Imperial Science Rescues a Tree: Global Botanic Networks, Local Knowledge and the Transcontinental Transplantation of Cinchona

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SUMMARY

During the course of the nineteenth century, the rise in the number of British troops stationed in India, along with the increasing number of women and children who joined the colonial administrators, made military and public health a matter of imperial concern. Malaria in particular was responsible for thousands of English deaths. Worried at the South American monopoly over the quinine trade, British colonial administrators and scientists put together an ambitious plan that was to result in the establishment of an enormous global network of exploration, collection and systematisation of botanical knowledge, a centralised array of botanical gardens, and a colonial science of natural resource management.

This paper follows the official records of the quinine story, in particular the memoirs of Sir Clements Markham, an employee of the East India Company and an amateur geographer who volunteered to undertake the exploration of the Peruvian forests in search of the cinchona tree. I use the case of the cinchona tree to examine the rhetoric of colonial science in conjunction with its economic and political functions. I suggest that in order to understand how ideas of progress are constituted by historically specific constructions of nature, we can draw methods and insights from at least three fields. I write this from within the field of Science Studies, which I seek to open up to insights from the study of colonial political economy and from the field of Environmental History

Towards the end of the eighteenth century, several Spanish expeditions descended with their natural history manuals and measuring equipment upon South American landscapes with a view to filling in the constitutive details of Linnaeus' classificatory system. Other European countries followed suit. Large numbers of botanical specimens were transferred across the Atlantic to the private herbaria and public gardens of Europe.

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During the course of the nineteenth century several species of plants were transferred from South America to be domesticated in other parts of the world, most of them tropical colonies of the French, Dutch and British. In this paper I use one instance of such a transplantation to open up some questions about the power of imperial science and the status of indigenous knowledge.

The frenzy of collecting and measuring did not go unnoticed by South American governments. A Brazilian government agent said suspiciously of Alexander von Humboldt, 'I never saw anyone measure so carefully land that was not his'.[1] What gave geographers and botanists the authority to measure land that was not theirs, and to collect specimens from outside their own imperial possessions? I will explore how scientific knowledge served as the link between national self-interest and humanitarian service, by examining one small, but critical, moment in the development of British economic botany in the mid-nineteenth century. Botanical knowledge was, in this process of exploration and collection, becoming a resource (both intellectual and political) that could be deployed in the rhetoric of national, imperial or of universal human progress.

In the mid-nineteenth century Cinchona seeds and saplings were taken from Peru, nurtured in Kew Gardens, and then transplanted to the Nilgiri hills of South India. The man who took credit for this transcontinental transplantation was Clements Markham, later knighted for his contribution to science. In this paper Markham will be the chief protagonist, around whose exploits and writings I will frame two sorts of questions: (a) methodological ones, regarding a possible exchange of insights between the fields of environmental history, science studies and cultural studies, and (b) questions about how some kinds of scientific knowledge come to be seen as more true than others, and about the significance of economic processes for those epistemological judgements.

AN ADVENTURE STORY

I'll offer first a close-to-the-ground picture of cinchona collecting in Peru through the eyes of my protagonist, Sir Clements Markham.[2]

The cinchona-growing region of Peru was known as the Caravaya forest, and bordered Bolivia's cinchona regions. By the mid 1850s, the governments of both Peru and Bolivia were aware of the global interest in quinine, and were becoming protective of their cinchona resources. Markham writes, of his exploration of the Caravaya forests: 'This part of the enterprise was surrounded by peculiar difficulties, arising from the jealousy of the people, habitual with the Bolivians, and recently excited in the minds of the Peruvians of Caravaya ...' (p.66). He had hoped to be undisturbed in Caravaya, and to find the Peruvians less possessive about their trees than the Bolivians: 'As a considerable part of the revenue of Bolivia is derived from the bark trade, which is not the case in Peru, the Bolivians

are exceedingly jealous of their monopoly' (p.105). However, in Caravaya, Markham ran into Don Manuel Martel, a former member of the Peruvian military, who was making a clearing in the forest to grow sugar cane. Martel related to him the story of Justus Hasskarl.

Justus Charles Hasskarl,[3] a Dutch botanist sent by the government of Java to collect plants and seeds for their botanical gardens, had spent over a year in Peru collecting plants. In the village of Sina, near the Peru-Bolivia border, under a false name, José Carlos Muller, he requested a supply of cinchona plants from the governor. The governor refused, but introduced him to Henriquez. Henriquez, whom Markham describes as 'a clever and intelligent but dishonest and unscrupulous man', employed an 'Indian' to collect the plants. Hasskarl left with his booty, but the inhabitants of the villages bordering the cinchona forests raised an outcry and threatened to cut off Henriquez's feet if they caught him. In 1852 the first cinchona plantation was established just south of Batavia, in Java.[4]

After telling Markham the story of Hasskarl's cinchona theft, Martel vowed that if anyone else were to attempt to take cinchona plants out of the country, 'he would stir up the people to seize them and cut their feet off'. Markham comments, 'there was evidently some allusion to myself in his bluster...' When Markham arrived at Sandia, from where he had planned to begin his collecting, he found a hostile municipality who, he says, 'took measures to prevent me from procuring a supply of chinchona plants or seeds, influenced by motives which exposed their ignorance of political economy, while it displayed their activity and patriotic zeal'. Martel had, apparently, written to the inhabitants of Sandia, and was busy warning the inhabitants of villages bordering the cinchona forests to prevent the foreign explorer from removing plants and seeds. Markham reports,

> My mission was becoming the talk of the whole country; and I at once saw that my only chance of success was to commence the work of collecting plants without a moment's delay, and, if possible, anticipate any measures which might be taken to thwart my designs.

Although one Indian abandoned Markham's party after the first day, he was able to continue with three men, and was successful in gathering abundant supplies of cinchona plants. Deeper in the Caravaya forests, he made the acquaintance of Quechua *cascarilleros* (veterans of the bark trade, which had ended in 1847) and *collahuayas*, collectors of drugs and incense (traditional travelling healers who passed their knowledge of herbs from father to son). Markham employed Mariano Martinez, a cascarillero who had guided the French botanist Weddell on his 1846 visit, to lead him into the forest 'where no European had been before'.

Markham describes a long and arduous journey in search of cinchona trees, where he scrambles up 'giddy precipices,' entreats and threatens (in Quechua) 'mutinous Indians', dodges wild animals, injury and disease, and chews coca to

dull his hunger. He managed to collect about five hundred cinchona plants of different varieties, which his gardener packed in cases specially designed to withstand the long journey to London.

On emerging from the forest, however, just as they finished packing the plants, Markham's local assistant, Gironda, received 'an ominous letter' from the Alcade Municipal, obviously instigated by Martel, ordering him to arrest Markham and his guide (Martinez), and to prevent Markham from taking away any cinchona plants. Markham wrote back, quoting the provisions of the Peruvian Constitution, contesting the Alcade's power to order his arrest:

> ... concluding with an expression of my sense of his patriotic zeal, and of regret that it should be accompanied by such misguided and lamentable ignorance of the true interests of his country. Nevertheless, I felt the imperative necessity of immediate flight, especially as I obtained information from an Indian that Martel's son and his party ... were coming down the valley to seize me, and destroy my collection of chinchona-plants (276).

Judging discretion to be the better part of valour, then, Markham escapes with his precious booty of saplings, thwarting his pursuers (who, the narrative suggests, had they been successful, would have destroyed not only him and his collection, but the future of the cinchona tree).

A METHODOLOGICAL DETOUR

The story of how the west won the cinchona tree is, after Lucile Brockway's (1979) *Science and Colonial Expansion*, well known to historians of botany. The cultural influence of colonial natural history was examined in Mary Louise Pratt's widely read *Imperial Eyes* (1992). Natural history itself was accorded a central place in the 'history of man' in Michel Foucault's *The Order of Things* (1973). What can science studies gain from the cinchona story, or contribute to the study of natural history and global botanic networks?

I have chosen to resurrect the story of the cinchona tree as I think that, first, a science studies perspective can creatively combine the two approaches that Brockway and Pratt open up; and second, that this exercise suggests the need to further open up science studies itself to interdisciplinary influences, particularly from environmental and economic history. The story of the transplantation of the cinchona tree from the Andes to the Nilgiris is one that lies at the intersection of at least three disciplines – environmental history, political economy, and science studies.

In the last two decades science studies, primarily through research that is commonly known as the sociology of scientific knowledge (SSK), has been offering increasingly complex analyses of science as 'culture'. An observational methodology borrowed from anthropology has given us a close, micro-level understanding of negotiation, networking and rhetoric within and between

scientific communities, while SSK's extension and modification of traditional sociological methodology through an epistemological relativism has helped us understand how scientists operate in the larger social sphere by revealing the myriad modes of 'construction' that scientist employ. Given the openness of the field to new methodological approaches, it seems to me that the importing of methods from the study of political economy and environmental history can now enrich science studies, and perhaps serve as a corrective to the sometimes debilitating effects of extreme relativism and self-reflexivity. Bruno Latour has recently diagnosed these effects as resulting from an inadequate development of the principle of symmetry that was first defined by the strong programme in the sociology of knowledge:

> [T]he principle of symmetry as defined by Bloor leads rapidly to an impasse. ... it is asymmetrical not because it separates ideology and science, ... but because it brackets off Nature and makes the 'Society' pole carry the full weight of explanation (Latour 1993: 94).

Latour argues that a radically constructivist notion of 'nature' only serves to perpetuate a dichotomous model of nature and culture, the latter being made to bear the burden of all explanation – a weight which it cannot bear if it continues to be modelled merely as sets of social conventions.[5] He argues that 'the very notion of culture is an artifact created by bracketing Nature off' (104) and suggests that we should study not natures *and* cultures, but 'nature-cultures.' Appeals to take nature seriously appear in many forms and varied contexts today. 'Nature' seems a crucial intellectual and political resource, yet it often remains nebulous and undefined as an analytical category. What might a 'nature-culture' look like? How might we simultaneously analyse social and environmental change?

In addressing these questions I shall take a step back to Raymond Williams' 1980 essay *Ideas of Nature*. Williams, coming to the analysis of nature through a route very different from Latour's, paints a similarly complex picture of the inextricability of nature and culture, but one that seems to chart out more clearly the methodological routes we might take to study this tangle that is nature-culture.

Williams says that 'ideas of nature ... are the projected ideas of men'. This might easily be assimilated into the claim that science constructs our notions of reality. Is 'nature' lost forever, then, in the swamp of social constructions of it? Yes, nature is lost if it is a pristine untouched nature that we seek. But all is not lost – to acknowledge the irreducible sociality of our understanding of nature is not to give up the attempt to have our descriptions of it refer to actually existing systems that are partially but not wholly defined by particular cultural representations of them. Thus we might acknowledge, with Marx, that 'the nature that preceded human history no longer exists anywhere';[6] this leaves us with the task of building an integrated theoretical framework that helps us simultaneously understand nature and culture, ecology and economics. How might we do this?

Williams gives us concrete suggestions, when he points out that the history of ideas of nature is the history of changing social relations: 'Out of the ways in which we have interacted with the physical world we have made not only human nature and an altered human order; we have also made societies.' One of the tasks of a historical sociology of knowledge is then in understanding how ideas of nature have shaped and been shaped by social, political and economic relationships. While Williams' essay points out a direction for such research, we must look to historians for concrete examples.

It is under the imperative of writing a historical sociology of 'nature' that interdisciplinarity in science studies becomes necessary. The analysis of the rhetoric of science (which SSK pioneered) can profit from the long time frame that environmental history operates within, and from the analysis of states and economies that political theory offers.

The particular story of the cinchona tree, for example, can be told as one of the discursive construction of nature, or of ecological imperialism, or of the commodification of cinchona bark. I will briefly examine what each of these narrative/ analytical strategies entails, and suggest how science studies might synthesise their strengths and overcome their weaknesses.

We have a model for the first in Mary Louise Pratt's *Imperial Eyes*, which offers an analysis of the textual practices employed by eighteenth-century travel writers. Pratt notes that in the same year that Linnaeus' *Systema Naturae* was published, the first 'scientific' expedition to South America was launched (this was the French expedition headed by botanist Charles de La Condamine, which I shall mention again). She sees the two events as marking a watershed in European modes of thinking about the rest of the world. She argues that they mark the emergence of what she calls a European 'planetary consciousness', a mode of understanding and representing the self and the Other, and a method for 'the construction of global-scale meaning through the descriptive apparatuses of natural history'. She claims, further, that this 'new planetary consciousness ... is a basic element constructing modern Eurocentrism' (Pratt 1992:15), thus postulating a historical link between natural history, eighteenth century European travel writing and modern forms of representation that undergird new modes of domination. While Pratt sets up her historical context meticulously, her argument centres on the texts produced by travellers. Her analysis of their representations of nature and of the native populations of non-European lands raise questions, for us, about the modes of dissemination of scientific (especially ethnographic and botanical) theories and the effects of scientific theories on imperial policies, bureaucracies and scientific institutions. An emphasis on textual analysis can be useful to science studies in raising such questions; however, an exclusive emphasis on rhetoric and representation is, by definition, unable to answer these questions satisfactorily, for they demand answers that take into account political institutions, scientific practice, and economic processes. Thus, for example, Pratt mentions what she calls the 'suggestive analogy' between 'Linnaeus' documentary, totalising approach' and 'centralised bureau-

cratic and military systems of administration, surveillance and manufacture'. Without some historical investigation of the specific links between these two, the connection cannot go beyond being a suggestive analogy. This is not to fault Pratt's work itself, for it is a work of literary criticism, and thus is not compelled to answer such questions. Science, on the other hand, works through texts *and* through institutions and practices. Science studies has valuable lessons to learn from work such as Pratt's, which is beginning to bridge the traditional differences between literary and historical analysis. Scientists' writing must be read with the analytical rigour that has so far been the province of literary critics. In the story of the cinchona tree, our primary text is *Travels in Peru and India while superintending the collection of chinchona plants and seeds in South America, and their introduction into India* , written in 1862 by the leader of the British cinchona expedition, Sir Clements Markham. Science, of course, works through texts *and* through institutions and practices. A close reading of Markham's text, in conjunction with historical accounts of institutional structures and intellectual practices, helps address questions such as: How did economic and political concerns inform theories of how to manage nature? What distinguished local, indigenous 'ecological' knowledge of the cinchona tree from European botanical knowledge of the same tree? Who spoke for 'nature', the native Andeans who taught the Spanish, French and English explorers the medicinal use of 'quinaquina', the colonial geographers, explorers, and botanists, or the indigenous inhabitants of the Nilgiris whose lands were taken up for cinchona plantations? I would like to claim these questions as lying within the domain of a standard science studies problematic, in that they address the construction, efficacy and scope of scientific knowledge in a particular social context. However, the field of science studies, interdisciplinary in origin, is not methodologically self-sufficient, and might profitably borrow insights from fields that have in recent years been addressing questions about the political and cultural meanings of environmental change.

The transfer (or smuggling) of a species from one periphery of an imperial globe to another, and the systematic domestication of it there for the military and commercial interests of an imperial power brings to mind the phrase coined by environmental historian Alfred Crosby: Ecological Imperialism. Alfred Crosby, in *Ecological Imperialism* (1987), argues that the colonisation of the New World by Europeans was more than a question of superior arms and organisation – it was also, he suggests, a question of biology, or ecology. European colonisers were aided and abetted by the animals, weeds and diseases that they carried with them from the Old World, against which the lands and peoples of the New World had little resistance. Thus it would seem that these colonisers had Nature on their side. While Crosby gives an excellent account of the 'natural' or ecological effects of imperialism, human actors seem conspicuous by their absence in his narrative. We are left with the sense that there was little human agency in the transformation of New World landscapes beyond the initial, almost inadvertent, introduction of new species. We can only guess at the role of human agency in

the slaughter of buffalo, in the fencing of prairies, and in the spread of disease among Native Americans.

Crosby's work is important in our current search for methods because of (a) its attention to the long-term ecological effects of colonialism and (b) its emphasis on material, or 'non-human' actors of the kind that Latour calls attention to. I will, then, add these to my list of methods science studies might smuggle from other disciplines. We must turn elsewhere for model theorisations of human agency in environmental change.

A very different environmental history is William Cronon's history of Chicago and the American mid-west, *Nature's Metropolis*. Cronon has in common with Brockway (1979) an attention to global economic processes, political systems, and environmental change. Cronon traces the historical process of the creation of the commodities wheat, lumber and meat; Brockway does the same with cinchona, rubber and sisal. Cronon moves between city and country, metropolis and prairie, to write a history of 'nature' that is simultaneously a history of 'culture', an ecological story that is also an analysis of political economy as it reveals the connections between a historically specific mode of production and the idea of nature. Brockway's global reach is broader than Cronon's, although her level of detail is less. She demonstrates the benefits of broadening our scholarly focus, suggesting:

> In its broadest aspects, then, our unit of analysis is not any one society or empire, but the network of relations emanating from the West that penetrated all societies, binding colonised to colonisers, and colonisers to each other (p. 9).

Thus if we were to borrow methods of close textual analysis from literary studies, an attention to long-term ecological effects and an emphasis on the material world from environmental history such as Crosby's, and an attention to political economy from environmental history such as Cronon's and Brockway's, we would have a collection of analytical tools that allow precision at the micro-level and range and depth at the macro-level.

KNOWLEDGE AND COLONIAL POWER

The natural resources of tropical countries were a crucial source of raw material and revenue for the European imperial powers of the eighteenth and nineteenth century: the Dutch obtained gold and diamonds from South Africa, cocoa from west Africa, coffee from Java, sugar from the Caribbean, tobacco and rubber from Malaya; the British obtained tea, coffee, rubber, and opium from India and Sri Lanka, sugar from Trinidad and Guyana; France obtained rice from Vietnam and sugar from Haiti (see Wolf 1982). Most of these were plantation crops; many were not indigenous, but were cash crops introduced explicitly for the benefit of imperial coffers. As Eric Wolf points out:

> During the latter part of the nineteenth century ... [w]hole regions became specialised in the production of some raw material, food crop or stimulant ... Regional emphasis on a monocrop or single raw material product demanded, in turn, that other areas raise crops to feed the primary producers, or furnish labor power to the new plantations, farms, mines, processing plants, and transport systems. Through the expanding commitment to the production of commodities, changes on the level of the world market had consequences at the level of household, kin group, community, region, and class.

That cinchona bark yielded an alkaloid from which a malaria-fighting drug could be obtained was known to the indigenous dwellers of the cinchona forests long before Spanish colonisers arrived. However, this information did not become a commodity until a network of manufacturers and markets acquired it. One of the questions this paper addresses is what distinguishes 'local' from 'global' knowledge, or 'indigenous medicine' from 'European science'. One of the answers this story suggests is that most of the differences lie in the realm of the networks of communication into which each system was hooked. But such a realm is often thought of as being 'external' to the context in which we judge the truth or falsity of theories. However, as I show, Quechua knowledge was represented by colonial scientists as being unscientific, although indigenous Quechua guides and doctors were crucial to the success of the colonial cinchona quest. Thus Quechua knowledge about the cinchona tree appears to have been considered both true and unscientific by colonial scientists. How could knowledge be simultaneously unscientific and true? One explanation is that it might be considered empirically true but lacking in theoretical sophistication and therefore unscientific. How then are we to understand 'theory' in science here?

Several models of scientific knowledge have been advanced in the last decade or so that suggest modern western science gets its power from its inherently penetrative and totalising methodologies. Some feminist and post-colonial historiography has analysed Enlightenment science as an effort to dominate nature, one that in its practice and rhetoric alike embraced violent means of extracting nature's 'secrets', and forged out of this violently extracted knowledge an analogously cruel power over human existence. The nineteenth-century scientific expeditions to South America certainly sought botanical knowledge in the interests of imperial economic power; patterns of natural growth in both South American and South Indian forests were destroyed in order to create man-made patterns of growth; a tree that had been extracted from its natural habitat was artificially inserted into a foreign climate: 'nature', thus, might be seen as having been manhandled, disrupted, manipulated, dishonoured. As Carolyn Merchant argues, 'Enlightenment thinking disenchants nature by removing [the] magic and turning the subject into an object' (Merchant 1994: 5). In this critique, western science is seen as driven by the logic of 'Enlightenment rationality,' which is inherently an oppressive mode of thought. Indigenous knowledge, on the other hand, is seen as closer to nature, as avoiding in some way

the subject-object hierarchy that is fundamental to western scientific knowledge. Merchant explains:

> Tribal societies pursued their needs through the imitation of nature. Human beings became as much like the animals they hunted as possible ... So powerful is the mystique of reason as instrument in the control of nature and human bodies that it banishes other modes of participating to the periphery of society ... Instrumental reason and enlightenment are thus synonymous with domination. (pp. 5-6)

This view, it seems to me, oversimplifies indigenous knowledge and exaggerates the power of Reason. Tribal societies systematised nature in ways that suggest that they observed, classified and manipulated their surroundings in rational ways.[7] Hunting, gathering and agrarian communities all represent and utilise nature in ways other than Merchant's image of identification through imitation suggests. On the other hand, while I am sympathetic to critiques of the Enlightenment that point out the necessary connection between the philosophy of the Enlightenment and the systematic oppression of people by those who claim to speak in the name of Reason, I feel that the burden of explaining scientific colonialism must rest on more than an abstract conception of reason. 'Reason' did not, after all, function in a vacuum – it functioned (oppressively or otherwise) within an economic and political system.

Analyses of natural history in the seventeenth and eighteenth centuries illustrate this point well. Pratt and other historians have suggested that the methodology of natural history was based on the description of surfaces, as opposed to anatomy and physiology whose emphasis was on the analysis of underlying structure, and thus relied literally on penetration or dissection. This difference between natural history and 'biology' has been noted by Foucault in *The Order of Things*, and is the basis of his claim that the transition from the former to the latter was one of the markers of the shift to a modern episteme. If natural history was essentially pre-modern (Foucault's term is 'Classical'), it is not clear how much of the critique of Enlightenment reason applies to it. Yet Pratt's analysis of natural history parallels Merchant's analysis of Enlightenment science, as for example her assertion that the natural historical system of nature 'overwrote local and peasant ways of knowing,' or her suggestion that 'Linnaeus' documentary, totalising approach' paralleled oppressive state-level structures such as 'bureaucracy and militarisation [which] are the central instruments of empire.' While being interdisciplinary it is important to remember that critiques of 'Reason' cannot automatically be carried over from one century to the next. The analysis of scientific thought and practice in a specific context must not be conflated with critiques of modernity or of Enlightenment Rationality.

The claim that scientific reason is inherently dominating reduces to the assertion of an essentialism unless it is contextualised, i.e. the philosophical critique ought to go hand in hand with a historical elucidation of the modes of operation of specific forms of rationality within their own conditions of exist-

ence, namely economic and political structures. Thus, while wanting to preserve the real insights that the anti-Enlightenment critique has provided,[8] I think there are many historical constructions of nature, and of interactions between humans and nature, and between different groups of humans, that tend to get obscured when the metaphor of violent opposition is relied on too heavily as an analytical tool. Valuable questions about the nature of scientific reason come to us from the philosophy of science; we need to contextualise and question the extent of their explanatory adequacy even while using them to motivate our historical investigations.

KNOWLEDGE IN CONTEXT: SYSTEMS AND INSTITUTIONS

Before returning to the story of Markham's cinchona hunt, I will give three brief illustrations of the importance of institutional and intellectual contexts for the historical analysis of scientific knowledge.

I will not attempt an overview of natural history's development, but will use two books published on British colonial botany to illustrate (a) the significance of global exploration for the practice and theorisation of the discipline of natural history, and (b) some culturally specific claims associated with the pursuit of observer-independent objectivity.

In 1855, Joseph D. Hooker[9] and Thomas Thomson published *Flora Indica*, a projected (but never completed) systematic guide to the plants of British India. They explained the pressing need for comprehensive and standardised reference works for use in medical and economic botany, as these fields in India were 'at a standstill for want of an accurate scientific guide to the flora of that country' (p.3). Hooker and Thomson perceived the field of natural history as going through a crisis of authority. The rising number of amateur botanists and the resulting proliferation in the number of varieties reported as 'discovered' was proving too great for the Linnaean cannon by which 12 words were allowed for a specific character.

In this introductory volume, explaining the urgent need for systematisation, the authors complain about the proliferation of erroneously classified species and genera, suggesting that the lack of conceptual and consolidating work threatens the progress of the science and its commercial applications. They declare themselves impatient with 'backyard botanists' who fail to understand the full range of the science, and whose view is skewed, unlike 'those who extend their investigations over the whole surface of the globe' (p.13).

Exploration of the globe's flora had led to an explosion in number of species becoming known to scientists. This was not merely a quantitative shift, but a development that prompted something of a conceptual crisis in the field of natural history. The global reach of botanical science now demanded a science that could both integrate the bewildering diversity and bring analytical rigor to the examination of single plants. Attempting to professionalise and systematise

the field so as to exclude the bungling amateurs who were threatening to suffocate its systematicity in meaningless detail, Hooker and Thomson assert,

> We are .. anxious to refute the too common opinion ... that descriptive botany may be undertaken by anyone who has acquired a tolerable familiarity with the use of terms. ... to develop the rules of classification, to refer new and obscure forms to their proper places in the system, to define natural groups and even species on philosophical grounds, and to express their relations by characters of real value and with a proper degree of precision, demands a knowledge of morphology, anatomy, and often of physiology (p.9).

Natural History was being drawn closer to more professionalised sciences such as medicine.[10] Thomson himself was a surgeon, as were several other botanists in India. The explosion of descriptive information caused by increased global exploration was precipitating the search for modern modes of systematisation. Natural history was thus going beyond an emphasis on surface descriptions, as it was increasingly influenced by the methods of the newer biological sciences and medicine.

Thus a globalisation of the domain of science was causing qualitative shifts in natural history's methodology and practice.

I. H. Burkill's *Chapters on the History of Botany in India* were published in a series in the *Journal of the Bombay Natural History Society* from 1953 through 1960. They were completed when he was 93, but grew out of experience gained in his posts as Reporter on Economic Products to the Government of India and Economic Botanist to the Botanical Survey between 1901 and 1912. Introducing his subject, Botany, he says:

> I beg to my reader strictness of thought in keeping apart the natural science Botany from the generality of objects which are quite properly termed botanical. A writer in Calcutta claims that those who wrote in Sanskrit possessed the natural science, on the ground that they applied Sanskrit names to plants. The argument is false. Apply the test, namely which is at the centre, man or the plant; when applied it will be found that man maintains his post at the centre.

Burkill asserts that this development – the displacement of 'man' from the centre of knowledge so that he, the scientific subject, is able to have precise knowledge of the object-world of nature – accounts for the universality of botanical knowledge:

> [A] system emerged out of the Technology of Healing in a particular part of Europe, was accepted and clad there with a vocabulary of precision, as Sciences must be, and .... this system has been spread over the World, India included, without meeting a rival. Its origin was, as it were, by a sublimation in which 'Man' was displaced from the focus of thought that 'the plant' might be placed there (p 1-3).

Burkill, then, sees natural history as more objective than indigenous systems of plant science because, by excluding the observer from the system of knowledge,

subjective biases and cultural meanings can be eliminated from it.

Even without an exhaustive overview of the field, then, from these two scientific treatises we get a sense of what was at stake (in short, systematicity, professionalisation and observer-independent objectivity) in botanical science from the middle to the turn of the nineteenth century. Let us look equally briefly now at its institutional context in the same period.

From being the private garden of Princess Augusta in 1759, a large area of land on the south bank of the Thames grew to be one of the central instruments of both botany and empire. Before it became a state institution, Kew Gardens[11] was managed by Sir Joseph Banks, an amateur botanist who had close connections to the royal family. William J. Hooker became its first official director in 1841, and although Kew was handed over to the state, royal patronage continued, and noblemen such as the Duke of Northumberland and the Earl of Derby privately funded botanical expeditions. Joseph Hooker describes his father's practice :

> [T]hrough his influence with the Admiralty, he obtained the privilege of having all packages addressed to Kew coming by the Royal Mail India steam packet sent freight free. By these means Mr. Purdie was sent to New Granada, and Burke and Geyer to California and Oregon, ... and by similar arrangements with the Treasury, Foreign, Indian and Colonial Offices, there were subsequently sent Oldham and Wilfred to Japan, Formosa and Corea, Mann to the Cameroons .... (quoted in Brockway 1979:84).

Kew's global reach and its connections with state power are both evident here. J. D. Hooker himself was active both in the imperial service and as a professional botanist, often combining the jobs, as for example when he surveyed Bengal-Sikkim border (from 1847-51) while collecting (about 7000) specimens of Himalayan plants for Kew. In 1848 W.J. Hooker and his colleague John Henslow set up a Museum of Economic Botany at Kew. As a later director put it, Kew's purpose was 'aiding the Mother Country in everything that is useful in the vegetable kingdom' (102).

Sir Joseph Banks was not only the first person to manage Kew Gardens, but was also a founder and Secretary (from 1778-1797) of the African Association (which was the precursor of the Royal Geographical Society), the President of the Royal Society, and, in 1795, the first Englishman to be knighted for scientific services to the nation.[12] Banks extended the African Association's sphere of interest to Australia (he obtained the royal order for forming a settlement at Botany Bay), and Asia (he obtained the support of East India Company for the first exploration of Tibet).

From 1820 to 1830, exploration became steadily more central to imperial interests. Intensive surveying activity in British India provided an impetus to map and instrument makers, which in turn facilitated exploration. Several of the early British administrators sent out to India were amateur geographers whose survey maps and statistics helped build up a considerable geographical literature.

Markham writes, '[t]he establishment of our Indian Empire also led to the necessity for surveys, and consequently to great advances in geographical knowledge.' At around this time, a gentlemen's club of 'travellers' called the Raleigh Club brought together 'the most eminent Travellers in London:'

> [T]he object of the Club was that travellers may assemble in social converse, who have visited distant countries, particularly those that have been little explored...

In 1830, along with members of the African Association, they formed the Royal Geographical Society [RGS]. Its charter stated that

> [The RGS's] sole object shall be the promotion and diffusion of that most important and entertaining branch of knowledge – geography; ... the interest excited by this department of science is universally felt, [and] its advantages are of the first importance to mankind in general, and paramount to the welfare of a maritime nation like Great Britain, with its numerous and extensive foreign possessions; ... its decided utility in conferring just and distinct notions of the physical and political relations of our globe must be obvious to every one ...

Among its primary tasks was:

> To prepare brief instructions for such as are setting out on their travels, pointing out the parts most desirable to be visited, the best and most practical means of proceeding thither, the researches most essential to make, phenomena to be observed, the subjects of natural history most desirable to be procured, and to obtain all such information as may tend to the extension of our geographical knowledge (pp. 18-20)

Thus from an amateur group of travellers who met for conversation, a strategically important imperial instrument grew within less than fifty years. Initially not funded by the state, its members were the aristocratic elite, with enough wealth and leisure , plus curiosity and a love of adventure. The imperial ruling class was drawn from the ranks of exactly such men. For example, among the six members of the founding committee of the RGS was Mountstuart Elphinstone, who had spent most of his life as an Indian Civil Servant, and had been Governor of Bombay from 1819-1826. In 1832 an affiliated Geographical Society was formed at Bombay, supported by the Navy Surveyors.

The fourth President of the RGS, William Hamilton,[13] characterised geography as a selfless search for universally beneficial knowledge:

> The real geographer becomes at once an ardent traveller, indifferent whether he plunges into the burning heats of tropical deserts, plains, or swamps, launches his boat on the unknown stream, or endures the hardships of an Arctic climate, .. Buoyed up in his greatest difficulties by the consciousness that he is labouring for the good of his fellow creatures, he feels delight in the reflection that he is upon ground untrodden by man, that every step he makes will serve to enlarge the sphere of human knowledge, and that he is laying up for himself a store of gratitude and fame (p.37).

Through amateur scientific practices and organisations, an institutionalised science emerged that was explicitly imperial, yet simultaneously represented itself as a universal, humanitarian project. I will explore such simultaneously nationalist and universalist claims in the context of Markham's description of the cinchona transplantation, and argue that, rather than see them as simply contradictory or representative of the 'bad faith' of modern scientific rhetoric, we can use these apparently contradictory moments as analytical wedges to help us understand the political and economic interests undergirding the accumulation of scientific knowledge.

BACK TO SIR CLEMENTS MARKHAM

The primary source for this section is a memoir by Clements Markham, an amateur geographer who was knighted for his successful career in exploration and science. *Travels in Peru and India* (1862) is a book of over five hundred pages, filled with not only detailed discussion of the logistics and economic viability of the cinchona project, but reflections on the responsibility of colonisers toward the colonised and of the scientist towards nature.

Although my main text is from the mid-nineteenth century, science and political economy were closely linked long before the nineteenth century. This was especially important for a world power like England. In Elizabethan England, geographical knowledge had been systematised for the benefit of both explorers and scholars. Richard Hakluyt, one of the most famous of the explorers of the seventeenth century, worked for the East India Company, and used his geographical knowledge to draw up lists of commodities that could be bought or sold at various ports around the world. Clements Markham saw himself in the tradition of 'adventurers' such as Raleigh and Drake, who were, he says, 'fathers of our science' in a time 'when it was the highest ambition of the flower of England's sons to add to her fame by achieving discovery in distant lands' (Markham 1881:5). He was Secretary of the RGS and wrote the official history of it for its fiftieth anniversary in 1881.

When, by the middle of the nineteenth century, it was becoming evident that there was a danger that a South American monopoly over quinine might be established, it seemed only logical to call for an explorer to seek a solution. The problem was complex, involving several different fields of knowledge and activity. It called for an explorer with an understanding of the role of adventure and discovery in the maintenance of Empire; but it also called for someone who was both botanically and linguistically well-versed. The explorer needed not only to be able to identify the particular species and variety of plant that would provide a commercially viable yield of quinine, but also to be able to converse with the native South Americans in order to elicit information about the whereabouts and accessibility of the plant specimens. Aside from exploration,

the project included the envisioning, planning and execution of a massive program of transcontinental transplantation. The key resources, then, were located on three continents: South America had the plant, but Britain did not have South America; Britain, however, had India, which had, the geographers estimated, a climate that would be hospitable to the plant; and in London itself, there was the pivotal resource, Kew. Kew Gardens would serve as incubator to the plants uprooted from their native South American soil, nursing them to a state sufficiently vigorous enough to withstand a second voyage and a subsequent transplanting in foreign soil. Kew was a mid-way resting point for the plants on their voyage from Peru to the Nilgiris; moreover, it had the professional gardeners, the greenhouses, and the expertise that India lacked. Kew also marked cinchona's point of transition from uncultivated rainforest growth to commercial cash crop.

In addition to its obvious economic import, such a transformation carried with it considerable symbolic significance in the context of a scientific discourse of progress that dominated much of nineteenth-century colonial thought. Progress could be measured by the advancement along a trajectory defined by several oppositions: societies could be arranged on a scale from savagery to civilisation in terms of their advancement from (social, political and biological) chaos and wildness towards cultivated orderliness, from locally effective power to global penetration, from passive effeminateness to active, powerful virility, from concrete and empirical forms of knowledge to the abstract and theoretical. Thus, while the empirical knowledge of the healing properties of *quinaquina* bark may have been with the native Andeans for hundreds of years, it remained trapped in the forests of the Andes, and was, in this form, useless to the rest of the world.

We receive hardly any information about indigenous use of the bark prior to the internationalisation of the trade. Markham does not count indigenous knowledge of cinchona as scientific, even though, almost every step of the way, he is guided, tutored and sheltered by indigenes. Markham asserts that even though there is evidence that the 'Indians' had long known about the medicinal properties of cinchona, 'they attached little importance to them.' There seems little evidence for this assertion, however, as Condamine, Jussieu and Ruiz all reported that the Indians had taught the Spanish the use of the bark. Humboldt and Spruce had both described elaborate indigenous systems of healing (based on the 'hot' and 'cold' properties of various illnesses and cures), in which cinchona bark had a specific place.

Markham records[14] that 'the first description of the cinchona tree is due to that memorable French expedition to South America, to which all branches of science owe so much.' This was made by Condamine, 'the first man of science who examined and described this important plant'.

Thus a colonial history of quinine could only, by definition, recognise the first description of the cinchona tree to have been made by a European scientist, even though native South American bark collectors had been carrying the bark around in their medicinal pouches for some time. How are we to understand the

distinction between scientific and non-scientific description here? The sentences in Condamine's description did not, in themselves, constitute scientific knowledge – thus, the same words spoken by a Quechua 'native' would not have counted as a scientific description.[15] However, these same sentences in the context of the explicitly scientific purpose of the expedition, its institutional support, and its framing in terms of already established paradigms of research, constituted something that was recognisable as 'scientific knowledge.'

How did the La Condamine expedition meet these criteria? Alexander Cockburn and Susanna Hecht, in *The Fate of the Forest*, describe this expedition in its institutional context. They recognise the significance of the La Condamine expedition for the production of scientific knowledge, and distinguish it from preceding expeditions:

> The eighteenth century saw numerous explorers entering the Amazon, but usually their function was surveying of boundaries, the staying of Spanish and other incursions, or the importation of the Christian God. The first 'true' scientific exploration was launched in 1736. The French Academie des Sciences, intent upon resolving some of Newton's theories regarding the shape and size of the earth, mounted an expedition to the Amazon. The party contained one of the Amazon's most famous visitors, Charles Marie de la Condamine, travelling with ten other 'natural philosophers'. La Condamine's journey differed from earlier ones in that it was sponsored by a scientific institution and in principle concerned the accumulation of pure knowledge; but his botanical descriptions of plants had very practical consequences, and changed the region forever. Rubber, quinine, curare, ipecac, and copaiba oil made their entrance into European history, first as exotica and minor trade novelties, and later as the basis for substantial economic enterprises. (Hecht and Cockburn 1990)

Knowledge would be systematised, disseminated, and constituted as 'scientific' only if it was produced under certain conditions. The conditions of production of scientific knowledge, then, are constitutive of its efficacy, and thus central to the process by which it achieves the status of universal truth.

What rhetorical strategies were employed to establish the boundaries between scientific truth and unscientific ignorance? Reading Markham's memoirs in the context of the models of colonial natural resource management that were developing during the nineteenth century in the official administrative literature, we can discern an interesting aspect of the metaphors he uses to describe humans' interactions with nature. While Markham the explorer did pit himself against the elements in order to wrest the cinchona tree from the depths of the Peruvian wilderness, this struggle is portrayed more often in lyrical than in antagonistic terms. More importantly, nature was something that had not so much to be battled against[16] as battled *for*. Markham the modern scientist was a defender of nature against the ignorance and greed of less advanced societies. For example, Markham quotes the Spanish botanist Ruiz's protests against the practices of the bark-collectors of Loxa:

> [He] declared that it was very injurious to the trees, many having been destroyed by it... thoughtlessly destructive ... They often pull up the roots, while the annual burning of the slopes, and the continual cropping of the young shoots by cattle, assist the work of destruction. It is therefore well that the *C. Chahuarguera* and *C. Uritusinga* , the earliest known and among the most valuable of the chinchona trees, should have been saved from extinction by timely introduction into India (Markham 1862: 25).

Markham repeatedly draws our attention to the contrast between the respectful and conservative attitude of European science towards nature, and native brutality towards nature. The image of the ignorant, destructive native (aided by his beasts) is in deliberate contrast to the nurturing hand of European science. Further, this language suggests, scientific knowledge is employed in the service of all humanity, while native interests are by definition narrow and short-sighted.

He complains,

> The collection of bark in the South American forests was conducted from the first with reckless extravagance; no attempt worthy the name has ever been made either with a view to the conservancy or the cultivation of the chinchona trees; and both the complete abandonment of the forests to the mercy of every speculator, as in Peru, Ecuador, and New Granada, and the barbarous meddling of Bolivia, have led to equally destructive results (p.44).

Markham portrays Nature as under attack: its assaulters are those ignorant of science, while its defenders are those who can exploit and sustain it at the same time. It is possible here to disentangle two kinds of ignorant, unscientific behaviour – one that is ignorant of methods of conservation and regeneration of valuable natural forest growth, and another that is ignorant of the logic of the free market. The two are connected in interesting ways.

The 'barbarous meddling' in Markham's complaint above refers to Bolivia's attempts to restrict the removal of cinchona bark by non-licensed collectors and foreign nationals. A conflict over national sovereignty, ownership of resources and access to international markets is here construed as a conflict over how to treat nature properly – Bolivia's legislation is said to have wreaked havoc on the cinchona tree. The short sightedness of both individuals and governments is explained as stemming from their lack of awareness of the fragility and value of the natural wealth they are tampering with; or their lack of scientific knowledge of nature. If Bolivia had pursued, or allowed more advanced nations to take over, the argument goes, the systematic and scientific development of its resources, the cinchona plant would not be threatened, as it is now. The present embattled state of the cinchona tree, however, calls for drastic measures. In order to support his claim, Markham cites other explorers, like the Spanish botanist Ruiz, who had characterised the bark-collectors of Peru as 'thoughtlessly destructive.' As Peru and Bolivia lacked the capability to nurture the tree as was needed, it was a good scientist's duty to rescue the tree from the danger of extinction. What ensues is an action-packed chase drama through the forests of Peru and Bolivia,

with Nature, or the cinchona tree, as the damsel in distress, to whose rescue the gallant knights of European science rush, pursued by the misguided Bolivian nationalists who seek, from selfish motives of national profit, to thwart this mission.

But Markham's writing is a fascinating and sometimes inexplicably self-contradictory mixture of botanical evangelism and unabashedly commercial profit-and-loss talk. While the book is clearly framed in the rhetoric of a conservationist agenda, in the details of the story are embedded explicit declarations of the economic motives of this project. For example, early in his narrative Markham points out that the real fear of European governments is not for the ultimate survival of the cinchona tree (nor, we might note anachronistically, for the preservation of the biodiversity in Peruvian forests), but for the regular supply of the alkaloid for the use of their troops and administrative staff stationed in tropical climates.

> The danger ... is not in the actual annihilation of the chinchona trees in South America, but lest, with increasing demand, there should be long intervals of time during which the supply would cease, owing to the forests being exhausted, and requiring periods of rest.

While he is explaining the scientific interest in cinchona, he notes that the question of introducing the plant into other countries 'and thus escaping from the entire dependence on the South American forests has long occupied the attention of scientific men of Europe.' The science and the economics of cinchona cultivation were thus obviously intertwined from the very beginning.

Richard Spruce, one of the collectors in Markham's cinchona crew, an eminent botanist who had spent 17 years of his life in the Amazon, put the real issue clearly when he exclaimed 'How often have I regretted that England did not possess the Amazon valley instead of India!' (quoted in Cockburn and Hecht:9).

Markham and the British colonial state were, of course, not the first to recognise the potential commercial and military importance of domesticating the cinchona tree. In the eighteenth century, cinchona's potential had been pointed out by natural historians Charles de la Condamine and Alexander von Humboldt, and in the nineteenth century the French[17] and the Dutch[18] were both attempting to cultivate it. But the political reality of the vested imperial interests in cinchona cultivation did not stop Markham from representing the transplantation project in terms of universal human benefit. He tells us that the efforts of colonial powers to redistribute resources to their economic advantage is only a fulfilling of the logic of civilisation:

> The distribution of valuable products of the vegetable kingdom amongst the nations of the earth – their introduction from countries where they are indigenous into distant lands, with suitable soils and climates – is one of the greatest benefits that civilisation has conferred upon mankind (60).

Moreover, the tree, if wisely conserved, is a resource that lasts forever; thus the transplantation of a tree, and the institutionalisation of the corresponding systems of conservation and management in the colonies, serve as an eternal monument to the benevolence of the colonial state. Markham argues that the redistribution of natural resources, in addition to 'ensur[ing] material increases of comfort and profit,' has effects that 'are more durable that the proudest monuments of engineering skill.' He notes:

> It is by thus adding to the sources of Indian wealth that England will best discharge the immense responsibility she has incurred by the conquest of India, so far as the material interests of that vast empire are concerned. Thus too will she leave behind her by far the most durable monument of the benefits conferred by her rule.

While Markham's own text is generous to the historian in terms of the internal contradictions that allow us to read the discourse of universal progress along with the discourse of economic rationality, other documents of the time make even more explicit connections between cinchona and imperial rule. In 1879 the Superintendent of the Government Central Museum, Madras, Surgeon-Major Bidie, wrote to the Assistant Director of Kew, Thistleton Dyer, about cinchona:

> To England, with her numerous and extensive Colonial possessions, it is simply priceless; and it is not too much to say, that if portions of her tropical empire are upheld by the bayonet, the arm that wields the weapon would be nerveless but for Cinchona bark and its active principles (cited in Brockway 1980).

In Markham's discussion of the applications of cinchona, he notes that in addition to 'the commercial point of view', there are 'motives of humanity' which ought to move coffee planters to plant cinchona for the treatment of their estate employees. Finally, he adds that he also hopes the natives will start cultivating cinchona in their gardens, as they do with coffee. In order of importance, then, he has: 'commerce', or national profit; private enterprise (for Europeans in the tropics); plantation labour (which, if healthier, will work more efficiently, and show higher productivity); and, as a possible incidental spin-off, the adoption of home-grown quinine by natives. The last never happened. The first two did, to a certain extent, although British quinine was never as successful on the international market as Dutch. The cinchona transplantation project succeeded in making quinine available for military and administrative personnel in all the tropical British colonies, but was a failure both as a profit-making cash crop and as a public health measure in India. Yet it was spectacularly successful as a symbol of the benevolence of both science and empire, and as a result of this served to legitimate the influence of the imperial botanical expert in colonial agrarian activity, and to make Kew Gardens the powerful centre of a whole network of colonial botanical gardens by the late nineteenth century.

In the 1878 *Report of the Cinchona Committee*, Colonel Campbell Walker addresses various criticisms of the cinchona project that have been brought up in Parliament, by private investors, and in public discourse. To the demand that

the government process Nilgiri bark locally so as to make available a cheap febrifuge (the alkaloid source from which quinine was extracted) to the native population, Walker responds that 'a procedure of this nature would be of no benefit to the natives of India for whom a cheap febrifuge is so much desiderated,' since they would be denied access to the cheap product anyway, by 'speculators' who would 'buy up the febrifuge and send it home [i.e. England] to manufacturers for the extraction of quinine', selling it there at a profit. Thus, he argues, the product would automatically find its true market price, and the natives would be no better off under this scheme, while the state would be worse off, the speculators having made the profits. He states:

> We do not believe in the ability of any Government to cheapen artificially the production of a commodity of public utility. But in demonstrating that cinchona can be profitably cultivated, the Madras Government has exercised an enormous influence in stimulating production, which in due course will have a decided effect in regulating the supply of bark and reducing the price of alkaloids, not for India only, but for the whole world.

Such an argument assumes that market forces, like scientific knowledge, will 'naturally' benefit all humanity. The easy slide from 'native' to 'India' to 'world' is significant here. The power of the new botanical networks and of the commercial market model both derive from their globality. The local disparities, some pre-existing, some produced by the functioning of these global processes, can be glossed over, or regarded as cancelled out in the universal equation of the advancement of knowledge and profit. If the natives are still dying from malaria, it is not because science and economics have not done their best; it is only a matter of time before the results of global processes penetrate every locality. That the resources for the production of quinine (indigenous peoples' knowledge and land) had come originally from some of these very local contexts could not count since, in such a generalised scheme, all contexts are equivalent, and must follow the laws of the market.

The rhetorics of economic and scientific morality are hard to separate in the narratives both of cinchona's domestication (in India) and of its discovery and rescue (in South America). In the South American context, the cascarillas are described as having access to the material aspects of cinchona bark harvesting but not to the science, and this is supposed to explain their non-conservationist habits.[19] The examples we are given of 'native' use of the tree date from the period of the intensive South American bark trade, beginning in 1820, when European demand for the bark had risen enormously, and private collectors, *cascarilleros*, had entered the forests in large numbers. The depletion of the bark that ensued was halted in 1834 through legislative intervention by the Bolivian government, who tried to establish a regulated system whereby all bark would be picked for the state, which would supervise the international trade. This early attempt at resource conservation was met with outrage by European governments, who protested what Markham refers to as a 'most barbarous legislation'

based on 'a system of protection and monopoly'.

Protectionist economic practices, then, and non-conservationist, unscientific attitudes, were portrayed as alike in their barbarous consequences. In this case, of course, the consequence of both was the same: less cinchona bark, at a higher price, for European nations.

Economic progress was, on the one hand, defined as the establishment of a global free market for natural commodities; however, the means by which the British, French and Dutch acquired Peruvian and Bolivian cinchona seed was not exactly within the provisions of such a market system. What constituted the legitimation for the theft of the cinchona tree from Peru and Bolivia? The fact that each of the expeditions that collected specimens of the tree travelled under the aegis of science, which was a pursuit of knowledge that knew no national boundaries. Once the natural object had been transformed into a commodity, however, it became subject to the laws of the market, and here national interest could be legitimately invoked. Thus the rhetorics of universal scientific benefit and economic self-interest operate side-by-side in Markham's narrative, their separate logics sustaining what appears to us as inconsistency.

Let's look further at how the cinchona mission's benefit is universalised through invoking the 'human race' or colonial subjects as recipients of its bounty. Announcing the success of his mission, Markham reports:

> After much anxiety, extending over a period of three years; after all the hardships, dangers and toils which a search in virgin tropical forests entails; and after more than one disappointment, it is a source of gratification and thankfulness that this great and important measure, fraught with blessings to the *people of India*, and with no less beneficial results to the whole civilised world, should have been finally attended with complete success, in spite of difficulties of no ordinary character.

At the beginning of the book, Markham explains:

> There is probably no drug which is more valuable to *man* than the febrifugal alkaloid which is extracted from the chinchona-trees of South America; and fewer blessings could be conferred on *the human race* than the naturalisation of these trees in India (emphases added).

The use of universals such as 'man' and 'the human race' upon whom the blessings of cinchona shall fall, and the invocation of dangerous tropical adventures undertaken to bring these blessings to them evoke the image of the benevolent scientist toiling in the service of humanity. Noting the successful transplantation of cinchona in the Nilgiris and looking forward to 'similar happy results ... [in] other hill districts of Southern India,' Markham suggests:

> Thus will the successful cultivation of the quinine-yielding chinchona-plants confer a great and lasting benefit upon the people of India, as well as upon the commerce of the whole world ...

Here the imperial scientist/explorer is the agent of civilisation; through him

nature's benefits are conferred upon mankind. The scientist speaks and acts on behalf of nature, and is willing to go to great lengths to defend it against the actions of those less scientifically savvy than himself. Thus we are to understand that the local skirmishes over property rights that mark the initial phase of the cinchona project are fought – although they might contravene the laws of less advanced nations – in the name of all humanity, including the natives of colonised nations, who, although not truly able to know and to nurture nature, are still worthy of receiving the fruits of civilisation. Therefore the natives of India are repeatedly invoked as the potential beneficiaries of the cinchona project. They will enjoy the fruits of scientific labour even while remaining, themselves, ignorant of science. Colonialism, thus, is the agent of science and the spokesman for nature.

Where do the native Andeans fit in this scheme? They were not invoked as beneficiaries of the transplantation (after all, they weren't British colonial subjects); on the contrary, they were the first link in the information-transfer chain. Interestingly, Markham never denies or obscures this position. Neither Markham nor any of the European explorers before him had been in any doubt about the fact that native Peruvians who lived in and around the cinchona tracts 'knew' the medicinal properties of cinchona bark. Furthermore, whenever Markham sought information or guidance, it was from a 'native.' (Needless to say, it was always indigenous guides who also carried his supplies and made his travel possible.) He freely admits this, saying, for example, about the Quechua guide who led him through the Caravaya forests (at considerable danger to himself, as the Bolivian state wished them deported, while Martell's gang had threatened collaborators with violent death):

> I owe much to the intelligent assistance of our guide Martinez, who, to great experience in woodcraft, added a lynx's eye for a Calisaya-plant; and it required no little quickness and penetration to distinguish these treasures, amidst the close entanglement of the undergrowth, in the dense forests. Martinez spoke Spanish very imperfectly, and, without a knowledge of Quicha [sic], I should have found much difficulty in conversing with him; but he had a most complete and thorough knowledge of all forest lore, and was acquainted with the native name of almost every plant, and with the uses to which they were or might be applied (p.250).

Martinez is a good guide because he has empirical knowledge of his surroundings. The 'Native' knows 'Nature.' However, the native is also represented as very close to nature – too close for objective knowledge; too close for knowledge that is abstractable from the thick tangle of information about places and things that it comes embedded in. The indigenous medical system in which *quinaquina* bark had its place was one based on degrees of 'hot' and 'cold' qualities possessed by illnesses and their cures, and by foods, oils, and so on. This system of ordering integrated humans, their daily food habits, and their illnesses with the natural world; moreover, it drew conclusions about essential characteristics of substances based on some unmeasurable qualities, rather than by 'objective'

standards, such as would be met by a description of observable surfaces or by chemical analysis.

Michel Foucault in his reading of natural history suggests that its scientificity lay in the fact of its classificatory system or language, which provided a unifying structure for the multiplicity of facts about the natural world.

> Natural history can be a well-constructed language only if the amount of play in it is enclosed : if its descriptive exactitude makes every proposition into an invariable pattern of reality ... and if the *designation* of each being indicates clearly the place it occupies in the general *arrangement* of the whole (p.159).

Natural history, then, was a formalised language that enabled scientific knowledge to be produced. The structure and continuity assumed to be inherent in nature now had to be revealed by the objective description of visible surfaces – descriptions that were clear, finite, almost mathematical in their representations of identities and differences between natural entities, for it was only through being placed in a scientific order that these entities could truly be 'known.' Explaining the significance of designating places within this system, Foucault notes:

> [A]ll designation must be accomplished by means of a certain relation to all other possible designations. To know what properly appertains to one individual is to have before one the classification – or the possibility of classifying – all others. . . An animal or a plant is not what is indicated – or betrayed – by the stigma that is to be found imprinted upon it; it is what the others are not; it exists in itself only in so far as it is bounded by what is distinguishable from it. (p.144)

It was necessary, therefore, to know the entire classificatory system before one could claim true scientific knowledge of a particular tree or herb. Moreover, the language of taxonomy ensured that no extraneous, 'subjective' information could creep into a scientific description of nature. This further distinguished it from spontaneous and non-scientific language which 'leave[s] interstices open' between scientific propositions and designations, which then might be inhabited by 'individual experiences, needs or passions, habits, prejudices ...' (p.158). The intrusion of the knower's position and history into the realm of knowledge would corrupt it; scientific language had to be kept pure of cultural contamination. If the 'play' of language was restricted – that is, if the flexibility of everyday language and the variability in everyday experience could be curtailed – one could have the accuracy of exact description; one could then *see* without error.

While colonial scientists would not deny that the 'natives' could *see* natural entities, they suggested that they saw them not as continuous elements of an overall order, but as entities invested with cultural (material and mythical) meanings. Thus this knowledge, while often empirically accurate in some ways, would not be considered error-free, as it was irreducibly social.

One of the main differences between indigenous knowledge and a science framed by the language of natural history was the position of the observer/

knower with respect to the object of knowledge (nature, or the natural world).[20] The human observer, according to the ideal of natural history, ought to be invisible or irrelevant: any educated scientific reader, in any part of the globe, would by definition 'know' a plant once provided with the precise description of its features and its position in the taxonomic grid. Local knowledge, on the other hand, is by definition impossible without the experience of living with and in the natural system concerned. Thus for an indigenous Peruvian to 'know,' say, the woodlands in France would be inconceivable within this system. This distinction between local and global knowledge about nature helps us avoid the assumption that 'native' or 'indigenous' people are somehow inherently eco-friendly, as it reminds us that knowledge (local or global) is inextricably bound up with specific practices.

Cross-contextual knowledge became possible only in conjunction with the transnational flow of men and money; along with colonialism emerged an international exchange economy in which knowledge and capital could move rapidly together across the globe in the service of increasingly efficient production.

The power of the scientist lay in his supposed ability to transcend the specificity of place and time and to fashion a knowledge that posited itself as universal. The force of such a claim depends in large part on its being taken as transhistorically true. The scientist then appears both omnipotent and dispassionate, being detached from all constraints of politics and history. The scientist's supposed transcendence of the constraints of place and history are in direct contrast with the representation of the 'native' as rooted in a specific geographic and social location. However, as I have suggested in this paper, the representation of scientific knowledge as transcending place and time was a move that always served to obscure the very specific 'rootedness' of this knowledge in a particular political economy and set of cultural practices.

By demonstrating that behind every claim of scientific universality there lie socio-political enabling conditions that are rendered invisible by a language of precision and context-independence, we can begin to understand the structures that underpin this asymmetry between indigenous and colonial, or local and global knowledge. Both 'native' and 'imperial' knowledge derive their force from the specifics of place (geography) and time (history) *through* which their level of efficacy emerges. To assert this is not to claim that 'native' and 'imperial' knowledges were equivalent, or equally powerful. Imperial knowledge clearly had greater instrumental efficacy : it straddled several contexts, and crossed (dramatically, in this case) national boundaries; it 'did' things in 'the world' and it had historical effects that indigenous knowledge never did.

But this was precisely because imperial scientific knowledge was undergirded by objective structures of power: economic and political networks that literally spanned continents, so that it was possible for enormous material resources and skills to be deployed by European nations in order to extract information and natural resources from another continent and transport it back, and transform it

into a further resource for the building of imperial political and economic power. In other words, the claim to universality was not merely a rhetorical move made by imperial knowledge. Systems of knowledge cannot be understood solely as rhetorical constructions, but must be understood within the economic and political system that forms the frame for their conditions of production. It seems to me, then, that we might profit by adding the analysis of the political economy of science to our definition of the nature of science studies.

NOTES

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[1] Quoted in Hecht and Cockburn 1990.
[2] Page numbers in this section refer to Markham, Clements, *Travels in Peru and India* (London:1862)
[3] Markham says of him, 'M. Hasskarl deserves the greatest credit for the zeal and determination displayed by him in his journeys, during which he was surrounded by no ordinary amount of difficulties and dangers. He certainly proved himself to be a most indefatigable and courageous traveller.' (51)
[4] The sun and the volcanic soil, however, did not prove conducive to the plant, and Markham reports the experiment as 'languishing' by 1855. However, Richard Drayton has recently noted that despite Markham's much fêted project, the Dutch were ultimately far more successful than the British in manufacturing quinine for the world market. Drayton traces this to the fact that Markham ignored an immensely productive species of cinchona, *C. Ledgeriana*, named after Charles Ledger, an even more colourful explorer and adventurer than Markham. Ledger, after being turned down by the British, sold his seed to the Dutch in 1865, and by the 1880s Dutch quinine from Java had practically driven British quinine out of the world market (Drayton 1993).
[5] See also Sismondo 1993, in *Social Studies of Science*.
[6] *Grundrisse*; quoted in Hecht and Cockburn 1990: 38.
[7] See, for example, N. Viswanathan Nair, *Tribal Health and Medicine in Kerala: A Study in Interrelationship between Habitat, Health, Medicine, Society and Culture.* Calicut University unpub. diss. 1985. Charles Taylor's definition of a minimal rationality is useful here.
[8] As, for instance, in works such as Sandra Harding's *Whose Science? Whose Knowledge?* and Londa Schiebinger's *The Mind Has No Sex.*
[9] J.D. Hooker was the son of William J. Hooker, first official Director of Kew (from 1841-1855). J.D. was assistant director of Kew from 1855-1865, and served as Director from 1865 until 1885, when his son-in-law Thistleton-Dyer took over.
[10] This if course raises interesting problems for Foucault's periodisation (Natural History dies in 1800; 'Biology,' a fundamentally different, 'modern' science, is born) in *The Order of Things.* However a discussion of this would take me too far afield; in this work Foucault is rather fast and loose with his generalisations and overly structural-functionalist in his theoretical framework, although some of his detailed analyses of the individual 'human sciences' are very insightful.

[11] The following sketch of Kew's history is from Brockway 1979. Page numbers refer to this book.
[12] The following account of institutionalised geography is from Clements Markham's 1881 history of the Royal Geographical Society. Page numbers refer to this book.
[13] During his tenure the Rosetta stone and the Elgin marbles were acquired by the RGS for the British Museum
[14] Markham also explains that the person to whom 'millions ... are indebted for the priceless febrifuge to which they owe their lives', is the 'benefactor of mankind ... the illustrious and once beloved Ana de Osorio, fourth Countess of Chinchon'. It was not contested that natives might have been cured by cinchona bark for years; however, it was the treatment of an eminent Spanish noblewoman that was the first significant cure for the science of botany; the cure was commemorated in 1742 by Linnaeus, 'who was the first botanist who described the new genus', naming it Cinchona 'with the intention of thus immortalising the great and beneficent acts of the Countess of Chinchon'.
[15] This is not, of course, to say that non-Europeans could never contribute to colonial science. Markham gives several examples of native assistants who produced botanical knowledge, once having been introduced to the professional methods of observation and recording.
[16] Recall Merchant's characterisation of scientists as putting nature on a torture rack to extract her secrets. It is interesting that Markham represents the 'natives' as doing something similarly violent to nature; colonial scientists are represented as nature's saviours.
[17] Markham describes the French botanist Weddell as an 'able botanist and intrepid explorer [to whom] science is indebted to no small extent.' His first 'cinchona trip' to Peru was in 1845, and his 1849 *Histoire Naturelle des Quinquinas* was 'the most important work that has yet appeared on the subject,' according to Markham in 1862. The French were attempting to cultivate cinchona at the Jardin des Plantes in Paris.
[18] The Dutch botanist Hasskarl led an expedition to Peru in 1852. The Dutch had extensive experimental cinchona plantations in Java, but the weather did not prove hospitable to the varieties of cinchona they initially experimented with. It was only more than a decade after their inception, with saplings bought and transplanted from Kew, that the plantations became a thriving operation. See note 4 above.
[19] However, as Brockway points out, the coppicing technique adopted in the Nilgiri plantations was 'consistent with the native Andean harvesting practice' (119).
[20] 'Man' was believed to be at the centre of non-scientific systems of knowledge, while the presence of 'man' was abjured in scientific systems. See Burkill's discussion, earlier in this paper.

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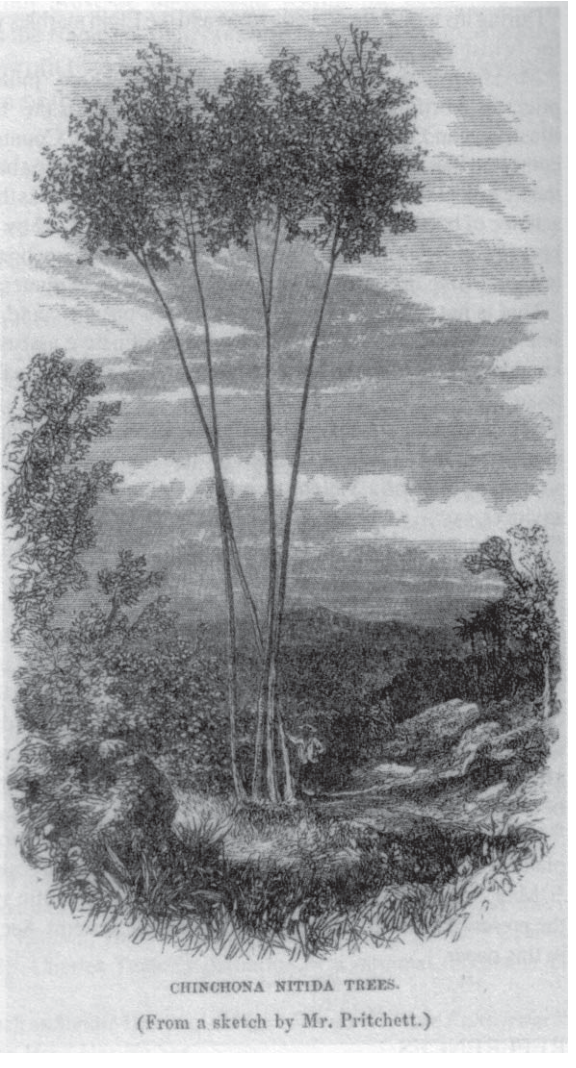

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