

A HISTORICAL REVIEW OF INSTITUTIONAL AND CONSERVATIONIST RESPONSES TO FEARS OF ARTIFICIALLY INDUCED GLOBAL CLIMATE CHANGE:

**The Deforestation-Desiccation Discourse
in Europe and the Colonial Context 1500-1940**

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Concepts of artificially induced climatic change have a much longer history than one might imagine (1). Nowadays, of course, they have become a part of our popular culture, and part of a widespread and possibly justifiable environmental neurosis. They are especially familiar and useful in providing the justification for new plans to prevent tropical deforestation and reduce outputs of carbon dioxide into the atmosphere.

It is, moreover, not well known that the fear of artificially caused climate change, and much of the modern conservation thinking which that anxiety stimulated, developed specifically in the tropical colonial context (2). These fears and these connections attained their most vigorous forms, in terms of deliberate state policy, during the heyday of imperialism. Geographers, and the Royal Geographical Society in particular, played a major role in formulating and then propagandising ideas about deforestation, desiccation and climate change, often as a basis for proposing large scale forest conservation. However, the antecedents of this institutional role have to be sought very early on in the history of colonialism.

An awareness of the detrimental effects of colonial economic activity and, above all, of capitalist plantation agriculture (the potential profits from which had stimulated much early colonial settlement) developed initially on the small island colonies of the Portuguese and Spanish at the Canary Islands and Madeira (3). It was on these islands that the ideas first developed by the Greek naturalist Theophrastus in his essays on deforestation and climate change were revived and gradually gathered strength, as his works were translated and widely published during the Renaissance (4). For example

Columbus, according to one of his biographers, feared, on the basis of his knowledge of what had happened after deforestation in the Canaries, that similar devastation in the West Indies would cause major rainfall decline.

Certainly these ideas were already fashionable by 1571 when Fernandez Oviedo, in Costa Rica, soon followed by Francis Bacon and Edmund Halley in England, began to theorise about the connections between rainfall, vegetation and the hydrological cycle (5). Edmund Halley's fieldwork on this subject, carried out in 1676 on the island of St Helena during a summer vacation, while he was a student at Queens College Oxford, showed remarkable insight. Furthermore it was on St Helena that some of the earliest and best documented attempts were made to prevent deforestation and control soil erosion, both of which were serious by the end of the seventeenth century. These attempts were elaborately recorded by officials of the English East India Company, which controlled the island. However, the early conservation methods and local environmental thinking developed before 1750 on islands such as St Helena, and also in a similar fashion on Barbados and Montserrat, were purely empirically based, localised and often unsuccessful in application (6). Indeed they were not based on any coherent body of climatic theory, despite the knowledge of Theophrastus' desiccationist hypotheses that already existed in some intellectual circles in Europe and South America.

The increasingly complex infrastructures of colonial rule under the British and French after the mid-eighteenth century provided the basis for the kinds of information networks needed to systematically collate environmental information on a global basis and to respond to perceived environmental crises with effective forms of environmental control based on unitary climate theories. These information networks were based primarily on the botanic gardens of Europe and the colonies and were a direct consequence of the rapid growth in interest in economic plant transfer and agricultural development which took place between 1750 and 1850 (7). But these networks were not sufficient on their own. As I shall argue in this paper the development of conservationist ideas and early environmental concern was also critically dependent on the diffusion of desiccation concepts, or the formulation of a desiccationist discourse linking deforestation to rainfall reduction. Developing notions of species rarity, extinctions and endemism also played a significant although secondary part in early environmentalism (8). To some extent it seems that the colonial networks of botanical exchange and the botanic gardens themselves acted as social institutions that encouraged the slow development of an environmental consciousness (9).

The linking of deforestation to climatic change and rainfall reduction (the essence of desiccationism) laid the basis for the initiation and proliferation of colonial forest protection systems after the Peace of Paris in 1763, particularly in the West Indies. The intense interest which developed during the eighteenth century, particularly in France, in theories linking climate to theories of cultural "degeneration" and human evolution assisted this process (10). But after about 1760 empirical observations of deforestation and the impact of droughts in the colonies were now complemented by the widespread promulgation of desiccationist theories by metropolitan institutions in Britain and France, and especially by the Académie des Sciences in France and the Society of Arts in Britain. While deforestation in temperate countries, especially in North America,

tended to be seen as beneficial, quite the opposite view pertained in many of the tropical colonies by the late eighteenth century (11). Climatic change, it was believed, threatened not only the economic well-being of a colony but posed hazards to the integrity and health of the settler populations of the plantation colonies of the Caribbean and the Indian Ocean (12).

The business of forest protection and tree-planting had thus acquired, by the late eighteenth century, far more acute meanings in the colonial setting than it had in contemporary Europe (13). The timing of the development of colonial forest protection actually depended both on the existence and complexity of institutions with an intellectual involvement in the colonies and on the pattern of diffusion of desiccationist ideas. Whilst the Royal Society had taken an early interest in forest preservation, colonial deforestation was not a concern of the Society, even though it played a part in the development of the desiccationist discourse in the late seventeenth century. Instead the institutional connection between desiccation ideas and the colonial environment was made in the wake of the foundation of the Society of Arts in 1754 (14). Simultaneously the Académie des Sciences developed an interest in the matter, so that the intercourse between French and British intellectuals became of prime importance in the development of colonial environmentalism and indeed remained so until the mid nineteenth century.

The elaboration of early desiccation ideas into complex physical and biological theories depended at first on the work of John Woodward at Gresham College in London (the founder of the first chair in geology at Cambridge University) in establishing the basic principles of transpiration (15). In his *Vegetable Staticks* of 1726 Stephen Hales of Corpus Christi College, Cambridge refined this work further in estimating the amount of moisture contributed by trees to the atmosphere (16). Buffon's subsequent translation of Hales's work came to the attention of Duhamel du Monceau, the great French meteorologist and arboriculturist. In a popular work on tree-planting, published in 1760, Du Monceau developed the connections between trees and climate at length (17). These ideas were then transferred across the channel once again and were widely discussed at meetings of the new Society of Arts, which included the Marquis de Turbilly, the Comte d'Abeille and other members of the Académie des Sciences among its members (18). However, the whole matter might have remained academic had it not been for the fact that at least two members of the Society of Arts also served as members of the powerful Lords Commissioners for Trade in the Colonies, the body responsible for planning land-use in the new West Indies possessions.

The most significant of these figures was Soame Jenyns, the M. P for Cambridge (19). It seems to have been due to his influence that the Lords Commissioners were apprised of desiccation ideas at some point between 1760 and 1763. With the signing of the Peace of Paris in 1763 the Ceded Isles of St Vincent, St Lucia, Grenada and Tobago all came under British rule. As part of their plans for the survey and division of lands on the isles, all of them still inhabited by substantial numbers of Carib Indians, the Lords Commissioners made provision for the gazetting of large areas of mountain land as forest reserve, for "the protection of the rains" (20). These were the first forest reserves ever to be established with a view to preventing climate change. The most extensive

of them, on the highlands of north-western Tobago, is still in existence. In 1769 some very similar reserves, based on the same theory and with the same intellectual precedents, were established on Mauritius (then known as the Isle de France) by Pierre Poivre, the Commissaire-Intendant of the colony (21). We know that Poivre had been an advocate of colonial forest protection for some time and that he had given, in 1763, a major speech in Lyons on the climatic dangers of deforestation (22). This speech may go down in history as one of the first environmentalist texts to be based explicitly on a fear of widespread climate change.

Poivre's forest conservation programmes on Mauritius were encouraged by a government of physiocratic sympathies and by the botanists of the Jardin du Roi in Paris (23). In the British Caribbean colonies on the other hand, the more autonomous institutional influence of the Society of Arts remained critical in promoting tree planting and, to a lesser extent, forest conservation. The Society had been instrumental in founding the botanic garden at Kingstown on St Vincent, the first such garden in the western hemisphere (24). It was the existence of this garden and the activities of its superintendents, particularly those of Alexander Anderson, a Scottish physician, that ensured institutional support for further forest protection measures in the Caribbean, especially on St Vincent and the other islands of the Grenada Governorate (25). On St Vincent a comprehensive law was passed in 1791 to protect the Kings Hill Forest with the specific intention of preventing rainfall change (26). This legislation was subsequently imitated on St Helena and subsequently in India (27). Incidentally a major stimulus to forest protection activities in 1790 and 1791 was the occurrence of droughts in tropical regions on a global scale (28). These events appear to have been caused by an unusually strong El Niño current in those years, which caused severe drought in Southern India, Australia, St Helena and the West Indies as well as at locations in central America, especially in Mexico (29).

Once colonial forest protection ideas, based on desiccation theories, were firmly installed, notably on Tobago, St Vincent, St Helena and Mauritius, they acquired a momentum of their own, assisted by emerging colonial botanic garden information networks, and particularly the lines of communication between the gardens at St Vincent, St Helena, Cape Town, Mauritius and Calcutta (30). The influence of the metropolitan centres in these networks was actually relatively weak. This remained the case even after Sir Joseph Banks began his period of dominance of botanical science in Britain and Kew began to achieve pre-eminence. Although aware of the possibilities of environmental change, not least on St Helena, Banks cannot be counted among the major environmentalist pioneers. The Royal Botanic Gardens at Kew only became a significant player in colonial conservation after Sir William Hooker became Superintendent in the 1830s.

Probably the first environmental theorist in the British colonial context to parallel the pioneering work of Pierre Poivre and his colleague Bernardin de St Pierre on Mauritius was Alexander Anderson. His *Geography and History of St Vincent*, written in 1799, and his *Delugia*, an early geological history of the world, mark him out as a visionary environmental thinker and the pioneer of a generation of surgeon-conservationists and geographers (31). The colonial expertise of men such as Anderson and Poivre meant

that the role of metropolitan institutions in initiating “centres of environmental calculation” (to adapt the terminology of Bruno Latour) (32), remained relatively unimportant and derivative. Even much later, after 1800, the emergence of a school of environmentalists in India in the ranks of the East India Company Medical service, long after desiccationist forest protection policies had emerged on the island colonies, was largely an internal and indigenous matter, drawing heavily on Indian environmental knowledge and tree-planting practice, and the desiccationist ideas put into practice on St Vincent and St Helena (33). However, the influence of the Society of Arts remained important for a while. For example, William Roxburgh, the second superintendent of the Calcutta Botanic Garden, promoted extensive tree-planting policies in Bengal with the active encouragement of the Society of Arts (34). Indian forest conservation practice and environmentalism after 1842 also drew on the climatic theories of Alexander von Humboldt and Joseph Boussingault, as well as on the forestry methods inspired by French physiocracy and its German physiocratic imitator (35).

Initially local colonial scientific societies in India provided the impetus and professional authority necessary to establish the first forest conservation agencies in India to be based on desiccationist notions (specifically the Bombay Forest Department and the Madras Forest Department) (36). In the early 1850s, however, the proponents of forest conservation on an all-India basis found it necessary, in the face of state reluctance to finance such an establishment, to resort once more to a source of metropolitan scientific authority, namely the British Association for the Advancement of Science. In 1851 the BAAS commissioned a full report on the “physical and economic consequences” of tropical deforestation (37). This helped to legitimate the theoretical and environmental basis for the subsequent development of an all-India forest administration. Seven years later the BAAS became the forum for discussions on “the general and gradual desiccation of the earth and atmosphere” in the wake of a paper delivered by J. Spotswood Wilson (38). This paper can be said to mark the onset of a truly international environmental debate in which processes operating at a global scale were being considered.

In the ensuing two decades the BAAS continued to serve as a forum for advocates of forest and species preservation. Professor Alfred Newton and Alfred Russell Wallace both utilised the BAAS for launching their conservationist opinions and programmes and evoking discussions on extinction and deforestation (39). To some extent, however, the BAAS proved unsatisfactory as an institutional setting for the airing of environmentalist views, partly because it only met for a limited time, once a year, and partly because its influence in the colonial context was relatively weak. As a result the Royal Geographical Society displaced the BAAS, during the 1860s, as the most prominent institutional setting for the discussion of the desiccationist and conservationist discourses that were receiving so much attention from botanists and policy-makers in the colonies. At this period, it should be pointed out, the construction of environmental agendas and local land use policies in the British colonies, in contrast to the French case, did not yet receive any backing or guidance at all from governmental institutions at the centre. In other words, there was no imperial environmental “centre of calculation” sponsored by the state in Britain itself (and this remained the case until the establishment of the

Imperial Forestry Institute at Oxford in 1924) (40). Instead any government centres of calculation were all situated at the imperial periphery, especially in Madras, Bombay, Port Louis, Cape Town and, more latterly, at Dehra Dun, the headquarters of the Indian Forest Service and training schools.

In France, on the other hand, the imperial forest school at Nancy had served as a centre of environmental ideas and training, much of it desiccationist in nature, since 1824 (41). The Royal Geographical Society, therefore, was effectively required to fulfil a centralising role and did so in a very important sense, particularly with respect to the transfer of forest conservation and desiccation ideas between India, where they had become well established, and the rest of the British colonies, above all those in Africa. In the course of being utilised in this way the RGS effectively played a role in the globalisation of desiccation concepts and hence a major part in the diffusion of a particularly exclusionist and hegemonic forest conservation ideology. In the course of acquiring this environmental role the RGS began to undergo a significant transition in terms of its own *raison d'être* and in terms of the influence which it exerted over the emerging agendas of academic geography.

The publication of Charles Darwin's *Origin of Species* in 1859 had set the scene for a decade of existential and religious crisis in which old assumptions about birth and death, time and chronology, religion and generation, already much fractured, were finally broken. These anxieties were mirrored, or coped with, in an unprecedented wave of environmental concern throughout the 1860s. Thus the decade saw the foundation of the all-India forest department, the founding of the Commons Preservation Society, the passing of the first British bird protection legislation and the publication of G. P. Marsh's *Man and Nature* and the publication of Dr Hugh Cleghorn's *Forests and Gardens of South India* (42). The main focus of academic geography soon reflected this shift in the emergence of "evolutionary physical geography" and in the birth of "denudation chronology". Indeed the RGS *Proceedings* of 2nd May 1869 advertised Sopwith's geological models in wood, one of which was called "Valleys of denudation". And it was in the field of denudation and desiccation that the RGS and early environmentalists such as Hugh Cleghorn, John Croumbie Brown and George Bidie found much in common.

The intellectual ground had been well prepared by Livingstone's reports of what he believed to be evidence of chronic and irreversible desiccation in parts of the Kalahari and northern Bechuanaland. It was this data that first stimulated the writing in 1858 of a paper by J. Spotswood Wilson on "the general and gradual desiccation of the earth and atmosphere" (43). This is one of the earliest papers on the "greenhouse" effect and held out the stark promise of an early extinction of humanity as a result of atmospheric changes brought about by natural desiccation and augmented by the upheaval of the land, "waste by irrigation", and the destruction of forests. Wilson quoted liberally from the works of Livingstone and other travellers, giving descriptions of desiccated landscapes in Australia, Africa, Mexico and Peru, all of which had "formerly been inhabited by man", as Wilson put it. On March 13 1865 a paper remarkably similar in theme, especially in its references to Southern Africa and to Livingstone's writings, was given at the RGS (44). Significantly an earlier version of the paper had first been given at the BAAS (45). One may surmise that the fact that the same paper was then delivered at

the RGS was due to the intervention of Colonel George Balfour of the Indian Army, a member of the RGS Council. George Balfour was a brother of Dr Edward Green Balfour, then deputy Inspector-General of Hospitals, Madras Presidency (and later Surgeon-General of India) and one of the earliest and strongest advocates of forest protection in India (46).

At meetings of the RGS in 1865 and 1866 Colonel Balfour spoke at some length on developments in forest conservation that were then taking place in several different colonies. This display of his unrivalled knowledge was no mere vanity. George Balfour clearly saw it as his task to propagandise what he saw as the merits of forest protection in stemming the threat of global desiccation. By 1865 the terms of a debate about the causes of desiccation in the tropics had been set far more clearly. While in 1858 it had remained acceptable to attribute the process to tectonic upheaval (which David Livingstone favoured, for example) RGS discussions by March 1865 saw the appearance of an entirely new interpretation of global processes of degradation. Desiccation was not natural, James Wilson argued, "but was entirely the consequence of human action". Wilson felt that one could demonstrate this well in the case of South Africa. "The human inhabitants (of the Orange river basin) are a prime cause of the disaster" he wrote, and "the natives have for ages been accustomed to burn the plains and to destroy the timber and ancient forests... the more denuded of trees and brushwood, and the more arid the land becomes, the smaller the supply of water from the atmosphere". Thus "the evil advances", Wilson went on apocalyptically, "in an increasing ratio, and, unless checked, must advance, and will end in the depopulation and entire abandonment of many spots once thickly peopled, fertile and productive" (47).

He followed this warning with a global survey of locations in which climatic changes had followed on deforestation. The lessons were clear, Wilson thought, where "in our own British colonies of Barbadoes, Jamaica, Penang, and the Mauritius, the felling of forests has also been attended by a diminution of rain. In the island of Penang, the removal of the jungle from the summits of hills by Chinese settlers speedily occasioned the springs to dry up, and, except during the monsoons, no moisture was left in the deforested districts. In the Mauritius it has been found necessary to retain all lands in the crests of hills and mountains in the hands of government to be devoted to forest, the fertility of the lower lands having been found by experience to depend upon clothing the hills with wood" (48).

Only draconian controls, it was implied, could stop a world-wide ruination of the forests of the British colonies and indeed the entire economic demise of large areas of country. Wilson was especially concerned with South Africa, "it being a matter of notoriety... that the removal piecemeal of forests, and the burning off of jungle from the summits of hills has occasioned the uplands to become dry and the lowlands to lose their springs... it becomes of extreme importance to our South African fellow-subjects, that the destruction of the arboreal protectors of water should be regarded as a thing to be deplored, deprecated and prevented; and that public opinion on the matter should be educated... but we must not stop there. The evil is one of such magnitude and likely to bear so abundant a harvest of misery in the future, that the authority of law, wherever practicable, should be invoked in order to institute preventive measures. Not only

should fuel be economized, but the real interests of the British colonies and Dutch republics, for many long years to come, would most certainly be represented by the passage of stringent enactments which should in the first place forbid, at any season or under any circumstances whatsoever, the firing of grass on field or mountain. The absolute necessity which exists for keeping as large a surface of the ground as possible covered with vegetation, in order to screen it from the solar rays, and thus to generate cold and humidity, that the radiation from the surface may not drive off the moisture of the rain-bearing clouds in their season, ought to compel the rigid enforcement of such a legal provision. Those colonial acts on this subject which are already in existence – for the Colonial Parliament at the Cape has found it necessary to pass restrictive measures – are not sufficiently stringent to be of much service, inasmuch as they are not entirely prohibitory, permitting the burning of the field at certain times of year” (49).

The main discussants of Wilson’s seminal paper at the March 1865 RGS meeting were, on the one side, Drs Livingstone and Kirk, who both contested social explanations of deforestation in favour of non-anthropogenic explanations of continental desiccation, which both believed to be taking place in Africa. Ranged on the other side of the argument were Francis Galton, the secretary of the RGS, (and a cousin of Charles Darwin), Colonel George Balfour and Lord Stratford de Redcliffe. Sir Roderick Murchison, chairing the discussion, also declared himself in favour of the interpretations offered by Wilson and in favour of his radical interventionist solutions. Livingstone, for his part, pointed out that “the author of the paper did not seem to know that many of his suggestions had already been adopted at the Cape, where immense quantities of *Eucalypti* were grown in the botanic garden for distribution among those who wished to plant trees. In four years the trees grew to a height of twenty feet”. Such exchanges of basic information serve to indicate the role which could be played by the RGS. However, the discussion following the Wilson paper also exposed, in a somewhat embarrassing fashion, the very slow nature of the diffusion of environmental information and ideas between colonies and, even more, between colonies and the imperial centre.

This was particularly apparent to George Balfour who, in successive RGS debates, saw it as his duty to advertise the efforts made in particular colonies, above all in India, Mauritius and Trinidad, to protect forest and thereby forestall climatic change. Possibly as a result of Balfour’s lobbying two further papers given at the RGS, at meetings in June 1866 and in March 1869, dealt very specifically with the issue of state responses to deforestation and desiccation. The paper given by Clements Markham in 1866 (“On the effect of the destruction of forests in the western Ghauts of India on the water supply”), seems to have been intended to demonstrate and publicise the contemporary efforts being made to control deforestation in upland India (50). The ensuing discussion took on much the same format as that of 1865, bringing together a whole variety of self-confessed experts and travellers from several different colonies. Initiating the discussion of Markham’s paper Murchison commented that the subject of the destruction of forests “was one of very great interest to all physical geographers” (51). Murchison added that it was a subject upon which he had himself much reflected in reference to other countries, “even our own country”. He was happy, he said, to see many gentle-

men present connected with India; and he would, in the first instance, call upon Sir William Denison, late Governor of Madras, to make some observations upon the subject.

Under Denison's able administration, Murchison informed the gathering, some of those very forest protection operations had been undertaken to which Mr Markham had alluded. A three-cornered discussion then followed which fiercely debated the culpability or otherwise of the "native" for deforestation. Denison believed that Indians "cut down trees without hesitation, and no-one ever dreamt of planting a tree unless it were a fruit tree". George Balfour, reflecting the anti-establishment attitudes of his conservationist brother, Edward Balfour, countered that it was "the practice of rich Hindoos to sink wells and plant topes of trees" (52). Another discussant, Mr J. Crawford, pronounced it his opinion that "the presence of immense forests had proved one of the greatest obstacles to the early civilization of mankind" and made the assertion that Java, free from forest, was "incomparably superior to all the other islands of the Indian Archipelago". Balfour's unusual advocacy of the significance of indigenous knowledge reflected the beliefs of the first generation of (East India Company) colonial conservationists in India, in stark contrast to Denison's comments which typify the more racist, harsh and counter-productive exclusionism of much post-Company Indian forest policy after 1865 (53).

Sir Henry Rawlinson, in his contribution to the RGS debate, opined that "it was a matter patent to every traveller, and it might be adopted as a principle in physical geography, that the desiccation of a country followed upon the disappearance of its forests". It was this realisation that the emerging discipline of physical geography could be enlisted in the cause of global forest protection that seems to have persuaded the core of the Indian forest service establishment to patronise the meetings of the RGS in the late 1860s. Furthermore, in the absence of any other imperial institution, at least in London, showing any significant interest in the pressing issue of colonial deforestation, the RGS provided a sympathetic oasis in what was otherwise an institutional desert. Thus it was that on 25th January 1869 that Hugh Cleghorn, the Inspector-General of the new Indian forest department, attended a meeting of the Society addressed by Dr George Bidie on the subject of "the effects of forest destruction in Coorg" (54). Murchison claimed on this occasion that "it was highly gratifying to geographers to see various branches of natural history combined in illustration of a great subject in physical geography".

Introducing Dr Cleghorn, Murchison suggested that "we were more indebted than to any other gentleman in reference to this important question" (55). Deforestation could best be understood, Cleghorn believed, in terms of an analysis of the amount of capital being invested in forest areas, principally by British planters. The native population in the Western Ghats, he pointed out, were almost universally of the opinion that the climate was drier on account of the changes that Europeans were gradually introducing. The Madras Forest Department, he added, was a new one, initiated only 13 years before. It was gradually increasing in usefulness and it was now receiving the official attention that it deserved (56).

Attempts to prevent deforestation in other colonies had, as late as the 1860s, received virtually no support from the imperial centre. Instead important propaganda for conservation was being created at the periphery, not only in India but, in particular, in

South Africa. Thus some of the most strenuous extra-Indian efforts to promote forest protection and tree-planting and restrict grass-burning had been made by John Croumbie Brown, a missionary and the Colonial Botanist of the Cape Colony from 1862 to 1866 (57). However, local funding for these pioneer efforts had been removed, without protest from Whitehall, in 1866 and a resentful Brown had had to return to Scotland (58). From there he proceeded to publish a stream of works on hydrology and forest conservation, many of which soon came to the attention of the colonial authorities in the Cape, Natal and elsewhere. The two most important of these works were *A Hydrology of South Africa* published in 1875 and *Forests and Moisture* published in 1877 (59). These works, far more influential on policy in the colonial context than the writings of G. P. Marsh, drew heavily on the debates which had taken place at the RGS during the 1860s, and derived authority from them. In Brown's books the discourse of desiccationism was refined and made, in a sense, into an environmental article of faith. Furthermore his dictums on deforestation and climate were repeated and developed throughout the colonial context during the ensuing 40 years (60).

Brown's frequently expressed proposals for an Imperial School of Forestry (the idea itself was largely of his authorship) were ultimately developed at Coopers Hill in Surrey and Dehra Dun in India and eventually in the form of the Imperial Forestry Institute at Oxford in 1924, exactly a century, incidentally, after the foundation of the French Imperial Forestry school at Nancy. 61 In the long interregnum between the establishment of forest conservation in India and the establishment of forestry training in Britain the RGS had acted as a highly formative centre of debate and calculation and as a centre of academic authority of great practical use to such fervent early environmentalists as John Croumbie Brown. Above all, the Society had served to legitimate a notion of global environmental crisis, articulated in a desiccationist discourse of remarkable political power, and the subject of a wide degree of consensus. The warnings against the "evil" consequences of deforestation which were expressed at the RGS in the 1860s were closely connected with an emerging contemporary consciousness of the possibility of extinction which Darwin had sharply focussed in 1859 (62). A sense of existential crisis and sense of impending loss was translated, through the RGS, into a highly empirical debate about deforestation and the possibilities of intervention and environmental institution-building.

The hegemonic prescriptions for colonial forest control which the new consciousness stimulated and which the RGS encouraged can be interpreted, perhaps, as a desire to re-assert control over a new existential chaos and over environmental processes that might threaten the existence of humanity itself. Prescriptions for forest conservation, for grass-fire prevention and for irrigation can be seen in this sense as redemptive or in terms of atonement. Brown had originally been a Congregationalist missionary. He had found it logical and congenial to adapt the dire warnings of such desiccationists as Wilson and Bidie as a kind of environmental gospel. His otherwise "scientific" accounts are sprinkled with references to Old Testament texts. The publication of *The Origin of Species* had simply helped to make the threat of desiccation more dire. Darwin made extinction a necessary part of natural selection and evolution. This gave deforestation and desiccation a much strengthened meaning, necessitating human and conser-

vationist, intervention. New scientific theory could not, however, immediately displace religious meaning in the environment. Desiccation continued to be associated with an expulsion from the Garden of Eden and with evil. If society failed to make conservationist amends for the evils of deforestation, extinction and ruin would follow. In the circumstances of this new thinking colonial conservation acquired the overtones of a kind of redemptive and confessional doctrine (63).

For this purpose the evidence of desiccation needed, of course, to be global or cosmological, while its prescriptions needed to be universalist. It need hardly be said that practical policy prescriptions for counteracting desiccation, principally through forest reservation and soil conservation, would turn out to be highly palatable to the agendas of colonial rule, particularly when it came to controlling the landscape, and manipulating "chaotic" subject populations. Those who attended the RGS debates during the 1860s probably did not fully appreciate that. Instead, placed at the centre of such transitions, it is not surprising that geography itself should soon have been affected by a redemptive cosmology. The redemptive element was reflected particularly in the new discipline of physical geography as it developed after 1870 and is best understood in the writings of Archibald Geikie. "Evolutionary Geography", he wrote, "traces how man alike unconsciously and knowingly has changed the face of nature... it must be owned that man in most of his struggle with the world had fought blindly for his own immediate interests. His contest, successful for the moment, has too often led to sure and sad disaster. Stripping forests from hill and mountain, he had gained his immediate object in the possession of abundant supplies of timber; but he has laid open the slopes to be parched by drought or to be swept down by rain. Countries once rich in beauty and plenteous in all that was needful for his support are now burnt or barren or almost denuded of their soil. Gradually he had been taught by his own experience that while his aim still is to subdue earth he can attain it not by setting nature and her laws at defiance but by enlisting them in his service... he has learnt at last to be a minister and interpreter of nature and he finds in her a ready and uncomplaining slave" (64).

The final lines of Geikie's text indicate that, even while it assumed an environmentalist guise, geography continued to exhibit some of the attributes of a discourse of domination. However, it was a discourse that was ultimately contradictory. Thus the efforts made by colonial conservationists and metropolitan geographers to understand the mechanisms of environmental degradation could hardly fail to touch on the uncomfortable and dynamic connections between the kinds of economic development unleashed by imperial expansion and annexation and the alarming patterns of global environmental change that had become apparent to audiences at RGS debates after 1860.

After the 1860s desiccation and "desertification" fears, incorporated particularly into the forestry and land management policies of the French and British colonial empires, continued to exert a periodically powerful impact, and an impact that was reinforced after extreme climatic events and in periods of rapid political change. The initial thrust to this policy in the British context was given by the Kew establishment of Sir Joseph Hooker, when he pressed for a more systematic application of forest policies in a series of lectures in 1872. (Hooker 1872) The environmental texts and propagandas of particular

individuals were highly influential to this story. Like those of Brown and Geikie such narratives of environmental alarmism were frequently evangelical and even millennial in their tone. Their prescriptive ambitions held out the promise of an increased status for scientists and their funding. Partly as a result of this, desiccationist and conservationist ideas, in which considerable claims were made for the virtues of state land control, became a major feature of the technical agendas of French and British colonial rule, not least during the expansionist phase of the late nineteenth century. This tendency was magnified as governments consolidated their rule in climatically marginal areas that were highly vulnerable to periodic droughts. Soon after the publication of J. C. Brown's first two texts in the 1870s India, Southern Africa and Australia were all affected by droughts of an almost unprecedented severity, the result of the strongest *El Nino* since 1791-2. In India the droughts resulted in especially high mortality, and led to a wholesale re-examination of the evidence for deforestation-rainfall links in the reports of the Famine Commission of 1880. This led in turn to a strengthening and effective militarising of the powers of the forest department in India. It also resulted in the systematic investigation of global teleconnections between climatic events at the colonial periphery, research that led eventually to an understanding of the Southern Oscillation and the mechanism of the monsoon. Communications between Indian and Australian scientists were especially important in this respect. Meanwhile roving experts from the IFD travelled throughout the newly expanded British Empire, reproducing the models of forest management that had been developed in the previous 40 years in India. Indian precedents were adopted in Southern Africa (particularly in Natal and the Cape), Cyprus, Central America, South-East Asia, Australia and elsewhere. Even in coastal West Africa the desiccationist message began to diffuse, not least in the work of Alfred Moloney (1889), the Governor of the Lagos Colony. By the late 1880s the form of desiccation-driven forest policy in the French and British colonial states was so closely inter-related that it can be said to have constituted a single ruling philosophy rather than two separate traditions. French and British forestry journals were alert and imitative of the experiences of their rival services, while many British foresters were actually trained at the French Imperial School at Nancy. The latter included such significant pioneers as Charles Lane-Poole, later Chief Conservator of Australia. French foresters were even employed directly by the British colonial services; the employment of the Count Vasselot de Regne in the Cape Conservancy in South Africa being a notable example of this. Similarly German-trained foresters were widely employed by both French and British colonial governments, above all in the Indian Forest Service. In the colonial context this resulted in an intermixing of German forest science methods and an Anglo-French tradition of desiccationism. The sheer vigour of the Anglo-French forest "movement", as one might legitimately term it (which even found its way into a form of words in the title of the 1934 Anglo-French Boundary Forest Commission) began even to influence the very tardy development of conservationism in the United States. Thus Franklin Benjamin Hough, one-time director of the United States census (and a local historian and evangelical preacher), who was a keen student of colonial forestry methods as well as a close friend of John Crombie Brown, wrote a series of reports after 1873 that led to the foundation of the United States Forest Service.

The turn of the century saw a renewed interest developing in somewhat millennial theories of global desiccation. Significantly perhaps, these were preoccupied with regions that lay outside the areas of Anglo-European and American colonial control. In particular they posed a post-glacial desiccation of the environments of Central Asia and China based on the twin tenets that wet conditions characterised the glacial phases of the Pleistocene and that aridity had increased since the warming of the Pleistocene icesheets in the Holocene. Travellers in Central Asia pointed to dry water courses and lakes and abandoned settlements as evidence of this desiccation and suggested that deteriorating environmental conditions had spurred successive nomadic invasions of their more civilised neighbours during periods of increased aridity (65). The work of Kropotkin (1904) and Ellsworth Huntington (1907) are conspicuous examples here (66). However, like the work of G. P. Marsh the ideas of Americans such as Huntington had only a limited effect in the European colonial context. Similarly Theodore Roosevelt's famous Conservation Conferences exerted, at first, only a limited effect outside North America, even though Roosevelt's main advisers, Gifford Pinchot and William McGee, were well informed themselves about Anglo-French colonial forest conservation initiatives, and admired them.

Ironically this was a period when British colonial administrations in West Africa were encountering formidable and effective indigenous opposition to the imposition of their forest policies from chiefs and other interests in the Gold Coast and Nigeria (67). This was a problem that, in general, was not encountered at this stage by the French in West Africa; although German forest administrations in Tanganyika and Togo found it necessary to implement their forest regulations through the use of draconian punishments. In the Gold Coast and Nigeria colonial governments were forced to abandon their Indian-derived forest management programmes entirely, only replacing them with policies sanctioned by the chiefs after the First World War, at a time when the word "development" started to appear in colonial government publications. Some of the anxieties and the military language of the period leading up to the First World War were reflected in the continued interest in global desiccation in, for example, William Macdonald's *Conquest of the desert* (Macdonald 1914).

It seems quite possible that a generalised revulsion at the human destructiveness of the Great War was reflected in a strengthened awareness of the possibilities of human environmental destructiveness on a world scale. This would help to account for the flurry of colonial publications and commissions on the connections between drought and human activity that appeared in the early 1920s. In 1920 it was the turn of the French to voice their desiccation fears, above all in an influential article by H. Hubert, entitled "Le dessèchement progressif en Afrique Occidentale" (68). However, it was in semi-arid South Africa that the gospel of desiccation found its most pronounced and didactic post-war expression. Here, in 1919, E. H. L. Schwartz published an article entitled "The progressive desiccation of Africa; the cause and the remedy" (69). Even the wording of the title echoed that of J. Spotswood Wilson's seminal article of 1865 on "the progressing desiccation of inner Southern Africa", which had been based on the text of an address to the Royal Geographical Society (70). Schwartz followed the article with a book published in 1923 on *The Kalahari or thirstland redemption*, a title which

surely gives us a clue to a critical crusading element of the desiccation discourse. Schwartz's message was directly reflected in government publications by the 1922 report of the South African Drought Commission, a highly alarmist document. This alarmism may have reflected the beginnings of a North American influence on colonial soil and forest conservation, at least in South Africa. Two of the Afrikaner members of the Commission had worked in the United States as refugees after the South African war (1899-1902). H. S. D. Du Toit, its chairman, trained there as an agronomist; he later became head of South Africa's agricultural extension service. R. J. Van Renen studied *civil engineering and worked on irrigation projects in Nebraska before returning to the Transvaal civil service*. T. D. Hall, one of the first South Africans to write systematic historical studies of pastures, studied agriculture in Illinois in the 1910s.

During the 1920s, too, the experience of Central Asia continued to exert an influence on the desiccationist school. C. Coching, in 1926, summarised much of this thinking in a paper entitled "Climatic pulsations during historic times in China" (71). Geographical periodicals and institutions were, as in the previous century important fora for the desiccation debate. In Africa this meant that the concerns of the 1920s now began to embrace some colonial territories that had not featured in the environmental literature of the years before the Great War but which were now the subject of considerable colonial interest and infrastructure investment. This was especially the case in the Anglo-Egyptian Sudan, about which some of the first literature on desert-spreading or "desertification" now began to be written. A pioneer in this area was E. W. Bovill, who echoed Schwartz in South Africa in his 1921 paper on "the encroachment of the Sahara on the Sudan" (72). His arguments were further followed up in an article entitled "The Sahara" in 1929 (73). Bovill's arguments were developed much further by G. T. Renner in one of the first articles to paint Africa as a potentially famine-ridden continent, as "a famine zone in Africa; the Sudan" (74).

The impact of North American 1930s "Dustbowl" thinking on African colonial conservation thinking has been extensively explored by scholars such as Beinart and Anderson (75). However, its influence may have been over-exaggerated, since it had little effect on forest policy and far less on French than British colonial policy. Although influential in the semi-arid parts of East and Southern Africa, the American ideas received much lesser attention in the wetter colonies of Central Africa (such as Nyasaland) and West Africa. In West Africa, however, Indian concerns once more made themselves felt. Soil erosion had become a prominent issue in India during the 1920s and huge investments were made in anti-erosion schemes in such regions as the Etawah district of the United Provinces of northern India, long before scientific reactions were articulated to the American "Dustbowl". In 1934 E. P. Stebbing, a very prominent Indian forester (and early historian of Indian forestry) visited West Africa for a few weeks during the dry season. His perceptions of the dry season Sahelian landscape provoked him into writing a feverish warning on what he saw as the dangers of desertification. The title of the essay ("The encroaching Sahara; the threat to the West African colonies") leads one to suspect that he had read Bovill's similarly titled 1921 article on "the encroachment of the Sahara". Stebbing's alarmism contributed directly to the founding of the Anglo-French Boundary Forest Commission. This commission, initiated in 1934, soon

found that Stebbings' warnings were largely unfounded; and his analysis was decisively dismissed by B. Jones, a member of the Commission in 1938 in an article published, as Stebbings' had been, in the *Geographical Journal*. Nevertheless, the damage had been done and Stebbings' alarms were soon echoed by much more popular writers, and above all by Jacks and Whyte in their inflammatory and inaccurate account entitled *The rape of the earth; A world survey of soil erosion* (76). This book, which set the scene for the post-war British colonial obsession with soil erosion and gullying in its "second colonial occupation" as well as for the desertification myth of the 1970s and 1980s, may owe at least some of its desiccationist obsession to the prevailing and well-rooted anxiety about the fascist threat, a threat which was a good deal more real than the desiccation danger sketched out by Jacks and Whyte, and initially engineered by Stebbing and his American dustbowl colleagues (77).



NOTES

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- 1) See R. H. Grove, *Green Imperialism; colonial scientists, tropical island Edens and the development of global environmentalism 1600-1860*, Cambridge University Press, 1994. Also R. H. Grove, "Conserving Eden; the East India companies and their environmental policies on St Helena, Mauritius and in Western India, 1660-1854", *Comparative Studies in Society and History*, 35 (1993), 318-351.
- 2) See R. H. Grove, "The origins of environmentalism", *Nature* (London), May 3rd 1990, pp. 5-11.
- 3) There is no single useful work on the environmental impact of colonial rule. However see the useful secondary summaries in Clive Ponting's *A green history of the world*, London 1991; and the useful regional study by David Watts (*The West Indies; patterns of development, culture and environmental change, since 1492*, Cambridge, 1987.) A forthcoming book, *A plague of sheep*, by Elizabeth Melville (Cambridge University Press 1994) tackles the impact of Spanish colonisation and horse-culture in 16th century Mexico.
- 4) The most useful contextualisation of Theophrastus is in C. Glacken, *Traces on the Rhodian Shore*, Berkeley, 1967.
- 5) See Edmund Halley, "An account of the watry circulation of the sea, and of the cause of springs", *Philosophical Transactions of the Royal Society*, 142, 7, (1694), pp. 468-472.
- 6) Detailed information on the environmental history of the West Indies and on early conservation thinking on the islands can be found in D Watts, *The West Indies; patterns of development culture and environmental change since 1492*, Cambridge 1987. For an excellent case study of Montserrat see Linda M. Pulsipher, *Seventeenth century Montserrat; an environmental impact statement*, London, 1986, Institute of British Geographers.
- 7) Unfortunately there is as yet no coherent account of the growth of these networks on a global basis. For a sketchy and doctrinaire but still useful account of colonial botanic gardens see Lucille M. Brockway, *Science and colonial expansion; the role of the British Royal Botanic Garden*, New York, 1979. A forthcoming book by Richard Drayton, *Nature's Government*, Yale University Press, 1995, deals with the ideology and politics behind the rise of the Kew system. The origins of the Dutch colonial system of plant exchange are usefully covered for the seventeenth century by J. Heniger in *Hendrik Van Reede tot Drakenstein and the Hortus Malabaricus; a contribution to the study of colonial botany*, Rotterdam, 1986.
- 8) My interpretation of the origins of western environmentalism clearly differs in its emphasis on the importance of the periphery from such orthodox explanations as that given in David Pepper, *The roots of modern environmentalism*, London, 1986. More recent work has been far more insightful than that of Pepper in its stress on the significance of Rousseau's circle in provoking a new environmental consciousness' e.g. see G. F. Lafreniere, "Rousseau and the European roots of environmentalism", *Environmental History Review*, 14, (1990) pp. 241-273. Even Lafreniere, however, does not recognise the direct impact of Rousseau's thinking on the beginnings of conservation in the French colonial context. Perhaps the best regional work to date on the early history of conservation is L. Urteaga, *La Tierra Esquilmada; las ideas sobre la conservacion de la naturaleza en la cultura espanola del siglo XVIII*, Barcelona, SerbaNCISIC 1987.
- 9) The best study to date on the working and social influence of a single colonial scientific institution is probably J. E. Maclellan, *Colonialism and Science – Saint Dominique in the Old Regime*, Baltimore, Johns Hopkins University Press, 1992.

- 10) E. Spary, "Climate, natural history and agriculture, the ideology of botanical networks in eighteenth century France and its colonies", unpublished paper presented at the International Conference on Environmental Institutions, St Vincent, West Indies, April 1991. See also Cambridge PhD thesis on the same subject, Cambridge, 1993.
- 11) See K. Thompson, "Forests and climatic change in America – some early views", *Climatic Change*, 3, (1983), pp. 47-64.
- 12) For a typical contemporary expression of these views see Edward Long, *A History of Jamaica*, Vol. 3, London, 1777, pp. i-iv.
- 13) For the significance of tree-planting in Britain at this time see K. Thomas, *Man and the natural world - changing attitudes in England 1500-1800*, Oxford, 1983; and F. Perlin, *A Forest journey- the role of wood in the development of civilization*, and S. Daniels, "The political iconography of woodland", in D. Cosgrove and S. Daniels, *The Iconography of landscape*, Cambridge, 1988.
- 14) For the early programmes and ideology of the Royal Society of Arts see D. G. C. Adams, *William Shipley – founder of the Royal Society of Arts, a biography with documentation*, London, Scolar Press, 1979 and Henry Trueman Wood, *A History of the Royal Society of Arts*, John Murray, London, 1913.
- 15) J. Woodward, "Some thoughts and experiments concerning vegetation", *Philosophical Transactions of the Royal Society*, 21, (1699), pp. 196-227.
- 16) A. Clark-Kennedy, *Stephen Hales, DD FRS – an eighteenth century biography*, Cambridge, 1929. See Stephen Hales, *Vegetable Staticks*, London, 1727, p. 20. Hales owed a great deal to the pioneering chemical work of the Leiden establishment and cited Hermann Boerhave's *New Method of Chemistry* translated into English in 1727 by P. Shaw and E. Chambers.
- 17) Duhamel du Monceau, *Des semis et plantations des arbres et de leur culture*, Paris, 1760.
- 18) Royal Society of Arts Archives, John Adam Street, London W1; Members Files.
- 19) R. Rompkey, *Soame Jenyns*, Twayne Publishers, Boston Mass. , 1984, and "Soame Jenyns, M. P., a curious case of membership", *Journal of the Royal Society of Arts*, 120, (1972), pp. 532-542. See also PRO CO1021 beginning "representations of the commissioners" PRO Kew , Richmond, Surrey, UK.
- 20) Public Record Office, Kew Richmond Surrey, UK. Ref. No. CO1069 CO1011 No 26
- 21) See J. R. Brouard, *The Woods and Forests of Mauritius*, Government Printer, Port Louis, Mauritius, 1963
- 22) Lecture to the Agricultural Society of Lyon, MS no. 575 folio 74, pp. 27-29; Archives of the Bibliothèque Centrale du Muséum National d'Histoire Naturelle, Paris.
- 23) Louis Malleret, *Pierre Poivre*, Paris, 1974. Physiocracy was an economic philosophy developed after about 1757 in France by Francois Quesnay and the Marquis de Mirabeau and their colleagues. It attempted to relate economic systems to the workings of natural systems. It was an economic philosophy that was very hostile to the unrestricted activity of speculative bullion and investment markets and to absentee landlordism. Physiocracy encouraged the application of science to agriculture and commerce but saw agriculture as the most important economic activity.
- 24) See Anon. , *Premiums by the Society established at London for the encouragement of Arts, Manufactures and Commerce*, issue dated June 10th 1760. The society offered large cash prizes for tree planting and in this case for the establishment of a botanic garden, which it advocated in 1760. The garden was actually founded in 1763 by Robert Melville, the first Governor of the Grenada Governorate. See R. Dossie, *Memoirs of Agriculture*, 1789, Vol. 3, p. 800
- 25) There is as yet no useful or comprehensive biography of Alexander Anderson's extraordinary life. But see Lancelot Guilding, *An account of the botanic garden in the island of St Vincent*, Glasgow, 1825 for some biographical details.
- 26) The act was proclaimed at St Vincent on 2nd April 1791. The second reading of the bill for the Act had taken place in the St Vincent Assembly on 13th November 1788. PRO CO26321.
- 27) See Grove, "Conserving Eden", *op. cit.*

- 28) For case-studies of the way in which the El Niño current has historically had a global impact see Michael Glantz, ed., *Teleconnections linking worldwide climate anomalies; scientific basis and social impact*, Cambridge, 1991.
- 29) For details of the unusual strength of the El Niño current in the years 1790-1792 (as well as for details of evidence of other major El Niño events see W. H. Quinn and V. T. Neal, "El Niño occurrences over the past four and a half centuries", *Journal of Geophysical Research*, Vol. 92 No C13, (1987) pp. 14449-14461. The strength of the 1791 El Niño was recorded by J. H. Unanue in *El Clima de Lima*, Madrid, 1815.
- In the West Indies detailed records of the 1791 droughts appear in the Proceedings of the Legislative Assembly of Montserrat for the year 1791, dt August 13 1791 (Petition of the Council to the Governor of the Leeward Islands). On *St Helena* the 1791 droughts are recorded in H. R. Janisch, *Extracts from the St Helena Records*, Jamestown, 1908, p. 202, entry dt June 25th 1791. Bad as the drought was in St Helena in 1791-1792 it was "much more calamitous in India". (Alexander Beatson, *Tracts relative to the island of St Helena*, 1816, p. 98) Beatson recorded that "owing to a failure of rain during the above two years, one half of the inhabitants in the northern cirar had perished by famine and the remainder were so feeble and weak that on the report of rice coming up from the Malabar coast five thousand people left Rajamundry and very few of them reached the seaside although the distance is only fifty miles." Beatson had culled this information from a letter written by Dr James Anderson, Curator of the Madras Nopalry Garden, to Robert Kyd, curator of the Calcutta botanic garden. The evidence for the 1791 drought in Australia is impressionistic but decisive. By the end of 1791 the Tank Stream, the main water supply for the convict colony at Port Jackson, had dried up and "tanks" were cut in the bed of the stream to conserve water. Drawings of the colony in early 1792 show that the stream was still empty, while in later pictures of Sydney the stream is always full; see T. McCormick, *First views of Australia 1788-1825*, Sydney, 1987.
- 30) This emerges in the correspondence of Sir Joseph Banks; See W. R. Dawson, ed., *The Banks Letters; a calendar of the manuscript correspondence of Sir Joseph Banks preserved in the British Museum*, London, London, 1958.
- 31) Alexander Anderson, "Geography and History of St Vincent" and "Delugia"; MS book manuscripts, Archives of the Linnaean Society, London.
- 32) Bruno Latour, *We have never been modern*, Cambridge Mass., 1993.
- 33) See Grove, *Green Imperialism*, New York, 1994, *op. cit.*
- 34) British Library, India Office Library and Records (IOL) ref no. F44427. For details of Roxburgh's tree-planting experiments in Bengal and Bihar see Home Public Consultations letters, National Archives of India, New Delhi; especially letters dated 31 Jan 1798 and May 23rd 1813, and "Botanic garden letters 1816-1817. His methods are detailed in HPC, NAI Letter dt. 23rd Oct. 1812" E. Barrett (Acting Collector of Bauleah) to Richard Rocke, Acting President and member of the Board of Revenue, Fort William, Calcutta.
- 35) Alexander von Humboldt, "Sur les lignes isothermes de la distribution de la chaleur sur le globe", *Société d'Arcueil, Mémoires*, 3, (1817), pp. 462-602.
- 36) See Grove, "Conserving Eden", *op. cit.*
- 37) 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 economic 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. 22-45.
- 38) J. S. Wilson, "On the general and gradual desiccation of the earth and atmosphere", *Proceedings of the British Association for the Advancement of Science, Transactions*, (1858), pp. 155-156.
- 39) Both Newton (the designer and drafter of Britain's first bird Protection legislation passed in 1868) and Wallace used their respective presidencies of sections of the BAAS meetings as platforms for propagandising their own conservationist agendas. Both men linked global deforestation and desiccation with species extinctions.

- 40) To some extent the forestry school founded at Cambridge in 1904 could be seen as a centre of environmental calculation and was certainly responsible for much innovation in colonial forest policy. It was more autonomous in some respects than the later Oxford Institute which replaced it in 1924. See Cambridge University Library Archives; files on the Forestry school.
- 41) For a period Indian foresters were trained at Nancy. See E. P. Stebbing, *The Forests of India*, Vols 1 and 2, Edinburgh, 1922.
- 42) There is no general work as yet on the "environmental decade" of the 1860s. Separate works on and from the period are Lord Eversley (George Shaw-Lefevre), *Forests, commons and footpaths*, London, 1912; George Perkins Marsh, *Man and Nature; or physical geography as transformed by human action*, New York, 1864; H. F. Cleghorn, *The forests and gardens of South India*, Edinburgh, 1861. For a very limited treatment, confined to Britain itself see J. Sheail, *Nature in Trust*, London, 1976.
- 43) J. S. Wilson, "On the general and gradual desiccation of the earth and atmosphere", *op. cit.*
- 44) J. S. Wilson, "On the progressing desiccation of the basin of the Orange river in Southern Africa", *Proceedings of the Royal Geographical Society*, (1865), pp. 106-109.
- 45) J. S. Wilson, "On the increasing desiccation of inner Southern Africa", *Report of the British Association for the Advancement of Science, Transactions*, (1864), p. 150.
- 46) See especially Edward Green Balfour, "Notes of the influence exercised by trees in inducing rain and preserving moisture", *Madras Journal of Literature and Science*, 25, (1849), pp. 402-448.
- 47) J. S. Wilson, "On the progressing desiccation", *op. cit.*
- 48) *Ibid.*
- 49) *Ibid.*
- 50) Clements Markham, "On the effects of the destruction of forests in the western Ghats of India on the water supply", *Proceedings of the Royal Geographical Society*, (1869), pp. 266-267.
- 51) Report of discussion, *Proceedings of the Royal Geographical Society*, (1869), pp. 267-269.
- 52) *Ibid.*, p. 268.
- 53) This is the later policy usefully characterised by R. Guha in "Forestry and social protest in British Kumaon, 1893-1921", *Subaltern Studies*, 4, (1985), pp. 54-101.
- 54) G. Bidie, "On the effects of forest destruction in Coorg", *Proceedings of the Royal Geographical Society*, (1869), pp. 74-75.
- 55) Report of discussion, *Proceedings of the Royal Geographical Society*, (1869), pp. 75-78.
- 56) *Ibid.*
- 57) See R. H. Grove, "Scottish missionaries, evangelical discourses and the origins of conservation thinking in Southern Africa", *Journal of Southern African Studies*, (1989).
- 58) R. H. Grove, "Early themes in African conservation; the Cape in the nineteenth century", in Anderson, D., and R. H. Grove, eds., *Conservation in Africa; people, policies and practice*, Cambridge University Press, Cambridge, 1987, pp. 21-39.
- 59) J. C. Brown, *A hydrology of South Africa*, Edinburgh, Oliver and Boyd, 1875; *Forests and Moisture*, Edinburgh, Oliver and Boyd, 1877.
- 60) See W. Beinart, "Soil erosion, conservationism and ideas about development; a southern African exploration, 1900-1960", *Journal of Southern African Studies*, 11, (1984), pp. 52-83.
- 61) E. P. Stebbing, *The forests of India*, Vol. 2-3, Edinburgh, Dent, 1922. See also Ravi Rajan, "Colonial science and imperial environmental history - the case of forestry in the British Empire"; Chapter 1 of Oxford D. Phil Thesis entitled "Imperial environmentalism - the development of forestry in the British Empire".

- 62) The background to this emerging consciousness of the possibility of extinctions is discussed by Mario di Gregorio in "Hugh Edwin Strickland (1811-1853) on Affinities and Analogies or, the case of the missing key", *Ideas and Production*, 7, (1987), pp. 35-50.
- 63) I discuss these issues at greater length in "Conserving Eden", *op. cit.*
- 64) Archibald Geikie, "On evolutionary geography", *Journal of the Royal Geographical Society*, 2, (1870), 232-245.
- 65) Not all investigators of the time agreed with these views, however. Sven Hedin, the Swedish explorer, for example, thought that much of the apparent desiccation could be explained by rivers shifting their courses; see S. Hedin, *The wandering lake*, New York, 1940.
- 66) P. Kropotkin, "The desiccation of Eur-Asia", *Geographical Journal*, 23, pp. 722-741; and E. Huntington, *The pulse of Asia*, London, 1907.
- 67) See R. H. Grove, "Chiefs, boundaries and sacred woodlands: the defeat of colonial conservationism in the Gold Coast and Nigeria, 1890-1914", in press, *Escaping orthodoxy; environmental assessments in Africa*, IDS, Sussex.
- 68) *Bulletin du Comité d'Etudes Historiques et Scientifique de l'Afrique Occidentale Française*, 1920, pp. 401-437.
- 69) *South African Journal of Science*, 15, (1919), pp. 139-190.
- 70) J. S. Wilson, *op. cit.*
- 71) *Geographical Review*, 16 (1926), pp. 274-282.
- 72) *Journal of the Royal African Society*, 20 (1921), pp. 175-185, 259-269.
- 73) *Antiquity*, 3 (1929), pp. 4-23.
- 74) *Geographical Review*, 16 (1926), pp. 583-596.
- 75) Beinart (*op. cit.*); D.M. Anderson, "Depression, dustbowl, demography and drought; the colonial state and soil conservation in East Africa during the 1930s", *African Affairs*, 83, (1984), pp. 321-244.
- 76) G. V. Jacks and R. O. Whyte, *The rape of the earth; a world survey of soil erosion*, London, 1939.
- 77) Jacks and Whyte were not the only scholars who may have articulated their geo-political anxieties in environmental terms. Sir Aurel Stein embarked on a similar exercise in 1938 in an essay called "Desiccation in Asia, a geographical question in the light of history", *Hungarian Quarterly*, 13 (1938).



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