upon the question. It has been suggested that the circumstances of the district of Azimghur afford some illustration of the subject, and we shall be glad to receive a correct report of any facts relating either to that district or others which may be calculated to throw light upon the subject of our enquiry.[181]

The despatch was a sophisticated document, clearly based on a good deal of research and survey of literature as well as the information which Gibson had provided to the Court. It was also innovative in its breadth of approach and went far beyond the simple utilitarian statements of Sir George Arthur. The Court accepted the desiccation arguments largely on the strength of Gibson's wielding the spectre of climatic deterioration and imminent agrarian crisis on the west coast of India. It also went on to accept unquestioningly the reputation of Humboldt's South American work, despite the company's earlier hostility to Humboldt himself. The readiness of the Court to take on board the links between economic and climatic change may seem surprising

180 Ibid., p. 122.

181 Azimghur, it should be noted, was a district mentioned specifically by Butter in his *Topography of Dudh*, and it seems that the Court had referred to his work. The despatch is quoted in E. G. Balfour, 'The influence exercised by trees on the climate and productiveness of the Peninsula of India', in Government of India, *Famine Commission*, IV, p. 100.

when contrasted with the difficulty the surgeons had initially experienced in convincing the government of India of the dynamics of the deforestation problem. However, while one cannot adduce specific evidence, the constructive and research-oriented response of the Court to Gibson's approach can probably be attributed to an official exhumation of much earlier desiccation arguments put forward on St Helena, St Vincent and Mauritius after the 1790s.[182] In these earlier cases desiccation had already been accepted as posing a potential threat to colonial agriculture and therefore to the long-term future of the company.

The specific mention made of Azimghur in Despatch no. 21 almost certainly relates to the attention of the Directors having been drawn to Butter's report on Oudh, a report which had itself been influenced by Wallich's well-known opinions about the same region. Clearly the weight of scientific opinion had been increased by the fact that it came independently from several quarters of the global scientific community. The opinions of Butter and Gibson were by the end of 1846 also reinforced in a more contemporary way by other authorities, not least by C. S. Logan. The latter had first publicised his work on deforestation, drawn from his experiences in the Malay peninsula, in a lecture to the Asiatic Society of Bengal in 1846. While this lecture was not published until 1848, it seems clear that Logan's opinions had helped to influence the evolving view of the Directors.[183]

The significant development here lay in the extent to which the collating of examples of environmental deterioration from different parts of the world (including Penang and the Americas) put forward by a number of scientists had played a part in convincing the Directors of the gravity of the situation. Moreover, it had encouraged them to perceive the problem in India, as Butter had started to do, as part of a global phenomenon. This was a direct inheritance from Humboldt, and the holistic connotations were reflected in the opinion of the Directors that 'the subject is one having a strong practical bearing on the welfare of mankind'.[184] This was a particularly surprising statement in that it originated with a traditionally conservative body. The about-turn taken by the Directors at this stage is a clear indication of the potency of the desiccation argument as well as the extent to which the Humboldtian analysis had become acceptable to them. Even to the company the implications

182 Ibid.

183 J. S. Logan, 'The probable effects on the climate of Penang of the continual destruction of its hill jungles', *Journal of the Indian Archipelago*, 2 (1848), pp. 534–5. This was a version of his lecture to the Asiatic Society of Bengal in Calcutta in 1846. At the time, Logan, a geologist, was the editor of the *Journal of the Indian Archipelago*. He had had field experience in both Malaya and India and was able to compare deforestation in the two countries.

184 Despatch no. 21, quoted in Balfour, 'The influence exercised by trees', p. 100.

were clear: Deforestation could no longer be treated as a purely local problem amenable to local solutions.

More striking, however, was the way in which the anxiety which the new scientific insights induced in the Directors meant that the problem of timber supply as a simple raw-material problem had faded into the background, at least temporarily.[185] There were several reasons for this. First, the climatic threat, so successfully articulated by the medical service and by Gibson in particular, by implication threatened the whole fabric of the colonial enterprise and the future of company rule in India. The potential for overall agricultural failure caused by a change in rainfall went beyond supply factors to encompass famine and social breakdown. These concerns had already been pre-empted by the Bombay government in its conservationist response to the firewood crisis and in its appointment of Gibson as a scientist capable of interpreting the degree of risk and the need for a response to apparently unpredictable natural processes. These fears were now taken on by the company as a whole. The anxieties expressed about the 'welfare of mankind' by the Directors need to be seen in context. The strength of the scientific arguments, as well as the improved status of science (and this applied to the medical service in India in particular), was a major factor in explaining the vigour of the Directors' response to Gibson's initiative. However, more subtle political perceptions had provided a fertile ground for the scientific arguments. Europe itself in 1847 and 1848 was becoming increasingly turbulent politically, and Chartism and early syndicalism in England had already made a sharp political impact both domestically and in the colonies. In Ireland the famine had started to take a heavy toll, and, from the point of view of the Directors, Gibson's analysis seemed to promise more of the same for India. It should be recalled that the experience of the famines in 1837–9 in Southern India had prepared the way for changes in the attitudes of the presidency governments. By 1846, with the added lesson of the Irish famine, the Court of Directors had itself undergone a parallel transition in attitude.

On receipt of the Court of Directors' despatch, the government of India, usually tardy in its relations with the presidency governments, took uncharacteristically immediate action and asked the Madras government to provide 'information respecting the effect of trees on the climate and the productiveness of a country or district'.[186] The Madras government acceded surprisingly quickly to this request both by soliciting information on the subject through

185 Ribbentrop (*Forestry*, p. 68) states that by the early 1840s 'the necessity of scientific advice was beginning to be more constantly urged'.

186 Government of India to Government of Madras, 28 Aug. 1847, quoted in Balfour, 'The influence exercised by trees', p. 100.

newspaper advertisements throughout the presidency and by circularising officials, mainly through the Revenue Board and the military authorities.[187] The alacrity of the Madras government in this case can probably be explained as the consequence of persistent lobbying of that government by Gibson, now conservator of forests in Bombay, in concert with Blane, the collector in Canara, with whom Gibson co-operated and corresponded extensively. During 1847 and 1848 Gibson and Blane plied the Madras government with letters and papers that copiously documented the economic and climatic consequences of deforestation. The Madras government had, in a sense, brought this stream of conservationist propaganda upon itself. This was because, after refusing an offer by the Bombay government to make Gibson responsible for the Canara and Gondah forests, it had indicated instead an interest in taking advantage of Gibson's experience.[188]

Gibson's success in utilising the threat of agricultural failure on the west coast were deforestation not to be controlled encouraged him to pursue a similar strategy with the Madras government, in cooperation with Blane. This time Gibson raised the threat posed to river and coastal trade and transport. Both in his letters to the government and in his first report to the Bombay Forest Department, he drew attention to the widespread and chronic siltation of ports and rivers along the coasts of Madras as a direct consequence of deforestation and the ensuing soil erosion.[189] This was the same kind of threat which had proved conclusive in promoting government controls on Mauritius fifty years earlier. Although Gibson may not have been aware of the Mauritius experience, his deputy and afterwards successor as conservator, Dalzell, certainly was.[190] Gibson himself had had ample time to become aware of the connections between deforestation and siltation both during his time in the Bombay Marine (where he must have witnessed the steady decline in the capacities of some ports and rivers) and during his extensive travels as a vaccinator in the Deccan and Kandeish.[191]

Gibson's lobbying of the Madras authorities thus helps to explain the ready response of the presidency government to the Court of Directors' despatch. As the reports from the collectorates and different parts of the presidency started to flow in, most of them tended to confirm the Court's anxieties.[192]

187 Ibid.

188 Stebbing, *Forests*, p. 119.

189 Ibid., pp. 120, 213, 215.

190 N. A. Dalzell, *Observations on the influence of forests and on the general principles of management as applicable to Bombay*, Byculla, 1863, p. 5.

191 Burkhill, *Chapters*, p. 101.

192 Balfour, 'The influence exercised by trees', p. 100. The first responses to the circular arrived very quickly from Canara, on 31 Aug. 1847 and 8 Nov. 1847, thanks principally to the interest of Blane, the collector, in the subject and to his earlier work with Gibson on the topic. Other reports received were from Rajahmundry, 6 Jan. 1848; Coimbatore, 6 Jan.; Kurnool, 29 Feb.; Nellore, 4 March; Calicut, 4 March; Trichinopoly, 7 March; Bellary, 9 March; North Arcot, 26 April; Salem, 10 May.

(The method of acquiring information by circular throughout the presidency, while innovative, was not without precedent. Surgeon Patrick Russell [appointed Madras government naturalist after the death of Koenig in 1785] had used the same method to obtain material for his zoological surveys during the early 1790s.)[193]

The environmentalism and radicalism of Edward Green Balfour

By mid 1848 the impact of the replies from the collectorates had served to alarm and even radicalise the Madras government on the deforestation issue at least as much as the Court of Directors had been alarmed by Gibson. Most of the respondents, while confirming the high rates of deforestation (and the surveys of the late 1830s provided a convenient benchmark for these impressions), also confirmed the opinion that rainfall had declined through deforestation. The possibility that famine would result from the reduction in forest cover now became uppermost in the mind of the Madras government. This was a development reinforced by the approach made to the government by assistant surgeon Edward Green Balfour in late 1847.[194] Balfour had been alerted to the government's position by the advertisements placed in the *Madras Spectator*, and he immediately 'furnished the government with a copy of a memorandum on the subject [of deforestation–climate links] which I had written and published about the year 1840'.[195] His interest in the subject was of long standing. It had originated, as Balfour told the secretary to the Madras

193 See Chapter 7.

194 'Notes on the influence exercised by trees in inducing rain and preserving moisture', *Madras Journal of Literature and Science*, 25 (1849), 402–48. Edward Green Balfour (1813–89) was educated at Montrose Academy and Edinburgh University. He arrived in India in 1834 and obtained a commission as an assistant surgeon in 1836. Like Alexander Gibson, Balfour was a scholar in several Indian languages as well as Persian. He founded the Madras Government Museum and library in 1850 and compiled the *Cyclopaedia of India* in 1857. The latter followed a prolific and polymathic output of work in literature and science. From 1858 to 1861 he was political agent to the Nawab of the Carnatic and in 1875 was instrumental in the founding of the Madras Medical College for Women. He personally translated and had printed in Hindi, Telugu, Tamil and Kannada Dr T. Conquest's *Outlines of Midwifery*. His later researches were mainly in the fields of Indian indigenous medicine and forestry practice. A list of his publications is to be found in the 1885 edition of the *Cyclopaedia of India*. Balfour stands as the clearest example of an apparent duality of humanist reform and conservation concerns.

195 'The influence exercised by trees', p. 100.

government, in a 'remark in Dr Priestley's writings'. This had 'directed my attention to the influence of trees in the health of man'. It was this that had led him to 'arrange a few notes which I had collected . . . on the influence of trees in inducing rain and preserving nature'.[196]

By this stage the government of Madras had finally submitted plans to the government of India for an establishment to cover the costs of running a forest department on the Bombay model. Provoked by the lack of central government response to its application, the Madras government took the step of reprinting Balfour's 1840 article, with additions, and sending it out to the 'Governments of Bengal, Bombay and Agra' for comments.[197] On 26 May 1849 this elicited a response from the government of India that was distinctive in its complete lack of awareness of the forest problem as it was conceived by the presidency governments. The letter resurrected the old contentions about the sanctity of private property rights and assured the Madras government that landowners were 'always the best stewards of their own lands'.[198]

This unimaginative response from the government of India exasperated the governor and Council in Madras, and it was at this stage that a decision was taken to propagandise the problem by the same methods earlier used by Gibson. This was a very unusual move on the part of government and illustrates the degree to which the Madras authorities found themselves peripheralised and hampered in their ability to respond to what they saw as a crisis. Effectively driven into the same perceptual camp as the medical service, partly as a result of the successful lobbying of the latter, the Madras government found itself adopting the methods of the scientific community and becoming a lobbying interest on its own. In this way, then, a decision was taken by the Madras authorities to sponsor publication of some of the material submitted by Balfour, along with copies of some of the responses received from the collectorates, in the *Madras Journal of Literature and Science.* This initiative was applauded as being likely to promote further investigation of the subject. Certainly it won the Madras government specialist backing in its campaign for establishment of a forestry department. The editor of the journal, J. J. Losh, commenting on the reports, noted:

> Three of these having been placed at the disposal of the Literary Society for publication in their journal, the first inserted is a paper by Assistant Surgeon Balfour, whose attention having been directed to this subject for many years past, his own observations will be found to be interspersed

196 Letter, 3 Feb. 1848, Balfour to Secretary, Madras Govt. in BL, IOL, Home Consultations, V/27/560/107.

197 Minutes of consultation of 8 Sept. 1848, Madras Government, quoted in Balfour, 'The influence exercised by trees', p. 100.

198 Stebbing, *Forests,* p. 123.

> with the remarks of different authors, the whole forming a summary of all that is known regarding this very important subject . . . with this paper before them, future enquirers will be able to prosecute their labours with all the exactness that a scientific inquiry of such vast importance to India demands.[199]

The editor pressed the point home with an allusion to the political influence which scientific expertise could confer:

> That the subject will now be fully investigated there can be no doubt, for besides an interesting letter received from Surgeon Smith, a very important one has also been received from General Cullen, whose well-known scientific character is sufficiently appreciated to ensure the attentive perusal of any remarks that proceed from his pen.

Quoting widely from Boussingault's 1838 paper, Balfour assembled evidence with a thoroughness which had not been attempted before.[200] His report remains valuable as a representative survey of the literature available to scientists in India in the late 1840s on the connections between forests and climate. The paper was unashamedly global in its scope and search for precedent. In this sense Balfour showed the kind of concern to present comprehensive information which was to culminate in his compilation of the *Cyclopaedia of India* in 1857.

However, Balfour's 1849 paper is important for reasons going far beyond the merely technical. He was undoubtedly both unusually radical and open-minded by nature. These were characteristics which may have been encouraged in his youth by his uncle, Joseph Hume, the leader of the radical party in the House of Commons and a man who had also at one time been an East India Company surgeon and who continued to be an active critic of the company.[201]

Edward Balfour's openly anti-colonialist sentiments must have owed much to his uncle, with whom he remained in frequent contact until the latter's death in 1855. But they also typified a set of reformist and radical attitudes that was widespread among Scottish staff in the company medical service by the end of the 1840s. Both Hume and Balfour were strongly affected by their intellectual acquaintance with the physiocrats, but with greatly differing results. In Hume's case, physiocracy persuaded him towards free-trade radicalism, while for Balfour physiocracy justified a statist case for environmental protection – both, of course, stemming from a basic concern for 'natural law'. Moreover, both men were attracted by the ideas of Jeremy Bentham and

199 Vol. 36 (1849), 400–1.

200 Balfour, 'Notes on the influence exercised by trees'.

201 Valerie Chancellor, *The political life of Joseph Hume,* Stratford-on-Avon, 1986, pp. 9–17.

Francis Place. Other aspects of their radicalism were also closely related, as well as being unusual for the time. For example, Hume was an early advocate of female suffrage, a cause which brought for him the ambiguous soubriquet 'Scotland's gift to the world'.[202] Balfour, as an equally strong feminist, pioneered female medical education in India, bringing about the opening of the Madras Medical College to women in 1875. Hume advocated land reform and state intervention to avoid famine in Ireland, just as Balfour did at precisely the same time in India. Perhaps most significant, both men had an avid interest in vernacular literature: the one, of Ireland; the other, of India. While in Balfour's case this was certainly a sympathetic 'Orientalism' (he spoke and wrote several Indian languages and was at one time employed as a government translator of Persian), his enthusiasms indicate a significant and specialised interest in local knowledge and traditions. These gave rise, above all, to his expertise in indigenous medicine and environmental knowledge.[203] Like Sleeman, his contemporary, Balfour was much attracted by Islamic literatures and religion and even set up the Mohammedan Public Library in Madras. Though there is no direct evidence that his Islamic reading influenced his attitudes to the Indian environment (as it clearly did in Sleeman's case), the connection is an intriguing one.

Following a career path almost identical in its first years to that of his illustrious uncle, Balfour managed to combine careers as an acclaimed medical surgeon and a recognised writer on India. From an early date, his reading was wide and cross-disciplinary and was carried on in several European and Indian languages. As a consequence, he was able to supplement his reading on the environmental factors influencing disease (a field on which he published widely in the 1840s) with an appreciation of many of the environmentalist texts and theories already outlined in this book. By 1849 he probably possessed a more comprehensive knowledge of the available literature on climate and environment than anyone else in India or perhaps further afield. He had read from Stephen Hales through Gilbert White to Alexander von Humboldt and had covered even later and more local authorities. But his writings indicate a bias towards the more radical writers, especially those combining environmental critiques with those of the social impact of colonialism, since he quotes lavishly and approvingly from Bernardin de Saint-Pierre and Alexander von Humboldt, who, he asserts, 'must be regarded as valuable authorities'.[204] Bal-

202 *Scotsman*, 1 Sept. 1830.

203 See Balfour, *The Vydian and the Hakim, what do they know of medicine?* Madras, 1875, and *Gul-dastah; or, The bunch of roses*, Madras, 1850. The latter was a lithographed series of extracts from Persian and Hindustani poets.

204 'Notes on the influence exercised by trees', p. 421.

four's interest in Saint-Pierre and in Mauritius appears to have been aroused by a visit he made to that island in 1834, in the course of which he climbed Mount Pieter Both and explored its wet mountain forests. However, he did not confine himself to Saint-Pierre for information on the Mascarenes and quotes other lesser-known sources about Mauritius and Bourbon.[205]

From a reading of his assembled texts, but relying mainly on Bernardin de Saint-Pierre's *Studies of Nature*, Balfour listed twelve facts which he thought could be established regarding the favourable impact of trees on climate. He began his 1849 paper with some exaggeration, stating that 'with the exception of a few localities in Southern India the whole country seems destitute of trees'. Echoing Butter's opinions of 1838, Balfour advocated the widespread introduction of plantations to deal with this shortage: 'Southern India would be greatly enriched and its climate mellowed by the introduction of arboriculture.'[206] In order to achieve reconstructive measures on the scale required, Balfour did not hesitate to advocate a strongly statist solution. It was, he said, only 'the government or the civil servants of the state who could accomplish anything on a great scale, but their efforts may be seconded by every individual resident in it'. Paraphrasing the Zoroastrian sayings of Pierre Poivre, he added that 'the man who makes a few trees grow where none grew before will be a benefactor to this country'. He reinforced his analysis of deforestation–climate links by citing specific historical examples of the connections between drought caused by deforestation and the occurrence of famine in India. Although not specifically rejecting the idea that traditional responses to famine might be distorted by overexacting revenue policies, Balfour preferred to concentrate on demonstrating a link between increased famine incidence, artificially induced changes in water supply and local climatic trends. 'Famines', he wrote,

> have occurred in this country and one or two of them have been caused by wars but most of them have been owing to droughts and our efforts to prevent their recurrence must be . . . to procure an ample supply of water, for rich as the soil is in many parts of India, the soil acts as a very secondary part . . . to obtain our utmost supply of water from the atmosphere we must plant trees; to prevent the rain as soon as it falls from rushing to the rivers and hence to the ocean, in fact to retard its flow and thus be enabled for a longer period to employ it for agricultural purposes we must plant trees, and we must plant trees in order to have a few springs of water trickling from the mountainsides . . . considering

205 E.g. remarks made on moisture in the forests of Bourbon in a 1709 work by a M. de la Roque and an article by J. Hayter in the *Illustrated London News*, 2 Sept. 1848, p. 142.

206 'Notes on the influence exercised by trees', pp. 445–6.

> the great numbers famines have destroyed it cannot seem an unnecessary anxiety again to obtain a more abundant and more regular supply of rain from the country to prevent their recurrence.[207]

Despite his caution in the main text of the 1849 paper, Balfour implied in a footnote that he considered the 1770 famine, as had Reynal and Howitt before him, as being a straightforward consequence of the onset of British colonial rule and revenue policies.[208] 'Within the first five years from our first acquisition of the technical sovereignty of the Bengal Provinces in 1765, a famine prevailed which swept off in two years' time one-third part of the entire population – probably an exaggeration, but which is not denied by any party – and destroyed as many of the human race as the whole inhabitants of the present Kingdom of Holland.'[209] Not content with this historical reference, he cited a more recent example of famine, that of 1837–9 – the very famine that had stimulated J. F. Thomas to write his critique of the EIC's laissez-faire policy.[210] Balfour was here responding to opposition to tree-planting schemes among those Europeans who believed that forests might be engines for disease.[211] Contemporary arguments about the origins and vectors of disease were interconnected with broader environmental arguments. Balfour tried to dismiss the apprehension about miasmic 'reservoirs' of disease in terms of 'relative misery', in which he clearly assessed the health of Europeans as far less at risk than the vast native majority were at risk from famine. 'The dangers to Europeans', he wrote,

> are purely imaginary and equally so, in my opinion, to the native population, although their spare diet and spare forms, their food and mode of life expose them to the influence of vitiated air. But even with every excess we may with full confidence assert that increased mortality which many most gratuitously assume as the inevitable consequence of much vegetation, would never amount to five hundred thousand, the number of the native population that are said to have died in 1839 in India of famine alone. A famine sweeping whole cities, nay whole districts of the earth must far exceed, in the amount of misery and death it occasions, the hardships which could be entailed on a family by one of its members being carried from a more sickly climate, even supposing that the planting of trees would ever become excessive or cause a climate to change, which I do not believe.[212]

207 Ibid., p. 447.
208 Howitt, *Colonisation and Christianity*, p. 268.
209 'Notes on the influence exercised by trees', p. 448.
210 Thomas, 'Notes on ryotwar'.
211 See e.g. Spry, *Modern India*, pp. 184–96.
212 Balfour, 'Notes on the influence exercised by trees', p. 440.

An explicit connection made here by Balfour between forest cover and famine incidence, and the possibility which he held out that protection and planting might actually stem famine helps to explain the alacrity with which Balfour's ideas were taken up at an official level. Indeed, the governor in council 'perused with much pleasure and satisfaction the valuable and very interesting report furnished by Assistant-Surgeon Balfour', deeming it of importance that local revenue officials should be 'in possession of information so intimately concerned with the welfare of the districts under their respective charges'.[213] The paper, it was explained, had already been printed in the Fort St George Gazette for 'general transmission to the Government of India and the Governments of Bengal, Bombay, Agra and the Honourable the Court of Directors'. These statements by the Madras government tend to give the impression that Balfour's desiccationist arguments were accepted without question. In fact, this was far from the case, and some of the responses and debates printed in the *Madras Journal* indicate that his assumption that rainfall decline and deforestation were closely connected was actually strongly contested. Major-General Cullen, for example, the resident in Travancore and Cochin, disputed the forest–rainfall connection, supporting his case with a statement to the same effect made by the Dewan of Cochin.[214] The Madras government clearly sought to control the terms of this debate on rainfall causation; clearly supporting the views of the desiccationists, it sought to give prominence, for example, to views diametrically opposed to those of Cullen which were expressed in documents sent to the chief secretary by surgeon C. I. Smith of the Mysore Commission. This was not surprising, since J. F. Thomas, the Madras chief secretary, was himself a radical who, as we have seen, had advocated strong and statist interventions in famine and forest matters. Furthermore, he seemed more inclined to give credence to the views of the medical surgeons than to the anti-desiccationist views of lay army officers such as Cullen and his colleagues on the revenue boards. Personal contacts made through Thomas and his colleagues with the Madras Literary Society at its headquarters in the city may also have contributed to this government bias towards the views of trained scientists.

The high reputation which Balfour himself enjoyed with the Madras government can partly be attributed to his earlier record, since he had already achieved some prominence as an authority on public health and on the ethnology of hill and forest tribes in Central India.[215] Furthermore, earlier in

213 *Madras Journal of Literature and Science*, 36, (1849), p. 401 (editorial).
214 Letter from Cullen to J. F. Thomas (Chief Secretary, Madras Govt), dated at Cochin, 31 March 1849, *Madras Journal of Literature and Science*, 36 (1849), pp. 400ff.
215 'On the migratory tribes of natives of Central India', *Edinburgh New Philosophical Journal*, 1843, pp. 29–47.

1849 he had published some notable papers on the statistics of cholera incidence and on the reasons for the discharge of Indian soldiers from the army.[216]

The links between water supply and cholera, although not proven, were already suspected in 1849. Public health and disease control in general were beginning to acquire an important place in ideas on social reform at this time, particularly after the publication of the Chadwick report in 1842, and the concept of government intervention in this area had become acceptable.[217] In a broader sense, it should be noted, government intervention in health had been advocated in urban areas in Britain since as far back as 1770.[218] Bearing these evolutionary factors in mind, it should therefore come as no surprise to find that Edward Balfour found it both logical and expedient to present the 'forest problem' as being fundamentally a public-health question demanding the kinds of interventionist solutions in the countryside that were being adopted in the urban sanitary landscape. In fact, this was Balfour's major contribution to the analysis of environmental change. Advocates of forest protection could now claim the high ground of what were accepted public-health priorities in India and the metropole.[219]

In endorsing Balfour's views as part of its own propaganda campaign in favour of forest protection, the Madras Presidency had picked a figure who stands out as the most singular representative of a group of government scientists of reformist persuasion. These men, whose influence was first strongly felt in the Madras Presidency in about 1838, combined a reasonably sensitive and atypical interest in the culture and welfare of the indigenous population with an equivalent concern to develop public works specifically related to the basic resource needs of the population. Famine, disease, water supply and forest protection were inextricably linked in their minds. This concern for basic needs far outweighed more short-term commercial considerations, whose facilitation was anyway quite unrelated to the likely employment status and promotional potential of a government surgeon.

216 *Statistics of cholera*, Madras, 1849, and 'Remarks on the abstract tables showing the number of native soldiers discharged from the Madras Army, during the five years from 1842–3 to 1846–7', *Madras Journal of Literature and Science*, 36 (1849).

217 E. Chadwick, *Report on the sanitary conditions of the labouring population of Great Britain*, London, 1842.

218 R. E. Lewis, *Edwin Chadwick and the public health movement, 1832–1854*, London, 1952, p. 27.

219 Balfour himself continued to develop the interest in forest protection which he had acquired by way of a concern for adequate water supplies and through his reading of Butter, Boussingault and Humboldt. His interest in the culture and survival of the hill tribes played a part in this; see 'On the migratory tribes'. The *Cyclopaedia of India*, edited by Balfour in 1857, contained extensive references to the forest-protection problem, and he went on to publish further books on forestry in 1862 and 1885; see Balfour, *The timber trees . . . as also the forests of India*, Madras, 1870.

Retaining the full confidence of the presidency governments, and at the same time open to the most radical reforming concerns then current in Britain, the surgeons were able to take full advantage of the enormous influence which their social position conferred upon them in the company context. Ideas and information flowed quickly and easily among them as a coterie of qualified men. In relating famine incidence to deforestation, Balfour offered the possibility of an effective palliative to widespread utilitarian concern about the ills of the ryots in a way in which discussions of land-tenure problems and land revenue rating alone could not. This is why the Madras government campaign of 1849 is exceptional. It represented a tentative beginning to a structured and interventionist state response to what was by 1849 already being seen as a resource crisis and a social crisis. Moreover, it is hard to conceive of a more millennial threat than the famine-death scenario put forward by Balfour. With the important exception of the efforts of William Roxburgh in Madras in the 1780s, earlier responses to famine had consisted largely in providing granaries and limited public-works schemes for the starving, in even more limited direct relief, in pious hopes that Smithian laws of supply and demand might save the day, or, in some quarters, in a fatalistic and Malthusian acceptance of widespread famine death.[220] Forest conservation presented itself as an alternative solution and, furthermore, one which offered the government opportunities for more direct control over arable land and over unruly 'tribal' people.

It is quite conceivable that the success of the surgeons in changing the policies and views of the presidency governments was assisted by a contemporary shift in the strength of reformist, humanitarian and statist attitudes within the establishment. As suggested above, these shifts in attitude may have been speeded up by the official experiences of Indian and Irish famines, the full appalling scope of which was just beginning to be understood by British society and governments. The exchanges which took place between Hume and Balfour on such matters were simply part of a larger and increasingly anxious official response to famine.[221] Nevertheless, three more local

220 See Ambirajan, 'Malthusian population theory and Indian famine policy in the nineteenth century', pp. 5–8.

221 See Woodham-Smith, *The Great Hunger*, pp. 132–269. In order to understand these links further, a study of timing, diffusion of ideas and personnel would be required. Woodham-Smith notes in this respect that 'the conduct of the British government during the Famine is divided into two periods. During the first, from 1845 until the summer of 1847, the government behaved with considerable generosity. An elaborate relief organisation was set up, public works were started on a scale never attempted before . . . but during the second period, after the transfer to the Poor Law in the summer of 1847, the behaviour of the British government is difficult to defend' (p. 408). Nevertheless, in late 1846 and in 1847 the fear of total social breakdown in Ireland was manifest, and it had probably been present earlier. In 1848 Lord Monteagle warned Sir John Russell that 'the crack of the gentry is going on

factors were sufficient impetus: the close contact surgeons necessarily had with the realities of human suffering, their empirical grasp of the resource situation, and their ability through scholarship and wide reading to relate the discoveries and writings of such foreign scientists as Humboldt and Boussingault to the Indian predicament. In exposing the trends of long-term deterioration in soil quality, water supply and climate, they made plain the dangers of laissez-faire governmental strategies. More important, in hoping to husband resources, reduce hazards and promote social-welfare objectives, they allowed the preconditions for a 'development-oriented' governing and land-use philosophy to acquire embryonic form. In harnessing the ecological facts of forest clearance and drought to the threat of climatic change and famine as well as to possible loss of production and revenue, the surgeons had uncovered an apparently unassailable argument.[222] It was one which, although not always accepted, became more sophisticated in its formulation and policy consequences as time went on. Edward Balfour in particular continued to play a central part in propagandising desiccationist theories of famine incidence, not least when he was surgeon-general of India at the time of the famines in 1877–9.[223]

The initiatives which Balfour took in 1849 while still a junior assistant surgeon in Madras government service were not initially successful in the face of the intransigence of the government of India. The major perceptual differences among levels of government persisted – an extraordinary phenomenon in view of the environmentally interventionist position adopted in 1847 by the Court of Directors. Nevertheless, it was one whose essence had been understood at an early stage by Alexander Gibson and Edward Balfour in their advocacy of the conservation case outside the confines of India. The key to Gibson's success with the Court of Directors and to Balfour's success with the Madras government had consisted in using the authority of internationally generated scientific expertise as an essential part of their propaganda. The essence of this scientific approach lay in its appeal to phenomena not confined to India but experienced world-wide.

right and left', a Poor Law inspector spoke of 'the dread of the break-up of all society' and said that the state of the gentry is awful', and the *Times* prophesied 'a tremendous crash . . . in which all interests and all classes will be swept away': all quoted in Woodham-Smith, p. 373.

222 In a wider social sense the obsession with climate in India and other colonies was reflected in the pages of almost every issue of the popular and scientific journals circulating amongst Europeans in India in the 1840s. Comparisons were often made in Indian medical journals with the climatic conditions in other colonies; see e.g. M. Stovell, 'Notes on the climate of the Cape of Good Hope', *Transactions of the Bombay Medical and Physical Society*, 1849, pp. 195–215. These climatic obsessions set the stage for the more widespread fears of global desiccation which became current in the 1850s; see e.g. Wilson, 'On the general and gradual desiccation of the earth and atmosphere'.

223 See Government of India, *Famine Commission.*

The reluctance of the government of India in 1849 to respond to the medical environmentalists soon led another surgeon, Hugh Cleghorn,[224] to take the political approach of Gibson and Balfour a stage further by publicising the deforestation crisis in India in an extra-Indian scientific context, with the express aim of securing a unitary state strategy for forest protection in India. He did this by raising the issue at a meeting of the British Association for the Advancement of Science (BAAS) in 1850 and then securing a grant from the BAAS to finance a year-long programme of research and a survey of the literature on the whole problem of tropical deforestation throughout India and South-East Asia. The results of the research were published as a twenty-two-page report in the proceedings of the association in 1852.[225]

The report was nominally compiled by a committee but was actually written and edited by Cleghorn himself. It reiterated all the conservation arguments of the previous fifteen years and as such represents a landmark in the history of the colonial response to environmental change. It can be compared both in scope and in the impact it had on government conservation policy with the impact of the Chadwick report of 1842 on public-health policy in Britain.[226] In both cases, a permanent extension of the role of the state was being advocated in a collective interest and in contravention of the interests of private capital. The two reports, one produced at the core of empire and the other at its periphery, were in fact more closely connected in the basis of their thinking than might at first appear. Both reports prescribed state intervention to control water and run-off, the one in the city, the other in the country, on the ground of public-health imperatives. However, although both justified state intervention on the basis of public health and disease (or famine) prevention as being a moral good, the ideological motives behind the reform

224 Hugh Francis Cleghorn (1820–95) was born in India, educated at the University of Edinburgh and returned to India in 1842 as assistant surgeon at Shimoga in Mysore, adjacent to the heavily forested Western Ghats. He arrived at Shimoga at a time when extensive forest clearance was taking place. The process clearly made a great impact on him, and he spent the rest of his professional life involved in matters of forest protection. He was made professor of botany and materia medica at Madras in 1851 and was appointed conservator of forests in Madras in 1855 and inspector-general of Indian forests in 1867. Cleghorn acquired his botanical interests from his father, Hugh Cleghorn (1787–1834), private secretary to the governor of Ceylon, who had himself been trained by Johann Peter Rottler, a Tranquebar medical missionary and friend of J. G. Koenig, the first Madras government naturalist. The younger Cleghorn's interest in Humboldt and his appointment of German staff to the Madras Forest Conservancy may be related to these German botanical connections. The governor of Ceylon during Cleghorn's youth there was George Walker, who had previously been governor of St Helena. Whether Cleghorn junior became acquainted with St Helena's problems thereby is open to surmise. See Cleghorn, *Forests and gardens of South India, DNB*, and Burkill, *Chapters*, pp. 76–86.

225 Cleghorn et al., 'Report of the committee'.

226 Chadwick, *Report on the sanitary conditions of the labouring population of Great Britain.*

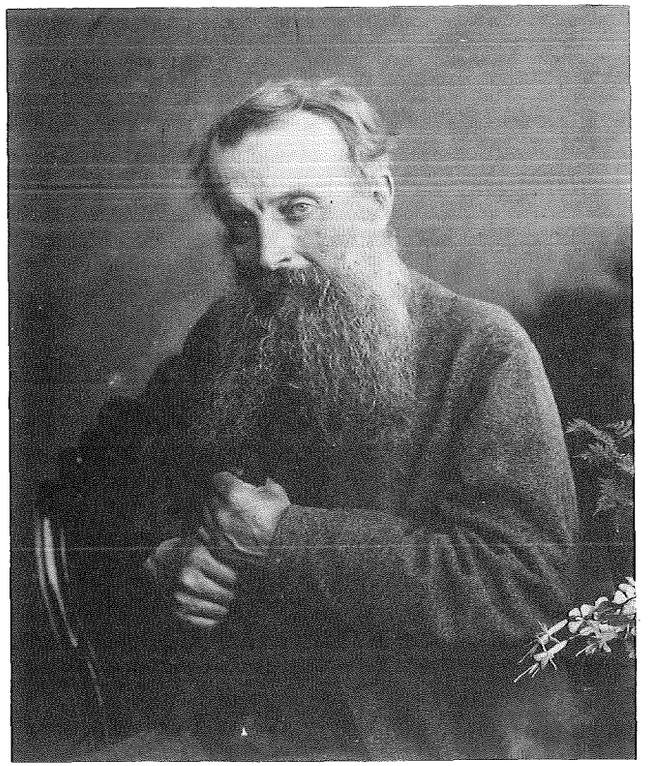

Plate 22. Hugh Francis Cleghorn, 1820–95, conservator of forests in the Madras Presidency (1855) and inspector-general of Indian forests (1867). (Reproduced by permission of the University of St Andrews)

programmes of both Chadwick and Cleghorn need to be treated with some circumspection. In fact, it seems likely that Chadwick was inspired principally by Benthamite ideas about control and state power rather than by reformist altruism, and that elimination of the misery of poverty was not his principal objective.[227] However, the medical service's connections with Bentham were far less explicit than they were with the quite different ideology of Alexander von Humboldt. Any attempt to explain Cleghorn's environmentalism (which, like that of Balfour, influenced forest policy over several decades) would probably require, initially, some exploration of his religious background. This consisted in almost fanatical adherence to a personal and idiosyncratic evangelical revivalism coupled with a Scott-like enthusiasm for 'romantic' scenery.[228] As an early environmentalist in India, Cleghorn could, and did, exercise both of these personal bents, in much the way that his Scottish contemporary, John Croumbie Brown, preached and practised an environmental gospel in South Africa.[229] Along with Balfour's papers, the Cleghorn report and its recommendations became the basis, in terms of analysis and prescription, for most of the subsequent colonial responses to the problems of environmental degradation in India and further afield. Before this could take place, however, it required the utilitarian efforts of yet another Scot, Lord Dalhousie, as governor-general, to convert the environmentalism of the surgeons into an all-India forest-protection policy. In the course of doing so, in his first few years as governor-general Dalhousie appears to have absorbed the tenets of the medical environmentalists and, equally important, the implications of pre-colonial models of arboricultural practice, especially those found in Sind and the Punjab.

227 See Julian Martin, 'Edwin Chadwick: Social or medical reformer?', M. Phil. diss., Dept of the History and Philosophy of Science, University of Cambridge, 1984, pp. 27–8.

The legacy of Balfour and the Sindhi amirs: Lord Dalhousie and the influence of pre-colonial forestry on a utilitarian project

Lord Dalhousie arrived in India in 1847. The new governor-general's utilitarian bent and his ambitions for expanding the administrative and technical role of the state quickly led him to sympathise (albeit for partially different motives) with the interventionist approach adopted by the medical service to what was now widely referred to as the 'forest problem'.[230] In fact, it seems that Dalhousie was first alerted to the significance of the forest issue through his meeting with J. D. Hooker, son of Sir William Hooker, director of the Royal Botanic Gardens at Kew. This occurred through the chance circumstance that both men travelled out to India in 1847 in the same entourage.[231]

228 See University of St Andrews Archives, Cleghorn Papers: Hugh Cleghorn's notebooks on sermons, Box 12.

229 See Grove, 'Scottish missionaries, evangelical discourses and the origins of conservation thinking in Southern Africa', *Journal of Southern African Studies*, 15 (1989), 22–39.

230 See Stokes, *The English Utilitarians and India*, pp. 248–51. While Stokes discussed Dalhousie's interest in establishing all-India authorities, he did not deal at all with what was one of Dalhousie's longest-lasting legacies: the all-India Forest Department, the basis for which was first established in 1851 in the Punjab. The department was formalised in a memorandum of 1854, the same year in which Dalhousie's famous 'education despatch' was gazetted.

231 W. B. Turrill, *Joseph Dalton Hooker: Botanist, explorer and administrator*, London, 1963, pp. 50–1; Huxley, *Life and letters of Sir Joseph Dalton Hooker*, vol. 1.

As a result, Hooker played a major role in alerting Dalhousie to the possible consequences of deforestation. He thereby perpetuated the part played by his father in lobbying both Alexander Gibson and the Cape government on the advisability of forest protection. It was Hooker's visit to St Helena and Ascension Island in 1842 that had convinced him conclusively of a dynamic relationship between forest cover and rainfall. He had been especially impressed by the alleged success of Roberts's and Beatson's reafforestation programmes on St Helena in promoting an increase in rainfall on the island.[232] These claims had been enabled by Sir Joseph Banks's efforts to promote a continuous series of meteorological observations on St Helena from 1811, in direct imitation of Roxburgh's earlier weather researches in the Madras Presidency.[233] This had led Hooker, in turn, to promote a tree-planting programme on Ascension Island with the Navy authorities, for whom the island had recently acquired a degree of strategic importance. Shortly after Dalhousie's contacts with Hooker on the subject, he was supplied by the Madras government with Balfour's 1849 paper. This would have reinforced Hooker's St Helena dictums, since Balfour had made great play of Boussingault's findings on the effects of afforestation on Ascension Island and of the reports made in the *St Helena Almanac* of 1848, which had attributed the considerable rainfall increase during the 1840s to government tree planting.[234] Dalhousie's enthusiasm for government intervention in arboriculture and forest reservation was thus given considerable initial encouragement by the example of St Helena and, even more conclusively, by the literature surveys of Edward Balfour.

By 1850, too, the continued influence of Hooker and the well-publicised efforts of the Madras government to instigate and fund a formal conservancy had helped to convince Dalhousie of the significance of deforestation and the need for a centralised state response, as he admitted in a minute he wrote in February 1851. In it he recorded that when, during the last season, he had

> traversed the plains of the Punjab . . . there was one characteristic of the wide tract which could not fail to strike the least observant traveller . . . I refer to the almost total absence of forest trees and of even fruit trees and of bushes leaving the whole territory unadorned by the foliage which is its natural cover, nor stocked with the timber requisite for a thousand purposes in the every-day life of the people who dwell in it . . . this is a manifest and will shortly be felt to be an increasing evil unless some measures are taken to provide at present a remedy for the future . . . the

232 Duffey, 'The terrestrial ecology of Ascension Island'; Beatson, *Tracts*, pp. 194–5.

233 Beatson, *Tracts*, p. xxxv.

234 Boussingault based his comments on Ascension Island on an essay by one Desbassyn, quoted in Balfour, 'Notes on the influence exercised by trees', p. 436. Balfour, in turn (p. 408), had used the 1848 *St Helena Almanac*, p. 5.

> Government should provide some means to that end and should bring them into operation without delay.

At this stage Dalhousie was already well aware of the climatic arguments, as he made clear in the memorandum. As a result, he felt strongly

> the urgent duty of endeavouring to give to this country the clothing of forest trees from my knowledge of the well-ascertained and beneficial effect which trees produce on the healthiness and fertility of the tracts in which they are found. No power has been more clearly established than this salubrious and fertilizing effect of foliage in an Indian climate. It has been the subject of much enquiry and has been affirmed and demonstrated in every report submitted from different parts of India, many of which have passed through my hands, and one of which I forwarded to the local government in the Punjab some time ago . . . None of us can live to see the complete result of that which we now propose to commence. Few of us will gather the fruit where now we plant. But if we succeed in framing this design and advance it in some degree towards completion, we may at least enjoy the satisfaction of feeling that we shall leave behind us an heritage for which posterity will be grateful.[235]

An examination of the language and terms used by Dalhousie in his Punjab minute indicates a strong reliance on Balfour's environmentalist arguments, which the governor-general clearly found convincing, supported as they were by the authority of J. F. Thomas and the Madras government.

It was the military annexation of the Punjab in 1849 that provided the context for a pioneering attempt at state arboriculture in North-West India. The detailed planning for this enterprise, which provided the first field experience of state forestry for Dalhousie, is extensively documented in the records of the Agri-Horticultural Society of the Punjab. This episode has, to date, been entirely neglected by writers on the history of Indian state forestry. As a consequence, the critical influence of pre-colonial forest practices in providing models (rather than just a legitimation) for early management methods in colonial state forestry has not been properly appreciated. The history and enormous scale of the forest system established in the Indus valley by the Amirs of Sind has already been referred to in this chapter. The annexation of Sind by Sir Charles Napier provided an opportunity to set up an embryonic forest administration based directly upon the infrastructure of shikargahs, or game and forest reserves. This development was due largely to Napier's per-

235 'Minute on agriculture' from Dalhousie to Agri-Horticultural Society of Lahore, 20 Feb. 1850, read to the Society on 12 Aug. 1851 and published in J. L. Stewart, ed., *Select papers of the Agri-Horticultural Society of the Punjab from its commencement to 1862*, Lahore, 1865, pp. 1–5; quoted in J. Storr-Lister, 'Tree-planting in the Punjab', *Cape Monthly*, 1873, pp. 365–8.

sonal interest in forestry matters. The shikargahs had first come to his notice during the military campaigns against the Talpur amirs in 1843, when the reserves had been very effectively used as coverts for guerrilla action by the indigenous forces. In May 1843 Napier learnt that the amirs were accustomed to sell firewood rights in some of the shikargah forests for up to 300,000 rupees per annum for a single forest. 'If this species of property is so valuable', he wrote, 'it may well demand a district establishment to attend to it.'[236] Napier therefore recommended to Lord Ellenborough, the governor-general, that he write to J. C. Loudon, a celebrated forestry expert of his acquaintance, for advice and assistance. 'If your Lordship', he added, 'could appoint someone acquainted with the care of forests to be at the head of an establishment it would prove a great source of revenue . . . I formerly devoted much of my time to this study, but it is impossible for me to attend [now] to such matters.'[237] Whoever was appointed, he thought, 'must be eternally in these woods to regulate the cutting and pruning'. Loudon, he thought, would suggest 'someone whose character he could depend on and who would come to this country accompanied by half a dozen assistants'.[238]

Ellenborough, however, preferred to use local expertise and suggested that a Captain Baker, of the Bengal Engineers, should be appointed with 'several scientific officers' to survey and administer the ancient canals and forest reserves of the amirs under a single agency.[239] Baker duly arrived in Sind in 1843, while the efficient Ellenborough despatched the necessary scientific survey instruments to Karachi by sea.[240] One of the earliest measures taken by Napier and Baker's new forest administration was to open the forests up to the local peasantry and small landowners to enable them to forage their animals and take forest produce free of charge. Since this represented a complete reversal of the exclusionist policy of the pre-colonial ruler, much short-term political credit was thereby gained, although in a fashion much criticised by some contemporary British officials.[241]

The further development of the Sind Canal and Forest Department is of great importance to our narrative. This is not least because two of its early

236 PRO, Ellenborough Papers, 30/12/61: Letter to Ellenborough, 22 May 1843. See also Sind Archives, Karachi: Political 201, Sind file for 1843.

237 PRO, Ellenborough Papers, 30/12/61.

238 John Claudius Loudon (1783–1843) was probably the best-known arboriculturist of the time. As the founder of the *Gardener's Magazine*, Loudon was John Ruskin's first publisher. He also laid out the Birmingham Botanic Garden and published *Arboretum et fruticetum Britannicum* (8 vols., London, 1838), which would have been known to Napier.

239 PRO, Ellenborough Papers, 30/12/94: Letter to Napier 16 June 1843.

240 Ibid., 13 Aug. 1843.

241 John Jacob, 'Notes on administration,' (original MS), p. 58n, quoted in H. T. Lambrick, *Sir Charles Napier and Sind*, Oxford, 1952, p. 322.

administrators, John Ellerton Stocks (a company surgeon) and N. A. Dalzell, became prominent in the early development, structuring and methods of the Bombay Presidency Forest Department and (in the case of Dalzell) in establishing the theoretical desiccationist and climatic rationales for an all-India forest-conservation system.[242] Similarly, Alexander Gibson, founder of the department, possessed an intimate knowledge of the pre-colonial Sind system and incorporated many of its features in the running of the first large-scale colonial forest-reserve system outside Sind itself, where the reserves were run much as they had been under the amirs, albeit in a rather more relaxed fashion.[243] The first few years spent in working the Indus valley shikargahs as a forest department are extensively documented and indicate a constant chopping and changing of policy by a chronically undermanned forest staff, largely overwhelmed by the demands that were now made on the forests by the local inhabitants as a result of Napier's indulgent policy on access.[244] Until about 1850 the experience of the Sind Forest Department was really the only working example of formalised state forest reservation that was available to the East India Company authorities outside the plantations run on the sites marked out by Roxburgh and Wallich. Although by 1850 some experimental teak plantations had been started by Lieutenant Connolly at Nilumbur in Malabar at the suggestion of the local rajah, few of the trees were more than six years old. As a result, Dalhousie's interest in developing state arboriculture in the Punjab meant that surgeon John Stocks was soon consulted by the Punjab Board of Administration on the long-established management system of Sind. This took place at the same time as district officers throughout the Punjab were being asked to provide local forest information. Stocks, however, was the only outside expert consulted at this stage.[245] Stocks's career is clearly of some interest in considering the diffusion of the Sind forest-management system. As a surgeon and botanist, his knowledge of the Indus environment had become well developed since his transfer from Bombay to Sind in 1843. Several years later it was stated locally that 'none gave so much satisfaction as did Stocks while [the forests] were under his management . . . for works of this

242 See Dalzell, *Observations on the influence of forests.*

243 Gibson's expertise on the Sind forest system and the probability that he adapted it for use in the Western Ghats are attested to by Edward Balfour in his 1885 edition of the *Cyclopaedia*, entry 'Alexander Gibson'.

244 Lieutenant Walter Scott, *Report on the management of canals and forests in Scinde*, Calcutta, 1853, esp. pp. 63–7; BL, IOL, V/23/206 (or National Library of India, Calcutta, G.P. 333.5 (5431); B 639, SPB, no. 7). See also Baker, 'Report on the economic condition of roads, canals and forests in Sind', 1846, 56pp, IOL, V/23/345 (1).

245 Proceedings of the Board of Administration for the Affairs of the Punjab, 13 April 1852, and circular sent to all Commissioners, 1 March 1852, in Stewart, *Select papers of the Agri-Horticultural Society*, pp. 5–6.

description where improvements are so invaluable to the revenues, men of first rate abilities are necessary'.[246] However, this emphasis on revenue gives a somewhat misleading impression, since the forest staff in the late 1840s considered that a major part of their raison d'être was to protect the forests in order to prevent river-bank erosion and the agriculturally disastrous incidence of sand drift. Scott, for example, in his 1848 report (printed in 1853) pointed to the significant role played by the amirs' forests in this respect. 'I am clearly of the opinion', he wrote, 'that the woods in Scinde are extremely useful in preventing the drift of sand and that they ought to be extended' for this purpose, 'as I proposed in a former portion of this report'.[247] However, to do this, he thought, it would be necessary to 'exclude cattle' and remove the provision of free access Napier had allowed to the local farmers. The main advantages of this would consist in preventing sand drift and assuring a local supply of firewood. The negligible financial returns from the forests, Scott asserted, did not show by any means their value to the government'.[248]

The priority of protecting forests and preventing erosion rather than increasing revenue was reflected in the report which Stocks presented to the Punjab Board of Administration in October 1852. Stocks was particularly keen that the new government should follow the methods of the amirs, commenting that 'the mode which they took to ensure the growth of a jungle was well suited to the ends proposed'. He noted that 'by stakes or walls' they enclosed 'large tracts of ground and let the natural jungle come up unrepressed, *taking especial care that no goats and no animals got admittance, or indeed any living being as far as they could prevent it*'.[249] Such measures under the amirs, he pointed out, had required 'co-operation on the part of neighbouring Village authorities, combined with the presence of a Government Keeper, or a Fence and Keeper'.[250]

These strictures by the amirs, Stocks noted, contrasted with the much looser colonial regime, under which 'since our occupation, nothing has been done, but to keep up the wood at present existing . . . but all this within the

246 *Scindian*, 12 July 1856, quoted in Balfour, *Cyclopaedia* (1857), article entitled 'Timber and Fancy Woods of Eastern and Southern Asia', p. 1936.

247 Scott, *Report on the management of canals and forests*, pp. 63–5.

248 Initial plans to charge the grazing fees imposed by the amirs were soon abandoned, as Scott recorded: 'Captain Rathbone settled with me that as the people derived absolute and great advantages from being allowed to cultivate the forest at all, that they ought not to be allowed to graze free. He has now changed his opinion, however, and says that the charge for grazing interferes with cultivation . . . at present much of my time is taken up with forest disputes and the people are so detached [*sic*] that I cannot be certain that I even get the truth of any complaints' (ibid., p. 65).

249 'Report on the forests of Sind by Assistant Surgeon J. E. Stocks, Forest Ranger in Sind', 29 Oct. 1852, in Stewart, *Select papers of the Agri-Horticultural Society*, pp. 18–21 (my italics).

250 Ibid., p. 19.

old forest limits, which have also been encroached on by cultivators by permission of Government to a vast extent, as far as the unwooded and waste parts of the forest are concerned'. Stocks therefore advocated a reversion to the methods of the amirs. His opinions are important for a number of reasons, not least because they demonstrate that the enormous reserves of the pre-colonial regime were run a great deal more tightly and unsympathetically to small farmers than was the case after colonial annexation. Considerations of access by the local population were more important under the colonial regime than in earlier times. Furthermore, Stocks's recommendations were seized upon by Dalhousie and the Punjab authorities and seem to have formed the basis for much of Dalhousie's later attitude towards forest administration. In particular, he acted on Stocks's approval of the expansionist policies of the amirs in rapidly enlarging the areas of state-controlled forest, even at the expense of revenue-earning agriculture.

Stocks himself, along with N. A. Dalzell and Alexander Gibson, went on quite independently to apply the exclusionist policies of the amirs in the Bombay Presidency, as Gibson's official reports reveal. Before 1865 the local subordinate officers of the Bombay Conservancy, as in Sind, were employed and named according to indigenous usage rather than according to imported terms.[251] Indeed, adherence to indigenous models took place to such an extent that little recourse was made in the pre-Mutiny period to the Continental forest-management systems of Germany and France, which have long been supposed to have been slavishly adhered to by early colonial foresters in India. Even Dietrich Brandis himself acknowledged the legacy, noting that 'we owe the maintenance of forests in Sindh and of the rukhs in the Punjab entirely to the actions taken by the former rulers; and that during the first period after the occupation of the country, the action of the British government has not in all cases been favourable to the preservation of forests and woodland in the arid and dry regions of India'.[252] One could hardly hope to find a more au-

251 For local nomenclatures and the influence of Sindhi and Maratha pre-colonial management models, see Alexander Gibson, 'Description of the system adopted for the forestry conservancy of the Bombay Presidency', in Gibson, ed., *A handbook for the forests of the Bombay Presidency*, Byculla, 1863. E. Aitken, in the *Gazetteer of Sind* of 1847, pp. 40ff, notes that Scott was followed as forest ranger (conservator) by 'Capt. Crawford, Dr Stocks, Captain Hamilton, and Mr Dalzell' and that it was Hamilton and Dalzell who first re-marked the boundaries of the pre-colonial shikargahs as forest reserves. All these men, it should be noted, went on to join the Bombay Presidency Forest Conservancy under Gibson and then (in the case of Stocks and Dalzell) to succeed him as conservators. Sind was also a training ground for figures who later became prominent in foresty circles much later in the century. Schlich, for example, who later became professor of forestry at Oxford University, was made conservator of Sind in 1871.

252 D. Brandis, 'On the distribution of forests in India', *Transactions of the Scottish Arboricultural Society*, 7 (1873), 90, and 'Sind forests', *Indian Forester*, 4 (1879), 359–64.

thoritative testament to the significance of pre-colonial forestry methods in North-West India. Moreover, as Brandis went on to say, 'past neglect' by the British in this respect had been made good in the Punjab, 'where extensive plantations have been made . . . which now cover upwards of 12000 acres'. Of course this was a derisory figure in comparison with the area of over a million acres reafforested by the amirs between 1783 and 1843. Nevertheless, it provided Dalhousie with some important interventionist, and largely indigenously inspired, experience in the critical period before he decided on a fully fledged and utilitarian forest project for the whole of India.

A survey of the forests of Burma in the late 1840s by surgeon John McClelland, an ardent enthusiast of natural history and an advocate for the preservation of rare plants, provided a further stimulus to Dalhousie's interest in forest protection, since McClelland strongly advised rigorous state intervention and reservation to save the rapidly disintegrating forests of Pegu.[253] One part of his report was especially innovative and constituted articulate advocacy of a notion that in more modern parlance would be termed 'sustainable yield'. A forest, McClelland argued,

> may be a regarded as a growing capital, the resources of which are young trees, and unless these are preserved and guarded to maturity, it is obvious that a forest must necessarily degenerate from the nature of an improving capital to that of a sinking fund, which, given time, must become expended. The loss occasioned by the removal of an undersized tree is not merely the difference in value as compared with a full-grown tree as a piece of timber, but must be estimated by the number of years the forest may be deprived, by its removal, of the annual distribution of its seed, which period will vary according to the stage of growth at which it was cut down, and the time which it would otherwise have taken to arrive at maturity.
>
> If we fail in the comparatively simple duty of preserving the old forests, we can scarcely hope to succeed in the more difficult task of creating new ones. Planting as a means of extension, when carried out in connection with thriving forests, might, indeed, become a duty; with a view of perpetuating an object that conferred a lasting benefit on society. . .

The economic justification presented here for a programme of conservancy in *existing* forests, in preference to an arboriculture to create new forests, was

253 Burkill, *Chapters*, p. 155; Stebbing, *Forests*, p. 206. Exports of finished teak from the Moulmein district of Burma were rising rapidly at the time McClelland recommended the exclusion of private timber companies from Burma. E. O'Reilley, in 'The vegetable products of the Tenasserim Provinces', *Journal of the Indian Archipelago*, 4 (1850), 55–65, records the following exports of finished teak prior to 1850 from the Moulmein region (in net timber tons): 1840, 4,952; 1841, 6,399; 1842, 11,457; 1843, 10,528; 1844, 14,245; 1845, 13,360; 1847, 11,225; 1848, 18,000.

clearly found convincing by the authorities. Indeed, the continued influence of McClelland's report and of the slightly earlier Cleghorn report led directly to the formulation of the 'Dalhousie memorandum' of 1855 which became the main basis for the centralised forest-management policy adopted in India after 1860.[254] In the Madras Presidency, Hugh Cleghorn's increasingly senior status in the medical service and his editorship of the BAAS report led directly to his appointment by Lord Harris as conservator of forests in the Madras Presidency, the Madras Forest Department being finally established in 1855. A year later a further department, run on a co-operative basis with the princely government, was opened in Mysore. This too was headed by Cleghorn, at the request of Sir Charles Cubbon.[255] By the time of the Mutiny, therefore, the basic infrastructure of state forest conservation was in place in all presidencies as well as elsewhere in India. The significance of this development has, perhaps, been lost in much recent historical literature. This is largely because attention has been focussed on the undeniable erosion of customary patterns of access to Indian forests during the colonial period and the patterns of popular resistance that developed in some regions as a consequence. While important as part of a 'subaltern' history of colonial India, this preoccupation has served to obscure another equally interesting story. This consisted in an unusually precocious and (often literally) non-conformist response to a series of ecological, climatic and subsistence crises which were perceived to exist on a scale paralleled in more modern times only by the drought crises of sub-Saharan Africa since the 1970s.

This response was based primarily on the prescriptions and political influence exerted by six EIC surgeons, William Roxburgh, Alexander Gibson, Edward Balfour, Hugh Cleghorn, John Ellerton Stocks and John McClelland.[256] Their success in promoting environmental interventionism as part of the re-

254 Burkill, *Chapters*, p. 155; Stebbing, *Forests*, p. 206.

255 Cleghorn, *Forests and gardens*, p. x.

256 Of course the much later rise to prominence of Dietrich Brandis, employed after the Mutiny to set up an all-India Forest Department on the recommendation of Hugh Cleghorn, was an important development. But it took place long after the principle of a state forest-conservation service had been established throughout India. This should be borne in mind when considering some recent analyses of the history of the forest service in India, e.g. R. Guha in 'Forestry in British and post-British India: A historical analysis', *Economic and Political Weekly*, 1983, pp. 1882–96. Since Guha attributes to Brandis many of the foundations of a 'scientific' ideology used to conceal straightforward considerations of the imperial need for raw-material resources, the divergence is an important one. Brandis was in fact far less concerned with the climatic risks of deforestation than were the Scottish surgeons who first promoted state conservation. It was not, either, simply a question of the introduction of German forest methods; German foresters had been employed as early as 1856 by the Madras Forest Conservancy, and Herr Wrede had been employed as a forest consultant by the Bombay authorities as early as 1805: See Cleghorn, *Forests and gardens*, p. 19.

sponsibility of the colonial state marked the continuing, and for practical purposes permanent, influence of a mixture of physiocratic, Priestleyite, Scottish Hippocratic and Humboldtian thinking on British colonial environmental attitudes. But this was not all. Underlying their environmental critique, a radical and reformist message was being articulated in which a real concern about environmental health was used as a vehicle to express anxieties about the social and moral consequences of colonialism and industrialism. Sometimes this concern was expressed in millennial terms, so that famine and the dire physical and economic results of deforestation were actually cast as the consequences of a social transgression committed on the Indian peasantry. This idea was particularly strong with Edward Balfour and can be seen as a consequence of his effective conversion to the texts and physiocratic reformism of Bernardin de Saint-Pierre and his strong family connections with a Scottish radical tradition. But Balfour was not alone. Many of the other Scottish surgeons shared this radicalism, as well as sharing an interest in indigenous environmental knowledge and forest management.[257] Nevertheless, the rich variety of motives underlying the scientific arguments of the surgeons would have been of little avail were it not for the fact that they were fronted by climatic arguments threatening famine, economic failure and societal breakdown.

Setting the commencement of environmental protection in India in a wider perspective

The very early incorporation of conservationism as an accepted part of the role of the colonial state in India needs to be set in a broader context. There is no doubt that environmental sensibilities in Britain, for example, were, among some groups, almost as well developed by the 1860s as they were among the scientific services in India.[258] They were very different kinds of sensibilities, however, and were associated with different kinds of social critique. The biota of Europe were simply not perceived as being threatened by

257 There is no doubt, for example, of the particularly radical social opinions of Surgeon Robert Wight; see Cleghorn et al., 'Report of the Committee', p. 32.

258 See P. D. Lowe, 'Values and institutions in the history of British nature conservation', in A. Warren and F. G. Goldsmith, eds., *Conservation in perspective*, London, 1983, pp. 329–51. Lowe deals mainly with the transition from animal-protection movements to bird preservation. These movements did not involve a consciousness of the ability of man to destroy the environment on a global scale. Lowe also omits the critical part played by scientists in lobbying government and ignores the fact that systematic ecological research began in India (principally with surgeons Hugh Cleghorn and M. P. Edgeworth). See also D. E. Allen, 'The early history of plant conservation in Britain', *Transactions of the Leicester Literary and Philosophical Society*, 72 (1980), 35–50.

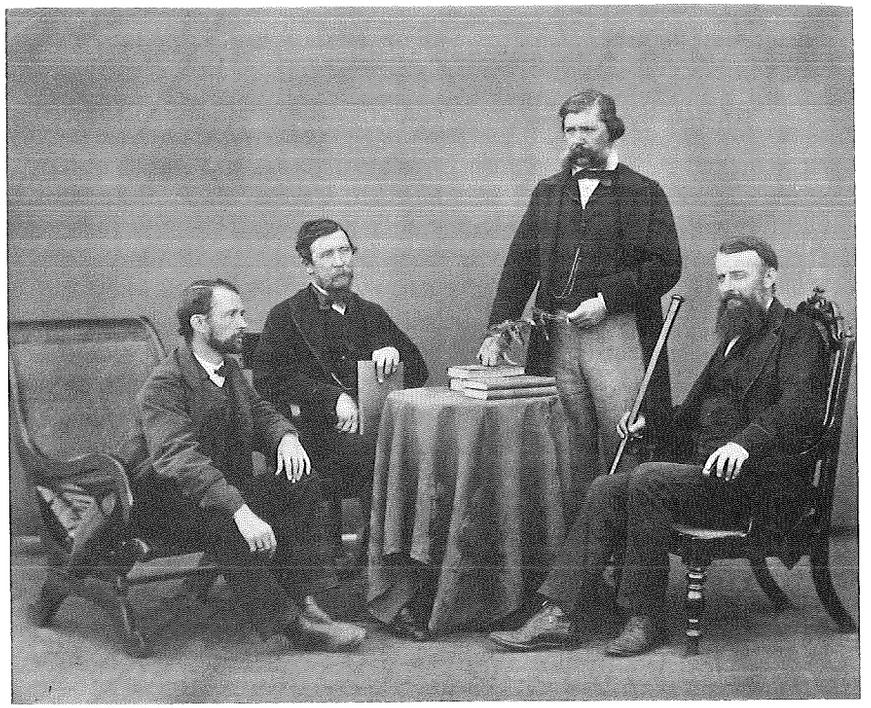

Plate 23. The Committee of the Madras Literary and Scientific Society in about 1860. Hugh Cleghorn (holding a symbolic staff of teak) sits at the far right. Edward Balfour (appropriately holding a fern specimen) is the standing figure. (Reproduced by permission of the Sprott family of Stravithie, Fife)

rapid ecological change of the kind that was taking place in India. As a result, embryonic worries about the destruction of rural landscapes and about species extinctions remained the concern of a largely ineffective minority. Only the cause of animal protection, strongly advocated by the Quakers, had resulted in serious legislation. As Turner has shown, this was a cause with strong institutional and personal links with anti-slavery campaigning, and it was strongly identified with an emerging urban reform movement.[259]

Interest in the aesthetics of the rural landscape in metropolitan France and Britain was already well developed by the end of the eighteenth century, as the writings of John Clare, Southey, Gilpin and some others demonstrate.[260]

259 J. Turner, *Reckoning with the beast: Animals, pain and the Victorian mind*, London, 1980, pp. 15–38.

260 'Within the last thirty years', wrote Southey in 1807, 'a taste for the picturesque has sprung

So too, the rise of what Raymond Williams has called the 'green language' corresponded to the emotional commitment that had developed in relation to the threat perceived to the old landscape pattern (and the rural working lives and ethos it represented) in the context of the 'agricultural industrialisation' of the late-eighteenth-century enclosures. By the 1840s what had been a minority interest at the time of John Clare had flowered into a major literary and popular preoccupation or cult.[261] In 1844, for example, Sir Robert Peel is reported to have commented at some length on the reasons why he collected pictures of 'wild' landscapes and on the solace that such landscapes were to him in his urban work.[262] In spite of this, the fact remains that where individuals did campaign against the despoliation of the landscapes they valued by the forces of capital and by the spread of railways and, above all, by the incursions of urban housing, their efforts were, until at least the mid 1850s, notably unsuccessful. The failure of the attempts made by William Wordsworth to restrain railway building in the Lake District serves to illustrate this point.[263]

Concerns about species extinctions in Europe developed much later than the preoccupation with rural landscape, as attempts to outline the intellectual history of concern about species extinction in Britain have already demonstrated.[264] Here too the early expression of concern about human depredations on species did not result in any direct involvement by the state. The idiosyncratic and exceptional efforts made by Charles Waterton to make his estate into a nature reserve constitute an interesting precedent and are an indication of the level of awareness of the human destructive potential that had developed by the 1830s in Britain.[265]

up . . . a new science for which a new language has been formed and for which the English have discovered a new sense in themselves, which assuredly was not possessed in their fathers', quoted in K. Thomas, *Man and the natural world*, p. 267.

261 R. Williams, *The country and the city*, pp. 127–42.

262 C. Brown, *Dutch paintings*, London, 1983, p. 11. Brown quotes Mrs Jameson, in *Private galleries of art in London* (1844), recording a conversation with Sir Robert Peel when he was prime minister. She remembers Peel saying, ' "I cannot express to you the feeling of tranquillity, of restoration . . . with which, in an interval of harassing official business, I look around me here." . . . he turned his eyes on a forest scene of Ruisdael and gazed on it for a minute or two in silence.'

263 *A complete guide to the English lakes*, London, 1842, pp. 160, 150–5.

264 Allen, 'The early history of plant conservation in Britain'.

265 N. Moore, ed., *Essays on natural history by Charles Waterton*, London, 1871, pp. 119–35. His actions were exceptional, even eccentric. One of the interesting features of Charles Waterton's initiatives is that he had travelled very extensively in South America shortly after Humboldt, and there is little doubt that his enthusiasm for natural history and for the fate of species in Britain was closely associated with his enthusiasm for tropical wildlife and tropical forests in particular; see Waterton, *Wanderings in South America, the North-West of the United States*

Consciousness of the role of man in causing extinctions had, as we saw in earlier chapters, developed much earlier among botanists stationed in tropical-island colonies and in India than it had in Europe. Certainly by as early as 1810 Saint-Pierre and Commerson on Mauritius, Alexander Anderson on St Vincent, Burchell on St Helena and Kyd and Roxburgh in Bengal had all acquired some insight into the phenomenon; and it undoubtedly affected their approach to matters affecting environmental control by the state. At a more generalised level of discourse, this early colonial awareness, particularly of processes taking place on St Helena, was vital in acquainting Charles Darwin with ideas about extinction and endemism at critical points in the voyage of the *Beagle*.

But Darwin was not alone in this. By the early 1840s Ernst Dieffenbach, in his work on the fauna of New Zealand and the Chatham Islands and then in his studies of Mauritius, had become acutely aware of the potential for further rapid extinctions as European capital-intensive economic activity spread over the whole globe.[266] Others reacted with interventionist ideas. For example, Hugh Edwin Strickland, first made aware of the extinction problem by his work on the palaeontology of the dodo and other extinct birds of the Mascarenes, actually suggested that the entire colony of New Zealand should be made a nature reserve to save its remaining indigenous fauna.[267] This was at a time when the value of rare island faunas was being recognised in the formulation of theories about species origins, not only by Darwin but also by Strickland, Dieffenbach and Joseph Hooker.[268]

The striking thing about all these early colonial concerns with extinction is that, whilst they certainly constituted a hidden motivation behind many of the other arguments used to justify forest protection in Mauritius and India before 1847, they rarely made overt appearances in scientific debates and very rarely affected government policy. There are notable exceptions to this rule, one example being the case of the measures taken to protect the elephants of Knysna Forest in the Cape Colony during 1846, although even this can prob-

and the Antilles in the years 1812–1824, 2nd ed., London, 1880, esp. pp. 289–94. Here he writes of the forests of the Americas that 'Nature is fast losing her ancient garb and putting on a new dress in these extensive regions . . . spare . . . these noble sons of the forest beautifying your landscapes beyond all description; when they are gone a century will not replace their loss, they cannot, they must not fall.'

266 *Travels in New Zealand:* on extinctions, pp. 7–12, 50–2; on forest destruction, pp. 257, 297–98; on the destructive impact of man, pp. 416–17.

267 H. E. Strickland, 'Report on the recent progress and present state of ornithology', *Report of the Proceedings of the British Association for the Advancement of Science*, 1848, pp. 170–221; Strickland and Melville, *The dodo and its kindred*.

268 See M. Di Gregorio, 'Hugh Edwin Strickland (1811–1853) on affinities and analogies, or, The case of the missing key', *Ideas and Production*, 7 (1987), 35–50.

ably be explained better in terms of previous decisions taken for quite other reasons to protect the forests in which the elephants lived.[269]

At the time that Alexander Gibson was attaining some success in securing state conservation in the Bombay Presidency in 1847, the threat of species extinction was still not a truly credible one in the eyes of most scientists in India, let alone in the eyes of the colonial state. Even in the pages of the Cleghorn report to the BAAS, the concept of species extinctions made only a veiled appearance when it was pointed out that forest destruction might entail the disappearance of many medically and potentially economically useful plants.[270]

It is true, however, that individual conservation propagandists such as surgeons Hugh Cleghorn and Robert Wight often expressed a virulent hostility to much in the way of development of a colonial infrastructure.[271] Cleghorn in his own books deprecated the extension of railways into the highlands of Southern India, largely for aesthetic reasons.[272] His opinions were later echoed by Sir Richard Temple, who also attributed some of the famines of the 1870s to the indirect effects of deforestation for railway purposes.[273] Moreover, both Cleghorn and Wight attributed the principal cause of damaging deforestation in the Nilgiri Hills to the activities of European planters, who, they believed, were the real villains of the piece.[274] Cleghorn further commented in 1869 on the high flow of 'capital' into the hills and the inevitable destruction that would result.[275] Some of this hostility to the activities of European private capital can even be identified in the operating methods of the Madras Forest Service at the time Cleghorn was its chief conservator, especially in the differential treatment accorded particular privileged groups of 'tribal' shifting cultivators in comparison with lowland Indian incomers and European plant-

269 Grove, 'Early themes in African conservation', pp. 23–9.

270 Cleghorn et al., 'Report of the committee'.

271 Cleghorn, *Forests and gardens*, pp. 3–4; Wight, quoted in Cleghorn et al., 'Report of the committee', p. 87.

272 Cleghorn, *Forests and gardens*, pp. 3–21. Cleghorn's sharp awareness of the speed of change occurring in forests once 'left to nature, thinly peopled' was enhanced 'by his reading of Anton Hove's *Travels* of 1786', Buchanan-Hamilton's *Journey through Mysore* of 1807 and Valentyn's *Travels* of 1804. The intervening forty years had wrought immense changes, Cleghorn believed, and 'the axe of the coffee planter and of the kumari cultivator have made extensive and often wanton havoc, devastating a large portion of the area of primaeval forest': *Forests and gardens*, p. 2. The word 'primaeval' was a favourite of Cleghorn's and helps to explain the nature of his interest in protecting the forests in their undisturbed 'natural' state.

273 Minute of 14 April 1878, quoted in Danvers, 'A century of famines', pp. 9–10, 18–19.

274 See e.g. Wight in a letter quoted in Cleghorn et al., 'Report of the committee', p. 37.

275 Cleghorn, in the discussion after presentation of a paper by G. Bidie, 'On the effects of forest destruction in Coorg', at the Royal Geographical Society, 25 Jan. 1869, in *Proceedings of the Royal Geographical Society*, 1869, pp. 80–3.

ers.[276] However, these kinds of attitudes and arguments, hostile to both private capital and state-sponsored 'development', were rarely directly used in attempts to secure government support for forest conservation. Instead the threat of artificially induced drought and famine was quite adequate to the needs of the conservation propagandists, particularly when combined, after the 1860s, with the threat of shortages of urban firewood and timber for railway sleepers.

Nevertheless, it was the threat posed by the consequences of artificially produced climatic change which primarily motivated the entry of government into extensive state forest control and started to bring about the exclusion of private capital from forestry activity after 1847. Imperial timber needs (largely those generated internally in India, and not so much externally, as is often supposed) certainly became a factor in forest policy after about 1862, once railway building had commenced.[277] Timber needs alone, however, were not initially the main stimulant to the extension of government forest control, as some authorities have suggested. Indeed, it might be recalled that the old conservancy system, originally founded purely to ensure a sustainable timber supply for the East India Company, the Royal Navy and the Bombay Marine, had been completely dismantled by Munro in 1823. By the time raw-material needs did actually become more urgent, the principle of state forest control for reasons of firewood supply, soil and water conservation, and famine prevention was already well established, especially in the two presidency forest departments.

The threat posed by the economic and social consequences of desiccation, first effectively promoted by Butter, Gibson, Balfour and Cleghorn, continued to preoccupy the official mind of government throughout the period 1850–80.[278] Moreover, a growing number of scientists, in and outside the medical

276 Cleghorn, *Forests and gardens*, pp. 54–5. Cleghorn was especially mindful of the efficacy of pre-British forest reservation, noting that 'in the days of the rajahs (in Gumsur) the felling of timber was systematically discouraged'. He was well aware of the difficulties in distinguishing between 'kumari' felling carried out by 'tribal' people and that carried out by incomers (see ibid., pp. 120–7, 140–1), a distinction not at first understood by the Madras government.

277 See e.g. C. Brownlow, 'The timber trees of Cachar', *Journal of the Agricultural and Horticultural Society of India*, 1865, pp. 336–62; he wrote that 'the future supply of sleepers for Indian railways is becoming an important question'. Cleghorn referred in 1865 to 'the wants of the Sind railway': 'Memorandum on the timber procurable by the Indus, Swat and Kabul rivers', *Journal of the Agricultural and Horticultural Society of India*, 1865, p. 73. In 1858 he had written that 'the requirements of the Indian Navy, the Madras and Bombay railways, the Public Works and Telegraph departments, have been unusually heavy' (quoted in Cleghorn, *Forest and gardens*).

278 See e.g. Government of India, *Famine Commission*, IV, pp. 505–25 (selected evidence on denudation of forests); Balfour, 'The influence exercised by trees'; minutes of evidence by

service, believed that they had found new evidence to support theories linking deforestation with run-off, rainfall and famine incidence.[279] After Cleghorn's BAAS report had been published in 1852, the issue gradually gained international recognition, leading directly to further initiatives in state conservation on Mauritius and in the Cape and Australia.[280] Supra-colonial scientific gatherings subsequent to the BAAS meeting of 1851 reinforced the impression that the colonies faced a worsening desiccation crisis, resolvable only by the wholesale extension of government forest reservation. Unfortunately, it appeared to require a famine to lend credibility to scientists in the eyes of government and to provide the required impetus for the state to intervene with measures to protect the environment. In India, for example, serious droughts in 1835–9, the early 1860s, and 1877–8 were all rapidly followed by the initiation or renewal of state programmes designed to strengthen forest protection, often with the specific aim of preventing subsequent droughts. Of course such legislation had the convenient by-product of increasing state control over land and timber supplies. This expansion in state forest control almost always took place at the expense of traditional rights and customs over forests and grazing. While the desire to control rebellious minority tribal groups and to secure a sustained supply of cheap timber encouraged this expansion, the fear of climatic change remained an important motive.

In a similar pattern in South Africa, the early pioneer of state conservation in the Cape Colony, John Croumbie Brown, was able to secure government agreement to new measures on forest conservation and the prevention of grassland burning only after the disastrous drought of 1861–3 had wrought havoc on settler agriculture throughout the colony.[281] In fact, the Southern African drought of 1862 encouraged the development of a whole school of desicca-

Sir Richard Temple, qq. 1–236 (27 February – 7 March), in Government of India, *Famine Commission*, IV, pp. 29–43. See also A. J. Stuart, *Extracts from 'Man and Nature' . . . with some notes on forests and rainfall in Madras*, Madras 1882.

279 See Stuart, *Extracts from 'Man and Nature'*; Bidie, 'Effects of forest destruction in Coorg'; Government of India, *Famine Commission*, IV, pp. 505–25; Balfour, 'The influence exercised by trees'; C. R. Markham, 'On the effects of the destruction of forests in the Western Ghauts of India on the water supply', *Proceedings of the Royal Geographical Society*, 1869, pp. 261–7. The discussion which followed the reading of the latter paper at a Royal Geographical Society meeting chaired by Sir Roderick Murchison was important in providing the opportunity for a number of scientists in the audience to debate the relative rates of desiccation in different parts of the world, including North America, Trinidad, Java, Persia, India, Australia and South Africa.

280 See Grove, 'Early themes in African conservation'; Powell, *Environmental management in Australia*, p. 80. As Powell points out, it was not until N. A. Dalzell moved from Sind to become conservator of forests in the Bombay Presidency in 1862, succeeding Alexander Gibson, that the rationales adopted by Indian conservationists made themselves felt in Australia.

281 Grove, 'Early themes in African conservation'.

tionist theory (closely related to its contemporary Indian counterpart) which was convinced that most of the semi-arid tropics were undergoing long-term aridification as part of a process aided by colonial deforestation. Theories of widespread climatic change acquired further credibility when a paper was read at the Royal Geographical Society in London in March 1865 entitled 'On the Progressing Desiccation of the Basin of the Orange River in Southern Africa', by James Fox Wilson, a naturalist and traveller. He believed that the Orange River was 'gradually becoming deprived of moisture' and that 'the Kalahari desert was gaining in extent'.[282] Wilson believed that the desiccation was due to 'the reckless burning of timber and the burning of pasture over many generations by natives'. David Livingstone, present at this lecture, disagreed strongly with Wilson's analysis. Rainfall decline, Livingstone asserted, was a natural result of geophysical phenomena. Another speaker, Francis Galton (a cousin of Charles Darwin's), believed that the introduction of cheap axes into Africa by Europeans had promoted excessive deforestation and consequent drought. Yet another member of Wilson's audience, Colonel George Balfour of the Indian Army, struck a more caustic note. Rainfall decline in India, he believed, was caused principally by the deforestation activities of the whole community, including European plantation owners. Countermeasures were necessary. He had been informed that morning, he said, that in the West Indies the government of Trinidad had 'passed a law prohibiting the cutting down of trees near the capital in order to ensure a supply of rain'. Balfour was quick to point out on this, as on other occasions, that in pre-colonial times it had been the practice of Indians to sink wells and 'plant topes [groves or clumps] of trees' to encourage water retention. In another Royal Geographical Society debate, in 1866, Balfour pointed out too that 'in the Mauritius the Government had passed laws to prevent the cutting down of trees, and the result has been to secure an abundant supply of rainfall'. The debate about climatic change had thus become international in reference and relevance by the mid 1860s. It was reinforced by more detailed research that raised the possibility that the very constitution of the atmosphere might be changing. Such views, the beginnings of the current 'greenhouse' debate, had found early advocacy in the writings of J. Spotswood Wilson, who presented a paper in 1858 to the BAAS entitled 'On the General and Gradual Desiccation of the Earth and Atmosphere'.[283] This paper had probably helped to influence the ideas of the debaters at the Royal Geographical Society in 1865–6. Upheaval of the land, 'destruction of forests and waste by irrigation' were not sufficient to explain the available facts on climate change, the author stated.

282 Published in *Proceedings of the Royal Geographical Society*, 1865, pp. 106–9.

283 Published in *Report of the Proceedings of the British Association for the Advancement of Science (Transactions)*, 1858, pp. 155–6.

He believed the cause lay in the changing proportions of oxygen and carbonic acid in the atmosphere.[284] Their respective ratios, he believed, were connected with the relative rates of their production and absorption by the 'animal and vegetable kingdom'.[285] The author of this precocious paper concluded with a dismal set of remarks. Changes in 'the atmosphere and water' were

> in the usual course of geological changes, slowly approaching a state in which it will be impossible for man to continue as an inhabitant . . . as inferior races preceded man and enjoyed existence before the earth had arrived at a state suitable to his constitution, it is more probable that others will succeed him when the conditions necessary for his existence have passed away.

The raising, as early as 1858, of the spectre of human extinction as a consequence of climatic change was clearly a psychologically shocking development. It was consistent, however, with fears that had been developing among the emerging world scientific community for a considerable period. By the early 1860s, therefore, long-established anxieties about artificially induced climatic change and species extinctions had reached a climax. The penetration of western-style economic development, spread initially through colonial expansion, was increasingly seen by more perceptive scientists as threatening the survival of man himself.

The publication of *Man and Nature,* by G. P. Marsh, in 1864 served only to aid the development of an already existing belief in a desiccation crisis of global dimensions, similar in its essentials to that which had been so assiduously cultivated by Balfour and Cleghorn in 1849 and 1850. Marsh himself has long been seen as the fountainhead of the North American conservation movement.[286] Certainly his work served to reinforce the already long-held and long-published opinions of such scientists as Cleghorn. The correspondence of Indian colonial scientists with Marsh (and that of their pioneering Cape Colony counterparts) and their familiarity with his ideas served only to make

284 A few years later, John Tyndall developed the concept of the 'atmospheric envelope' and the notion of 'greenhouse' retention of radiation heat by particular gases in the atmosphere. In doing so he built upon theories of heat transfer in the atmosphere first developed by Jean-Baptiste Fourier between 1807 and 1815; see Tyndall, *On radiation: The Rede lecture at the University of Cambridge, 16 May 1865,* London, 1865.

285 This theory was elaborated on by Arrhenius in 1896 when he raised the possibility that increasing concentrations of carbon dioxide due to the burning of fossil fuel could lead to global warning. He later calculated that doubling the level of carbon dioxide could raise average temperatures by 5°C.: S. A. Arrhenius, *Les atmosphères des planètes: Conférence faite de mars 1911,* Paris, 1911.

286 See e.g. Lowenthal, *George Perkins Marsh,* pp. 245–76; D. Worster, *Nature's economy,* Cambridge, 1977, p. 268; R. P. McIntosh, *The background to ecology: Concept and theory,* Cambridge, 1985, p. 292.

them more confident in their theories.[287] Nevertheless, such Indian forest conservators as N. A. Dalzell, in their writings on conservation, drew far more inspiration from what they knew of St Helena, Mauritius and the eighteenth-century French experience than from Marsh, to whom they rarely referred.[288]

287 Cleghorn wrote to Marsh saying, 'I have carried your book with me all along the slope of the northern Himalaya, and into Kashmir and Tibet, and in course of my duty have endeavoured to direct the local authorities to the general changes and prospective consequences of railway works now in progress in Upper India. The result of my observations has been strongly corroborative of the view which you have so usefully promulgated': University of Vermont Library, Burlington, Vt., Archives Dept, Marsh Papers: Letter from Rome, 6 March 1868, to Marsh at Florence. On 23 March Cleghorn wrote to Marsh: 'I leave for you a copy of the Forest Report 1866–7 which will show that the Indian Forest Department is still in an early stage of development.' This was the first of a series of documents on India sent by Cleghorn to Marsh, who was, up to this time, largely ignorant of developments in India. In 1869 Cleghorn sent him Baird-Smith's *Irrigation in Italy* and *Irrigation in Southern Europe,* by C. C. Scott Moncrieff, and he wrote that he would 'look for any new publications likely to interest you': 12 Feb. 1869. Cleghorn also revealed on the latter occasion that 'I have been employed by the Secretary of State in selecting the best of 90 candidates for Forest employment in India and hope to find 4 superior youths for training in Germany and 4 others for the "Ecole Imperiale Forestière" in Nancy.' Much later, on 3 Feb. 1875, Cleghorn wrote: 'I sent you the *Gardener's Chronicle* containing a biographical sketch of Dr Brandis and am glad that you refer to the work in which he is engaged in India. Your notice may help to strengthen his hand – I was glad to learn that he has made your formal acquaintance.' These extracts tend to emphasise the extent to which Marsh and his American colleagues were dependent on the initiatives of Cleghorn himself in learning anything about the Indian situation.

288 Dalzell, *Extracts on forests and forestry,* Madras, 1869, pp. 1–4, 101–5. Dalzell's main sources on Mauritius were Brisseau-Mirbel, *Elémens de physiologie,* and articles published in the *Pioneer,* quoted in *Extracts on forests and forestry,* p. 22. Dalzell noted (p. 22): 'It is interesting to watch the change which public opinion undergoes under the gradual but certain advances of scientific knowledge and perhaps there are few questions in which the general feeling has undergone a greater change than the estimation in which trees and forests are held in India . . . those who had been most prejudiced against the trees were compelled to admit the great increase in sickness which had followed their destruction . . . we have come to regard the trees as friends instead of enemies.' It should be noted that Dalzell does not quote Marsh at all. Similarly, in 1917, R. S. Troup, erstwhile inspector-general of forests in India, in his survey of authorities on forest–climate relations, noted that 'those who gave every attention to the subject may be named as St Pierre, Dr Priestley, Humboldt and Boussingault; and in India Dr Gibson and Mr Dalzell have been conspicuous': R. S. Troup, ed., *The work of the Forest Department in India,* Calcutta, 1917, p. 2. Here too Marsh did not figure; the discontinuity in information flow seems to have been almost complete. What does emerge from both Cleghorn's letters to Marsh and Troup's work of 1917 is the impression that the task of propagandising the need for forest protection was a difficult and unpopular one – although Dalzell conveys a more optimistic view of his experience in the Bombay Presidency. Thus Troup wrote: 'The earlier years of forest administration were beset with difficulties which is not surprising, considering that the department was charged with the unpopular duty of protecting the heritage of nature from the repacity of mankind, a duty which naturally aroused the antagonism of the population of India . . . the early years of the Forest Department were marked by a constant struggle against opposition in various forms for, although

This is not surprising, since the apparatus of Indian state forest conservation long predated that of the United States. When, stimulated partly by the work of Marsh, the United States Congress itself decided to explore the options for government forest conservation in the early 1870s, F. B. Hough, its main adviser and consultant on the subject, held up German, French and, above all, Indian methods of conservation as examples that might be imitated. Gifford Pinchot, another important campaigner for North American forest conservation, was similarly influenced by what he knew of the history of the Indian forest service.[289]

If one stands back to survey the transition from uncontrolled deforestation to the ambitious programme of state conservation that had developed by the time of the first Indian Forest Act of 1865, a number of milestones stand out. An intensive period of campaigning by the EIC Medical Service, based principally on the dangers of the climatic effects of deforestation, culminated in the establishment of the Bombay Forest Conservancy in 1847. Further lobbying by Joseph Hooker and a decisive advocacy of the economic case for sustainable forest management by McClelland served to convince Dalhousie of the case for wholesale state intervention in the forest sector, much against the wishes of private capital. As we have seen, General Napier and John Stocks ensured that the pre-colonial management methods of the Sind shikargahs by the Talpur amirs provided a convenient model for state forestry in other parts of India. After the end of company rule, the institutional strength and continuity of the earlier-established conservation policy, inimical to private interests and heavily influenced by the cumulative strength of the desiccationist case of the scientific lobby, was soon explicitly restated under Crown rule. Indeed, this restatement, expressed in a letter from the secretary of state for

Government had proclaimed its forest policy, this policy was not always appreciated by district officials many of whom were unable to discern the potential value of the forests or to see the baneful results of their destruction': ibid. In this sense, it is not surprising that the American experience was seen to offer few practical lessons for Indian forest protection.

289 F. B. Hough, ed., *Report of the Committee on the Preservation of Forests*, U.S. Congress, House of Representatives, 43rd Cong., 1st sess., House Report 259, Washington, D.C., 1874, p. 43. Hough quotes frequently in this paper from a report written on the Madras forests by C. Walker (*Reports on forest management in the Madras Presidency*, Madras, 1873). See also Hough, 'On the duty of governments in the preservation of forests', *Proceedings of the American Association for the Advancement of Science*, 72 (1873), 1–10. Hough himself was much influenced by the work of John Croumbie Brown (whom he knew personally and toured with in Scotland) in advocating state involvement in forestry. However, this close connection between British colonial forestry and the origins of the U.S. forest service has apparently gone unnoticed among American environmental historians, as has Hough's primacy in pioneering American state environmentalism. See e.g. S. Fox, *John Muir and his legacy: The American conservation movement*, Boston, 1981, and D. Worster, ed., *American environmentalism: The formative period, 1860–1915*, New York, 1973.

India to the governor-general in Calcutta, serves as an appropriate summary of the political and propaganda success of the Hippocratic conservation lobby in its relations with the colonial state in India. 'Most countries', the secretary of state pointed out in 1862,

> have suffered from similar neglect [to that in India], not only in the dearth and consequent high price of timber, but very often in the deterioration of climate, and in the barrenness of land formerly cultivable, if not fertile, situated at the base of hills, when these have been stripped of the forests which clothed them, condensed the vapours into rain and gave protection to the country below them . . . it is very satisfactory to me to learn that you have come to the same conclusion as Her Majesty's Government, that individuals cannot be relied upon for due care in the management of forests, inasmuch as private capital must be opposed in this instance to public interests.[290]

From its earlier location at the colonial periphery, the language of climatic environmentalism and reformist conservation had now assuredly moved to centre stage in the imperial apparatus.

290 Quoted in Stebbing, *Forests*, p. 551.

Conclusion: The colonial state and the origins of western environmentalism

I have aimed in this book to recount some of the main milestones in the intellectual development of the global environmental consciousness which emerged in the context of European colonial expansion between 1660 and 1860. This new kind of consciousness can now be observed to have arisen virtually simultaneously with the trade and territorial expansion of the Venetian, Dutch, English and French maritime powers. It was characterised by a connected and coherent intellectual evolution of ideas and concepts which had complex and yet identifiable roots in an Edenic and Orientalist search and in the encounters of a whole variety of innovative thinkers with the drastic ecological consequences of colonial rule and capitalist penetration.

The early phase of territorial expansion along the great trade routes to India and China undoubtedly provided the critical stimulus to the emergence of colonial environmental sensibilities. While the early oceanic island colonies provided the setting for well-documented episodes of rapid ecological deterioration, they also witnessed some of the first deliberate attempts to counteract the process artificially. The isolated settlement at the Cape Colony provided an analogous context for the formulation of conservationist attitudes.[1] The colonisation of the oceanic islands was especially significant in the evolution of remarkably sophisticated insights into the mechanisms and processes of ecological change brought about by the introduction of European settler agriculture in both freeholder and slave-plantation manifestations. Prior to 1700, episodes of deforestation and soil erosion in Europe, the Canary Islands, the Caribbean and South America had rarely elicited sophisticated insights into process, nor did they give rise to the kinds of programmes for environmental control which developed on St Helena and Mauritius and in the Eastern Caribbean during the eighteenth century.

Environmental deterioration particularly threatened the island economies and the security of supplies for the ships of the new European companies

1 See Grove, 'Early themes in African conservation' and 'Scottish missionaries, evangelical discourses and the origins of conservation thinking in Southern Africa'.

trading to India. The responses of the different nations and their companies to the process were not uniform in character. Nevertheless, a shared heritage of intellectual and scientific developments, the product of late Renaissance literature and science, proved an influential stimulus to a new valuing of the tropical environment in literary, scientific and economic terms. The institutional development of the colonial botanical garden, particularly as it was developed by the Dutch at the Cape, the French on Mauritius and the British on St Vincent, formed the basis for a new kind of learning, information collecting and networking in the tropical environment. This learning was global in its approach and in its aims. Above all, the colonial botanical garden provided the basis for the institutional emergence of environmentalist ideas.

Some of the first systematic attempts at forest and soil conservation in colonies began on St Helena and created significant precedents for later East India Company land-use ideology. At first, however, the lack of any credible expertise or corpus of intellectual justification to explain the ecological decline set in train by settlement meant that the English East India Company only very slowly became cognisant of the nature of the physical problems which its 'improvement' programmes and trade requirements engendered. Eventually St Helena became disproportionately significant in stimulating a wider intellectual awareness of the rate at which the European might degrade the tropical environment and bring about species extinctions.[2]

In the course of the emergence of colonial state conservation, the significance of initiatives taken by local actors on the basis of local and indigenous knowledge cannot be overestimated. By contrast, the writings of better-known western environmentalists writing outside the colonial context (G. P. Marsh is a noteworthy case in point) were of surprisingly little import in the formation of state policy. Instead the experience of perceiving and countering deforestation and land degradation at first hand, especially on tropical islands, proved to be far more influential. The centrality of the colonial periphery in stimulating environmental innovation was strongly reinforced both by the growing cultural significance of island environments and by the growing preoccupations of Orientalist and Humboldtian thinkers with the non-European 'other' of the tropics. The considerable importance of the tropical island as a cultural metaphor for the newly 'discovered' world as well as for the projection of discontents and Utopias helped to heighten awareness of the efficacy of

2 Taking St Helena and Ascension Island together, one can see that before 1870 the experience on those islands was taken up in turn in the theories of J. R. Forster (1774), Bernardin de Saint-Pierre (1769–96), Alexander Beatson (1816), J. B. Boussingault (1837), L. Bouton (1837), J. D. Hooker (1842), E. G. Balfour (1849), Charles Darwin (1859), C. G. B. Daubeny (1863), Etienne de Clave (1863), G. P. Marsh (1864) and N. A. Dalzell (1869) (dates refer to publication in English).

man as an environmental agent. Here again St Helena played a key role, not least in Godwin's *Man in the Moone*, in providing a model for later Utopian discourses, both scientific and otherwise, and in highlighting a new awareness of isolation, extinctions, race and gender, often coupled with increasingly global perceptions of natural processes. This literary interest in islands and isolation was crystallised ambiguously in Defoe's *Robinson Crusoe*, a work which not least provided a model for the French cult of the Utopian South Sea island which flowered in the wake of the writings of Rousseau, Commerson, Bougainville and Bernardin de Saint-Pierre in the 1760s and 1770s. The seminal influence of the works of both Godwin and Defoe was indicative of a two-way process by which particular literary discourses powerfully shaped changing perceptions of nature and the globe, and in which literature was, in its turn, increasingly influenced by new understandings and 'discoveries' in an expanding European world system of economic dominion and ruling discourses.

Thus, in the same way that European expansion entailed the encompassing of vast new territories under a European economic yoke, it also opened up a vast new mental domain. Expansion of this domain followed and facilitated the growth of trade, but it also fostered an exchange of experiences and ideas about the environment that became progressively complex and global in scope as trade and colonial dominion became global in reach. The tropical island, however, remained critical to the focussing of these ideas. The way in which this focussing occurred was largely dependent on the nature of the relationship between the emerging body of natural philosophers or scientists and the colonial states that they served. This relationship was much closer in French colonies than in those of England or the Netherlands.[3] This close relationship is one of the reasons why it was the French management of Mauritius which saw the first comprehensive attempts by colonial scientists to analyse rigorously and then to attempt to control the environmental consequences of European economic rule – or, more specifically, to control the ecological impact of a capital-intensive, slave-utilising plantation economy.

3 Of these three maritime powers, the discontinuity between science and state was greatest in England in the second half of the seventeenth and the beginning of the eighteenth century. There is some irony in this, since it was in England that Francis Bacon had first extensively elaborated on the need for natural philosophy to serve the interests of and to be controlled by the state. The onset of the Commonwealth prevented this development from taking place and ensured that the Royal Society remained relatively independent and relatively weak. In France, however (under Colbert), the Baconian approach became incorporated in state policy; hence the nature and scope of the 1669 Forest Ordinance and its colonial inheritors, including the Mauritius forest legislation of 1769. I am indebted to Dr Julian Martin for a discussion of this. One may argue that the East India Company itself acquired a more distinctly 'Baconian' role in science than the British Crown ever itself did before 1857.

The initiation of a major programme of conservation on Mauritius arose out of the coincidence of a specialised set of circumstances very specifically related to the objectives and structures of the French polity. This was due mainly to the success of physiocracy as a land-use ideology guiding the policies of the colonial state, coupled with the wish to play out a particular kind of insular and Utopian vision. Thus it is on Mauritius that one can observe the emergence of an environmental policy which, while not inspired by the state alone, increasingly relied on the state for its execution. The conservationism espoused by the physiocratic regime on Mauritius demonstrated for the first time the very significant effect of a new kind of valuing of the environment by an influential elite in checking the progress of ecological transition.

The mental image of Mauritius as both a tropical island paradise and as a hoped-for location for a physiocratic moral economy or Utopia came to occupy a surprisingly dominant role in the mainstream of intellectual discourse in France itself wherever the relationship between man and nature was the object of discussion. This philosophical nexus between Mauritius and Europe can be attributed almost entirely to the popularity of the fictional and non-fictional texts of Bernardin de Saint-Pierre. Indeed, it contributed greatly to the way in which a romantic environmentalism actually emerged as a vital precondition to the realisation of a social Utopia. However, this alone would not have been sufficient to ensure the involvement of the state in an environmentalist programme which required a set of rather more empirical justifications for obeying the 'laws of nature'. These were supplied by a physiocratic science.

Pierre Poivre, in particular, was able to perceive the vital importance of being able to utilise a society of established experts to make the new ecological risks credible and, indeed, dangerous in the eyes of the state. The strong institutional connections that developed in the French colonial system among the state, the tropical botanical garden and the Parisian botanical establishment facilitated the availability of such experts on Mauritius. Furthermore, the initiation of the physiocratic conservation programme on Mauritius demonstrated the peculiar suitability of the colonial state in providing a context within which independent scientists and conservationists could work. Placed in an alien environment, they were still able to take advantage of a considerable pool of intellectual experience. This meant that as early as 1770 the conservation lobby on Mauritius could draw upon published literature dealing with the environmental thinking of Europeans in locations as far apart as Europe, North America, South America, India and China.

Working within the milieu of the innately insecure fabric of the colonial state, the new scientific interest group, directly employed by the state for the first time on Mauritius, was able to exercise political leverage unheard of in metropolitan Europe. Environmentalism on Mauritius took advantage of two coupled phenomona: the demonstrable vulnerability of a small island to the

rigours of plantation agriculture and an emerging literature on the interconnections among climate, trees and society that was used increasingly to imply a connection between climatic 'virtue' and social or political virtue. The latter connection became especially important in the years immediately preceding the French Revolution. The sense of insular vulnerability was made more concrete by the emergence, before the end of the eighteenth century, of a knowledge of plant types and distributions which was global in scope. This new expertise was personified particularly in Philibert Commerson. Apart from any Utopian and literary connection, it had its roots, as did much of the developing global awareness of the potential impact of the European on the environment and on other societies, in the scientific circumnavigations of the world by Bougainville and Cook.

While problems of forest degradation and soil erosion were easily understood on Mauritius, it was not long before the concept of species extinction also gathered a new momentum on the island. This was an important development, since it permitted the making of a direct theoretical link between perceptions of the vulnerability of the island and insights into the role of man as a destructive agent on a world scale. A third and most important component of ancien-régime conservationism concerned the re-emergence of desiccation theories. These theories, linking forest cover and deforestation to rainfall and rainfall change, had long existed, not least in the minds of Theophrastus and Christopher Columbus. On Mauritius, and also in the Eastern Caribbean, the revival of such desiccation theories formed the main justification for the participation of the state in environmental control. The close institutional connection which developed in the mid eighteenth century between the Royal Society and the Académie des Sciences was directly instrumental in the revival of desiccationism. It meant, for example, that such physiocrats as Pierre Poivre were able to reinforce climatic ideas co-opted from eastern thought by reference to the plant-physiological researches of Stephen Hales and the English Newtonians.

At another level the success of physiocratic conservation demonstrated the growing efficacy of the Hippocratic outlook. Medical perceptions were an essential component of physiocratic thinking, in which climate, environment and the human condition were closely related. In a similar way, desiccation theories had themselves originated in a medical concern with the nature of the relationship between health and the wider physical environment. On Mauritius desiccation theories were first used as a persuasive scientific and social lever by pioneering professional scientists (and were also used by individual ministers in government to secure a particular course of action by the state). In this sense the colonial state, with its overbearing economic and strategic preoccupations, actually constituted a more persuadable kind of institution than did the state in Europe. Later it only required the very deliberate and authoritative application of global climatic and atmospheric theories by Joseph Priestley and Alexander von Humboldt to make the desiccation argument politically powerful for scientists working on regional or national scales. Where the scientists were a powerful group of medically trained individuals, as they were in the Indian medical service, it was only a matter of time before global theories of desiccation became politically effective on a sub-continental scale, namely in India.

Early colonial conservation policies were almost always perceived as being a legitimate concern of the state rather than of the individual. Moreover, they often resulted in governments' attempting to restrict the activities of private capital or its direct and indirect agents in the prior, and longer-term, interests of the state. In essence, however, the emergence of a conservation policy related to a perception by the colonial authorities of the unacceptable risks implied in retaining an unrestricted status quo. In this respect one is dealing with a paradoxical kind of development, both in discovering that environmentalist ideas and policies emerged earlier at the colonial periphery than at the metropolitan centre and in the realisation that the colonial state was so readily influenced by independent groups of scientists. Moreover, it is perfectly clear that the motivations of those specialists who proposed controls (and who were critical of the ecological degradation which they saw happening) were by no means always identical to those of the state. On the contrary, they were sometimes actively anti-colonial.

Initially the European colonial invaders of the tropics were frequently forced to deal with a highly unfamiliar set of circumstances in which risks in the physical environment (in terms of disease, soils, water supply and fuel provision) were paralleled only by the dangers apprehended as being posed by an often equally poorly understood indigenous population. The instability of power relations between coloniser and colonised was thus frequently paralleled by the terms of a new dispensation of power defined in terms of an unknown ecology. In other words, an unfamiliar environment and populace might both present untold risks in knowing and controlling. This, of course, was a main part of the highly precocious message of Shakespeare's *Tempest*.

Above all, the course of future events was made unpredictable. As Mary Douglas has demonstrated, the problem of knowing about the risks which face it is a critical one in the self-regulation and stability of a society.[4] As a result, a minimal knowledge of future risks is required. It was this requirement which led to the conspicuous prominence of the scientist in the colonial context. The way in which the state treats the interpretation of risk offered by the specialist thus becomes of particular importance, since the expert has access to a knowledge of risks in the new environment not available to the lay person, or even

4 M. Douglas, *Implicit meanings: Essays in anthropology*, London, 1979, pp. 245–7.

to the lay state, for that matter. In an unfamiliar environment, empirical knowledge is at a premium. The traditional conventions evolved in a relatively stable and known relationship between people and land in Europe were not sufficient or apt when transferred to the tropics. Tradition had thus to give way to empirical knowledge or to local indigenous knowledge co-opted for colonial use. Prospero in *The Tempest*, it might be recalled, needed to undergo the transition from magician to natural scientist.[5]

One might argue that the sheer speed of ecological change implicit in the activities of capital in the context of colonial expansion made environmentalist ideas and conservation policies inevitable simply to protect European capital or settler investments. However, there are problems with this argument in its simplest form. Above all, rates of ecological change were not significant in eliciting intervention until they could be noticed, quantified and then worried about. In general, only the 'scientist' could effectively do the latter. This was why islands were important in the evolution of early environmental sensibilities and why the colonial state became so utterly dependent on the observations and then the predictions of scientists. Without observation or interpretation, any objective notion of rates of ecological change was politically irrelevant. Far more significant was the way in which the very nature of the colonial state and its privileged network of connections for the diffusion of information effectively promoted a sophisticated environmental critique, and, furthermore, one which was effective in encouraging the colonial state to enlarge its role far beyond that known to states in Europe. A growing interest in long-term environmental security ensured both continuity in policy and the evolution of an apparently contradictory role in land management for the colonial state. In this context, botanical gardens served a crucial purpose as symbolic texts, centres of calculation and repositories of information and expertise.

The social leverage acquired by the emerging scientific elite of the colonial state with respect to the environment demands some further exploration. Entirely contradictory motivations and ideologies could survive together, at least for a while, or even within the same state apparatus. For example, the extensive building of botanical gardens in the sixteenth and seventeenth centuries, first in Europe and then in the new colonies, arose out of plural motivations. On the one hand, there were medical and economic motivations; on the other, the botanical garden fulfilled a more complex sociological role in the recreation of an earthly paradise. The early colonisation of sub-tropical and tropical islands undoubtedly involved economic motives. But, as constructed in literature, islands also served a mental and projective purpose, as the writings of Dante, Columbus, More, Godwin, Shakespeare, Marvell and Defoe

5 See Chapter 1.

are sufficient to demonstrate.[6] Increasingly, then, while the process of expansion continued to serve the purposes of capital and the European market, it also began to promote a longer-term project. This consisted, after about 1700, in the search for the normative location for social Utopias and the simultaneous formulation of an environmental critique. In other words, the attempt to reconcile the human ecological impact with the laws of nature manifested itself both in environmentalism *and* in searches for better and more 'natural' (or even revolutionary) social dispensations.

Governor Roberts, for example, advocated conservation and opposed the 'improvement' plans of the East India Company on St Helena. Later Pierre Poivre wished to create a new moral economy of nature and society on Mauritius. Similarly, Bernardin de Saint-Pierre started to couple his pleas for ecological restraint with pleas for the release of slaves. In the West Indies, Alexander Anderson argued for forest protection while criticising the treatment of the Caribs. In India, Colonel Kyd advocated the production of famine-resistant crops and opposed continued territorial expansion in areas west of Bengal. In much the same fashion, Edward Balfour (quoting Bernardin de Saint-Pierre) advocated forest protection to fight the famines provoked by colonial revenue demands. While the reforms advocated in the conservation, public-health and medical fields by the surgeons of the EIC Medical Service were ostensibly motivated by a distinctly Benthamite utilitarianism, their policy prescriptions were also undoubtedly affected by the interventionist and radical ideas of Joseph Priestley and Joseph Hume.

Quite consistently, then, those who criticised colonial laissez-faire policies pertaining to deforestation, soil erosion and species extinctions tended also to be those who deprecated colonial exacerbation of famine and disease patterns and the treatment meted out to indigenous peoples. In this respect colonial scientists such as Bernardin de Saint-Pierre on Mauritius, Balfour in India, Dieffenbach in New Zealand and Strzelecki in Australia are all good exemplars of the close connections between nascent environmentalism and the social reformism of physiocracy and the Enlightenment.[7] The fact that the scientists

6 See Chapter 1.

7 Thus Bernardin de Saint-Pierre was a pioneering figure in the French anti-slavery movement; Edward Balfour was a leading advocate of the medical education of women in India; and Ernst Dieffenbach and P. E. Strzelecki were both vociferous propagandists for the rights of indigenous peoples under colonial rule. Strzelecki, an advocate of soil conservation in South Australia and defender of the rights of Aborigines, was also later a severe critic of British famine policy in Ireland; see Saint-Pierre, *A voyage to the Isle of France;* Chapter 5 (for Balfour); Dieffenbach, *Travels in New Zealand*, pp. 372–91; Strzelecki, *Physical description of New South Wales and Van Diemen's Land*, pp. 355, 342, 361. All these individuals, with the possible exception of Balfour, can be described confidently as having been strongly anti-colonialist in sentiment, and Dieffenbach was also specifically anti-missionary; see *Travels in New Zealand*, p. 372.

employed by the British were frequently either Scottish or Central European, and thus inherently peripheral to the imperial social establishment, only served to strengthen this connection. Much later the same dualism was to recur at the metropole. For example, Octavia Hill, the founder of the National Trust and an early advocate of landscape protection, was also the leading figure in urban housing reform in Britain.[8] The emergence of a duality in social reform plus a mirroring environmental critique was just as distinctive at the colonial periphery. Undoubtedly, it reached its most sophisticated level on Mauritius, thanks to the combination of a physiocratic ethos and a pre-Revolutionary Rousseauist and Romantic critique of European society.

One has to recognise here that concern about the environment mirrored social concerns and positions. Thus, while the environment may be at risk, it is the social form which demands inspection.[9] Similarly, a specialised view of the environment may reflect a sectarian view of society.[10] A survey of the evolution of perceptions of the environment by colonial scientists indicates that for some groups the tropical environment had acquired a highly loaded symbolic value. The manifest threat posed by western economic transformation to this image mirrored the social threats and insecurities felt by those individuals who had promoted a high valuing of the environment in the first place and who had in some instances actively sought careers away from the European centre. The isolationist career of Burchell on St Helena, for example, can be seen in this light.[11] In Europe the growth of a 'green language' as a form of social response to the alienating social and economic consequences of capitalism has been eloquently described by Raymond Williams.[12] At the colonial periphery this 'language' was even more conspicuous. Indeed, for a highly educated intelligentsia the colonial state offered great scope for the expression of unconventional environmental views in terms of active policy and lobbying power. Moreover, whether or not scientists shared sectarian social views, the sheer tyranny of physical and mental distance from the centre

8 W. H. Williams, *The Commons, Open Spaces and Footpaths Preservation Society 1865–1965: A short history of the society and its work*, London, 1965, pp. 1–29; Octavia Hill, *Our common land: Open spaces and the future of the commons*, London, 1877. The connections between public health and housing reformers (such as Octavia Hill), urban liberal reformers, Quakerism and the commons-preservation movement have yet to be fully researched. Both George Shaw-Lefevre and John Stuart Mill were committee members of the Commons Preservation Society; see Lord Eversley (George Shaw-Lefevre), *Forests, commons and footpaths*, London, 1910, pp. 27, 98, 187, 319.

9 For a useful discussion of this, see Douglas, *Implicit meanings*, p. 247.

10 M. Douglas and A. Wildavsky, *Risk and culture*, London, 1982, pp. 3–55.

11 See Burchell, *Travels in the interior of Southern Africa*, pp. 1–13.

12 *The country and the city*, esp. pp. 287–306.

contributed to the growth of peripheral or even sectarian sympathies. Even colonial governments became peripheral in their attitudes.[13]

The intellectual history of environmental consciousness in the context of European colonial expansion appears to exhibit several important kinds of elements. At one level, environmentalist discourses related to physical well-being and bodily survival. This is the element developed principally as part of a medical critique of environmental change, leading to concerns about climate, disease, the hydrological state and, by extension, famine. At another level, a new valuing of the environment related more strongly to the mental domain of the (sometimes 'Orientalist') 'other' represented by the newly colonised or 'explored' world. This second set of notions was stimulated by literary evocations of Eden, Paradise, Utopia and New Cytheria and by Romantic images of the 'Sublime' and 'Wilderness'.[14] Such notions were strongly connected to ideas about a moral economy or even to more utilitarian ideals about the desirability of new state structures or roles. Both preoccupations, in the physical (medical) and the mental realms, were ultimately constructed as ways of dealing with anxieties about the survival, nature and integrity of the human individual and human society. The one might have been physically at risk; the other, at risk in a more complex existential, emotional or even political sense. Historically, a growing awareness of extinction processes, especially on islands, served to unite these concerns towards the end of the eighteenth century. Increasingly, too, the literature and environmentalist texts associated with islands stimulated thinking about the dynamics of species change and human origins. The writings of David Corneille, Alexander Anderson, William Burchell, W. H. Webster, Joseph Hooker, Hugh Strickland and, not least, Charles Darwin are indicators of this long-evolving connection between insular discourses and the dynamics of species formation and extinction processes. As in the closely related evolution of environmentalism, the actual and psychological *isolation* of organisms and people on oceanic islands played a vital part in the formulation of new ideas. By 1859 the publication by Darwin of a theory of natural selection had completed this story of exis-

13 The stand taken by the government of Madras after 1847 was a case in point, as was the critical position taken by Governor Roberts on St Helena after 1708. However, probably the most important tensions set up between metropolitan centre and colonial government periphery arose when colonial officials were themselves enthusiasts for natural history. The stands taken by two successive colonial secretaries on Mauritius, Rawson W. Rawson (prior to 1853) and Edward Newton (after 1862), are good examples of this; see Grove, 'Early themes in African conservation', p. 26.

14 In fact, the history and etymology of 'Wilderness' is largely irrelevant to the story of early or colonial environmentalism in the Old World. For the American context, where it is more relevant, see R. Nash, *Wilderness and the American mind*, New Haven, Conn., 1967.

tential isolation and anxiety, so that even in Europe, where the dangers of extinction in a biological sense were less easy to demonstrate, the entire social order had become threatened by a theory which questioned the whole fabric of traditional beliefs and structures justifying and explaining man's place in the world and in time.[15]

Finally, one might ask how the apparently radical or extreme opinions of a peripheral minority, albeit an intellectual and vociferous one, could so sway the policy of the colonial state in regard to the environment. The answer is that, directly, they did not. Instead the ability of peripheral conservation lobbies to carry out their social prescriptions can be seen as a measure of their success in threatening the centralised colonial state with death, disease, famine and economic ruin. Increasingly, between about 1760 and 1850, the scientific lobby was able to make these threats credible in the tropics. This was particularly so after the El Niño–caused global drought of 1791–2, an extreme event which gave a decisive advantage to environmental advocacy. In other words, the state could be made to act by persuading it of the dangers to its own survival. These dangers were easily represented on islands. At a continental scale, in India or in Southern Africa, for instance, the passage of such extreme events as famines, depletions caused by war, or disease episodes tended to

15 Darwin, *Origin of species;* see also Turner, *Reckoning with the beast,* pp. 60–6; G. Himmelfarb, *Darwin and the Darwinian revolution,* New York, 1959, pp. 236–42, 280, 290–3. The response to publication of the *Origin* became particularly conducive to the efforts of those activists anxious to promote the preservation of species, especially threatened bird species. Alfred Newton, the professor of comparative anatomy at Cambridge (and the brother of Edward Newton, colonial secretary of Mauritius and a keen enthusiast of fossil ornithology and the protection of indigenous species), was the chief architect of the first bird-protection legislation in Britain; see J. Sheail, *Nature in trust: The history of nature conservation in Britain,* London, 1976, pp. 22–6. Alfred Newton (followed a little later by J. D. Hooker and T. H. Huxley) was the first natural scientist to recognise the validity of Darwin's work and had maintained a considerable correspondence with Darwin in the years preceding publication of the *Origin;* see Newton–Darwin correspondence and papers in the Balfour Libary, Department of Zoology, Cambridge University. In this sense Newton can be compared to other early species preservationists who were affected by their extensive correspondence with Darwin – e.g. E. Dieffenbach (in New Zealand), L. Bouton (on Mauritius) and J. Forbes Royle (in India). Apart from recognising the uniqueness of the St Helena flora, Darwin was himself remarkably unconcerned, or seemingly so, to advocate the prevention of extinctions or the preservation of forests. He thus stands in stark contrast to his co-author and colleague Alfred Russell Wallace, a strong supporter of conservation ideas. Wallace wrote in 1863: If this is not done [conservation proceeded with] future ages will certainly look back upon us as a people so immersed in the pursuit of wealth as to be blind to higher considerations. They will charge us with having culpably allowed the destruction of some of these records of creation which we had it in our power to preserve and while professing to regard every living thing as the direct handiwork of the creator': A. R. Wallace, 'On the physical geography of the Malay archipelago', *Journal of the Royal Geographical Society,* 32 (1863), 127–37.

facilitate the task of a 'sectarian' scientific lobby.[16] Fears of chronic social instability in the colonies, stirred up by contemporary political events in Europe, were another facilitating factor. But more important than these factors was the growing ability of the colonial conservation lobby to appeal to the credibility of evidence of a global threat to the environment from human activity. Initially this was made possible by the emergence of an internationally diffused scientific literature. Later, international and inter-colonial contacts among scientists reinforced the growth of a sense of a global environmental crisis. The proceedings of supra-colonial scientific meetings, such as those of the British Association for the Advancement of Science in 1851 and the Royal Geographical Society in 1865 and 1866, reinforced the strength of the desiccation threats wielded by colonial scientists and gave them a new source of authority which no single colonial state could safely decide to ignore.

At some periods, departments or agents of the colonial state have themselves taken on a sectarian or peripheral role in countering the complacency of a metropolitan centre unable or undisposed to be sensitive to the environmental risks perceived in the peripheral colonial state. The governments of St Helena, for example, entered this category in their relations with the EIC Court of Directors. Later the Madras Presidency government adopted scientific conservation propaganda to press its case with the government of India. The articulation of a threat of social breakdown on top of climatic or economic disaster was an effective political weapon in these cases.

Colonial environmental policies arose, therefore, between 1650 and 1850, as a product of highly structured tensions between colonial periphery and metropolitan centre and between the insecure colonial state and the climatic environmentalism of the new scientific conservation elites. In recognising the contradictions which arose in this way, one needs to reconsider the nature of the early colonial state and its relationship with science. It may also seem prudent to question some of the simplistic assumptions that have been made about the degree to which science itself has genuinely been subordinated to

16 The famines of 1838–9 in India and 1862 in South Africa were instrumental in creating the climate for conservation legislation; see Grove, 'Early themes in African conservation', p. 28. Similarly, the great famine in India in 1877–9 brought about first the monolithic proceedings of the Famine Commission of 1880 and then a spate of related infrastructural reforms affecting environmental and famine management, such as (to name a few) the famine codes, the formation of an all-India Department of Agriculture and the Meteorological Department, and the strengthening of watershed and forest-protection legislation; see Government of India, *Famine Commission,* vol. 4. On Mauritius the serious outbreaks of malaria in the mid 1860s led almost immediately to the strengthening of forest protection; see Thompson, *Report on the forests of Mauritius.* Glacken argues, in a more general sense, that the great Lisbon earthquake of 1755 had a long-lasting influence in opening the eyes of European scientists to the vulnerability of man to natural hazards: *Traces on the Rhodian shore,* pp. 521–2.

the interests of capital and the colonial state. Clearly in so doing one needs to be aware of the variety of levels of discourse, disguise and argument with which scientific elites have historically encountered the problem of influencing governments about environmental risk. In a much broader sense, our older assumptions about the philosophical and geographical origins of current environmental concerns need to be entirely reconsidered. It is now clear that modern environmentalism, rather than being exclusively a product of European or North American predicaments and philosophies, emerged as a direct response to the destructive social and ecological conditions of colonial rule. Its colonial advocates, and their texts, were deeply influenced by a growing European consciousness of natural processes in the tropics and by a distinctive awareness of non-European epistemologies of nature.

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Note: The manuscript details included here are based, in part, on the documentation utilised by Louis Malleret in *Pierre Poivre* (Paris, 1974) and *Un manuscrit de Pierre Poivre.* I have thought it appropriate to reference this material in full detail in view of the paucity of material available on Pierre Poivre in English and the extensive use I have made of my own translations of the Poivre material. Manuscripts in the archives of the Bibliothèque centrale du Muséum national d'histoire naturelle were consulted by myself. All other manuscript material listed has been personally consulted by myself in the countries concerned.