From Biopiracy to Bioprospecting: An Historical Sociology of the Search for Biological Resources.

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The love and support of my wife, Claire, has been deep and constant.
I dedicate this work to her.

DECLARATION.

This thesis is exclusively my own work.

This thesis has not been submitted to any other university.

Abstract.

With the 1992 United Nations Convention on Biological Diversity humanity's ongoing search for biological resources became subject to global regulation. The collection of biological materials for use in agriculture and medicine by one nation from another became conditional on criteria of informed consent, benefit-sharing, and the preservation of environments. This practice has become known as bioprospecting. Collections of biological materials and/or of "traditional" knowledge of how to utilize them which did not meet the Convention's requirements henceforth became known as biopiracy. The thesis takes its structure from the Convention, which is treated as marking a shift from historical biopiracy to contemporary bioprospecting..

The thesis is that critics of the Convention who oppose it and the forms of bioprospecting which it mandates in terms of neo-colonialism and neo-imperialism have misunderstood the character of contemporary economic and political power. The thesis argues that although contemporary bioprospecting is not practiced, as the Convention requires it to be, in ways that are "fair and equitable", it cannot be understood as a neo-imperialist practice. Instead, the thesis concludes that the Convention should be understood in the context of new forms of governance and sovereignty. The Convention facilitates planet management and supports the exercise of biopower.

Several cases studies of imperialist biopiracy are presented and their social impacts are discussed in contrast to contemporary bioprospecting. A broad range of historical and sociological literature is brought together for the first time.

The history of the transition from biopiracy to bioprospecting is described and discussed in terms of several social, epistemological/technological, scientific, political and economic changes, respectively: the transition from imperialism to globalization, a shift away from exploitation of "nature" toward management of "biodiversity", the transition from natural history to ecological science, the appearance of environmentalist concerns in national and global politics, the completion of the globalization of capitalist property relations and the demise of the notion of biological resources as the "common heritage of humankind".

Preface.

This study of the search for biological resources is concerned with humanity's historic and ongoing search for useful and potentially valuable biological resources. The research presented here is on humanity's exploration of the living environment in its social, ecological, geopolitical and biopolitical contexts.

People have often travelled long distances, often putting themselves in considerable physical danger in the course of the search for potentially valuable forms of life (an activity which only came to be known as bioprospecting in the early 1990s). Sometimes their search has resulted in death, sometimes in considerable wealth and fame. Sometimes their collections have been of precisely zero consequence, sometimes their collections have changed the lives of literally millions of people (arguably, of the entire global population). Some people have travelled around the world and failed to find what they were looking for; others have quite accidentally stumbled across valuable biological resources. Sometimes the collectors themselves have had the results of their life-long labours exploited by others, sometimes they have exploited others, quite consciously, in the course of their work. The collectors of some of the contemporary world's most valued and significant plants are unknown, anonymous and invisible to history while some of the world's most famous and best-remembered collectors actually made little significant social impact. With very few exceptions the collectors of the most significant plants (or, more accurately those recognised in the scientific/historical record as the collectors) have been male and of European descent.

Every student of sociology knows that as individuals our identity is constituted partly by our self-perception and partly by the way we are perceived by others. There is often considerable disparity between our self-perception and others' perception of us. This is especially true of bioprospectors, who are often perceived by others as *biopirates*. There are many ways in which we as individuals can describe ourselves but often our profession or working life figures prominently in our self-understanding. In turn, there are many ways in which every individual can describe their work. This also is especially true of bioprospectors. If we could bring back to life the explorers of the living environment – the bioprospectors – of the last five hundred or so years and interrupt them in course of their work – chopping off flowers, fruits, branches, fungi, travelling through forests, deserts, mountains or swamps with their eyes fixed down on the ground or up into the trees, wildly waving a butterfly net, casting a fishing rod, setting a trap, shooting at an elusive bird, asking the locals (perhaps in improvised sign language) about the living things they used in their everyday lives – and pose to them the sociologists' question, "What are you doing?" their replies would depend on the historical moment which we have hypothetically resurrected them from. Their various responses would *not* include "I'm bioprospecting" but they would be one of many historical equivalents. These would include "I'm looking for spices", "I'm exploring" or "I'm surveying", (the particularly loyal or patriotic might specify "for my King/Emperor/Lord" or "for Britain/France/Spain"), "I'm studying the Glory of God's Creation!", "I'm doing natural history", "I'm herborizing", "I'm botanizing", "I'm looking for new crops", "I'm looking for new medicines", "I'm looking for sources of dye/timber/rubber", "I'm looking for new types of fruits and vegetables", "I'm looking for tulips/orchids/ rhododendrons", "I'm looking for beetles/butterflies/frogs/birds", "I'm doing botany/ horticulture/entomology/ornithology/zoology/ecology".

However, it is likely that a great many of my interviewees would, with a shifty, guilt-ridden expression, refuse to answer the question, having been sworn to secrecy by their Royal, aristocratic, commercial or scientific patrons. Others, if their truths be told, would be afraid of being prevented from continuing their work, of being kidnapped, or even, and with some justification, of being murdered on the spot. The quick-witted among them would simply lie. A high proportion of those who had responded "I'm doing natural history" or by naming their particular branch of the natural sciences would in fact be lying or telling only half of the truth. In short, the sociologist of bioprospecting would be unable to trust the answers of his historical interviewees; a great many of them would be concerned to avoid the charge that they were engaged in biopiracy and that they themselves were biopirates.

Only rarely have collectors of biological specimens had no economic or political motivation. Only rarely would bioprospectors in the age of imperialism have felt safe and secure in honestly revealing the purpose of their work to a stranger posing questions. The sociologist and/or historian of bioprospecting, perhaps more than in other areas of research, must be unwilling to accept their subjects' self-understanding or self-definition.

The interpretative problems that confront all historical researchers – those caused by the basic course of economic-social-political changes – are perhaps especially acute for historians of "science", for several reasons (including, but not exclusively); because their subjects were often working before their various activities, researches and projects were unified as "science", because the unity of their work as one activity or institution that can be called "science" is now in doubt, because anything approaching "pure" science has only existed in, at best, very historically specific moments (and even then, such "pure" work has very quickly been put to one economic/social/ political use by others), and at worse, only in the imaginations of scientists and their various apologists.

The historical or contemporary "scientist" who would respond or does respond to the question "What are you doing?" with the answer "I'm doing science" is saying almost nothing of sociological interest beyond revealing that his or her own self-understanding is absurdly narrow, innocuous and modest relative to what any individual with the remotest interest in contemporary social, political or economic issues would say they were doing. Having said this, one of the sub-arguments of this thesis is that, over time, and especially since the second world war, "scientists" have been increasingly willing to acknowledge the extra-scientific motivations for, and consequences of, their work. There are though many who would still insist that their primary motivation is the pursuit of truth, facts and the advancement of knowledge.

As well as these three general problems confronting the historian of science there are added those specifically confronting the historian of bioprospecting. The first is that almost everyone who takes or has taken biological specimens from one location and moved them to another will be at risk of upsetting somebody. This is the issue of, in political terms access, and in economic terms, ownership. Put simply, for each and every individual who describes their work as what we would now refer to as "bioprospecting" there is another who will have some justification for describing that same work as "biopiracy" (or something synonymous), either on the grounds that the bioprospector has violated some geographical/national/political boundary or that they have violated property rights, and usually both. The second, and closely related, problem is that in many cases, those making the charge of "biopiracy" are not the same people said to have been the victim of injustice. There can be great distances between the removal of a biological specimen and the charges of trespass and/or theft; distances either of time or space, and usually both. The accusations are usually made by someone with a strong sense of affiliation or mutual interest or direct lineage with those said to be at the wrong end of the injustice, but sometimes these links are tenuous. The converse is also true, once a charge of biopiracy has been made, whether it be an historical or contemporary transfer of biological matter that is in question, there will be others with an interest in glossing said act as nowhere near as unjust, alarming or significant as the prosecuting party would like to claim, those who wish to damp down the flames of the controversy, and those who will concede that although the original act was unfair or outright wrong the benefits accrued from it are more than sufficient to render the act one of beneficial bioprospecting rather than socially damaging biopiracy (the consequentialist argument).

The response "I am doing science" or any historical equivalent of the contemporary "I am bioprospecting" would be *partly* truthful. However, alongside this role, bioprospectors have historically played one or several of a number of other roles. Those making what amount to charges of biopiracy can and do gain considerable legitimacy by pointing this out. Without yet getting into the specifics of biographies, anecdotes, examples and cases studies we can present the following lists. First, of the roles that historical bioprospectors have been playing either alternately, concurrently, simultaneously with their collecting work, or earlier or later in their lives and careers; ship's captain, ship's surgeon or surgeon's assistant, botanical illustrator, geologist, or surveyor. There have been merchants (of various imperialist nations' Company's), missionaries (of various denominations) who bioprospected, several high-ranking colonial officials (including more than one Governor-General of India), countless minor bureaucrats and colonial administrators of middle rank practiced botanical exploration, survey and collection, plantation- and slave-owners and surgeons/doctors on plantations have been active botanists, heads of colonial botanical gardens and their assistants and staff, have, it could go without saying, been important to the history of bioprospecting, but so have the less-well recognised multitude of lone adventure-seeking individuals, who, with no particular institutional affiliation, and thus less visible in the historical record, simply upped and left Europe, following behind their country's imperial professionals in search of any treasures they could lay their hands on (often metallic or antique but also botanic). In short, historians and other critics have shown bioprospectors to have effectively played, perhaps un- or only sub-consciously, the roles of imperialist, colonialist, expansionist, "advance guard of empire", spy, thief, and many equivalents.

The seemingly innocuous act of collecting plants, both in the past and in the present, is today understood in the contexts of the project of social improvement, of the "civilizing mission", the conquest of nature, of the turning of the world into a plantation and of a global enclosure of the commons. Bioprospecting is generally seen by critics in the context of imperialism, exploitation and theft. The figure of the pirate has been an attractive one for this reason.

All of this is to say that the historian and/or sociologist of bioprospecting/ biopiracy, in the course of describing the lives and work of his subjects, the related (scientific and extra-scientific) events, institutions, ideological, material and social changes related to that work and in the course of drawing conclusions about their contemporary significance (or as the case may be, insignificance) has to face interpretative and normative problems different to and beyond those of both the sociologist/historian of the sciences more broadly and of the student of more traditional sociological topics. My broad argument involves a moral judgement. It is my central conclusion and guiding thread that the sum total of the acts which make up the history of the search for biological resources should be seen as one of transition *from biopiracy to bioprospecting.*

More broadly, I argue that this transition runs parallel with and must be understood in the context of several other historical transitions, including transitions

a) from imperialism to globalization (or, as I will re-define the latter throughout, in terms derived from the work of Antonio Negri and Michael Hardt, from a society dominated by an imperialist form of sovereignty founded on and sustained by military power to one dominated by an emperial (with an "e") form of sovereignty founded on and sustained by biopower);

b) from a context in which there was little or no possibility of effective acts of resistance to, or claims of compensation for, biopiracy, to institutionalized "benefit-sharing" of the proceeds of bioprospecting;

c) from a society in which all biological matter was treated as "the common heritage of humankind" and there for the taking, to one in which all biological matter is treated as potentially a valuable resource and as a commodity;

d) from a context where there were seemingly limitless economically valuable botanical discoveries to be made to one in which all such enormously valuable bioresources have seemingly been identified and fully exploited; in crude terms, all that is left for bioprospectors in the globalized world is the crumbs that fell off the table of the imperialist one;

e) from a context where the natural environment appeared to be an immovable object, undamageable, both *eternal* and *external* and generally beyond the impact of human activity to a context where the natural environment is widely believed to be, and is treated as, susceptible and unpredictably responsive to human activity, fragile, finite and *internal* to human society,

f) in parallel to and in consequence of the latter, from a world in which Man lived and worked against Nature to a world in which the very category "nature", in the sense of "all that is non-human or non-social", is defunct;

g) from a world in which biological matter was treated as so many isolated, fixed examples of God's creativity, to be re-united and compiled in natural-history cabinets, botanic gardens, museums and encyclopaedic *Flora*, to one in which species could be improved for purposes of exploitation and ultimately to one in which biological diversity can be (if it can be "saved before it's too late") effectively treated as information and accordingly be managed, manipulated, and reconstructed;

h) from a scientific world concerned with collecting, surveying and exploiting to one concerned with managing the entire "natural" world as a single interacting system in such ways as to both maximise the economic value of non-human life whilst simultaneously minimizing human impact on its/our long-term survival (organized around the expansive and deeply controversial notion of the ecosystem);

i) from a world where bioprospecting work epitomized heroism, requiring years of hardship, self-sacrifice and physical risk to one where bioprospecting is no more difficult or risky than taking a summer holiday; in short, the physical act of bioprospecting has been radically altered by medical, transport and communication technologies. Similarly, it is considerably less financially costly; the strongest barriers to the procuring of biological resources are today social and (geo-)political rather than physical, material and financial.

j) There has been transition, in some ways a reversal, of the motivations of individual bioprospectors, and also in the rewards received for their labours (this trend is the inverse of the previous one). Historical bioprospectors often became wealthy, famous and decorated in reward of their efforts. These rewards undoubtedly served as motivating forces for subsequent botanists; today's bioprospectors are no wealthier than the average scientist and largely anonymous outside of their professional circle.

k) Finally, there has been an extension of what we could call the "bioprospecting chain of command" such that whereas in the past the bioprospector – often from an aristocratic or upper-class background, often self-funded or working "freelance" in the knowledge and reasonable expectation that there would be a market for the specimens collected – was in the position, to use crude terms, of "exploiter" – hiring for a pittance local labour not only to guide, hunt or carry but also to engage in the actual physical collection of specimens which then became the collectors' property. Today the bioprospector is waged, has no personal claim to ownership of the collected goods, and is arguably in the position of "exploited". This is especially so in recent decades in which pharmaceutical and/or agricultural corporations are the primary source of bioprospecting funding, and in which the results of collecting work are protected by patent. Bioprospectors in the past were invariably loyal to the Royal or at least highly prestigious organizations that funded them, today's bioprospectors are often critical of the rules and laws under which they work, and of the over-commercialization of medical and agricultural science.

Chapter 1. Introduction: the Convention on Biological Diversity as a Convention Against Biopiracy.

Chapter 1 will introduce my thesis by detailing the pre-history of the United Nations Convention on Biological Diversity of 1992 and arguing that the document can and should be interpreted as a Convention Against Biopiracy (the document is hereafter referred to variously as "the Convention", "the CBD" and "the CBD/ CAB"). My thesis uses the Convention as a benchmark by which to judge the difference between bioprospecting and biopiracy. Chapter 1 describes how the Convention exactly echoes three arguments made by bioprospecting scientists. These are, first, that biological resources need to be more systematically collected, studied and put to use, second, that traditional or pre-scientific knowledge of biological resources can and should be sought to assist in this program, and, third, that the need for such collecting grows increasingly urgent as environments and traditional cultures are put under the strains of urbanization and industrialization. The Chapter describes the emergence of the terms "bioprospecting" and "biopiracy" in the context of the environmentalist movement. It begins by describing how environmentalist politics and the ecological sciences have not always been as closely associated as they are today.

Ecological science, the search for new biological resources and environmentalist politics have not always been as closely associated as they are today. As I elaborate further below (in Chapter 9), the British and South African founders and leading pre-war figures in the "new science" of ecology did have concerns about man's impact on the environment (both in the colonies and in Britain). However, this came more from frustration at the difficulty of finding a "pure", "natural" environment (or as they were already saying "ecosystem") whose food chains they could set about describing than from any real conviction that human activity was likely to result in the total destruction of those ecosystems. So long as the early British ecologists could (with the University of Oxford Explorations Society –one part cutting-edge scientific mission, one part high-brow drinking club) travel to the arctic circle or their South African counterparts could motor off (on their "botanic bus") into relatively isolated grasslands the problem of anthropogenic species loss remained a source of methodological rather than political concern. Early ecologists actually looked with some relish at "disturbed" environments such as over-fished lakes or veldts recovering from tribal people's fires; the more of these there were, the more research and funding opportunities there would be for their work of re-stocking, restoring and reengineering what was still (somewhat stubbornly given the humanization of environments which I describe in Chapter 8) seen by most pre-war ecologists as "nature" (Anker, 2001).

In the decades after the war ecologists found themselves more richly rewarded for actually killing animals than for collecting or inventorying or saving them (Dunlap: 1999: 258-261). In Australia, after the failure of the continent-wide "Rabbit Fence", ecologists were called in to reduce the enormous rabbit population which had multiplied from the few animals introduced by early colonists, a task which, with the introduction of the myxomatosis virus they succeeded in doing. In New Zealand the ecologists' drastic solution to the stripping bare of forests by another introduced animal – the deer – was the deployment of helicopter gun ships – the 'mechanized equivalent of the Great Plains buffalo slaughter' (258). In its embryonic decades ecological thought and practice was not closely associated with environmentalist politics or practice.

Also in contrast to the contemporary situation, ecology in its early years was not heavily involved in the collection of biological resources. Early ecologists sought to distinguish themselves from the nineteenth century botanical collectors and to position their science not just above the other biological sciences, but as above the social sciences in the hierarchy of knowledge too. In this context bioprospecting was reduced to something of a menial task, sometimes necessary but generally seen as regressive.

Ecological thought, practice and institutions were relatively slow to develop in the United States, at least partly because, as several historians have pointed out, the North American wilderness continued to exist both materially and discursively until the turn of the twentieth century (albeit minus enormous numbers of wolves and buffalo) and, to a lesser extent, into the between-wars years in which ecological thought was gaining institutional momentum in Britain and its colonies. Here, the environment had long since been radically altered by human society and there was much less land deserving of the romantic name "wilderness" (Worster, 1985; Allen, 1994: Thomas, 1983; Dunlap, 1999). However, American concern over the depletion of "genetic resources" was certainly not absent in this period, in fact it was to be expressed in strong terms in U.S. government literature as early as 1936. Such concern was found first among agriculturalists, not ecologists.

The U.S. government had, in the first decades of the twentieth century, been continually funding bioprospecting for agricultural plants – wheat, barley, rice, and so on – in their indigenous locations for use in their highly active crop-breeding programs.[1] It was scientists on these projects who (literally) brought home the message that if such collecting activities were not intensified and conducted more systematically many potentially valuable, but relatively rare, wild species and ancient crop varieties would be "lost forever". This was the explicit argument, now-familiar to the point of truism, but at the time quite original, of a 1936 U.S. Department of Agriculture report; '"surviving variations"' of agricultural crop plants '"constitute the world's priceless reservoir of germ plasm... Unfortunately, from the breeders' standpoint, it is now being imperilled. When new barleys replace those grown by the farmers of Ethiopia or Tibet, the world will have lost something irreplaceable"' (Harlan and Martini, 1936, cited in Harlan, 1975: 619).

While the U.S. Department of Agriculture was already convinced of the accuracy of the 1936 report's arguments, 'No one' at the international level 'paid much attention to the prophetic warning of Harlan and Martini' until 'Cries of alarm began to be sounded on the international scene about 15 years ago', that is, in the early 1960s (619). Previously, even though "genetic erosion" – the increasing narrowing of the range of crop varieties grown on a large scale – had been 'under way for some decades' and was 'already well advanced' in the industrializing nations before WWII – thereby increasing the risk of epidemics of crop disease – the general belief in the U.S. and internationally was that 'ancient reservoirs of germ plasm were still there in the more remote parts of the world and seemed to most people as inexhaustible as the oil in Arabia'. Accordingly, beyond a few specialists in the fields of collecting and breeding new crop varieties the view was that 'we could always send [out] collectors... [to] assemble all the diversity we could use' (Harlan, 1975: 619).

The publication of Rachel Carson's *Silent Spring* in the early 1960s – which presented evidence showing the detrimental impact of industrial pollution on wildlife and habitats – is often seen, somewhat un-sociologically, as having caused an upswell of enthusiasm for ecological theory and environmentalist politics, in North America, Europe and Australasia. Whether or not we prefer to view this instead as symptomatic of an already-underway "greening" of politics among the post-war middle classes of the developed world it is clear that the 1960s and 1970s were indeed the years in which a) ecologists and agriculturalists, b) projects for the collecting and "banking" of biological resources and c) more-or-less urgent calls for action against their perceived-or-real loss to the effects of global industrialization began to be mutually associated. The specific terms "biodiversity loss", "bioprospecting" or "biopiracy" did not yet exist in political discourse and legislation but they were soon to have institutions expressly concerned with them; institutions at national and international levels for, respectively, preventing, conducting, and avoiding the charge of.

The torturously slow development of international institutions concerned with (the conservation of wildlife and) the preservation of biological resources was conveniently summarized by Harlan in an often-cited article typical of the growing sense of environmentalist urgency among biological scientists (1975). Fourteen years after the issue of 'plant exploration and introduction' was first discussed within the United Nations Food and Agriculture Organization (FAO) Harlan reported that 'remarkably little collecting has been done to date' and only 'a few collecting expeditions' had been funded. Although he expressed confidence that 'The next few years... should show an increase in plant exploration [and that f]unds should be available... to support adequate exploration programs', he claimed that 'For some regions it will probably be too late to salvage much' and argued that 'the urgency of the situation demands much more vigorous action than has been generated so far' (619). The situation at the time was indeed dismal, if we take it for granted that genetic erosion, biodiversity loss, species extinction and so on are really occurring as rapidly as bioprospectors, environmentalists and world leaders would have us believe and that the issue and necessary work is as urgent as its scientist proponents (then and now) insist.[2]

Proposals for, first, a single, 'Crop Research and Introduction Centre', in Turkey, and then multiple, 'Genetic Resource Centres' were made, approved, and instituted in the years between 1962 and 1974. But the structure for their directing and funding reads like something out of Kafka and signals a marked lack of conviction within the United Nations. The Centres were funded by The Consultative Group on International Agricultural Research (CGIAR), which received its funding via the 'joint sponsorship of the World Bank, FAO, and U.N. Development Program (UNDP)', to this was later added the sponsorship of a 'Technical Advisory Committee' (TAC) and the International Biological Program (IBP).[3] After the 1972 U.N. Stockholm Conference on the Human Environment had 'called for action on genetic resources conservation' at the global scale – a call that took a full twenty years to be formalized in the 1992 Convention – another body, 'The International Board for Plant Genetic Resources (IBPGR) was established' as a sub-division of the CGIAR. Despite all this bureaucratic attention the Turkish Centre – which had at least managed to do 'some collecting' and had 'excellent cold-storage facilities' – was able to continue its work – after being 'plagued with political, financial, administrative and personnel problems from the start' – only after the Swedish government (of all things!) in 1974 'agreed to support' it 'for a time', and the 'genetic resources centres in Ethiopia and Costa Rica' were no doubt relieved to hear in the same year that ' the Federal Republic of Germany [had] agreed to support' them! It is clear that these agriculturally motivated centres were lucky in the 1960s and 1970s to receive even this much interest and support; with 'respect to forest genetic resources' the 'parallel developments' amounted merely to the publication of 'newsletters' (not reports or journals but newsletters) detailing the discussions of 'technical conferences and meetings of experts' (Harlan, 1975: 619).

Some developing nations – Mexico, the Philippines, Peru – however, have been cognisant of the potential value to their agricultural and economic development of collecting and "banking" seeds of their regionally significant crops – maize, rice, potatoes respectively – and, more or less directly following the examples of the U.S., Japan, Australia and the leading European nation's – found the necessary resources to invest in government and non-governmental agricultural institutions for this purpose.* Although they are "International" centres for the storage of genetic resources and share seeds with other nations each was founded at the national level and retrospectively received partial CGIAR funding. Such funding in the late 1960s and 1970s was given with the intention of contributing to economic development, not primarily to conservation. Harlan's review describes the state of these collection as at best 'adequate' but urges much more concerted, systematic collection efforts, improvements in storage methods, and significantly increased financial assistance from international institutions.

The situation was similar, perhaps slightly worse, in the major industrialized nations, the U.S., the (then-) U.S.S.R, China, and Japan. Harlan describes significant loss of specimens to poor storage methods (in the U.S.S.R) and long-term freezes to the budget of the U.S. National Seed Storage Laboratory – which he refers to as 'stepchild treatment'. In China, the most naturally well-endowed nation in terms of wild and ancient crop varieties, the situation was 'discouraging'; agricultural scientists were said to be 'not collection minded' – in the 1970s rapid modernization there took priority and 'little effort [was] being made to conserve land races as they are replaced by modern varieties' (621). Japan, who, like the U.S. was sending out regular expeditions for the collection of specimens and seed, and Europe, with multiple 'major' 'genetic resources centres' were said to be leading the way, but at this time, in all countries, the main purposes of these institutions and collections was economic development and not environmentalist preservation;

> 'The necessity for genetic conservation is gradually being accepted throughout the world, but the urgency of salvage collection operations has yet to be generally appreciated... [although] tentative, unsystematic attempts have been taken to conserve much of it [the range of crop diversity] on a long-term basis. In the face of the current genetic "wipe out" of centres of diversity, it may be too little too late. We continue to act as if we could always replenish our supplies of genetic diversity. Such is not the case. The time is approaching, and may not be far off, when essentially all the genetic resources of our major crops will be found either in the crops [already] being grown in the field or in our gene banks. This will be a risky state of affairs' (621).

The above has then, a) briefly outlined how it was not ecologists who lead the way in projects to collect and conserve living biological resources; b) covered the "cries of alarm" coming from scientists working in agriculture, as early as the 1930s in the U.S. but not until the 1960s and 1970s at international level; c) presented a brief history and review of the state of (what would become known as) agricultural bioprospecting and the conservation of agricultural plant resources, up to the 1970s; d) shown that what progress there was in this area at international and national level was initially for primarily economic or "developmentalist" reasons and only toward the very end of the period for conservationist reasons.

Below I e) briefly show how the environmentalist cause gained in the 1970s the support of scientists working in the newly invigorated fields of ethnobotany, ethnopharmacology and pharmacognosy f) describe how in the 1980s the medically oriented institutions and corporations funding this and other fields involved in the search for new botanical resources also became, at least on the face of it, "save the environment" advocates g) outline the range of actors that began to at least attempt some serious action in this respect h) detail the emergence of the terms "biodiversity" and "bioprospecting", and i) present the most significant clauses of the 1992 CBD and put them in the context of all of the above.

Similar arguments as those made by Harlan for the urgent need to collect and conserve agriculturally useful crop species were also being made in the 1970s for the urgency of the need to collect and conserve *medicinally* useful plant species. The most high-profile proponent of this cause was Professor Richard Evans Schultes. Schultes was the leading expert in a range of economic plants, was editor for seventeen years of the major journal *Economic Botany*, and was by far the most influential figure in the "bioprospecting science" of ethnobotany.[5] Many of the students who he trained in the ethnobotanical method – Mark Plotkin, Michael Balick, Stephen King, Darrell Posey, Paul Cox– have gone on to become active in the field and have been involved in some of the most controversial projects to put to economic use the "traditional" knowledge of "indigenous" Amazonian peoples.[6] They have also gone on to become architects of the "benefit sharing" model of contemporary bioprospecting projects, their conservationist and developmentalist aims, and are some of the most vocal advocates of the CBD/CAB (although they are not all entirely uncritical of the latter and its consequences).

Arguments of the following type were made repeatedly by Schultes in a series of articles in the 1970s, and find multiple direct echoes in the 1990s work and writings of his most successful students. I take the argument as important not just in itself – no doubt there are literally hundreds of similar expressions of concern to be found in the 1970s literature – but because it was made by a man who had spent large parts of his working life in the Amazon, working with Amazonian populations in the collecting of "economic plants" and recording their potential uses, because Schultes was both a scientific and political hero to prominent contemporary bioprospectors, and because the ideas expressed here would eventually become the central tenets of bioprospecting policy at institutional, national and international levels.

First, he describes how '...many of the [Amazonian] Indian tribes possess an extensive pharmacopoea of presumed medicinal plants' and makes reference to his own 'incomplete' list which 'comprises more than 1300 species employed by natives in the northwest Amazon...' (Schultes, 1979: 264). Then he concisely lays out the *raison d'etre* of the bioprospecting sciences in their late twentieth century manifestation, and what, a little over a decade later, will become some of the key principles of the Convention on Biological Diversity (CBD), agreed upon in Rio De Janeiro by the governments of 157 nations:

> 'Everything points to the fact that the Amazon's green cover is a veritable, almost limitless, chemical factory – and a chemical factory almost untouched, waiting for the attention of scientific research... it is impossible to calculate how many chemical structures – some possibly of great importance in human life and health – lurk as yet undiscovered in the flora of the Amazon. It would seem that this potentiality alone might suffice to preserve from extinction the Amazon forests as well as the indigenous cultures privy to deep knowledge of their ambient vegetation' (264).

This statement is paradigmatic in that it points to a) the quantitative and qualitative lack of scientific knowledge of medicinal plants relative to b), the breadth and depth of "traditional" knowledge of medicinal plants, in that it claims c), that the location of these plants is under threat of extinction, therefore d), the plants and e). the holders of knowledge of their use should be regarded as something to be preserved for f) the universal benefit of humanity. All six of these points signal what I have described in previous work as a post-colonial and utilitarian-conservationist attitude (Christian, 2003).

As we have seen above, Harlan explicitly makes points, *c*. *d*, and *f* in relation to agricultural plants. Harlan and Schultes were certainly not alone in making their utilitarian arguments for the collection and conservation of biological resources. Institutional efforts toward implementing the agriculturally-oriented measures that Harlan had argued for were already under way, albeit with few signs of urgency, in the 1970s. This is a clear indication that they were widely understood and agreed with. Below I will outline how the equivalent medically-oriented institutional efforts were made in the 1980s , and how these parallel beliefs were rapidly unified and culminated with the widely-agreed upon 1992 CBD/CAB. The Convention, which the signatories agreed to enshrine in national policy, and ultimately, law, as we will see, explicitly contains statements *c* to *f* (and implicitly affirms statements *a* and *b* too).

The 1980s were the years in which conservationist concerns, increasingly now subsumed under the broader category of "environmentalism", moved out of their previously limited counter-cultural circles and became the serious concern of political and corporate bodies at both national and international level. Also in the 1980s, and in a closely related shift of attitudes, after decades of focusing on laboratory-based scientific research, a number of major scientific pharmaceutically-oriented institutions were showing renewed enthusiasm for field-based research, which significantly now included corporate financing to supplement the relatively low sums spent by governmental and intergovernmental bodies. What had previously been simply crop-breeding, "natural products research", or, within universities "economic botany", quickly became known as "biodiversity research". The term was a semantic by-product of, first, renewed interest in what (in the twentieth century) were relatively low-profile and low-status fields among academic, government and corporate institutions and their scientists, and, second, of the latter's increasing awareness of and apparent sympathy with the public's increasingly vociferous expressions of concern for "environmentalist" issues.

As these public and private institutions and their leading scientists became increasingly confident that they could and would profit (in terms of both new medical resources and knowledge and the resulting financial returns) from their speculative prospecting projects – most of which were taking place in the "biodiversity rich" but "cash poor" tropics – so did their awareness and anticipation of the potential for controversy inherent in such exploitation of Third World "genetic-" or "bio-" resources. Within a decade biodiversity (and its protection) and bioprospecting (and its regulation) became such "hot topics" among publics around the world and their apparently panicky governments that the United Nations was convening (what were, from Harlan, Schultes and other activists' point of view, long-overdue) high-level global conferences for their discussion, and conceiving global treaties for their management and regulation; the 1992 Convention on Biological Diversity. Previously, as outlined above, the topic was discussed and acted on only in poorly funded sub-sub-sub-divisions of the U.N. It had taken more than the 'few years' that Harlan had hoped but by the early 1990s the urgent need for bioprospecting action he spoke of was finally recognized at the highest levels of world governance.

The specific term "bioprospecting" first appeared in print in Christopher Joyce's *New Scientist* article in 1991, in reference to a three year project co-funded and conducted by Monsanto and the University of Missouri in speculative search for valuable biological medicinal resources in a range of tropical environments in the developing world; 'Monsanto calls the programme "bioprospecting" and is interested in micro-organisms as well as plants' (Joyce, 1991: 39).

The spending by Monsanto of 'several million dollars' on this is just one example of a renewed attempt on the part of multiple actors in the 1980s to develop new medicinal products from living sources. Other examples include, first, the 1981 establishment of an Institute of Economic Botany at the New York Botanic Gardens (NYBG), a body that was formed partly to 'search for plant species with new applications in agriculture, industry and medicine' (Balick, 1990: 22). A few years later, in 1986, the U.S. National Cancer Institute granted the NYBG funds to collect 1500 samples specifically for anti-cancer and anti-AIDS screening (22-23).

In the same year the U.S. National Research Council (NRC) held a National Forum on Biological Diversity, and the proceedings of that conference were published in 1988 as a successful book entitled *Biodiversity* (Wilson, 1988). Exemplary of the alarmed (alarmist?) tone set by the Forum and its report was the argument of Hugh Iltis. Iltis had, in the 1960s, after a plant collecting expedition in Peru, brought back specimens and seeds of an extremely rare variety of wild tomato, which, although he didn't know it at the time, was to become an economically significant find when an American agricultural company used it to breed a successful new variety of tomato plant (Sheldon and Balick, 1995: 49). In an article titled 'Serendipity in the Exploration of Biodiversity: What Good Are Weedy Tomatoes?' he argued along the environmentalist lines of his fellow bioprospectors Schultes and Harlan that rather than waste financial and intellectual resources on travelling to the moon and exploring space we would all be better off if the systematic botanic exploration of our own planet was given high priority; 'The moon and the planets will be out there forever, but the Earth's biological diversity is being exterminated now' (Iltis, 1988: 105).

Almost immediately both this and countless other rallying cries found institutional responses, and the popular (populist?) use of the snappy term "biodiversity" had entered the conservation plans and mainstream political discourse of both (developed) temperate and (developing) tropical nations. Equally rapidly, once the practice had become known as "bioprospecting", the writings of each and every one of its proponents, with not a single exception, connect their project proposals to, and justify them by, the need to protect environments under threat of anthropogenic "biodiversity loss".[7]

The specific use of the description "prospecting" for the practice of searching for, collecting and inventorying biological specimens and mechanically screening the collections for medically valuable chemicals was made in 1989. Cornell Professor of Biology Thomas Eisner, in a 1989 article entitled "Prospecting for Nature's Chemical Riches" enthusiastically reported on the Costa Rican government's plans to collect samples of every species to be found in its 'natural treasury' and, although it would require technological assistance from outside, to identify Costa Rican species containing potentially medicinal chemicals. Such plans fitted very nicely with the new-found interest within, and new biotechnological capabilities of, the U.S. pharmaceutical industry and its academic counterparts for natural products research, hence his enthusiasm.

Eisner's article is significant not simply because he uses the new phrase "chemical prospecting"; but also because he at once argues that conservationist values could and should be inherent in such work and that a proportion of any profits resulting from the speculative research could and should be returned to the host nation.

Like Harlan, Schultes, Iltis and many other bioscientists at the time Eisner believed, and argued in strong terms, that chemical prospecting should begin in areas/countries where bioresources are most at threat of extinction: 'In my judgement, what is primarily needed is a vast expansion of the initial exploratory probing for biological activities, and a substantial shift of that effort to the very parts of the world where mass extinctions are taking place – to the developing nations in the tropics' (Eisner, 1989: 32). Accordingly, 'Screening could be undertaken in conjunction with conservation programs, which are gaining momentum in developing nations… A major component of these conservation efforts is inventorying: the cataloging of the biological resources slated for preservation' (33). As we will see, this argument was made official international bioprospecting policy just three years later, and so was the following suggestion; 'pharmaceutical industries… may wish to enter into shareholding or profit-sharing agreements with developing nations… even before marketable discoveries have been made. It would set an extremely valuable precedent if the industry were to recognize that the mere custodianship of the natural treasury requires financial commitment' (34).

The industry was very soon able to set that precedent, in Costa Rica,

> 'which has set aside one-fourth of its land for conservation, [and] is mounting a major attempt to finance a National Institute of Biodiversity. A large contingent of biologists from inside and outside the nation will take part in the endeavor, which is intended as a long-range effort to catalog and monitor the nation's biodiversity. As expressly stated by government and academic officials, chemical prospecting of plants is to be a component of this exemplary project' (34).

This institution, known by its acronym INBio, was successful in its attempt to find financing among the U.S. pharmaceutical industry; it soon signed a bioprospecting contract with Merck.[6] The 1991 agreement was one of the first, and by a long way the most high-profile, such international "partnerships" to be based on explicit agreements to conduct bioprospecting according to the principle of "benefit sharing" and with the express intention of biodiversity conservation. Two of the newly conceived practice's defining values were quickly put into practice, before they had become international policy and law. This project, despite its adherence to the 1992 CBD/CAB, was also the first to be specifically denounced as "biopiracy", and ultimately, and despite the extreme care taken by Merck to avoid controversy, collapsed as the result of the Costa Rican people's angry and vocal opposition to their government's plans (Kaiser, 1997).

Just as the search for new *agricultural* plants had gradually become the concern of international agencies from the 1960s and 1970s the search for new *medicinal* plants was increasingly gaining the interest, but not yet the explicit support of international agencies, although starting at the later point of the mid 1970s. The CBD/CAB, which we will get to shortly, should be seen as the unification of these concerns. The Convention marks the culmination of the consciousness-raising efforts of their respective institutions. In the medical half of the bioprospecting field it was the World Health Organization doing the publicity work. Resolutions calling for a 'comprehensive approach to the subject of medicinal plants' (Akerele, 1991a: 3) had been passed at WHO conferences in 1976, 1977 and 1978. This "call", unconnected as yet to any explicit appeal to conservationist values, was slow to be heard at the UN level; a decade later the WHO was still banging the same drum. The tune issuing from the 1987 conference, however, had a distinctively new sound. Its commitment and message now was 'To initiate comprehensive programmes for the identification, evaluation, preparation, cultivation and *conservation* of medicinal plants used in traditional medicine' (4, my emphasis). To ensure that this new aspect didn't go unnoticed it was repeated in the simple statement that, 'the importance of conservation is recognized by WHO and its member states' (4). In 1988, a joint WHO/IUCN/WWF 'Consultation on Conservation of Medicinal Plants', in Thailand explicitly and primarily focused on the conservationist aspects. Significantly, because it indicates UN, conservationist-NGO and U.S. pharmaceutical industry co-operation toward the formation of bioprospecting policy, the meeting was partly funded by the United Nations Environment Programme, the World Wildlife Fund, and the American Society of Pharmacognosy.

The edicts issuing from this meeting, instead of putting the call for bioprospecting of medicinal plants first and making conservation secondary, put conservation first and made programmes to collect medicinal plants a necessary means toward this end. The so-called "Chiang-Mai Declaration", authored by 'We, the health professionals and the plant conservation specialists who have come together for the first time', ends, with melodramatic gusto, by calling 'on all people to commit themselves to Save the Plants that Save Lives' (the Chiang Mai Declaration, reprinted in Akerele et al, 1991: 1). In an exact restatement of the arguments made by Richard Schultes in 1979 (which I labelled arguments *c*, *d*, *e* and *f*, above); the Declaration explicitly 'Draw[s] to the attention of the United Nations, its agencies and Member States, other international agencies and their members and non-governmental organisations,'

1) 'the significant economic value of the medicinal plants used today and the great potential of the plant kingdom to provide new drugs',

2) 'the continuing disruption and loss of indigenous cultures, which often hold the key to finding new medicinal plants that may benefit the global community'.

and finally it

3) states that the conference 'View[s] with grave concern the fact that many of the plants that provide traditional and modern drugs are under threat' and invokes the 'urgent need… to ensure that adequate quantities are available for future generations'.

The first belief (and its equivalent for agriculture) has long been recognised, and was the driving force of much imperialist botanical exploration. The concern expressed in the third point has emerged gradually over the course of the twentieth century, and has now become a mainstream and official belief. The belief expressed in the second point of the Chiang Mai declaration and in the centrality accorded to it in the CBD/CAB, however, signals (at least on the surface) a historical reversal of scientific attitudes to non-western cultures, and as I have described it previously is a distinctively post-colonial idea (Christian, 2003).

The valorisation of "indigenous knowledge" is a hallmark of contemporary bioprospectors, especially those working within the Schultesian ethnobotanical tradition. Several of the latter, but most prominently Mark Plotkin (one of Schultes' most successful students of ethnobotany) have made repeated impassioned arguments to the effect that many Amazonian Indians have botanical knowledge that is as broad, deep and accurate as western scientists' knowledge, if not broader, deeper and more accurate (Plotkin, 1991: 57). Ethnobotanical bioprospectors' arguments along these lines have found wide recognition, and are written into the CBD/CAB.

Plotkin, writing just after the Chiang Mai Declaration and just before the Convention also affirms that "the key" to finding new medicines could lay with "traditional", pre-pharmaceutical, medicine; 'investigation of plants used for medicinal purposes by "unsophisticated" peoples can provide us with new biodynamic compounds that may have very important implications in our own society' (60). In a later book intended to popularize the new-found respect within the biosciences for the "shaman" or traditional medicine men of Amazonian cultures Plotkin goes so far as to state that

> 'The sophisticated botanical knowledge of these "uneducated" shamans astonishes Western researchers. In the rainforest these healers can sometimes identify every single species of tree, a feat that no university-trained researcher can accomplish... As nature continues to provide us with a cornucopia of new medicines, these shamans (in the rainforest and elsewhere) will prove to be the ultimate sources of knowledge' (Plotkin, 2000: 187).

And, simultaneously expressing the post-colonial attitude that such knowledge-holders are "technicians" and the post-colonial intention that such technicians should be rewarded, Katy Moran (in her position as advisor to the U.S. government on intellectual property law) argues that technoscientific attention to and employment of such knowledge 'could promote the conservation of biological resources in situ by ecosystems, sustain the livelihoods and lifestyles of indigenous cultures which choose to continue that method of subsistence, and distribute benefits to the technicians who had discovered, maintained, and innovated this knowledge within their cultures for generations' (Moran, 1992: 296).

The contrasting practices and attitudes of colonial botanists and imperial ecologists will be discussed in detail in subsequent chapters but it can for now be taken as given that such insistence within scientific, governmental and international institutions on the economic and social value of tropical peoples' botanical knowledge is a historically unprecedented and relatively sudden phenomena. Tropical *plants* have long been recognised as valuable but the idea that non-western, "pre-scientific", knowledge of them is equally important is quite new. In the same way that the (mid 1980s) emergence of the new term "biodiversity" occurred in a context of widespread concern for its perceived loss to global industrialization, this new concern to collate and protect the botanical knowledge of traditional cultures against the same forces also has new semantic expression; in the term "biocultural diversity".

In the very same volume that popularized the term and notion of "biodiversity", Mark Plotkin repeats the historically novel argument, made a decade earlier, to no avail, by his teacher and intellectual hero, that the collection of plants *and of " traditional knowledge " of them* must occur in tandem;

> '...very few tribal populations have been subjected to a complete ethnobotanical analysis and the need to do so becomes more urgent with each passing year. As we struggle to protect the dwindling rain forest and find new and useful plant species for the benefit of modern human beings, the people who best understand these forests are dying out' (114).

He goes on to make the argument that because the younger generation are either not interested in their grandparents' botanical/medicinal knowledge or are too busy earning a living in the industrial economy (possibly, and somewhat ironically, in the logging industry) Plotkin claims that 'Each time a medicine man dies, it is as if a library has burned down' (114).

In a discussion of U.S. policy, in which the (unsuccessful) move by two U.S. senators to have the value of traditional medicinal knowledge legally recognised in legislation on intellectual property rights is described, and which was published in a 1992 volume on these issues co-edited by Mark Plotkin, Katy Moran describes – again in thoroughly Schultesian terms – this historical shift of attitudes, and in passing makes one of the first uses of the term "biocultural diversity";

> 'As Western science would describe it, tropical forests represent laboratories of biologically diverse resources and tropical forest cultures represent similarly diverse libraries filled with information on how to use them. It is this complementary nexus of "biocultural diversity" within which ethnobiologists operate, that Western scientists now recognize as a critical but perishable resource as forests and forest cultures are destroyed' (Moran, 1992: 290).[9]

The above has been by way of arguing that the CBD/CAB, concerned as it to protect the new discursive object "biodiversity", and widely regarded as a marker of historical changes in attitude toward the "natural" environment, is, because of the close association of the two new discursive objects with which my thesis is concerned, also the most important document in the history of bioprospecting and biopiracy. It is in effect also a Convention on Bioprospecting and Biopiracy. It makes it possible to draw a line between the two, not just a methodological line, but a normative one, an historical one, a substantive one and a political one. And this is indeed how I will approach, treat and employ the Convention. It is the marker of the historical transition in the title of my thesis. As we will see, the Convention repeats

Schultes, Plotkin and the Chiang Mai Declaration almost word-for-word. It is in effect also a "Convention on Biocultural Diversity".

Most significantly, *the Convention makes biological resources national property*. Many nations had already legally protected their bioresources in this way; the Convention reaffirmed and endorsed such laws at international level for the first time. It effectively subsumed all biological resources within its (one hundred and fifty seven) signatory nations' borders under capitalist property law. This meant that any party or actor removing biological material from a signatory nation was committing an act of theft. It destroyed the notion that plants and animals are there for anyone who thinks they can make a useful or valuable product from them. Living material, post-Convention, no longer had the status of a being a "free good" or the "Common Heritage of Humankind". The moral value "Thou Shalt Not Steal", inherent in all property law, now applies to all living material within the borders of the signatory nations. The Convention is a "Convention Against Biopiracy" (CAB).

The CBD/CAB doesn't criminalize *all* trans-national transfer of biological resources. It does though make access to one nation's bioresources by another conditional on the fulfilment of a number of criteria. In brief these are that such collecting must

a) (where appropriate) respect the rights of "traditional cultures" or "indigenous populations",
b) aim to preserve the latter's botanical and ecological knowledge,
c) be undertaken only with the prior informed consent of the nation from which materials are collected,
d) be conducted under bilateral agreement that benefits accruing to the collecting nation must be shared with the host nation,
e) be conducted in accordance with conservationist aims.

The Convention does not officially or legally apply to historical bioresource transfer. There are no provisions for sharing the benefits of collections made in the past. If there were it is highly unlikely it would have found so many willing signatories in Europe. However, I will argue below and throughout that the Convention provides the historian with a useful, and widely-agreed upon, set of criteria, including normative or ethical criteria, by which to make a dualistic analysis. Recently it has become increasingly conventional among historians to avoid splitting history into distinct stages and to argue instead that the "stages" overlap to a considerable degree. Contemporary historians have to at least look like they are not splitting history into two halves, one marked "past" and one marked "present". However, it is my contention that the CBD/CAB makes such precise dualistic analysis possible. This is certainly not to claim that any historian of other social, political or economic change could or should seek or employ similarly precise markers of transition from past to present, but simply to state that the Convention is, for the historian and sociologist, a valuable methodological gift.

Such a methodological move might be problematic, if all collection of bioresources since the signing of the Convention blatantly ignored its moral, social, political and economic tenets, rules and effects. But this is certainly not the case. The major examples of bioprospecting projects since 1992 *have* intended to act in accordance with all of its criteria, *have* indeed found it possible, reasonable and correct to do so, *have* taken pride in their having such worthy intentions, and *have* generally acted as if they believe the Convention to be a legitimate regulation of their work. This applies also to projects undertaken by the one major nation not to have signed the Convention, the United States.

Charges of biopiracy made since 1992 have rarely been made on the basis that the bioprospecting party has contravened the Convention. They have instead been made on the basis that the Convention itself condones that which it aims to condemn. Such charges admittedly have consequences for my choice to take the Convention, at face value, as a trustworthy marker of a clear transition 'from biopiracy to bioprospecting'; they are discussed in Chapter 10 My thesis would be incomplete without an attempt to critique the Convention and make some judgement on the range of critiques that have already been made against it, and such is also made in Chapter 10.

First it is necessary to demonstrate that 1) the Convention does indeed contain the clauses and criteria as I have summarized them above, that 2) the Convention represents the official recognition of the arguments made by those involved in the bioprospecting science as I have presented them above, and 3) that my treatment of the Convention as a Convention Against Biopiracy is justified. Simultaneously I will point out in brackets the appearance in the text of the Convention of responses to the points and arguments made over twenty years earlier by Harlan and Schultes in their respective agriculturally- and medically-motivated calls to bioprospecting related action at the supra-national policy level.

Firstly, the Convention is indeed a Convention on the conservation of biological diversity because it contains many agreements, in dozens of variously phrased general affirmations, clauses and Articles to the effect that 'biological diversity is being significantly reduced by certain human activities' (this is point *c* of Schultes/Harlan argument), that 'the conservation of biological diversity is a common concern of humankind' (this is part *f* of the Schultes/Harlan argument), that the signatory nations are '*Determined* to conserve and sustainably use biological diversity for the benefit of present and future generations' (the latter and following are part *d*). In terms of action and policy, the 'Contracting Parties' commit in Article 6, to

> '(a) Develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity or adapt for this purpose existing strategies, plans or programmes which shall reflect, *inter alia*, the measures set out in this Convention relevant to the Contracting Party concerned; and (b) Integrate, as far as possible and as appropriate, the conservation and sustainable use of biological diversity into relevant sectoral or cross-sectoral plans, programmes and policies'.[lv]

Such concerns, and commitments to act on them, derive from both the utilitarian and non-utilitarian arguments for conservation: the Contracting Parties declare themselves officially to be

> '*Conscious* of the intrinsic value of biological diversity and of the ecological, genetic, social, economic, scientific, educational, cultural, recreational and aesthetic values of biological diversity and its components. *Conscious also* of the importance of biological diversity for evolution and for maintaining life sustaining systems of the biosphere'.

Secondly, the Convention is in effect a Convention on Biocultural Diversity because the signatory nations agree within in Article 8 (j) to:

'Subject to its national legislation, respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilization of such knowledge, innovations and practices'

So here part *e* of Schultes' argument is explicitly put into practice and the related part *b* is implicitly affirmed. Harlan did not explicitly make point *b*, but he did point to the importance of the as-yet unrecorded and collected knowledge of farmers in the developing world, which, we can fairly say, is covered here by 'local communities embodying a traditional lifestyle'.

Thirdly, and most significantly, the Convention is a convention against biopiracy because it and its signatories are, in its preamble, and in addition to the clauses requiring that benefits of bioprospecting be shared, '*Reaffirming* that States have sovereign rights over their own biological resources' and in Article 15.1, 'Recognizing the sovereign rights of States over their natural resources, [and that] the authority to determine access to genetic resources rests with the national governments and is subject to national legislation'. While the specific texts sidesteps some of the controversy attendant to the word "property" it is clear that "sovereign rights" ultimately includes property rights.

Further, the convention should be read as Convention Against Biopiracy because it and its signatories are agreeing, in Article 15.5 that collecting of, as it puts it "genetic resources" be conditional on the hosts' granting of informed consent and on their participation; 'Access to genetic resources shall be subject to prior informed consent of the Contracting Party providing such resources, unless otherwise determined by that Party', and in the more extensive but less strongly binding Article 15.6 are agreeing that 'Each Contracting Party shall endeavour to develop and carry out scientific research based on genetic resources provided by other Contracting Parties with the full participation of, and where possible in, such Contracting Parties' (note how "shall" in 15.5 becomes "shall endeavour… where possible" in 15.6).

Further still, the convention is a Convention Against Biopiracy because its signatories agree, in Article 15.7, to share the benefits arising from the development of products based on biological resources:

> 'Each Contracting Party shall take legislative, administrative or policy measures, as appropriate, and in accordance with Articles 16 and 19 and, where necessary, through the financial mechanism established by Articles 20 and 21 with the aim of sharing in a fair and equitable way the results of research and development and the benefits arising from the commercial and other utilization of genetic resources with the Contracting Party providing such resources [Article 19 repeats this with specific respect to biotechnology]. Such sharing shall be upon mutually agreed terms'.

The relevant part of Article 16 here is 16.3, which agrees that,

> 'Each Contracting Party shall take legislative, administrative or policy measures, as appropriate, with the aim that Contracting Parties, in particular those that are developing countries, which provide genetic

resources are provided access to and transfer of technology which makes use of those resources, on mutually agreed terms, including technology protected by patents and other intellectual property rights, where necessary, through the provisions of Articles 20 and 21 and in accordance with international law and consistent with paragraphs [16.]4 and [16.]5 below'.

Here, Article 16.5 requires that 'such [intellectual property rights] are supportive of and do not run counter to its [the Convention's] objectives', and Article 20 reiterates that benefits to be returned to the developing nation 'will take fully into account the fact that economic and social development and eradication of poverty are the first and overriding priorities of the developed country Parties'. Article 21 contains the agreement that the financial and technological benefits to be shared 'shall operate within a democratic and transparent system of governance'.

To complete the argument of this chapter it remains only to point out that part *a* of Schultes' 1979 account of the current state of his field work – that many living things are as yet 'awaiting scientific attention' – and which Harlan's equivalent outline of the inadequacy of institutions for the study of agricultural plants, did not make explicit but presupposes, is also internationally recognised in the Convention, whose signatories affirm in the preamble that they are '*Aware* of the general lack of information and knowledge regarding biological diversity and of the urgent need to develop scientific, technical and institutional capacities to provide the basic understanding upon which to plan and implement appropriate measures'.

In summary then, there is an exact fit between the arguments made in the 1970s by professional bioprospectors – those who work on the collection and putting-to-use of biological resources – and the 1992 Convention. Although the bioprospecting science of ecology did not in its early days have motivations related to environmentalist politics the bioprospecting sciences gained significant interest and impetus from the perception – increasingly widespread in and from the 1970s – that the biological and cultural resources they seek are under threat of anthropogenic extinction. By 1992 the belief in the need for urgent bioprospecting action was shared by bioprospectors and representatives of the majority of national governments. So too was the belief that bioprospecting should no longer be conducted without informed consent, mutual sharing of benefits and the right to charge illicit collectors with theft. The Convention is an attempt by an alliance of the institutions of the biological sciences and of global governance to bring an end to the history of imperialist biopiracy and an attempt, in the context of environmentalist concern about species extinction, to collect and put to use biocultural resources as soon as possible, for the benefit, it is claimed, of the global population.

Chapter 2. Bioprospecting and biopiracy defined, outline of method, review of literature and summary of chapter contents.

Chapter 1 has defined the *specific contemporary* meaning of the term Bioprospecting (which I will refer to from this point on with a capital B). Chapter 2 will begin by defining the *general historical* sense of the term bioprospecting (which I will refer to from this point on with a small b) and the *specific contemporary* meaning of the term Biopiracy (with a capital B), and, finally, also the *general historical* sense of the term biopiracy (small b).

In Chapter 2 I present the way in which today's Bioprospecting scientists explicitly and quite consciously understand their work as an attempt to avoid continuing the history of biopiracy which their scientific ancestors contributed to. Then I review the literature on historical bioprospecting/biopiracy and give an outline of the theoretical approach I am taking to it. Finally I describe the structure of my thesis and present a summary of the contents and argument.

The remainder of my thesis will present the details of both "minor" and "major" cases of biopiracy (this distinction is defined in Chapter 3) in the colonial/imperial era and describe, discuss and analyze the history of the transition from general, historical bioprospecting/biopiracy to contemporary, specific, Bioprospecting/Biopiracy in the context of the transition from imperialist to emperial (with an "e") sovereignty as the dominant form of power in society.

Bioprospecting and biopiracy defined.

To clarify: Bioprospecting (with capital B) is: The search for and collection of biological materials and often, but not always, the recording of local people's (including but not exclusively "indigenous" or "traditional" peoples') knowledge of the plants collected and their potential or actual uses, by individual scientists and/or their patrons in scientific institutions who

a) are often, but not exclusively, working for national government agencies, or trans-national pharmaceutical or agricultural companies,
b) are working with the intention of producing new medical or agricultural products,
c) are often, but not necessarily, based in a northern, and/or "developed" nation but conducting their search in a southern, and/or "less developed" nation (the latter will be referred to as the "host" nation and the former the "collecting" nation),
d) are working with the explicit permission and informed consent of the host government (that is, in a context in which the host government reserves the right to refuse permission and access to the collecting parties),
e) have entered into benefit sharing agreements with the host nation, whereby knowledge, products, technologies, and financial resources resulting from the collection are to be shared in a mutually-agreed-upon "fair and equitable" manner,
f) are committed to the preservation of biocultural resources, including
    i) the specific biological materials collected (either ex situ, or in situ, and wherever possible, the latter),
    ii) (where applicable) the ecosystems in which the collected materials live,
    iii) (where applicable) local people's knowledge (including but not exclusively "indigenous" or "traditional" people's) of them and their potential or actual uses,

g) are contractually bound, at bilateral level, to points *d*, *e* and *f* above.

In contrast then, Biopiracy is the collection of biological resources in any situation where condition *g* is not met.[11] That is, acts of Biopiracy are those collections of biological materials that do not adhere to the terms of the 1992 Convention on Biological Diversity. According to the principles of majority democracy, given that a significant majority of nations, in terms of both population and geography, (including China, Russia, India, Brazil, Japan and all the (then-) EEC nations, but not the United States), have agreed to these terms, this definition applies *whether or not the collecting nation is a signatory of that Convention* and, given that the signatories are committed to ratifying the Convention at national level, applies *whether or not the collecting nation has made the relevant terms of the Convention national law.* That is to say that the working definition of Biopiracy presented here is not taken as a legal definition, but it *is* based on international agreement and commitments.

Bioprospecting and Biopiracy in these specific senses, and with a capital B, did not exist until the Convention and *can only be said to occur after 1992.* Similarly, capital B Bioprospectors and Biopirates did not exist until that date. In the very broadest sense bioprospecting means simply the search for and collection of biological materials, and a "bioprospector" is anyone engaged in that search.

While many significant acts of bioprospecting have been conducted by individuals and institutions that can be broadly termed "scientific" (although these can not be said to be conducted by scien*tists* until the emergence of the term in and after the 1830s) there are cases where the bioprospectors had little or no knowledge of the bioprospecting sciences (natural history, botany, agriculture, ecology, and related fields). My thesis is not arbitrarily committed to the study of the history of science, nor even to the history of the bioprospecting sciences, but to specific acts of bioprospecting, and how and why they have come to be seen as constituting the generalized "history of biopiracy" that the signatories of the CBD/CAB and all those who aim to act in accordance with it seek to put an end to.

As the remainder of my thesis will detail, there has been a long history of bioprospecting, and the separate acts which constitute it have had a variety of significant economic, social, cultural, biopolitical, geopolitical and ecological consequences.[12] Often, the contemporary perception is that these consequences have been unjust and inequitable (in simply social terms, and increasingly also in ecological terms). Wherever there is a perception (whether accurate, inaccurate, well-established or contested) that biological materials were taken with negative, damaging or unfair consequences there is an implicit charge of what has recently fallen under the general shorthand term "biopiracy". This perception exists both within the sciences that make up the history of bioprospecting and among other interested parties – historians, governments, political activists – both in the ex-imperialist and the post-colonial nations. Whether or not the shorthand term biopiracy is explicitly used in relation to the perceived injustices resulting from the activity of historical bioprospectors, it should not be considered too problematic to refer to their collective history as the "history of biopiracy" (but to repeat one final time, there can be a "sociology and history of Bioprospecting and Biopiracy" *only* since 1992.). It should then be clear that so long as the terms are taken only as a shorthand there is nothing problematic in talking of the "history and sociology of bioprospecting and piracy".

Ethnobotanical bioprospecting and post-colonial intent.

Ethnobotanical bioprospectors, working as they do with peoples who have survived five centuries of European subjugation (to name but a few aspects of this; epidemics of disease, near or actual enslavement, deforestation of their lands, industrialization) are highly conscious of the possibilities for controversy inherent in their work of collecting and recording what little remains of "traditional" botanical and medical knowledge. Their respect and admiration for Amazonian medicine-men's knowledge is, I believe, genuine. Such attitudes translate into a post-colonial political mindset that often puts them at odds with the (often U.S.-based) corporate institutions that will ultimately profit most from their ethnobotanical research. Before the CBD/CAB made precisely such an approach a matter of international regulation and policy Paul Cox described his fieldwork practices thus;

> 'the ethnobotanist in any research team has a *special obligation to represent the interest of the indigenous healers*… during the ethnobotanical research every effort should be made to *respect and affirm the indigenous culture*… I make it clear to my [corporate] collaborators that the indigenous healers have a *financial interest in any marketable compound derived from their knowledge*. These interests are written in patent agreements signed by representatives of the institutions and the villages concerned. In unmonetized cultures, *financial interests can be translated into conservation efforts* to preserve and protect rain forest and other habitats valued by the healers' (Cox, 1990: 46, my emphases).

It is arguable that the more emotionally attached and politically committed ethnobotanists are to their Amazonian informants the more the situation becomes one in which the Bioprospectors themselves are subject to exploitation, whereas previously, as we will see (in Chapters 3 to 7) the accusation that bioprospecting was an exploitative practice (i.e. that it was biopiracy) was justifiably and legitimately directed, at the individuals doing the collecting themselves. In short, the bioprospectors of the past were loyal to and happily identified themselves with the collecting organizations funding their work, but contemporary Bioprospectors are now loyal to the people and governments of the host nations in which they work, are uncomfortable if and when they are identified by outsiders with their employers, and are much happier being seen as advocates for the rights of the historically exploited than as defenders of the historically exploitative practices of their scientific ancestors. The individual Bioprospectors doing the fieldwork today perhaps have as much trouble convincing their employers to act ethically as they do convincing their informants that they will do so. This reality is something that has not always been acknowledged or understood by contemporary critics of Biopiracy, who imply, more or less explicitly, perhaps simply out of habit, or perhaps for rhetorical reasons, that bioscientists from the developed world who work in the underdeveloped world are automatically neo-imperialist agents, proponents of "bioserfdom" or the like (RAFI, 1994; RAFI, 1997; Shiva, 1998).

Critics of Biopiracy either do not read the writings of the ethnobotanists involved in contemporary Bioprospecting projects or they do not wish to muddy the waters of their polemics by quoting from them. It is more useful to those seeking to raise public consciousness about, and oppose, the apparently neo-imperialist actions of U.S. pharmacorps to present the latter's scientific employees as naïve about the history of their disciplines and ignorant of the possibility of the injustice of their work than it is to complicate their campaigns by noting the more complex sociology of the contemporary Bioprospecting sciences. In the years between the mid-1980s renewal of corporate interest in tropical plants and the 1992 formation of international policy against the acts of Biopiracy that such interest was perceptibly at risk of leading to, there are to be found in the writings of many ethnobotanists analyses of the situation such as these:

> 'I think the trend is toward greater interest in ethnopharmacology... In the last two years I have been contacted by at least a dozen companies. I am very careful about who I collaborate with in industry. I ask that royalty agreements be provided so that we can compensate countries and colleges in these countries. I ask that data be provided to the country so they realize that the colonial era is over and they are no longer to be "mined" as countries... Then I ask that the costs of the collection programme be covered, and it's surprising to me how many companies refused' (Cox, 1990: 54).

> 'Now, more than ever, the Intellectual Property Rights of native peoples must be protected and just compensation for knowledge guaranteed. We cannot simply rely on the good will of companies and institutions to do right by indigenous peoples. If something is not done now, mining of the riches of indigenous knowledge will become the latest – and ultimate – neo-colonial form of exploitation of native peoples' (Posey, 1992: 48).

And once the "something" had been "done" and the Convention was drawn up Bioprospectors were not complacent. Their reaction was not, as cynics might have expected, that everything was now OK, that biopiracy was now suddenly consigned to the historical dustbin, that now, so long as they obeyed the rules of the CBD/CAB they were exempt from charges of Biopiracy or that any public perceptions that their work was colonialism with a smiley face were simply misguided or plain wrong. Nearly a decade after the Convention and the institutionalization of post-colonial rules on Bioprospecting, leading ethnobotanist Mark Plotkin was still openly expressing his awareness of the dark history of imperialist biopiracy;

> '...new mechanisms must be developed to protect the intellectual property rights of these local peoples and local governments: fortunately, the colonial/neo-colonial model of "Let's take what we need of local plants and wisdom and cart it off to the marketplace" is completely unacceptable as we enter the twenty-first century. New economic models and legal frameworks are being devised and put in place to share benefits from these new discoveries and avoid the "rape and run" approach to commercializing natural resources that characterized much of human history' (Plotkin, 2000: 190).

Even bioprospectors working in non-ethnobotanical fields, like the advocate of mass-screening methods[13] and coiner of the phrase "chemical prospecting" Thomas Eisner, were well aware of the continuing impact of colonial-era botany on the reputation and practice of their science, and the (as it turned out, very real) threat posed by this historical legacy to the possibility of continuing with their Bioprospecting work:

'Partnerships for bioprospecting are inhibited by lingering resentments in developing countries over past uncompensated exports of genetic material… Fortunately, institutional models are evolving in different parts of the world that show the way to a new approach to overcoming previous barriers of mistrust born of centuries of inequity' (Weiss and Eisner, 1998).

As already mentioned, the first major Bioprospecting agreement to be made according to the terms of the CBD/CAB, the joint U.S./Costa Rica, Merck/INBio mass screening programme which Eisner had been closely involved in, collapsed in 1997 amid widespread opposition among the Costa Rican public, and prominent NGO's vocal opposition to the project (I return to the Merck-INBio agreement and critiques of it in Chapter 10). Eisner was perhaps over-confident in the Convention's ability to nullify "lingering resentment" and over-optimistic that such barriers were "previous", but the point, which is one about his intentions, holds.

The point I am making here is that Bioprospectors are fully conscious of the history of their science, clearly intend to avoid continuing that tradition (this remains true whether or not we take the cynical view that these intentions were pragmatic rather than genuine), were neither surprised or unhappy at having their scientific freedom subjected to international anti-piracy regulations and, without exception, held no hopes that they could acquire biological materials and traditional knowledge of them for free. The story might be a very different one for the corporate financiers but the Bioprospectors themselves did not and do not expect to be able to gain the raw materials for new medicines or crop varieties without regulation, without permission and without the need to pay for them.

Outline of method.

My approach to the sociological study of bioprospecting has been heavily influenced by the existing literature. At the start of my study period I had been researching contemporary bioprospecting for nearly a year during work on my dissertation for my M.A. in social research (Christian, 2003). When I began my doctorate research in 2003 I was already aware that there was a long history of bioprospecting, that the search for biological resources had been a central aspect of both European imperialism and eighteenth and nineteenth century botanical science and that the histories of imperialism and the botanical sciences are so closely intertwined that they can be approached as one single history. I was aware too that contemporary Bioprospectors deliberately sought to avoid working in ways that might appear to be a continuation of the exploitative practices of botanists working in the age of imperialism, and had argued in my M.A. dissertation that contemporary Bioprospectors worked with "post-colonial" and even anti-imperialist intent. The critiques of contemporary Bioprospecting that sought to describe it as "biopiracy" and as a form of neo-imperialist exploitation accordingly seemed somewhat imprecise, especially given the recent work of Hardt and Negri which had theorised new forms of post-imperialist power (2000) and which I had read with interest.

So my research began with two distinctions, which seemed to run in parallel. That between historical, imperialist, biopiracy and contemporary, post-colonial, Bioprospecting and that between imperialist power and new forms of post-imperialist power. The available choice of method by which to approach the subject seemed, then, to be three: either to focus on the actual practice of contemporary Bioprospectors or to focus on the historical practices of imperialist biopirates, or to compare the two. If I took the former approach an ethnographic method seemed most appropriate. If I took the later approach I expected that there would be opportunities to conduct primary historical research in the archives at Kew gardens. I knew from the research I had already conducted that Kew gardens was central to the history of imperialist biopiracy – and had an extensive library of materials relating to that history which I would be able to access – and also that it was active in the contemporary search for biological resources, and that it might be possible to get myself invited onto a Bioprospecting team as an ethnographic observer.

Two things led me away from these two options and toward the third option – the one that I have taken. The first was the publication of an ethnographic study of a Bioprospecting project in Mexico (Hayden, 2003), which took exactly the sort of approach that I had already half-planned. The second was that during the course of the preliminary historical research I was conducting in the early months of my study period I was becoming increasingly aware of just how vast the secondary material on the history of imperialist biopiracy and the history of the botanical sciences was. Several highly detailed historical studies in both areas were available and I was finding it increasingly difficult to settle on a specific area of study that had not already been covered. My reading of both the literature on contemporary Bioprospecting and on historical biopiracy suggested that it would not be easy to conduct properly original primary research on either. Most importantly though, my reading of both bodies of work left me frustrated that there seemed to be no historians aware of contemporary bioprospecting practices and that contemporary commentators on bioprospecting seemed to simply presume that it was a continuation of the history of imperialist biopiracy without stopping to think whether the exercise of power in contemporary society can really be said to be continuous with imperialism.. No one was directly comparing and contrasting the practices of bioprospectors past and present. Here, then, was the best opportunity to fill a genuine gap in the literature, on both the historical and the sociological side. Hence, my decision to write an historical sociology of bioprospecting.[14]

The method by which to conduct such a comparison that I have employed is, as outlined above, to use the 1992 Convention on Biological Diversity, which I understood from an early date to be a Convention Against Biopiracy, as a marker of a historical transition from biopiracy to Bioprospecting. Once this decision was taken my study of the historical literature took a new turn. It became clear just how fundamental to the Convention is the (avowedly environmentalist) concern with the preservation of biological resources. So my reading of the literature lead me to see the significance of the Convention, which in turn required me to read the literature on the histories of ecology and of environmentalism, which, I was somewhat surprised to learn, were far from being synonymous. This, then, provided a third distinction; that between the historical botanical sciences' concern primarily with exploitation of biological resources and the contemporary ecological sciences' concern with the management of biological resources. My method, then, has been to give structure to a broad range of disparate existing literature by putting it all in the context of the Convention Against Biopiracy. If this method has succeeded it should be clear that the shift from biopiracy to Bioprospecting has paralleled a transition in the sciences from botany to ecology, a transition from the conquest of nature to management of ecosystems and a transition from societies dominated by imperialist power to a single global society dominated by emperial sovereignty.

Review of Literature.

A detailed discussion of historical biopiracy constitutes Chapters 3 to 7. We have already seen how Bioprospectors today understand and conduct their work in reaction to the history of pre-CBD bioprospecting, which they themselves view as the history of biopiracy. The remainder of Chapter 2 presents a broad sketch of that history as found in the work of contemporary historians, both "external" and "internal" to the bioprospecting sciences of natural history, botany, horticulture, agriculture, and ecology. By way of reviewing some of the large literature on the topic and the range of theoretical approaches taken the below sets the scene for the more detailed case studies to follow and introduces my own preferred theoretical framework to the topic.

My review of the literature intentionally strays at some points from the specific act of bioprospecting/biopiracy to discuss the broader contexts in which they occurred; that is, the review introduces such issues as the mutually beneficial relationship of European imperialism and the European botanical sciences, the place of plants in the geopolitics of the colonial era, the leading role the plant sciences played in both agricultural and social "improvement", the social, political and economic motivations for, and consequences of, the development of new botanical classification systems, and so on.

Lucile Brockway's *Science and Colonial Expansion: The Role of the British Royal Botanic Gardens* (1979) was the first monograph on colonial-era bioprospecting and has had considerable influence. Her analysis is broadly Marxist in that it shows the importance of the plants collected by botanical scientists and institutions to the competing mercantilist, proto-capitalist and finally fully capitalist national economies of the European colonial powers, especially in the nineteenth century (36-37). Brockway approaches the era and the international social and economic changes it wrought as constituted by a plurality of competing national imperialisms. Later historians have, I believe rightly, moved beyond her commitment to nation-based analysis and treated European colonialism and imperialism as a single phenomena.

Her work focuses on the successive "botanical monopolies" that Britain attempted to form and sustain, primarily through the work of Kew gardens. She argues that the work conducted there and by its world-spanning satellites was, first among the most important and influential of that conducted by Europe's bioprospecting institutions, and second, that such institutions and their hardworking, loyal and committed agents were among the most important motors of the colonial machinery.

The general purpose of her work was to argue that European colonial rule and its frantic economic activity was vital to the formation of the contemporary worlds' unequal distribution of global wealth (192). Her unqualified claim that Kew was an imperialist institution has not gone uncontested, but no historian who has followed up her work has attempted to claim that it was uninvolved.[15]

Aside from the valuable historical research that Brockway presents her sociological work is important to my thesis in that it supports, albeit in pre-Foucauldian terms, my reading of the history of bioprospecting in the terms of the history of biopower. She details how many bioprospected plants formed the basis of economically valuable plantations in the colonies, how profits were maximised by the disciplining and coercion of colonial subjects, who often worked in conditions of actual or near-slavery, and how, significantly, such co-deployment of deliberately bioprospected colonial resources and colonial labour had (bio)political as well as economic motivations and effects (190-191). The formation of new economic models was also the formation of new social formations, ways of life and subjectivities. I will argue throughout that this is just one of several ways in which bioprospecting should be seen in terms of its biopolitical effects.

Similarly focused on British botany in the context of imperialism and also emphasising the economic and geopolitical aspects of the search to put the New World's bioresources to use (rather than the place of that search in the history of ideas) is David Mackay's 1985 work *In the Wake of Cook: Exploration, Science and Empire, 1780-1801*. Like Brockway, Mackay gives a prominent place to the role of botanic gardens both in Europe and the newly-founded colonies, and the mutually beneficial relationship between the various branches of the botanical sciences and Britain's imperial economy. Botany in general 'played a vital imperial function' (Mackay, 1985: 14). His somewhat contradictory argument throughout is against the notion that Britain in this period had a determined and pre-planned imperialist policy. He argues instead that this is something historians have retrospectively attributed to the political elite of the period, and cites in support of this view the conflict between the Government's interest in frugality and the Company's financial corruption, extravagant expenditure and heavy debts. He does though agree with Brockway that botanists had clearly economic/imperialist intentions, and were at the time understood to be of significant benefit to the era's mercantilist Companies.

Both his and Brockway's general argument is that 'Scientific know-how, particularly when applied to the development of tropical cash and food crops seemed to provide possibilities for extending or modifying the mercantilist framework for imperial trade' (Mackay, 1985: i-ii). Mackay details a variety of East India Company schemes involving natural historians and botanical bioprospectors in identifying new goods, including both medical and agricultural produce, for investment and potential new industries. He effectively argues that while Britain had no coherent imperialist policy there was a coherent and effective "bioprospecting policy" both within and without the East India Co. personified by the influential bioprospector Joseph Banks.

One of the major cases of bioprospecting that he discusses – the seeking, collecting and removal of cotton seeds and specimens from India and their transfer to the Americas and Caribbean – is arguably the one act of bioprospecting, even more than the cases of tea, rubber and cinchona, that was most unequivocally and self-consciously an act of biopiracy. The case of cotton is absent from Brockway's work, despite the direct involvement of Banks, one of the figures most closely identified with Kew Gardens. Aside from the historical details of this case Mackay's work is exemplary of the basically economistic approach to colonial bioprospecting. His work is primarily an evaluation of the economic purposes of botany and says little of the ideological context in which this was done (beyond a rather traditional sub-plot about the "empiricism" of science in the period and the knock-on effects of Newtonian science on botany, and a brief nod to the general belief among the British landed gentry of the late eighteenth century in agricultural and social improvement).

It should be noted that Mackay seeks to balance what he sees as his historian peers' – including Brockway's – overstatement of the actual financial profits gained by the European Companies and their empires in general, but his argument that financial reward was primary in the minds of colonial agencies and agents, including and perhaps especially among travelling botanists and their employers, stands, whether or not such wishes were fulfilled.[16]

Finally, in his under-stated and under-emphasised discussion of the political motivations of the (initially ill-fated but ultimately successful) Banksian scheme to transfer breadfruit plants to the Caribbean in order to supply slave-owners with a cheap and reliable source of food for their imported labour, Mackay is aware, though not in so many words, of the biopolitical effects of the plant transfers and botanical science of the day.

In short, Brockway and Mackay's work constructs the economic foundations on which subsequent historians of colonial botany have built. Although they focus only on Britain, they show convincingly that botanists and their major institutions – the metropolitan and peripheral botanical gardens – can be considered an empire within an empire.[17] Their economic roles of locating, identifying, improving and distributing the colonial biological materials that would go on to become important articles of world trade remain historically and sociologically important to this day, even when considered quite aside from their cultural, intellectual and ecological impacts.

Historian Richard Drayton's information-packed and eloquently written account of the interrelation of the early European botanical sciences and European colonialism, *Nature's Government: Science, Imperial Britain, and the 'Improvement' of the World* (2000) is a more sophisticated work than either Brockway or Mackay's. While he arguably goes too far out of his way to avoid speaking explicitly of capitalism or even mercantilism (his discussion of cameralism gives the impression that its significance lies *only* within the history of ideas) he makes a valuable contribution to the history of bioprospecting by integrating it with the history of ideas. While Brockway tends to write as if there was no religious motivations for, or justifications of, colonialism and imperialism Drayton rightly makes these central. To Brockway natural history is treated as if it were a secular phenomena when in fact many early natural historians understood what they were doing as a form of Christian worship; natural theology. Their monarchs shared this understanding of botany, something which was of benefit to its leading proponents and embryonic institutions (Drayton, 2000: 77).

Similarly, while Brockway undervalues the role of monarchy in the promotion and putting-to-use of the new influx of botanical specimens and the broadening of botanical, especially agricultural, knowledge, Drayton shows how Kew was initially a symbol of monarchical power and wisdom rather than an economic instrument. In Britain, king George III was known as "Farmer George" and 'from the 1780s onwards, George III sought to win his subjects' loyalty, and his right to intervene in domestic and foreign policy, by making himself the empire's first gentleman, the paradigm of the "improver". The gardens at Kew became a theatre for the exhibition of royal virtue' (89)

Many imperialist bioprospectors shared this self-understanding of their role as being that of "improvers", both of "nature" and of the peoples of their home nations' gradually-expanding empire. Joseph Banks' certainly understood the work of his informal school of bioprospectors in these terms (as described below, in Chapter 4). While I do not discuss it at length, this biopolitical concept has had a strong influence on my understanding of the history of imperialism.

> 'By the late eighteenth century we see the rise of an imperialism of "improvement" which promised that people and things might be administered, in the cosmopolitan interest, by those who understood nature's laws. European power, joined to the scientific mastery of nature, would necessarily confer the greatest good on the greatest number. This was a hypothesis as useful to proconsuls, who sought to justify their dominion, as it was to those men of science who premised their appeals for public support and patronage on their utility' (xv).

Drayton is an important source in demonstrating that colonial bioprospectors, in direct contrast to today's post-colonial bioprospectors (see above), scorned and ignored the "pre-scientific" knowledge of their monarch's indigenous populations;

> 'It may seem perverse, indeed an oxymoron, to conjecture an imperialism of the Enlightenment. Yet benevolent and emancipatory hopes… easily lent their sanction to coercive projects. British "improvers" moved, at home and abroad, in the faith that they ultimately knew better than those on the ground. Their confidence depended, in part, on the assumption that they possessed a more profound understanding of how Nature worked… (90).

It is this general 'idea that the knowledge of nature would allow the best possible use of resources' that Drayton means by the phrase "Nature's Government" (Drayton, 2000: xv). It usefully unifies the bioprospecting sciences and European political theory in the age of imperialism.

Because one of the most forceful arguments made by critics of both Biopiracy and biopiracy is that the botanical sciences have been and/or are key aspects of the coercive "enclosure of the global commons" (Shiva, 1998; Hardt and Negri, 2000; Abernethy, 2000). Drayton's demonstration of how "faith" in 'enclosure was the key to "improvement"' (Drayton, 2000: 229) is significant for my thesis. As he puts it, 'The research of local plants and their uses was part of reconnaissance and conquest from the sixteenth century'(xv), and 'The surveying of natural history followed naturally from efforts to number and describe the people and chart the territory and resources of conquered lands' (122).

Historian James Walvin's 1995 book *Fruits of Empire; Exotic Produce and British Taste, 1660-1800*, doesn't, as Brockway and Drayton's do, focus on the particular details of how particular plants and crops were collected by bioprospectors, nor does it give prominence to the role of the botanical sciences in the introduction of the bioresources under discussion – sugar, tea, coffee, chocolate, tobacco and the potato. To invoke a problematic distinction, it is a work of cultural history rather than history of science. This makes it no less relevant, for the great strength of the book is its detailed look at how these post-Columban articles of trade and consumer products were culturally important to the indigenous populations of what would become European colonies, and how these then gradually became taken-for-granted products in European culture, broadening and enhancing the diet of (and in the case of the potato, essential to the survival of) millions, if not literally billions, of people.

I should note that to describe Walvin's work as a history of bioprospecting is to stretch the term to its broadest sense because many of the products he discusses arrived in European culture by anonymous diffusion – by the collective acts of merchants and other seamen rather than the result of conscious exploration and collection. But it is a history of the globalization of some of the most significant plant resources. The cultural focus of Walvin's history of plant transfer is absent in Brockway and Mackay. In this sense it is a necessary complement to their work.

Walvin describes how the diffusion of each of the plants which he discusses followed a similar top-down pattern; arriving first as a novelty in royal and aristocratic circles, and then gradually spreading into the gardens, fields and diet of the common man. Walvin discusses plant transfers in the context of three major historical phenomena.. First, in relation to the initial decimation of the Indian populations whose dietary staples are now ours; 'the crops of defeated and subjugated

Indian peoples, quickly became the necessities and pleasures of their conquerors, later still of the wider world' (Walvin: 1995: 64).

Second, in the context of how these decimated populations were replaced in the Americas almost immediately by millions of African slaves, who were put to work labouring in the fields in which the new-found crops were grown in large quantities, and then, once slavery was finally abolished, by the transfer and improvement (and here Walvin does acknowledge the role of the botanical sciences) of these crops to parts of Asia, where hundreds of thousands of subaltern colonial subjects were put to work on new, and highly profitable, plantations in poor conditions and with virtually no pay; 'what made everything possible were the slaves' (136).

Thirdly, Walvin gives an important, and I will argue, highly pertinent, account, of the ecological and environmental consequences of the above two historical phenomena (my discussion of these consequences constitutes Chapter 8). Walvin describes how just a few decades after colonization 'The islands *were* plantations' (136). It is our habit today to think of environmental change and damage to be the results of industrialization, but initially they were mainly the result of, to employ two ugly terms, agriculturalization or plantationization, both of which are inseparable from the general history of plant transfer and the more specific history of bioprospecting. The process was not confined to the Caribbean, and not confined to the colonial centuries.

Headrick's well-known 1988 social history of imperialist technology, and technological networks, *The Tentacles of Progress: Technology Transfer in the Age of Imperialism, 1850-1940*, covers the steam engine, railways, telecommunications, canals, irrigation and damming, mining and the technical college, but the longest chapter of the book is devoted to botany and bioprospecting/plant transfers. Headrick insists and emphasises like no other academic in the field that bioprospecting is to botany what technology is to science. The botanical sciences in the imperial age were certainly not pure and disinterested and were inseparable from the social, political and economic uses to which they were put. Further, he treats European imperialism as effectively synonymous with globalization. It is made clear in his work that, perhaps especially in the history of technology, there is no clear break between imperialism (generally understood to have ended in the middle of the twentieth century) and globalization. His work is valuable in that it rightly subsumes the globalization of plants, often, although not always, conducted at ground level by botanists and bioprospectors, under the history of the globalization of technology.

A third important aspect of his work for the way I have come to approach the history of bioprospecting is that he treats the globalization of the various technologies he discusses as a continuous integrated process. While they each had differential timing and different geographical diffusion, one technology often followed the other around the world. The collecting of biological resources was greatly influenced by the accelerating pace of transport and communication.

Headrick's emphasis on the material, economic and geopolitical importance of the collection and mass production of new plant resources in the imperialist era is certainly important. The importance of Londa Schiebinger's *Plants and Empire: Colonial Bioprospecting in the Atlantic World*, to my theoretical synthesis lies, however, in the opposite, that is, in its being a commentary on the production and transmission (and non-production and non-transmission) of knowledge of plants in the colonial era. While she under-emphasises the economic power of plant material, her work is a detailed exposition of the importance of not underestimating the sociology of botanical knowledge. While it is perhaps obvious that such macro-social or geopolitical interests drove botanists toward particular economically valuable plants, it is not always made so obvious in the literature that these priorities also had significant impacts on the European corpus of botanical knowledge, in terms of both what it contains and what it does *not* contain.

> 'I explore here instances of the nontransfer of important bodies of knowledge from the New World into Europe. In doing so, I develop a methodological tool that Robert N. Proctor has called "agnotology" – the study of culturally-induced ignorances – that serves as a counter-weight to more traditional concerns of epistemology. Agnotology refocuses questions about "how we know" to include questions about what we do *not* know, and why not. Ignorance is not merely the absence of knowledge but an outcome of cultural and political struggle' (2004: 3).

Her major example of this is the production of ignorance of abortificants. Her work is the only discussion I have come across on the use of plants as abortificants and the gender politics surrounding male botanists' disinterest in plants that were exclusively of use to women. Schiebinger convincingly shows how abortificants' potency was covered-up by male physicians whose concerns in the nineteenth century increasingly came to match the State's concern with population control (governmentality). In this sense, her work is also an important contribution to the history of biopower, especially in direct relation to the biopolitics of bioprospecting.

As we will see in some detail below (Chapter 7), collection of plants has always also been about the collation of an imperial (and today an emperial) archive of knowledge. Schiebinger looks at how, often, but with some important exceptions, local and indigenous knowledge of plants was disregarded, at how, when it wasn't disregarded it invariably went unacknowledged, at how African slaves took their botanical knowledge with them to the Americas and the Caribbean, and at how botanical classification systems mirrored the naming practices of European imperialists.

Her work is a, and thus far *the* only, feminist history of bioprospecting. Schiebinger presents important research on the few women who travelled to and in the colonies in the pursuit of potentially useful plants and botanical knowledge. It need hardly be pointed out that the vast majority of botanists, and every professional botanist without exception, was male. Just as men granted themselves the power of naming the geography of the New World that they colonized, it was European men and only men who have been in charge of giving names to plants, both of the New and Old Worlds. In parallel to economic imperialism there was linguistic imperialism, and this was also linguistic patriarchy. While some plant names do echo the locals' names for them, or have the names of women, the decision to so name them was always a (usually European) male botanists' one to make.

Schiebinger's account of linguistic imperialism centres around Carl Linnaeus, whose classification system must be prominent in any work on botany. Until Lisbet Koerner's detailed research (1994, 1999) it was not well recognised just how concerned Linnaeus was with economics. As she shows in her *Linnaeus: Nature and Nation* Linnaeus didn't define botany as an economic sub-discipline, he defined botany *as* economics, and it is perhaps even less well known that he defined economics *as* bioprospecting. He himself had undertaken bioprospecting missions, and was considerably ahead of the bioprospecting game in that during the course of collecting specimens of indigenous plants in northern Sweden he paid special attention to locals' use of them and recorded the botanical knowledge of the Lapps living there. He was undeterred when this failed to result in anything especially useful or profitable (his suggested solutions for Swedish poverty and reliance on imported foodstuffs were imaginative to the point of absurdity) and went on to educate whole teams of his students in this proto-ethnobotanical method, and to despatch these "apostles" on dangerous voyages around the world.

Koerner's work sets a good example to any historian of bioprospecting by continually insisting on the equal importance of the collection (or, if we are thinking in terms of biopiracy, appropriation) of botanical specimens *and* of local knowledge of them.

Koerner shows that Linnaeus was an ethnobotanical bioprospector with explicitly utilitarian motives. And through his influential teaching and writings effectively formed a "Linnaean school of bioprospecting" (which shared many of the methods, but not the political attitudes, of the contemporary "Schultes school"). He understood botany to be, first, a matter of national survival – it was in his phrase a "famine science" – and, second, to be a potential source of Swedish economic independence, national greatness, and hopefully, supremacy. Under the (misguided, but at the time not totally illogical) conviction that all plants could grow under any climatic conditions (or could be made to) Linnaeus initiated what we might call the first "big bioprospecting" schemes. His intention was to collect specimens of the range of Oriental cash crops – most notably tea and mulberry – as a way to reduce the Swedish monarchy's expenditure of silver. In the middle decades of the eighteenth century, he sent out, quite systematically, numerous "scientific travellers" to all ends of the world in pursuit of specific valuable botanical specimens, decades before Britain seriously attempted the same thing. These schemes were rather calamitous in both their execution – many of the Swedish bioprospectors succumbed to severe, often fatal illness – and in their results – the plants they collected either died *en route* to Uppsala, withered away in Linnaeus's experimental plots, or turned out to be completely different species to those sought (the Chinese successfully resisted the theft of tea plants simply by giving the Linnaean bioprospectors specimens of similar-looking plants). However, the specific intention to put bioprospecting labour to work for the economic and geopolitical profit of the nation was clearly in evidence in mid-eighteenth century Sweden.

Koerner also details how the very system for which Linnaeus is now so famous was originally and quite consciously intended as a quick and easy method by which to catalogue the influx of New World plants, and wasn't simply a disinterested result of botanical study. The very system on which botanical knowledge is based to this day was a specific product of European expansion. Linnaean classification, the European colonies and Europeans' attempt to employ botany and (ethno-)botanical exploration to national-economic ends make little sense if studied in isolation.

To recap. Brockway, Mackay, Drayton, Walvin, Headrick, Schiebinger, and Koerner's accounts of bioprospecting in the colonial era, each with different theoretical approaches to the subject which taken alone are incomplete, when synthesized, should make for a better-balanced and more complete account in which the economic, epistemological, ideological, geopolitical, cultural, ecological and technological contributions of botanical science to the contemporary state of global society all are given consideration.[18]

I attempt in the remainder of my thesis to describe and explain the shift from biopiracy to bioprospecting in terms of the rise of a single global empire whose characteristic form of power is biopower and whose society and politics are best understood in terms of biopolitics. The validity of this approach should be clearer once I have detailed the history of how the botanical sciences have gradually become the ecological sciences, how the work of bioprospectors fits into that shift, and of how environmentalist thought and ecological science are related (Chapter 9).

Not only specific works on the botanical sciences during the period of European imperialism have influenced my analysis of the history of bioprospecting to follow. From Thomas Richards' 1993 literary analysis of fictional accounts of colonial bureaucracy, and the use of knowledge as power, *The Imperial Archive: Knowledge and the Fantasy of Empire*, I take the concept of "the imperial archive". I follow Richards in stressing the importance of the Victorian mania for information and the perils of information overload that characterised the British empire in the period (and in fact, the century before too).

> 'The work of the Foreign Office was often done by any educated person, however unqualified, working in whatever department, stationed wherever, who felt he had to do it simply because he happened to be British. These people were painfully aware of the gaps in their knowledge and did their best to fill them in. The filler they liked best was information. From all over the globe the British collected information about the countries they were adding to their map. They surveyed and they mapped. They took censuses, produced statistics, they made vast lists of birds. They shoved the data they had collected into a shifting series of classifications. In fact, they often could do little other than collect and collate information...' (Richards, 1993: 3).

And, as the somewhat sarcastic and offhand reference to the "lists of birds" that Richards makes here inadvertently suggests, the same applies for the empire-within-an-empire constituted by the work of natural history collectors (and was even more extreme in botany than in ornithology). Just as a "fantasy of the imperial archive" guided the colonial bureaucracy there was a botanical bureaucracy, armed with the Linnaean classification system and sustained by constant streams of new botanical specimens which had its own guiding fantasy, what I would like to call the "fantasy of the botanical archive". Richards focuses on the literature of the late colonial period but we will see below that the phenomena described by authors such as Kipling and H.G. Wells was very much in evidence in botanical circles from the very early days of colonial bioprospecting. Although Richards doesn't deal with Susan Sontag's (1992) novel *The Volcano Lover* he could, had he wished, have discovered the phenomena of what I call "specimen overload" even without moving out of the literary field. Just as much of the information received by colonial bureaucrats was consigned to filing cabinets, never to be seen again, many of the specimens sent by colonial botanists also failed to find any particular use (although in this case, they might have been seen on display in the "natural history cabinet" of some wealthy aristocrat or bourgeois at least until they went out of fashion).

In a similar way to Schiebinger's work on the non-production of knowledge, by pointing to the great numbers of specimens sent home that found no productive use, I show that the plant or animal specimen that was put to economic use and founded the basis of a new cash crop or medicine was very much the exception to the general rule. The majority of the collections of some of the major and most successful bioprospecting missions (Joseph Banks' own collections on Cook's first voyage for example) gathered dust and awaited many years, and sometimes decades, to even be described by more taxonomically inclined botanists. This is partly because the collections, especially those made on the earliest European voyages, were brought home with very little knowledge to go with them. There was often some mundane descriptive information, but just as Richards says of the colonial bureaucrats 'I question whether the data they collected can be called "knowledge"' (Richards, 1993: 4), there are countless examples where the same question needs to be asked for the undescribed specimens, or specimens with only the most cursory notes attached, that the hundreds of amateur botanical collectors returned home in the belief that they were contributing to the advance of the botanical sciences. Even such well known and successful bioprospectors as Henry Bates and Alfred Wallace often knew nothing of the specimens they sent home in such large numbers and relied on men at home to classify and identify them (Raby, 1996: 79). It was one thing to collect specimens or scraps of information, quite another to turn them into useful knowledge.

All this is to take nothing away from the cases where this process did finally come to fruition and result in some valuable crop or lead to some great scientific insight (both Wallace and Bates's collections did ultimately have a role in confirming the theory of natural selection), but only to state that it was very far from being an automatic or easy process. In most cases, only plants that were collected in conjunction with local experts' knowledge of them had any major economic impact. The remainder of the many thousand specimens that found their way back to Europe had little effect other than to give their collectors a (largely false) sense of pride that they were contributing something to their nation's imperial efforts.

The above works have dealt with only limited sub-periods of the history of European imperialism and bioprospecting. Where they are rich in close-up detail they lack long-term vision. Also, they have (with the exception of Drayton, 2000) been only limited national histories of bioprospecting and imperialism. For both these reasons there are few theoretical claims about imperialism in general. These works can leave the sociologist of today's botanical sciences and Bioprospecting projects with the general impression that there is little continuity between the periods they cover and the contemporary world. Given that many of these works were written after the concept "globalization" arrived on the sociological scene with its mass of influential literature it is perhaps surprising that none of these historians make any explicit attempt to argue that European imperialism should be seen *as* globalization or even that it constitutes the pre-history of globalization.[19] None of these authors (with the exception perhaps of Headrick, who, though he doesn't use the term is clearly describing globalization's history)put the history of bioprospecting in terms of the history of globalization, perhaps because the habit of seeing their work as the history of distinct nation-based imperialisms dies hard. Especially because many of these scholars are working either directly or indirectly with the history of science and technology, and because the sciences and technologies of the European colonial powers easily crossed borders and were largely common to all, this is somewhat surprising.

However, this simple and hardly controversial argument has been persuasively made by David Abernethy in his 2000 book *The Dynamics of Global Dominance: European Overseas Empires, 1415-1980*. His argument can be seen as a toned-down and much less polemical version of the arguments made by Hardt and Negri in their works *Empire* and *Multitude* (2000, 2004, see also the supplementary material in Brown, et al, 2002). What the latter describe as a "hybrid constitution", based on an alliance of military power, state bureaucracy and capitalist modes of production, Abernethy describes as "sectoral cooperation"; cooperation of military, corporate and missionary institutions.[20] Both authors place heavy emphasis on the range of military, agricultural, industrial and social technologies employed by the agents of respectively, imperialism and Empire, or, as I call it, emperial sovereignty. Both authors make the broad argument that such technological control of natural resources and the putting-to-work of human labour with the intention of destroying traditional social forms and replacing them with more economically profitable ways of life is the definitive feature of imperialism. That is, they recognise that nature(s) and culture(s) are produced by power, and, specifically that they are co-produced.

Before comparing it to Hardt and Negri's I must point out one major fault with Abernethy's work. He lazily and unreflexively borrows from psychology the thoroughly unsociological and unhistorical terms (they are so vague that they don't even qualify as concepts), "drive" and "syndrome" in his history of imperial science and technology. There is, he says, a "drive to control" and, a "explore-control-utilize syndrome". But despite this his discussion of the fundamental importance of scientific labour, institutions and their twin material and ideological effects throughout the history of European-led globalization remains a valuable contribution.

Throughout the thesis I refer to "emperial sovereignty", "emperial society", "emperial rule" and so on. The term "emperial" is my own but it derives from my close study of Hardt and Negri's work. Hardt and Negri's work centers around the concepts "Empire" and "imperial sovereignty". They define this as a contemporary, hybrid, form of power, which works through biopolitical production – the production of ways of life, subjectivities and discourses – and the expropriation of the common, that is, of social and (increasingly) immaterial labour. "Empire", in contrast to previous "imperialism" is shown to work primarily through biopower – the power to create and sustain life (both human and nonhuman) – in contrast to imperialism which worked primarily through military rule and the power to take life. Hardt and Negri's work focuses largely on the twentieth century – it is not a history of imperialism. A large proportion of my thesis *is* concerned with the history of imperialism. Throughout the writing process I found that their term "imperial" was not capable of adequately distinguishing between historical "imperialist" sovereignty and contemporary "Empire" or what they call "imperial" rule. So I have taken the liberty of coining the term "emperial", with a lowercase "e" to help clarify the distinction. When I use "imperial" I am referring to historical forms of power, sovereignty and society. When I use "emperial" I am referring to what I, following Hardt and Negri, understand to be contemporary forms of (bio)power, (supranational) sovereignty and (global) society.

There is and can no be "emperial*ism*". One of the definitive features of emperial sovereignty is that there is no deliberate policy for its exercise, no consciously "emperial institutions" and no individuals who are ideologically committed to the exercise of emperial rule. In contrast, there were specifically imperial*ist* policies, institutions and individuals or roles. Policies, institutions and individuals can work in ways compatible with emperial sovereignty, its formation and reproduction, but they are never deliberately or consciously doing so.

One further clarification; although contemporary power is defined in terms of biopower, biopolitical production and biopolitics, these are not exclusively contemporary phenomena. They existed from around the late eighteenth century when governments and the institutions of early capitalism first began to have an interest in sustaining rather than taking life, and in disciplining their populations in Foucault's (1991) sense of the term. Hardt and Negri's argument is that these are now the dominant forms of power in global society. For my previous explanation of what is meant by "emperial" society see Christian (2004), an essay which defends Hardt and Negri's theory against those who, in the context of the American and British invasion of Iraq, continue to see the dominant form of power in society as neo-imperialist rather than emperial rule. One of the best secondary sources on Hardt and Negri's work is Pieterse (2004).

Abernethy frequently speaks in Foucauldian terms, certainly recognises that empires were not created by sovereign power alone, but, for unstated reasons, avoids the concepts "biopower" and "biopolitics", while Hardt and Negri build their work around them. However, their works, for all their political and conceptual differences, are compatible. From the very start of his lengthy study Abernethy describes

European imperialism as a 'global enclosure movement', while Hardt and Negri base their protest against the iniquities of global capitalism on continuous demonstrations of the "appropriation of the commons". While the former speaks historically, equating imperialism and the export of the Enclosure Act, Hardt and Negri speak primarily sociologically. Abernethy may not stray into what some will see as the excesses of poststructuralist theory but broadly speaking his historical work, especially in his commentary on the exploitative and increasingly ecologically damaging uses to which the biosciences and bioscientific knowledge have been put, can be translated into Hardt and Negri's terms.

Abernethy quietly acknowledges what Hardt and Negri noisily argue in respect of historical periodization too. He is aware that it is too simple to say that colonialism and imperialism ended with the post-WII granting of formal political independence and recognizes that nation-states are certainly not the only power-formations productive of social relations. His history of imperialism does, despite this, effectively end with the de-colonization movements of the 1940s to 1960s, with what he calls the final "fifth phase" of imperialism. But I broadly agree with Hardt and Negri's arguments (and the many similar ones which they draw on) that many of the defining characteristics of European imperialism remain definitive of society at the macro level today, and in some – especially the flexibility of power and the alliance (or hybridization) of different institutional forms – are even more so, and increasingly extensive and intense. Hardt and Negri's conceptualization of post-imperialist power in terms of a global Empire of capital which takes the entire global population and entire global ecosystem as objects to be managed could be described, in Abernethy's periodization, as a "sixth phase" of imperialism; the one in which imperialist power mutates into something historically novel. Abernethy's work has a lot to say, and rightly so, about the vital importance to imperial history of European's ability to put the natural, as well as the human, resources of the colonies to work and profit, but because of his apparent comfort with marking the mid-twentieth century as "the end of imperialism" it is necessary to draw primarily on Hardt and Negri's theory when describing what I see as a shift from (imperial) biopiracy to (emperial) bioprospecting.

A significant proportion of my research for this thesis has been taken up with the parallel study of the history of "environmentalist" politics and the history of ecological science. Two pertinent, but limited, works in the sociology of global environmentalism are Wilenius (1999) and Zhouri (2004). David Harvey is one of the few leading sociologists to have studied environmentalist practices, thought and politics in detail. His (1996) work in this area is informed by critical theorists' discussion of the concept "nature". As is mine, although such philosophical discussions are beyond the scope of my thesis.[21]

Although I do not cite it directly the work of Richard Grove (1990, 1995) has been very important to my research. His argument that "the beginnings of global environmentalism" are to be found in the eighteenth century is somewhat contradicted by his parallel argument that "environmentalism" was in the colonial world primarily focused on the preservation of game animals and timber supplies. To avoid what would necessarily be a lengthy explication and discussion of his arguments in the context of my own that the management of environments is almost exclusively a twentieth century phenomena I have avoided citing his work at all. However, especially in the early period of my research his work was important in guiding my approach to my subject. Although he doesn't discuss colonial biopiracy directly my thesis would have benefited much from engaging more directly with Grove's arguments. Unfortunately, I found that to do them proper justice required more space than I could spare. The same is true of David Arnold's work (1996, 2000).

My understanding of ecological science has been heavily shaped by Anker (2001), Golley (1993) and Elichirigoity (1999). Anker shows in details how the earliest ecologists' work and ideas were as closely connected to imperialism as the botanical sciences were in previous centuries. His account of how the early ecologists were already imagining their role in the management of global biological resources and global ecosystems deserves a wide audience. Golley's account of the post-war influence of cybernetics on ecology and Elichirigoity's account of how both ecological and cybernetic ideas found their way into the early institutions of global governance are likewise important to my interpretation of the significance of the CBD/CAB.

Summary of chapter contents.

Both the content and the structure of my thesis take the Convention on Biological Diversity/Convention Against Biopiracy (CBD/CAB) as their foundation. The CBD/CAB regulates three different aspects of bioprospecting; the material-economic, the cultural-ideological and the ecological. As a whole my thesis sets out to show that historically the search for biological resources has had significant material-economic, cultural-ideological and ecological impacts, from which, generally speaking, the few gained at the expense of the many, and that this history continues into contemporary society, albeit in some novel ways. In the briefest possible terms; I argue that while there has been an attempt – in and through the CBD/CAB – to replace inequitable biopiracy with equitable bioprospecting that attempt has failed.

The Convention regulates the material-economic uses of biological resources by, as we have seen, formally granting such resources property status so that host nations have the right, first, to charge those who illicitly acquire "their" resources with theft, second, the right to expect that bioprospectors seek and gain "prior informed consent" to collect "their" resources, and third, the right to expect a share of any benefits accruing from the collectors' exploitation of "their" resources. Together these clauses seek to end economic exploitation of one nation's resources by another. They seek to render imperialist biopiracy a thing of the past in and through the establishment, at the level of global governance, of all biological resources as national property. Chapters 3, 4, and 5 describe and discuss that imperialist history of material-economic exploitation. They show that historically bioprospecting was in fact biopiracy.

Chapter 3 is especially focused on how the material-economic value of biological resources "at home" was recognised and exploited before the bioresources of the rest of the world were actively sought. Chapter 4 focuses especially on the history of the commodification of biological resources. It shows how botanical specimens for the nursery trade and among amateur collectors and museums – in "specimen dealerships" – produced a growing class of professional bioprospectors who, while they often made large private fortunes and successful careers from their acts of biopiracy, did not make significant contributions to their national economy or their nation's imperial power. These remain important in that they show just how long-established is the trade in biological resources as commodities. This is by way of establishing that the CBD/CAB merely formalises and legitimizes the commodification of bioresources; it is the end of a long historical process, not the contemporary privatization of the biological commons that some critics (see Chapter 10) have taken it as.

Chapter 4 discusses how European bioprospectors – represented by Carl Linnaeus and Joseph Banks – from the eighteenth century believed that the biological resources of other nations or territories could be of both economic and geopolitical benefit to their own. Discussion of how their belief – especially Banks' – was borne out in imperialist practice constitute the remainder Chapter 4 and Chapter 5. These are broadly about the history of the material-economic aspects of biopiracy that the CBD/CAB reacts against.

Chapter 4 then goes on to discuss several "minor" acts of imperialist biopiracy and to describe their biopolitical motivations and effects – "biopolitical" in the sense that they were intended to shape, and indeed did shape, the ways of life of large populations, either in providing sources of food or in providing labour (which in some cases helped quell political unrest both in Europe and the colonies). Chapter 4 also discusses the geopolitical aspects of imperialist biopiracy, that is, it discusses "botanical reconnaissance" and "botanical wars" (the first half of Chapter 10 consists of discussion of a twentieth century act of neo-imperialist biopiracy that had significant geopolitical effects). Cases in which British botanists' work contributed to imperialist policy and in some cases led directly to the annexation of territory are discussed here.

Chapter 5 then introduces four "major" acts of biopiracy that can and should be seen as imperialist in both intention and consequences. British botanists' illicit acquisition of cotton, tea, cinchona and rubber plants were all acts of imperialist biopiracy of the sort that the CBD/CAB seeks to prevent from occurring in contemporary and future society. They all had economic, geopolitical and biopolitical intentions and consequences. The cultural and linguistic aspects of these cases – the exploitation of local knowledge of the plants in question – are then returned to in Chapter 6.

Chapters 7 and 8 take as their foundation the parts of the CBD/CAB which are intended to outlaw exploitation of local labour and local knowledge in the course of bioprospecting. They discuss how the contemporary attitude of "respect" for local populations and the attempt of the Convention to avoid exploitation of local labour and local knowledge (through the requirement that benefits of bioprospecting be shared) was largely historically absent among bioprospectors.

Chapter 6 shows how imperialist bioprospectors often employed local labour (at very low rates of pay) to do the actual collecting work for them and how that work was then presented as Europeans' own work. Then it shows that although this was the common practice their were some exceptions. Finally it shows that locals were not passive victims of either imperialism or imperialist biopiracy; there were cases of resistance to bioprospectors, sometimes violent.

The second half of Chapter 6 shows how local knowledge was central to the success of the major acts of biopiracy presented in Chapter 5. Also, it shows that generally Europeans had an attitude of superiority to the botanical and medicinal knowledge of non-Europeans; only if there was an economic or medicinal need to consult locals did they do so.

Chapter 7 elaborates on this point and goes on to discuss "linguistic imperialism". It discusses the form of botanical ideology (which the CBD/CAB seeks to oppose and reverse) that states that all non-European knowledge of plants is pre-scientific and irrelevant to the development of useful or valuable products. This ideology derived directly from Linnaean classification and the bioprospecting practices it mandated – namely that collecting local names for plants was not necessary and was in fact to be discouraged because of the confusion it could cause. Chapter 7 shows how the overriding purpose of collecting specimens of the world's plants was the formation of a botanical archive, not the collection of the world's cultures diverse knowledge of them. The completion of a homogenous, comprehensive, universal archive and attendant catalogue of its contents – in the form of *Flora* – was the (utopian) goal of imperial botany. The botanists' goal – despite having little apparent economic value – was supported by government funding.

Chapter 7 begins to anticipate the arguments made in Chapters 8 and 9 regarding the ambitions of ecologists and environmentalists to take up positions in the management of global biological resources. It ends with a discussion of how there is direct continuity between the imperialist botanical archives and the contemporary biodiversity database; both can be understood as expressions of desire among biological scientists to archive the entire global "stock" of biological resources. What is historically novel, however, is the urgency attendant to this stock-taking exercise in the context of the perceived rapidity and intensity of anthropogenic habitat destruction. Today the attempted completion of the botanical archive by bioprospectors is conducted in the belief that in order to "save" species and to effectively manage the environments in which they live it is necessary first to know how many are "left" in the stockroom. This has had the effect of turning species into "information"; and the diversity of nature into a "library", a process which is expressive also of the commodification of all biological "resources" and, in effect, of the entire global ecosystem.

As the Convention insists; bioprospecting has become an "environmentalist" task in the sense described above and also in the sense that the Convention encourages the directing of proceeds from any new biological resources into conservation programs. Appeals for funding for bioprospecting work have come to be made in populist – environmentalist – terms. Chapters 8 and 9, then, discuss in detail this "ecological" aspect of the Convention and its history. Taken together they argue that the becoming-environmentalist of bioprospecting must be understood in the context of a historical shift in humanity's relation to the natural world; from a relationship of conquest, to one of improvement and finally to one of management. The significance of the CBD/CAB is that it mandates a move away from basic exploitation of seemingly infinite natural resources to sustainable management of seemingly finite natural resources. This would not be problematic if it were not the case that ecologists have – from the earliest days of their science – held the ambition to be put in charge of a global technocracy that will not only have the power to manage the global ecosystem but will of necessity also require the power to manage – and in the cybernetic terms much loved of ecologists in and from the 1960s – to *steer* – global society. The ecological aspects of the Convention, when added to the commodification of all biological resources – though not implemented by a formal global government – are tools of global governance that appear to be very similar to those which the earliest ecologists' dreamt of one day being granted. The environmentalist movement – and its global popularity – has been a significant but unexpected aid to the production of such tools and to the perception of them as legitimate, and indeed as necessary to the survival of civilization. "Unexpected" because, ecologists until the 1960s worked quite independently of any environmentalist justifications for their work and in fact found funding from decidedly non-environmentalist institutions on decidedly non-environmentalist projects. "Significant" because the power to manage global natural resources as expressed in and through the CBD/CAB is inherently also the power to continue to manage global society along capitalist lines. This power has been granted to a tripartite alliance of ecologists, national governments, and transnational institutions (both corporate and governmental), undemocratically, largely without notice, and with little likelihood of being revoked. This alliance – which I describe in Chapter 10 as "emperial sovereignty" – has taken measures to show its post-colonial and even anti-imperialist intentions. These are genuine. The Convention indeed marks a shift from biopiracy to bioprospecting. However, while bringing an end to imperialist biopiracy the Convention has not succeeded in ensuring that biological resources are sought and exploited in ways that are just and equitable.

Chapter 3. Non-imperialist biopiracy: the commodification of biological resources.

While there are several significant historical cases of bioprospecting, and hundreds if not thousands of less significant cases, where none of the CBD/CAB's criteria were met, and are therefore by today's standards to be defined as biopiracy, not *all* pre-Convention bioprospecting can or should be seen retrospectively as biopiracy. This is certainly not the argument that I am making.[22]

It was not uncommon for wealthy individuals or institutions from Europe to gain bioresources by cash payment or trade. These would arguably now fall under the category of bioprospecting with shared benefits, although they would be open to what I call in Chapter 10 the "financial critique", which states that the fee paid was insufficiently high. Such payment was often understood by both parties as the equivalent of "consent" for their removal from the nation or territory in which they were purchased. However, the individual making the sale very often did not speak or act on behalf of their nation. It is questionable – in the equivalent of what I call in Chapter 10 the "institutional critique" – whether the recipients of the fee were the legitimate ones, that is, whether the specimens were the legitimate property of the vendor. There are in fact recorded cases where the individual making the sale was prosecuted and punished for doing so. Further, because there was often a disparity of knowledge regarding the specimens, seeds or other material – one man's worthless weed is another's potentially lucrative cash crop or rare ornamental – the criteria of *informed* consent would often be broken even if consent in the form of payment was granted.

Conversely, there are recorded cases (and certainly many unrecorded ones) in which European bioprospectors made payments for plant materials that ultimately had no value, perhaps because they were not, as the purchaser thought, "new to science", were not suitable for the intended use or simply because they were not in fact what the purchaser was told that he was buying (as when the bioprospector sent to China to procure tea plants for Linnaeus sent home plants that only looked like tea). The latter situation was in fact a common form of resistance to biopiracy. What appeared at first sight to be a potentially valuable fruiting or medicinal plant was often ultimately worthless. Indeed, many bioprospectors, especially in the early colonial period, had no means by which to judge the rarity, potential use or popularity – and so the value – of the specimens they bought and/or collected until they returned home to Europe. It is easy to overlook the fact that Europeans were not necessarily the party doing the exploiting. Instances of European collectors being duped by locals into parting with their hard cash or locally desirable European trade goods for very common and/or completely worthless specimens no doubt went unrecorded. In short, the practice of collecting, and especially of purchasing, plant material was a fraught business on both sides of the transaction. We cannot take it for granted that all European bioprospecting was a miniature act of imperialism, or an act of biopiracy.

I make a distinction throughout my thesis between "major" and "minor" acts of historical biopiracy. These terms should be taken as relative. "Minor" cases are *not insignificant*. They are only *relatively* insignificant when compared with "major" cases. The distinction needs to be understood in relation to two another distinctions; that between "imperialist", "neo-imperialist" and "non-imperialist" biopiracy and that between "economically", "geopolitically" and "biopolitically" significant cases of bioprospecting/biopiracy. Those cases that were economically *and* geopolitically *and* biopolitically significant are considered the "major" cases of biopiracy – of which I discuss five – four were imperialist (Chapter 5) and one neo-imperialist (Chapter 10). Then there are cases that are imperialist in that they were geopolitically and/or biopolitically significant but not at all or only relatively economically significant (Chapter 4). And there are cases which were economically significant – either in that they were the source of personal fortunes or in that they contributed to the history of the commodification of biological materials – but were not at all or only relatively geopolitically or biopolitically significant (Chapter 3). What is specifically meant by these latter two terms will become clearer as my presentation of the details of each case progresses, until then the following very simple definitions must suffice.

Biopiracy in general is considered more unjust and more significant if plants are procured illicitly (as in the biopiracy of cotton and tea where the collector actually wore disguise), in the knowledge that the host nation would not allow collecting by outsiders in the territory (as in the biopiracy of cinchona and rubber), or in the knowledge that the host nation was unaware of the potential value of the collected specimens (as in the biopiracy of a high yielding wheat strain – see Chapter 10) and so on. But it is not necessarily the case that if specimens were taken in these circumstances the act should be considered "major". The definition depends on the significance of its economic, geopolitical and biopolitical consequences.

"Economic biopiracy" are those transfers of bioresources from one nation to another which resulted in individuals, institutions or nations making financial profit. If the profit was so large that it contributed significantly to the wealth of a nation or empire it should usually also be considered geopolitical. However, as Chapter 3 will go on to show, often profits went only to individuals – through sale of specimens by the collector themselves, or a middle-man in a horticultural nursery or specimen dealership. or through a professional collector's salary. These cases remain significant in at least two senses: first, in that (however low the level of profit made) they are forms of resource extraction (and usually. but not always. forms or imperialist resource extraction), second, in the context of the CBD/CAB, they are important steps in the gradual process of the commodification of biological materials that the Convention recently mandated and legitimated at the level of global governance.

"Geopolitical biopiracy" is defined as; those international transfers of bioresources that made positive economic or political impacts in one nation or empire and negative economic or political effects in other nations or empires. Added to these are those acts of bioprospectors in which the actual procurement of plant specimens had little or no consequence but which went on to have economic or political impacts on the nation in which they were working. On more than one occasion botanists acted illicitly as surveyors of territory for the purpose of establishing its suitability for annexation, and on more than one occasion that survey actually resulted in military takeover of territory.

"Biopolitical biopiracy" is defined as those international transfers of biological resources that, sometimes inadvertently and sometimes intentionally, destroyed daily lives, social structures, social roles and identities and replaced them with new everyday lives, social structures, roles and identities. These were sometimes entirely novel and sometimes of a sort already existing in Europe or in other colonies. While these changes often occurred outside Europe, it is important to recognise that European colonialism meant major biopolitical changes at home too. They are *political* in that they are always the consequence of a disparity of power (and never simply neutral "social" or "historical" processes) and they require the prefix "*bio*" in that they are impacts on life; often the life of millions of people. So, for example, in these terms many other imperialist phenomena should be considered biopolitical – slavery, missionary work, the decimation of entire populations by disease, the illegalization of the speaking of native languages, and so on. In the context of biopiracy biopolitical consequences include changes in diet, agriculture, labour, and medicine and the consequent changes in the power relationship between the invading and invaded nations and peoples.

There is a fourth way in which biopiracy has had profound impact on society and history; through its *ecological* consequences. These are, at the trivial level, the (usually, but not always) temporary damage caused to environments in the actual act of collecting resources (for example, the felling of a tree in order to acquire an orchid growing on a branch); bioprospecting of this type is outlawed by the CBD/CAB. Usually the term will be used to describe those acts of bioprospecting and/or biopiracy which, when the plant acquired went on to be mass produced in agriculture or plantations, had a significant role in the imperialist process of the "improvement of nature" (as defined and discussed in Chapter 8). Ecological consequences of biopiracy are almost always also biopolitical.

I should make clear that dividing the history of bioprospecting and biopiracy into economic, geopolitical, biopolitical and ecological aspects, as I have done for methodological and narrative purposes, is not always theoretically appropriate. It is the economic, geopolitical, biopolitical and ecological effects of biopiracy *in combination and in total* which have contributed, and continue to contribute, profoundly to the formation and sustenance of imperial and emperial power.

Bioprospecting (begins) at home.

In seventeenth century Britain, amateur horticulturalists, amateur botanists and apothecaries regularly sought plants in the countryside. These bioprospectors were recording the results of their local explorations, and meeting to discuss their interests:

> 'Seventeenth- century Londoners sought willow herb, foxgloves and poppies to decorate their houses and constantly scrutinized the wild for plants worth importing to town gardens... From the seventeenth century onwards, botanists began to record the location of wild plants. The first published local flora was the catalogue made by Thomas Johnson in 1632 of the plants growing in Kent and on Hampstead Heath... Thomas Johnson's edition in 1633 of Gerard's herbal reveals the existence of many apothecaries and amateur botanists who engaged in the search for rare plants. By the end of the seventeenth century there was an informal botanical club which met at the Temple Coffee House in London' (Thomas, 1983: 270-271).

This section will show that when botanists began to systematically travel outside of Europe in pursuit of potentially useful and valuable biological resources in the mid and late eighteenth century, bioprospecting was already, as well as being the hobby of dedicated gardeners and enlightened individuals, an organized, and increasingly professional pursuit within Europe.

When the historian of the natural sciences David Allen (1994) details and describes the gradual establishment of the traditional field-based investigation of plant and animal life he is writing about what we could now call the history of bioprospecting. This tradition, though not unbroken or continuous in Europe, began in all likelihood much earlier than the surviving historical record suggests. We know that in the mid sixteenth century 'the physicians of Montpellier and Basel regularly searched for herbs in the hills that surrounded their cities' (Drayton, 2000: 12). Likewise in Britain it was "physicians" and apothecaries who were the first recorded bioprospectors. The London Society of Apothecaries, indeed anyone in the seventeenth century medical profession, had two means of supplying themselves with the raw materials of their already lucrative business; by growing them in a "Physic Garden", or by organizing "herbarizings" and "Simpling Days", that is, bioprospecting excursions into the countryside around London. Allen describes these regular trips as 'without any doubt, the major seminal influence in the establishment of the great field tradition that forms the core of modern natural history' (1994: 7).

We will return below to the subsequent expansion worldwide of a cash market for botanical specimens and to the nineteenth century emergence of the professional plant-hunter, or bioprospector. The commodification of bioresources that they represent was not, though, an exclusively nineteenth century phenomena. Allen describes how, from the beginning, bioprospecting had the creation of wealth as a primary motivation.

> '... of the earliest specialist societies of which mention has come down to us all but one were botanical – and most of these were brought into being from motives that were more vocational, or even monetary than purely scientific. We owe it to the needs of the [apothecary] trade, in fact, that the first substantial numbers of persons were brought together from amongst whom, more or less by accident, the first permanent nexus of naturalists was enabled to emerge. And *it was ostensibly for profit to the pocket, rather then to the senses or the head, that most of them were first introduced to the delights of exploring and investigating.* The agency we have to thank for this is the Society of Apothecaries' (4-5, my emphasis).

The Society had as one of its central reasons for existence the education of apprentices. One of the 'stiff tests' apprentices were required to take in order to qualify as an accredited apothecary

> 'was in the correct recognition of the "simples", or drug plants, that formed the raw material of their trade, and as these needed to be known in the fresh state, the Society had to take upon itself to maintain a botanic garden – latterly the famous Physic Garden at Chelsea, established in 1673 and still flourishing today – and to organize special "herbarizings", or field excursions into the countryside, on which the apprentices could be duly instructed in locating in the wild the commoner species then in use in medicine. The earliest of these excursions that can be traced in the Society's records was in May 1620…' (5).

So, organized bioprospecting in Britain began in the early seventeenth century with the need for apothecaries to locate, identify and collect the medicinal plants which they would then charge high prices for dispensing to the sick and injured. There must have been considerable demand for this already-specialized form of knowledge – despite the relatively ineffectual, if not entirely imaginary, qualities of the prescribed "medicinal" plants – because the Society's Simpling Days were a regular and frequent occurrence from the mid seventeenth century; there were six monthly excursions through each summer (ibid).

Allen further implies that the apothecary's business, if not these early bioprospecting trips in themselves, was rather lucrative when he describes how, by the late eighteenth century, the Society was able to afford a generous salary for the senior apothecary in charge of organizing the trips and disciplining the juniors; 'in later years a special paid official came to be appointed for the purposes, at an annual salary of £10, with the title "Demonstrator of Plants"' (Allen, 1994: 6). The tradition apparently fell into decline, with the trips becoming "unruly", but returned after 1777 with the appointment of one Thomas Wheeler who 'succeeded over a very long period of years in building up the "Herbarizings" to such a pitch of popularity that they came to take on the character almost of a sacred ritual' (6-7).

We will meet two of the instigators of international and long-distance bioprospecting – Joseph Banks and Carl Linnaeus – again in Chapter 4, but before moving on to discuss the impact of the early nineteenth century Apothecaries Act on the history of "bioprospecting at home" and the general history of the commodification of bioresources, it should be noted that these two high-profile botanists both honed their bioprospecting skills in Europe before attempting to procure botanical resources from the far ends of the world. Significantly, both moved beyond the somewhat haphazard practice of the Apothecary Society and sought the advice of local experts, and sought to turn this knowledge into profit for their respective nations, and via this, they hoped, into national power and glory. In today's terms they engaged in ethnobotanical bioprospecting, and both taught this practice to their many prodigies, who collectively made up informal Banksian and Linnaean "schools" of bioprospecting (the details and implications of their exploitation of local knowledge are discussed further in Chapters 6 and 7). Their methods will be familiar to the contemporary "Schultes school" of ethnobotanical bioprospecting (on which see above, and my previous research, Christian, 2003).

While Linnaeus declined to personally undertake long expeditions abroad, preferring to delegate the more ambitious and dangerous bioprospecting missions which he conceived to his students[23] he 'undertook five regional explorations. In these state-sponsored journeys, he searched for economically valuable indigenous life forms, mineral deposits, and production technologies. His inaugural professorial lecture in 1741 elaborated this "utility of scientific journeys within the fatherland"' (Koerner, 1994: 149). At this time Britain's apothecaries were still interested in collecting plants for their own narrow interests but bioprospecting in Sweden was already becoming a matter of national interest:

> 'Linnaeus gave botany two principal economic responsibilities. The first of these was the survey of new resources. In lectures and essays which were translated across Europe, he identified the discovery of the profitable uses of plants with Man's work of redeeming Creation. This task began at home, as he explained in his dissertation "On the Importance of Travelling in One's Own Country", which disseminated the idea of the natural historian as a patriotic actor…' (Drayton, 2000: 72).

Unlike Linnaeus, Joseph Banks, as self-appointed botanist on, and financier of, the first Cook voyage, did personally travel the world as a bioprospector. Like Linnaeus he educated himself on the botany of his home country with the help of local experts; 'Sir Joseph Banks, the future president of the Royal Society, as a schoolboy paid herb-women to teach him the names of flowers' (Thomas, 1983: 70, see also Musgrave et al, 2000: 14). Indeed, this was not unusual; 'Physicians and apothecaries had long depended on their supplies upon such persons, what William Turner called the "old wives that gather herbs"... A scholar might read Aristotle and Pliny, remarked a Jacobean authority on bee-keeping, "but when he cometh abroad to put his skill in practice every silly woman is ready to deride his learned ignorance"'

(Thomas, 1983: 73). Banks, in his later role as organizer of many imperialist biopiracy projects, would admonish his collectors to follow his example and seek the help and knowledge of the (not-so-"silly") locals.

Also like Linnaeus, Banks went on to take botanical knowledge and bioprospecting well beyond a means of stocking apothecary's pharmacopoeia. Banks believed the transfer of plants to be a vital activity of a successful empire. Scientific knowledge, including but not exclusively botanical knowledge, 'coupled with enterprise and industry could be utilised to augment the biological resources of the British colonies for the aggrandisement of the mother country' (Mackay, 1985: 18). Alternatively, Linnaeus believed the import of plants and their "acclimatization" to be a means by which Sweden could achieve the wealth and status of an imperial nation without the risk and effort required to win and hold on to one.

My thesis as a whole takes for granted that the most important influence on the history of botany, and indeed ecology, is what is popularly known, perhaps rather lazily, as "European imperialism", "European colonialism", "the age of empire", and so on. The equivalent, but somewhat more specialized, discourse on "European expansion", confined largely to academic history departments, has recently come under some scrutiny, not least by historian of bioprospecting Richard Drayton. I believe this issue to be relevant to sociologists as well as historians, and there is much to say on the subject, but for now I can merely summarize Drayton's critique as far as it is relevant to the history of botany in Britain and Europe.

In the course of describing the impact of the 1815 Apothecary Act on British botany (of which more below), David Allen in his book *The Naturalist in Britain* makes an implicit distinction between "field botany in this country" and field botany conducted elsewhere in the world: He suggests that the said Act is 'possibly the most important development ever to have taken place in the history of organized field botany in this country' (1994: 95). In making this distinction Allen is dividing the history of *British* botanical science from the history of botany more generally, the history of *global* botanical science. I would argue that for all Allen's valuable historical research, his decision to attempt to write a book which clearly isolates "the naturalist" to his home territory "in Britain" was both an arbitrary one and a misleading one. He rigorously excludes the world-historical events that constitute the history of British and European imperialism from his history of British botany. This enables him to claim one rather obscure Act of Parliament to be the most significant date in that history.[24] This claim may be entirely plausible if British botany and society is taken in isolation. But Britain was certainly not isolated from either European or world history in the early nineteenth century and to write (even for methodological purposes) as if it were, is, I believe, a serious mistake and leaves the reader with a distorted image of history. This mistake is made repeatedly throughout Allen's book; there is an astonishing lack of reference to the British empire.

It is this sort of skewed historical research that Drayton identifies as a major shortcoming of academic history, and that he has in mind when he notes that 'Our poor understanding of the wealth and poverty of nations depends in large part on the arbitrary way in which national histories, or that of "Europe", have been separated from that of the world as a whole' (Drayton, 2000: 194) and that

> 'It is only now, a generation after decolonization, that we are beginning to put back together the histories of Britain and its empire… We are beginning, just barely, to recognize modern Britain to be as much a product of processes of empire as modern India, Nigeria, New Zealand, Barbados or Guyana' (xiii).

Only recently 'historians came to realize that the process we inexactly call the "expansion" of Europe' was really 'the contraction of the world' (xiv).[23] This realization has several consequences, the most important of which for my account is that imperialism was a formative stage in the history of what we now call globalization, or, stated conversely, globalization and the formation of supra-national forms of sovereignty that come with it, was initially formed by competing nation-based imperialisms.

It is unlikely that Allen is unaware of the impact on Europe of Europeans' botanical investigations (and bioprospecting) in the rest of the world, but if he is aware that British botany is "as much a product of processes of empire" as British society then he neglects to acknowledge it.

Despite this, Allen's identification of the importance of the Apothecary Act of 1815 does actually have relevance to the history of bioprospecting and does relate directly to my argument in this chapter that the Convention on Biological Diversity is the culmination of a centuries-old process of the commodification of bioresources.

Throughout his work Allen emphasises the close relation of early British botany and early British medical science. To argue, as I will, that botanical science as conducted by British/European explorer-botanists in all corners of the Old and New worlds, was concerned with much broader and more economically, politically, and ecologically culturally significant ends than the identification of medicinal plants is not to claim that the location of, and trade in medical plants was insignificant in the period. Allen describes the Apothecaries Act in the following terms: 'What its main protagonists meant it to do was to control the dispensing of drugs throughout England and Wales', to prevent 'ignorant quacks from prescribing or dispensing drugs' by requiring them to pass examinations of their knowledge of medicinal plants (Allen, 1994: 95). In this it failed; no one had the power to stop unlicensed apothecaries from selling useless medicines. However, it had some important but unintended consequences. It meant that to pass the exam the more respectable apothecaries who wished to obtain a license had to undergo rigorous training in bioprospecting methods – the collection and identification of medicinal plants. This led to a 'remarkable burgeoning of field classes in botany' and, in turn, this meant that there were a lot more botanical specimens being collected. These specimens then came to constitute a nationwide trade and market. After the Act there was a growing number of both amateur and professional societies with the express purpose of trading in British botanical specimens.

By the nineteenth century "networks" for the exchange and trading of British botanical specimens were being institutionalized, which were parallel to, if not yet fully intertwined with, those for the exchange and trading of botanical specimens of colonial and international origin. British specimens were more readily accessible, and less valuable than those that arrived in Britain from the rest of the world, but their commonality made them no less important pieces of the floral jigsaw that was being collectively assembled by the many avid amateur naturalists of Britain.

As Allen tells it, the Apothecaries Act's multiplication of the number of men (for, invariably, it was men) engaged in bioprospecting at home had catalyzing effects on the ongoing collective task of assembling a national *Flora.* The Act led to the forming of societies for the exchange of British botanical (and zoological) specimens, which in effect was the start of the organized compilation of a comprehensive herbaria, botanical archive or "seed bank". It was a step toward the commodification of specimens, and ultimately of nature; specimens were now undoubtedly, if they were not already, from this point on both a form of *currency* and a form of *information.*

The Botanical Society of Edinburgh 'from the start [1836] resolved to make one of its primary functions the organized exchange of specimens on a national scale', through a botanical 'commodity exchange, to which collectors would send their surplus specimens and receive in return others that they particularly wanted, paying the equivalent of a brokerage commission on all exchanges effected, or alternatively, an annual subscription or entrance fee to make the whole undertaking economic…' (97).

Allen, who has no particular commitment to demonstrating that natural goods have been treated as commodities or information for centuries, describes this as a 'master-concept' organizing the pursuit of natural history in the period and describes how the Society required 'that a record of all labels sent in with the material for exchange was to be preserved, with a view to their use in the compiling of local Flora and ultimately, of a complete *Flora* of Britain' (ibid). The Edinburgh-based network of naturalists (which was not the only such organization) was, then, 'a grand information-exchange embracing the whole of natural history' (ibid).

As historian of the trade in botanical specimens Mark Barrow notes, 'during the second half of the nineteenth century…scientific natural history was almost entirely focused on collecting' (2000: 516). However – to borrow Raby's revealing phrase, 'South America had not yet been collected' (Raby, 1996: 75) – Europe *had* mostly "been collected". The wealthy Swiss botanist P. E. Boissier made the common complaint that the botanist wishing to locate new species in Europe was required to venture into its remotest corners (in his case, in Spain). Writing in 1845 of a bioprospecting trip conducted in 1837 he recalls how 'During this excursion I enjoyed, to the full, the delights of discovery; a pleasure which was keenly renewed and varied during every successive excursion in Andalusia, and which cannot be felt in Central Europe, where every inch of ground has been trodden and re-trodden by experienced botanists' (Boissier, 1845, extracted in Short, 2004: 204).

Botanical collecting at home – both in Britain and Europe as a whole – had by the early nineteenth century almost been collectively completed. Beyond the training of apothecaries there was little scientific or taxonomical need for it. It was by this time a popular middle-class hobby but those engaged in it were for the large part making their own collections of specimens already known to science (although the task of compiling and publishing comprehensive *Flora* would take some further decades).

Any botanists wishing to identify (and name) species "new to science", and to achieve the minor fame, or, if they were lucky, the wealth, that could come with it, would need to travel beyond Europe. As we will see in the following chapters, in this period there were indeed very many Europeans botanists making collections – some of them significant only taxonomically, some significant to horticulture, some to agriculture, some to medicine and some of world-historical importance – on all continents; most extensively, and profitably, in South America, but also in North America, Australasia, Africa and all regions of Asia.

Bioprospecting as resource extraction.

In Chapter 2 I showed how the contemporary Bioprospectors of the Schultes School are fully conscious of, and work in reaction against, the history of imperialist biopiracy. Paul Cox wrote of how he works with South American nations and people in such a way that 'they realize that the colonial era is over and they are no longer to be "mined" as countries…' (Cox, 1990: 54) and Mark Plotkin states that 'the colonial/neo-colonial model of "Let's take what we need of local plants and wisdom and cart it off to the marketplace" is completely unacceptable as we enter the twenty-first century' and describes how he actively seeks to 'avoid the "rape and run" approach to commercializing natural resources that characterized much of human history' (Plotkin, 2000: 190).

The major weapon which the signatories of the CBD seek to use against biopiracy is the formal recognition of national property ("sovereign") rights to bioresources. Historically,

> 'While Europeans often recognized each other's monopolies and claims (while continuously conniving to over-power them), they tended to assume that non-European peoples had no proprietary claims to lands, resources, or knowledges. In the early modern world, the spoils of green monopolies fell to those who could police them' (Schiebinger, 2004: 17).

The CBD/CAB aims to replace a "might is right" model in which European nations and/or companies could establish monopolies on trade in particular bioresources that they procured from non-European nations with one in which the nation from which bioresources originate has the final say over whether or not "their" resources can be bought to market, and if permission is granted, to share in any economic, scientific, technological and, therefore, political, advantage that is gained.

Cox's reference to how non-European nations were historically "mined" of plant resources is an apt one, for biopiracy was in fact a means of wealth extraction which occurred at a time when Europeans established, controlled and profited from large numbers of silver, gold, tin, copper, iron and many other types of mines – to which should be added large numbers of logging operations – in the colonies.

Brockway was surely right to 'emphasize the continuity, from the sixteenth to the twentieth centuries, of the European manipulation of Latin American raw materials – first precious metals, then, after the mid-nineteenth century, precious plants' and has no difficulty in showing that 'Europe was mobilizing the whole expanded world to her purposes' in the colonial period (Brockway, 1979: 20). In short, European biopiracy up to the twentieth century should be understood as a specialized form of imperialist resource extraction. It has a significant place in the history of Europeans' *conquest* of both the natural and the non-European social world, as contrasted with the forms of *management* of nature and society which ecologists of the twentieth century have attempted to practice (see Chapters 8 and 9).

It would, however, be misleading to claim that *all* of the plants imported from the colonies contributed to European economic or geopolitical strength. In numerical terms it was decorative plants that were most frequently biopirated. Many commercial species arrived in Europe from the time of the first circumnavigations of the globe but 'most dramatic of all was the vast influx of exotic flowers and shrubs', which were 'infinitely greater' in number than new agricultural or medicinal plants (Thomas, 1983: 226). Thomas cites historical research which suggests that the range of plants available for cultivation in Europe went from just 200 in 1500 to 18,000 in 1839.

Far from all of these plants arrived in Britain or Europe by systematic bioprospecting. British aristocrats seeking exotics for their gardens were already in the early seventeenth century using their Naval connections to obtain them. Drayton cites a letter of 1625 from John Tradescant to the Secretary of the Admiralty forwarding a request from his aristocratic employer to '"procure all manner of curiosities from abroad"', 'which shows how early Britain's naval and commercial power was applied to natural history collecting, and how important were the concerns of princely horticulture in organizing this activity' (Drayton, 2000: 34). By 1684 such appeals had clearly found respondents, Hans Sloane wrote in that year of 'the "vast number of East and West India seeds come over this year"' (17). This indirect method of collating a large collection of tropical "exotics" by simply soliciting donations or purchasing them from the increasing numbers of Europeans who travelled to and from the colonies continued alongside the later, more systematic, efforts that were put into procuring economic crops such as tea, cotton, cinchona and rubber;

> 'the expansion of British colonial influence had been accompanied by enormous interest in tropical plants, which were dried, sent home and assembled in a private herbaria. When Sir Hans Sloane amassed his vast accumulation in the early eighteenth century [which is now held in the British Museum]... he did it by buying up the collections of scores of individuals, apothecaries, merchants, sea captains, ships' surgeons and foreign naturalists' (Thomas, 1983: 271-272).

Although it did not have the geopolitical or biopolitical impacts of the "major" cases of biopiracy we will look more closely at the largely horticultural trade in "minor" biopirated specimens in the remainder of the chapter because of its importance to the commodification of botanical specimens. As Drayton concludes on the subject; '*By the seventeenth century, a sophisticated international market in exotic plants was already emerging*' (2000: 33, my emphasis).

Bioprospecting in the period was not confined solely to plant specimens. Animals were sought and collected *en masse* too, and, like their botanical counterparts, were symbols of wealth and power and objects of trade and commerce:

'Since the twelfth century the kings of England had collected lions, leopards and other ferocious beasts ... The royal menagerie symbolized its owners' triumph over the natural world... With the growth of European exploration and discovery, the import of rare species from every part of the world for private menageries assumed unprecedented proportions... in the seventeenth century a collection of colourful birds became a standard feature of every aristocratic garden, and there were many specialist dealers in exotic species...' (Thomas, 1983: 255).

The procurement of such animal specimens was another "minor" form of bioprospecting in the colonial period.[26] Animals were also considered potentially useful, in the sense that they could form new domestic herds, or be used for breeding with existing ones. In 1827 the Zoological Society, made the following appeal to anyone travelling outside Europe '"Living specimens of rare animals, and particularly of such as may possibly be domesticated and become useful here will be much valued by us"', and although it did receive living animals the Society still was 'forced to buy stock' (cited in Brandon-Jones, 1997: 159). Animals, as well as plants were internationally traded as commodities long before the CBD/CAB endorsed the trade.

While the parasitic method of obtaining random specimens from the colonies, exemplified by the Zoological Society's public appeal, Tradescant's appeal to the Navy and Sloane's purchase of sailors' collections, could be effective, 'the successful search for useful or beautiful plants, and the introduction of exotics into local agriculture, depended on colonial botanic gardens and on sending out men with expertise in collecting and culture' (Drayton, 2000: 108).[27]

As we have seen, bioprospecting at home was primarily concerned with providing a source of herbal medicine to the apothecary trade. The burgeoning profession was not slow to look beyond Europe for its "simples".

> 'The opening up of the New World intensified the search for plants which were medically useful; and it was in so-called "physic gardens" that the new species were cultivated. The practical utility of the plant world to mankind provided the botanists with their essential organizing principle' (Thomas, 1983: 53).

There is no place here for a discussion of whether such "medicines" had real or imagined properties or whether they in fact did more harm than good. What is important is that they were sought, traded and were felt to be a possible source of great wealth; 'The search for new and profitable drugs in the eighteenth century was not unlike bioprospecting today. Then as now, the European search for effective pharmacopeia was fuelled by the vast fortunes to be made' (Schiebinger, 2004: 73).

However, it is well established that the only "major" case of biopiracy involving a truly valuable medicinal plant was the illicit acquisition of the fever-easing cinchona plant, the source of quinine, widely used to lessen the debilitating effects of malaria. The story of the biopiracy of cinchona will be recounted in Chapter 5, once the rise of a capitalist trade in horticultural and herbaria specimens and the professional waged bioprospector (in the remainder of Chapter 3) and the wider imperialist aims of botanical science and the economically "minor" – but geopolitically and biopolitically significant – cases of biopiracy have been discussed (in Chapter 4).

Bioprospector's loss of life and loss of valuable collections.

The geopolitical climate was often a source of difficulty for the errant bioprospector. Wars of invasion and resistance, revolutions and coups often meant the revocation of permission to collect (or conversely such events could mean that where access to particular areas was previously impossible whole regions became open to collecting). The European bioprospector abroad was constantly at the mercy of social forces larger than him. However, the severest difficulties international bioprospectors faced were physical rather than political. Countless potential problems, which largely no longer face the bioprospector, conspired to prevent the success of bioprospecting missions; those caused by the unreliability and danger of travel across oceans, jungles and deserts and those caused by accidents, malnourishment or disease. Many men died in the physical act of bioprospecting, others suffered great loss of physical and/or mental health.

Those who survived often had their collections destroyed. As Raby put it simply, 'the wastage on all transported plants and seeds was staggering'(1996: 124). The loss of the results of months and years of hard work – the loss of collections of many thousands of specimens and/or live plants – to shipwreck, to water, cold or heat damage was a very common happening. The frustration caused by this was perhaps a fate worse than death to many bioprospectors. As Braudel described travel by sailing ship, with typical eloquence;

> 'in the shipping of the past, accidents and incidents were common coin. They made an incalculable difference to cost prices… The list of possibilities added piquancy to the expression "worse things happen at sea"; there were wars, pirates, reprisals, requisitions, and

> sequestrations; there were the vagaries of the winds which might keep a ship imprisoned in port for days, or blow it far off course; there were running repairs (leaks, broken masts, rudders); there were shipwrecks, on the coast or at sea, with or without the possibility of saving the ship; there were fires – a ship could become a floating torch, burning even below the waterline. Calamity could occur even within sight of home...' (1983: 369).

This and other dangers have led to the rise of a discourse around the "heroic bioprospector" (Short's 2004 compendium of extracts from such "heroic" bioprospectors was expressly conceived as an extended obituary for many of them). From the very beginning of European exploration there was a market for travel writing, a genre notoriously rife with exaggeration, embellishment and plain falsehood. Several bioprospectors, as opposed to just plain "explorers", found willing publishers for their accounts of their "adventures", and while they are very much alike – filled with almost stock accounts of being eaten alive by mosquitoes, leeches, ants, of being confronted by bears, alligators and lions – they remain an appealing genre. They have indeed attracted considerable academic interest, revelatory as they are of attitudes that moved from the initially curious, to the increasingly derogatory and ultimately disgracefully racist attitudes of the extant European travelling in the colonies and the Old World (see Chapter 7 for more on this).[28]

It is with some regret that I have had to exclude from my thesis a great deal of research I have made in this area . This regret is partly personal. As a boy I devoured all fourteen volumes of the children's book series written by Willard H. Price, with titles such as *Safari Adventure*, *South Sea Adventure* and (my particular favourite) *Cannibal Adventure*. Throughout the extremely repetitive series, written in the authors' extreme old age, in the 1960s and 70s in a tone of high nostalgia for the days of empire by an ex-collector of objects for museums, Price tells the story of two child bioprospectors, sent unaccompanied around the world by their father – a collector of animals for zoos – at implausibly young age in pursuit of rare and dangerous beasts. My delight in these stories as a boy has no doubt influenced my choice of thesis topic (subconsciously until I rediscovered them during the course of my research), and now repeats itself in my interest and enjoyment of the colonial-era travel narratives of such well-known bioprospectors as Bates, Wallace, Darwin, Spruce, and many others.[29]

However, although these "adult's versions" of Price's children's stories have given me a vivid sense of what the day-to-day life of the colonial bioprospector was like, they do not qualify as reliable source material. Even the most "scientific" of them must be read with an attitude of scepticism, if not outright disbelief. They have nevertheless informed my understanding of imperialist bioprospecting in relation to the arrogance and base racism of some European collectors (in contrast to those of contemporary ethnobotanical bioprospectors). It can safely be assumed that such attitudes, unlike many of the tales of heroism and stoicism, are not borne of the pressure put on their authors' by publishers to produce sensational accounts. While tales of fights with alligators, relationships with pet monkeys, and scaling sheer cliff faces in pursuit of wild flowers may be, and invariably should be, taken lightly, the attitudes of Victorian bioprospectors to their colonial "subjects" should not.

Having said all this, the discourse of heroism around the colonial era bioprospector is not entirely unjustified. It would be insensitive not to recognise that while their bioprospecting activities may by judged negatively from our historical vantage point *the acquisition of biological resources was considered so potentially profitable that men risked and indeed lost their health and lives for it.* Although my research has not involved any special effort to identify bioprospectors who have lost their lives or their collections I have incidentally come across at least twelve fatalities and ten cases of botanical collections being lost. There are, no doubt, other less illustrious and/or amateur bioprospectors whose death went unnoticed or unrecorded. The following list is compiled from sources only on British and Swedish bioprospectors. An exhaustive list would require much further research and would need to include sources on Spanish and French botany.

Francis Masson, 'Kew's first official plant hunter' (Musgrave et al, 2000: 39) made several successful plant hunting trips but ultimately died on a bioprospecting journey through Canada in 1805 (50). David Douglas, died 'in mysterious circumstances' whilst attempting to travel home from a long bioprospecting trip in North America (58). J. R. T. Vogel, botanist on board a ship, funded by the abolitionist African Civilization Society, that sailed up the river Niger, died of dysentery in 1841 (Short, 2004: 8). R. W. Plant survived an 1851-52 trip into 'the Zulu interior', 'for the purpose of collecting objects of natural history', but died of 'fever' on a repeat trip in 1858 (16-17). C. Barter, who was the 'appointed Botanist to the Niger Expedition under William Balfour Baikie' collected plants for William Hooker at Kew gardens (19) but 'died of dysentery in 1859' (26). W. G. Milne, also died of dysentery in West Africa, in 1866 (44) whilst seeking medicinal and economic plants (37). J. Arnold, while botanizing for the East India Company in Sumatra, died of fever (49). F. W. Leichhardt, who was an early ethnobotanist – 'one of the first to record the use of plants by Aborigines' – on one expedition 'very much oriented toward scientific discovery' watched one of his party be murdered by the locals, and then, on another, disappeared in the Australian outback, presumed dead in 1848 (150). George Forrest died on his fifth bioprospecting trip to China, in 1932 (116; Musgrave et al, 2000: 193). Swedish bioprospectors also succumbed as a result or during the course of their work; Johan Peter Falck, 'a crazed opium addict, slit his throat in Kazan, [Pehr] Löfling and [Pehr] Forsskål died of tropical fevers. Other now forgotten Linnaean travellers also died during their travels or returned insane or mortally ill. Still others [Carl Peter Thunberg] survived but lost large parts of their collections' (Koerner, 1994: 150).

Botanical collections, often large, probably valuable and certainly the result of much hard work, were lost in a range of circumstances (again, this list has not been actively compiled and is far from exhaustive).

Joseph Banks's first batch of collections from Australia and New Zealand on Captain Cook's 1768-71 *Endeavour* voyage suffered – as Banks put it, '"many [specimens] were savd but some intirely lost and spoild"' – when the ship struck the Great Barrier Reef (cited in Musgrave et al, 2000: 30). The Banksian bioprospector Francis Masson lost two collections on the same trip to the Caribbean in 1779-1780, the first on Grenada after he was conscripted into fighting (unsuccessfully) against French invasion, and the second when a hurricane on St. Lucia destroyed most of the island, including all his specimens. After this double disaster he sailed home 'in a state of utter dejection' (Musgrave et al, 2000: 48). Robert Fortune, who was responsible for the illicit transfer of tea plants from China to India (see Chapter 5) lost some of his collections to storm and others to theft (110-111). R. W. Plant, in the Niger region in 1851-52 abandoned much of his collection due to the death of his oxen (Short, 2004: 16-17). C. Barter, lost much of his collection as a result of damage sustained during a shipwreck (20). H. O. Forbes recounts 'a heart-breaking episode' in which much of the 'botanical collection' he made in Sumatra was lost to a fire in his camp (105). G. Forrest, during an escape from violent locals in Tibet, as he described it:

> '"lost nearly all the results of a whole season's work, a collection of most valuable plants numbering fully 2,000 species, seeds of 80 species, and 100 photographic negatives. It is difficult to estimate the value of such a loss; coming from an entirely unexplored area, probably one of the richest in the world, there was, undoubtedly a very large percentage of new species"' (Forrest, 1885, extracted in Short, 2004: 114).

F. W. Leichhardt, in Australia, after eating most of his pack animals, lost all his collections – which he claimed to amount to 5,000 specimens – when the last surviving bullock waded into a river (Short, 2004: 159). T. L. Bridges suffered the partial loss, in the mail home, of part of his collections of horticultural specimens in Bolivia (280). Alfred Wallace, at different points in his long plant collecting career lost specimens to fire and to shipwreck (Raby, 1996: 95). G. U. Skinner once lost three months worth of work collecting in North America in 1837 (Short, 2004: 266) to shipwreck, which, given that he made a staggering thirty-nine transatlantic voyages in the early and mid-nineteenth century (268), was perhaps a fortunately low total loss.

Fatalities and the loss of collections were never unexpected events. Insurance was available against both eventualities. In the case of the former, the usual arrangement for Kew gardens' collectors was for a nominal sum be paid to the bioprospector 'for expenses in the field', while 'the rest of the proposed salary, [for example] £150, would be saved on behalf of the men either to be conferred as a large cash gift if they returned alive, or passed on to their dependents if they perished' (Drayton, 2000: 140). And while the loss of collections was frustrating in the sense that it represented so much hard work, the wise bioprospector – such as Wallace –

was well insured and was at least financially recompensed for their lost specimens (Raby, 1996: 95).

So, as well as showing that the discourse of the "heroic bioprospector" is not entirely unfounded, the above accounts have shown that travelling the world with the aim of collecting plants and herbaria specimens was understood to be so potentially valuable that men would risk their lives and health to that end, and also that plants and herbaria specimens could be, and commonly were, insured for relatively large sums of money as if they were so many commodities.

Nurserymen, specimen dealerships and professional bioprospecting.

We have seen above how, from the 1830s there formed in Britain a kind of commodity exchange for herbaria specimens and seeds of indigenous British plants. We will now look at how from the same period there was a well-established market for tropical horticultural plants ("exotics"), especially among the British (and European) aristocracy, and, by the end of the nineteenth century in the United States. Dealerships in botanical specimens and a small class of "professional plant-hunters" are exemplary phenomena of the ways in which biological resources gradually came to be sought and traded as commodities. The stock of such specimen dealerships and the bread and butter of the men who collected them, were, by the terms of 1992's Convention, both derived from acts of biopiracy. In the cases discussed in this section, the host nation neither granted permission for the collection and transfer of specimens nor shared in any benefits thus accrued.

Although the bioprospecting discussed in this section often did occur in territories or nations that were under European colonial/imperial rule, they should be considered "non-imperialist" insofar as they did not generally contribute anything to a

European nation's economic or geopolitical advancement. While they were not as economically or geopolitically valuable as the "major" biopirated resources (cotton, tea, cinchona and rubber), the "minor" acts of biopiracy made by professional plant hunters remain significant in that, first, they contributed to the history of biopiracy and resource extraction that today's Bioprospectors seek to avoid the continuation of, and second, they contributed to the commodification of biological resources.

We've seen above that there was a British national market in horticultural plants from the seventeenth century. This early trade was based mostly around London; 'In the 1690s there were at least fifteen nurseries in the London area' but 'by the early eighteenth century there were more provincial firms in existence' (Thomas, 1983: 224) and 'there was also a great deal of direct trade with the continent as the nobility and gentry did much of their buying in France, the Low Countries and elsewhere' (224-225). The competitive nature of gardening and rapidly changing fashions in garden plants could to lead to escalations of plant values. During the well known tulip, orchid and fern "crazes" 'vast sums [were] spent on plants and seeds' (224). In the notoriously "gardening mad" Britain 'there occurred an expansion of flower-gardening on a scale so enormous as to justify our adding to all the other revolutions of the early modern period another one: the Gardening Revolution' (224). While the biggest fortunes to be made from botanical pursuits were closely associated with the work of scientific institutions these were also horticultural institutions, Kew gardens being exemplary in this respect. The rise of the professional nurseryman, specimen dealer and plant hunter arguably had more to do with this "gardening revolution" than it had to do with any "scientific revolution".

Among those for whom botany was a vocation there were very few lucky enough to be able to practice it in a position of financial comfort such as Darwin enjoyed.

> '[T]he prolific growth of interest in natural history did not immediately translate into the kinds of career trajectories for naturalists that historians of science have traditionally stressed: in museums, government agencies and newly emerging universities. At least in the short run, the growth of popular interest in natural history outran the ability of existing institutions to absorb all of those who hoped to pursue a career in the field' (Barrow, 2000: 495).

Especially in the late eighteenth and early nineteenth centuries the lack of institutionalized natural history meant that 'many aspiring naturalists resorted to various entrepreneurial activities to gain financial support for their activities' (496). The two alternate but closely associated choices in this regard were to establish a plant nursery or a specimen dealership or to work as a waged bioprospector. Thomas describes the changes underway in the nineteenth century in a tone suggestive of the rather sneering attitude of many (usually already-wealthy) academic botanists towards "for-hire" plant collectors and nursery owning horticulturalists; 'ultimately *the plant-collecting business fell into the hands of syndicates of professional dealers*' (Thomas, 1983: 228, my emphasis).

Although there was a distinct split between academic botany and horticultural collecting and specimen-trading, in at least two senses, 'the boundaries between commercial and scientific naturalists were quite fluid' (Barrow, 2000: 497). First, in that some waged bioprospectors also formulated significant scientific theories in the course and as a result of their collecting work (Alfred Wallace being the outstanding figure of this type). Secondly because specimen dealerships took on some of the roles of the university or museum; their funding of bioprospecting had the effect of 'encouraging and training new generations of collectors' and 'supplying and helping to fuel the museum movement in the second half of the nineteenth century' (497).

Barrow's sympathetic study of the specimen dealer is an implicit argument against the rather cynical Allen, who emphasised

> 'a *rampant commercialization* with distinctly unsavoury fringes. Alongside the taxidermists and the small, specialist suppliers of naturalists' equipment there now appeared a new breed: the natural history dealer, the sharp middleman whose salerooms became a favourite resort for the new kind of customer – the dead-insect collectors, the wealthy purchasers of new sets of botanical exsiccatae (like Henry Fielding and Charles Bailey, whose insatiable urge for amassing forced each to acquire an extra house, simply to hold their enormous collections) and all the other assemblers and re-assemblers of the fruits of other men's searching and field expertise… the specimens that changed hands were commonly unlocalized – or, if localized, of questionable provenance – so that any scientific value they might have had was thus unfulfilled' (1994: 169-170, my emphasis).

Allen goes on to describe how, among various anti-scientific practices in the specimen trade, there was outright deception; 'Some of the dealers were indeed dishonest – to the extent of importing quantities of insects at a cheap rate from France or Germany and claiming that they had been caught in Britain' (170).

The extra-scientific trade in zoological specimens had morally dubious aspects of a different sort. In the botanical specimen trade nurseries and dealerships, as we will see shortly, found it necessary to procure the raw materials of their trade by directly funding aspiring botanists to bioprospect for them. But stocks of zoological specimens arrived on the market with less effort; directly from the "hunter's bag". The nineteenth century was a time 'when virtually any sportsman who travelled any distance beyond established European habitation, and who bought back trophies of the trip, could easily provide eager museum workers and menageries alike with novelties' (Brandon Jones, 1997: 158-159). Here too, the lines between scientific and non-scientific institutions, though real, were not impermeable; 'The establishment of natural history museums and the popularity of zoological gardens gave a veneer of scientific legitimacy to *a trade in live and preserved exotic animals that originated in the much older sport of wild-fowling and big-game hunting.* The hunter's bag became a sought-after – and fought over – source of undiscovered species' (158, my emphasis).

A common career trajectory for those who amassed the largest and most valuable botanical collections was to start out, as a youthful botanist, bioprospecting abroad, and then to use this initial collection, as Schiebinger phrases it, as "biocapital" (2004: 58). Some specimens were traded for others and duplicates were sold for cash, which then bought other people's collections, which were then in turn broken up to trade or sell. Both Hans Sloane, in Britain and Nathaniel Ward, in the United States, in the eighteenth and nineteenth centuries respectively, amassed large collections in this way, with the former using his wealth to buy his way into the scientific community and the latter making a healthy living by supplying American museums and wealthy businessmen. Collections that were used for educational purposes, at best, and at worst for nothing more than display, were worth what seem now inordinately large sums of money. Sloane, after an initial bioprospecting trip in Jamaica, ultimately could boast a collection worth (or costing) fifty thousand pounds in the 1750s (58-59). Ward, perhaps the most successful commercial botanical specimen dealer in America, after selling some of the results of the collection he compiled in the Middle East and Africa, eventually accumulated and sold specimens worth three quarters of a million dollars in the mid- and late-nineteenth century (Barrow, 2004: 507).

Specimen dealerships were not isolated concerns; 'By the end of the nineteenth century, more than a hundred specimen dealers were plying their wares to collectors across the United States' (502), and neither were they small or narrowly focused. Ward's American dealership was something like a private version of Kew gardens, with an 'extensive collectors network' (507). Another American natural history business, "Frank Blake Webster's Naturalist's Supply Depot" (510) '...claimed to be in regular contact with "1,000 taxidermists and 4000 collectors" across North America' (512). Connections and clients were international too. Just one example of the ambitious scale of privately funded and commercially inspired bioprospecting expeditions was 'an 1897 trip to the Galapagos Islands', funded by Walter Rothschild 'the wealthy British eccentric who was amassing one of the world's most important natural history collections at his estate in Tring Park outside London' and conducted by Frank Webster's American enterprise; 'Two men died on the trip', but it returned with: '3075 bird skins, 400 birds eggs, 13 seals, 150 iguanas, 65 tortoises (many of which were still alive), 40 tortoise eggs, 8 turtles, 6 centipedes and several hundred lizards and marine invertebrates' (515).

Barrow cites 'the ornithologist Elliot Coues' to exemplify the general attitude of natural history collectors in the nineteenth century, who, when asked by the bioprospector in his employ '"How many examples of the same bird do you want?"'

replied "*All you can get*...Bird Skins are *capital*" (cited in Barrow, 2004: 523, original emphasis). The precisely contrary advice, which shows that like all markets, it was open to manipulation, was given to the Kew bioprospector Archibald Menzies who, when asking an anonymous colleague how many examples of particular specimens he should put up for cash sale was told, perhaps wisely: 'never to bring more than half a dozen of any rare shell he might find, as that number would always bring home more [profit] than any greater quantity' (Drayton, 2000: 140). Whichever particular strategy the botanical businessmen might prefer, *botany was big business*.

Specimen dealing was, like any other capitalist business, susceptible to the general condition of the economy: 'When the economy was strong, maintaining a steady inventory of merchandise remained a constant challenge', but when it 'languished... dealers were often forced into bankruptcy' (Barrow, 2004: 522) Nevertheless, it was this "rampant commercialization" and this 'economic calculus that undergirded the commodification of nature' in the nineteenth century specimen trade (524).

The same merchant's logic operated in the nursery trade.[30] The most common and taken-for-granted garden plants of contemporary British and American gardens are generally recognised to have originated elsewhere in the world (my own modest garden contains plants which I know to have originated from four continents without having specifically researched their origin). But few of the millions of people who shop at the many modern nurseries ("garden centres") of Britain put much thought to how these plants actually first arrived there. To cut the very long story of the arrival of thousands of decorative plant species in the contemporary garden very short; they were bioprospected.

The specific histories of each plant would have to be studied to assess the percentage of transfers of garden plants that should be classed as biopiracy but I do not think it too risky to suggest that it would be a high one. However, it is rather more risky to describe the acquisition of this form of botanical goods as a "minor" form of bioprospecting/biopiracy. Given the thriving and economically significant contemporary trade in garden plants it is very possibly a mistake to do so. Further, the transfer of horticultural plants certainly had dramatic effects on British/European/ American ecology. However, it is certainly not a trade that has any significant geopolitical or biopolitical effects. For this reason, despite the possibly multi-billion pound value of the trade in garden plants that were, in the majority, illicitly acquired, I will adhere to my classification.

Just one example from the large literature on the topic will suffice. One of the earliest, and ultimately horticulturally influential British nurseries was Veitch's. 'The impact that the Veitch dynasty had on horticulture is worth a book in its own right, but for the purposes of this story their key role was the dispatch of twenty-two plant hunters to collect exclusively for the Veitch dynasty. This far-sightedness proved to be very profitable' (Musgrave et al, 2000: 134). The practice began in 1832 when

> 'John Veitch's thoughts turned to employing his own plant hunters to gather exotics exclusively for the nursery. This was sound business acumen, for if a plant hunter sent back bulk quantities of seed of species already introduced but still rare, this would enable the nursery to sell exotics at an affordable price. Also, if the expedition was carefully targeted, there was the strong possibility that the plant hunter would send home valuable new species that would both command a premium price from the gardening elite and

offer scope for plant breeding, with any successful hybrids also commanding a high price' (136).

While aristocrats had been employing bioprospectors to make collections for their private gardens and more empirically inclined botanists had employed "researchers" to collect specimens for some time the precedent for commercial horticultural bioprospecting/biopiracy was set by Veitch's nursery. William Lobb, who was employed by Veitch, sailed to Rio in 1840 and 'visited the monkey puzzle forests [of south Chile] to collect seed' (137), he sent 3,000 seeds in the first package, 'and by 1843 Veitch was offering seedlings at £10 per 100', the tree 'was an instant hit… this single, early introduction confirmed that the policy of sending out plant hunters was a commercial success' (136-138). While it would require further research to be confirmed, it is extremely unlikely that Veitch, or Lobb, sought or were granted "informed consent" for the acquisition of the seeds from the newly independent Chilean government. Other nurseries followed suit and 'By the mid-nineteenth century, commercial nurseries, foremost among them the Veitch nursery, had come to recognize the profits that could be made from plant hunting' (10), that is, the profits that could be made from horticultural biopiracy.

The economic model for profiting from botanical specimens was of a peculiarly archaic form. In the age of industrial capitalism specimen dealers were continuing to operate with the money-making logic of the Middle Ages. As Braudel wrote of sixteenth and seventeenth century long-distance trade (which he controversially defined, contra Marx, as already a form of capitalism); 'The capitalist game only concerned the unusual, the very special, or the very long distance connection' (1983: 456). Bioprospected bird skins, sea shells, or ornamental plants were indeed, to a specialist collector, unusual and special; their value derived simply from their being obtainable only in distant lands – as did the value of spices and metals. Then, as in the late nineteenth century (although technological change would soon lessen the opportunities for profit of this sort) 'supply and demand [were] so effectively separated that the terms of trade were entirely dictated by the middlemen, who alone knew the state of the market at either end of the chain' (416). As we've seen briefly in the advice given to Menzies, the old merchant's wisdom of deliberately keeping goods rare was not forgotten.

The money to be made by natural history's middlemen resulted from the simple fact that 'When goods travelled, they naturally increased in price the farther they went' (168); their value derived from, as Braudel put it, the 'differential geography of profit' (432). Braudel's merchants travelled to the location of products (often, but not always, natural, and ideally not too bulky) that were rare in Europe but commonplace at their destination. They operated with the proverbial "buy low, sell high" logic; they did nothing to enhance the goods they traded, they did not attempt to manufacture more sophisticated products with them. Late nineteenth century bioprospectors did the same – choosing either to sell their collections in bulk to middlemen in nurseries or specimen dealerships – or to arrange buyers – "subscribers" – before they left and to sell specimens individually upon their return. Profitable as it could be, there was nothing innovative or ingenious about the "minor" bioprospecting business' basic logic.

As we will see in Chapter 4, the reign of George III over Britain and Joseph Banks over British botany was a time in which "scientific" bioprospecting was established and Kew collectors made forays around the world in pursuit of plants. But after the death of George III and Banks early in the nineteenth century Kew gardens, as all its historians have noted, went into a period of relative decline. The expensive European and colonial wars of the period made expenditure on bioprospecting seem frivolous. 'During the reigns of George IV and William IV, horticultural amateurs who initiated and funded missions in collaboration with public bodies, became the principal sponsors of scientific exploration' (Drayton, 2000: 139). 'While the treasury forced the recall of [two Kew collectors] Bowie and Cunningham, the Horticultural Society sent out many collectors at the expense of its members, to China, East and West Africa, Brazil, Mexico, and Central America' (133). In this period botany was funded primarily by the patronage of amateur horticultural societies, such as the Royal Horticultural Society, professional specimen dealers such as Ward or Webster, or nurserymen such as Veitch. None of these enjoyed high reputations among the small academic botanical community of the day.

In France, at the turn of the eighteenth century, John Baptiste Aublet 'complained that his compatriots in the colonies were in it only for the money. This, he professed, was not what motivated true naturalists. It should be enough for them to have "the satisfaction of being useful, and if successful, a little celebrated."' (cited in Schiebinger, 2004: 56). John Lindley, in the mid nineteenth century in Britain, was not the only self-respecting botanist to feel slightly ashamed that such a princely pursuit should be conducted on terms of employment that were essentially the same as the waged labourer, and whose object, in contrast to the grander economic and colonial aims of the Banksian bioprospectors of the late eighteenth century, was lowly garden plants. He 'in particular, understood that the way in which he and his colleagues earned their bread was damaging the scientific reputation of botany' (Drayton, 2000: 147), and several of his contemporaries (whose bioprospecting work is detailed by Drayton) felt that 'Botany's connection to horticulture was clearly costing it its intellectual dignity' (143) Collecting for a living remained 'socially degrading employment' into the late nineteenth century (Barrow, 2000: 145).

Not all aspiring botanists in the nineteenth century were able even to secure waged bioprospecting work, not even those working on major theoretical problems in botanical and zoological science. In fact, two men who ultimately achieved illustrious positions and scientific fame began their careers with a risky and unprecedented venture in self-employed bioprospecting. Henry Bates and Alfred Wallace met in the early 1840s at Leicester library and 'became friends and went on beetle-hunting trips together' in the local countryside. In autumn 1847, Wallace proposed to Bates a 'joint expedition up the river Amazon, for the purpose of exploring the natural history of its banks; the plan being to make for ourselves a collection of objects, dispose of the duplicates in London to pay expenses, and gather facts, as Mr Wallace expressed it in one of his letters "towards solving the problem of the origin of species"' (cited in Raby, 1996: 78).

> 'Bates, Wallace and Spruce belonged to a new breed of scientist. They were not sponsored directly by the government, or like Huxley or Darwin, attached to Royal Navy survey ships, they were not salaried, like the plant-hunters employed by the nurserymen, or even promised a reward on their safe return... They were scientific entrepreneurs, trading in beetles and birds and monkeys and dried plants, who needed to collect extensively even to pay their expenses... The British Museum assured them there would be a good market for their collections. They made arrangements with a London agent and dealer, Samuel Stevens...' (Raby, 1996: 79).

Wallace and Bates eventually split up, with Bates remaining to continue his (mostly) entomological collecting in the Amazon and Wallace heading off to South

East Asia, where he famously worked on and wrote his version of the theory of natural selection. Although Bates was able to make a living from his bioprospecting vocation he had, it seems from Raby's figures, in economic terms, perhaps chosen the wrong specialism – there was a less lively market for mounted specimens of butterflies, ants and beetles than there was for botanical and zoological specimens; 'Bates' profit for one twenty month period was just short of £27' (81), while just one of Wallace's shipments, despatched in 1856, contained 'five orang-utan skins in arrack, and a box that contained sixteen orang skulls and two skeletons... Wallace hoped for £250 or even £300 for the series... there were 7,000 insects – 5,000 for sale and 2,000 "private" – 60 bird skins, mammal skins, reptiles and shells' (155). Subsequently, in 1857 Wallace spent his 'most productive and happy period... on the Aru islands... [which] provided him with his most extensive and valuable collection: 9,000 specimens, of about 1,600 distinct species, whose sale financed his researches for a further five years' (156).

There were many other self-employed or waged bioprospectors who travelled outside of Europe, often for long periods of time. The lady bioprospector Maria Sibylla Merian, in the late seventeenth century

> 'joined commercial interests to her scientific voyage... Merian sought other varieties of caterpillars in Surinam that, like silkworms, might produce fine thread. Silk was, in this period, big business... In Surinam Merian found one potential silkworm... though she never brought this anticipated moneymaker into production. [Further, h]er commercial interests in Surinam focused on supplying the specimen trade back in Amsterdam' (Schiebinger, 2004: 34).

David Douglas, who named the famous fir tree, bioprospected for years on end in the 1820s and 30s 'on behalf of the Horticultural Society'. His trips were 'paid for by subscriptions from some of its wealthy members, who in return received seed of the new, exotic, and rare plants found on the expeditions. This policy of allocating the new plants to a privileged few in exchange for funds to send out plant hunters worked very well...' (Musgrave et al, 2000: 73).

T. Drummond left his position at Belfast gardens 'to become a botanical collector. Financial support was provided by the Edinburgh and Glasgow botanic gardens, and by private subscribers, the last of whom paid two pounds per 100 specimens... Drummond returned to North America in April 1831, and William Hooker received specimens and letters from him for several more years' (Short, 2004: 226).

Similarly, Richard Spruce, 'one of the most autonomous' Victorian scientists, (who we will meet again in Chapter 5 in connection with Kew's biopiracy of cinchona seedlings),

> 'obtained the precarious security of eleven firm subscribers for his [Amazonian] specimens: this was later increased to thirty, as the value and precision of his collecting became established. Financed solely by the sale of specimens which he would export back to England, he embarked on an expedition which would extend for an astonishing fourteen years' (Raby, 1996: 99).

While in the mid nineteenth century, at home, the "fern craze" saw many botanical entrepreneurs scouring the remoter corners of Scotland to supply the demand in Victorian cities (Allen, 1994: 124), T. L. Bridges; another professional bioprospector, 'collected plants and animals for various societies and wealthy individuals in Europe', including for the Earl of Derby. He collected in Chile, Panama and Bolivia (Short, 2004: 279).

At the turn of the twentieth century, George Forrest was privately funded to collect in China, near Tibet, in 1903-04 by 'a wealthy merchant' (Musgrave et al, 2000: 179) and M. Koch offered his services as a bioprospector in Australia to Kew in 1899, whose Director, Thiselton-Dyer, accepted, but paid only £1 per hundred herbaria specimens (Short, 2004: 192).

No one, though, could match the record set by Frank Kingdom-Ward, who 'was the longest serving professional plant-hunter, exploring Asia's mountains [especially Burma, Tibet, and Assam] for forty-five years' (Musgrave et al, 2000: 199) in the early and mid twentieth century.

Remarkably, the paths of professional bioprospectors could sometimes cross, thousands of miles from home. These marauding botanists would get into squabbles over "their territory" in much the same way as the European colonial powers did. Raby cites William Hooker to the effect that a particularly orchid-rich area of India was 'swarming' with British bioprospectors working on behalf of nurseries.

> '"What with Jenkins' and Simon's collectors here, twenty or thirty of Falconers', Lobb's, my friends Raban and Cave and Inglis' friends, the roads here are becoming stripped like the Penang jungles, and I assure you for miles it sometimes looks like a gale had strewed the road with rotten branches and Orchidae...". Hooker steered away from the plundered orchids and concentrated on more elusive plants' (cited in Raby, 1996: 146).

Others were less tactful. George Forrest, on a 1917-1919 trip sponsored by the Rhododendron Society

> 'was so successful that he collected over 300 new species... During these years other plant hunters, including Frank Kingdom-Ward were also exploring north-west Yunnan, much to Forrest's annoyance. Although he did not hesitate to follow in their footsteps, he became irritated when they encroached on his "territory"' (Musgrave et al, 2000: 193).

The many "minor" acts of biopiracy that constitute the careers of so many European botanists, as detailed above, that gave rise to the specimen trade and long careers as professional collectors were an important episode in the process that culminates with the Convention on Biodiversity's recognition of biological goods as property. The nursery trade, specimen dealerships and the professional – salaried or self-employed – bioprospector were all sustained by many "minor" acts of economic biopiracy. Collectively these acts helped individuals amass private fortunes and although they had no significant geopolitical or biopolitical consequences they are of considerable historical and sociological significance in that they 'tended to reinforce the idea that nature was nothing more than a resource or commodity' (Barrow, 2000: 523).

Conclusion to Chapter 3.

To recap: Chapter 3 takes as its foundation the contemporary international governmental consensus that biological resources are and should be treated as commodities over which national governments have sovereignty and first claim to. The CBD/CAB is an agreement to this effect. The Convention states that the removal of biological specimens should occur only with the permission of national governments and that governments have a legitimate claim to financial compensation for them. These are the material-economic aspects of the Convention on Biodiversity. In the historical cases discussed above, national sovereignty over bioresources was neither recognised or respected.

Chapter 3 has discussed the "non-imperialist" financial profits to be made in and through biopiracy. The above material on the nursery trade, specimen dealerships and professional careers for bioprospectors has been intended to show that, while some contemporary critics (as detailed in Chapter 10) argue against the Convention's positing of natural resources as private property (in what I call the common heritage critique) and act as if this is a novel twentieth century phenomena, they have in fact been treated as such since at least the eighteenth century. Chapters 4 and 5 discuss the imperialist acquisition of biological resources, and how these acts had geopolitical and biopolitical intentions and consequences, some "minor" and some "major".

Chapter 4. Imperialist biopiracy: Geopolitical and biopolitical aspects.

Linnaean and Banksian schools of bioprospecting.

As briefly outlined in Chapter 3, the first organized "school" of bioprospecting was that based at Uppsala University around the work of Carl Linnaeus (for which he was ennobled). On his travels within Sweden Linnaeus developed what we would now call an ethnobotanical method in the identification of potentially useful and valuable plants. His success was limited. None of the bioprospecting projects he engineered succeeded, largely because he greatly overestimated the ability of tropical plants to grow in near-arctic conditions. However, he is of great importance for several reasons. First, because he was the first to recognise the potentially enormous contribution botanists could make to a national economy and reputation. Second, because, like the more successful Joseph Banks, he sent large numbers of students long distances in the pursuit of economic crops. Third, for his innovation of ethnobotanical methods of bioprospecting. Fourth, because his construction of the famous classification system shows just how heavily influenced European botanical knowledge was by European exploration, imperialism and colonialism (a detailed account of this constitutes Chapter 7).

To Linnaeus, economics and bioprospecting were virtually synonymous. In his own words: '"the task of economics is to collect from other places and cultivate such things that don't want to grow [at home] but can grow [there]"' (Koerner, 1994: 147). He understood himself primarily as an economist, not a botanist (149), specifically a cameralist economist. Cameralists, including, perhaps *especially*, Linnaeus, believed that 'increased productivity would replace territorial conquest' (148). Linnaeus's preferred means of increasing productivity and reducing Sweden's expenditure on foreign food stuffs and luxuries was to establish Swedish tea, silk, tobacco and other industries. In order to do this the plants from which to base these new agricultural industries needed to be sought and returned to Uppsala. Hence the need for a Linnaean school of bioprospecting. All very logical, if only these crops were physically capable of growing in northern Europe's climatic conditions.

Linnaeus turned down a botanical post in Surinam in 1737, and in fact

> 'never left Europe, but conducted large-scale trade in plants through far-flung colonial networks... his extensive taxonomies depended on the colonial enterprise. By the end of his career, in fact, Linnaeus sat at the center of a vast scientific empire... [H]e received specimens and news of new discoveries from some 570 Swedish and foreign correspondents' (Schiebinger, 2004: 57).

Linnaeus 'termed his correspondence network' 'the international "Botanic Republic"' (Koerner, 1994: 146). To supplement the specimens he passively collected via his "Republic" Linnaeus called on all his contacts and ingenuity to amass the funds necessary to buy his students passage to those territories where the cash-crops he sought to establish on farms in Sweden were native, and thereby actively procure them.

> 'Linnaeus solicited travel funds for his travelling "apostles", as he styled them, from the Levant, Greenland and East India trading companies; the Bureau of Manufactures, the Academy of Sciences; Lund and Uppsala Universities; the estates, the cabinet of ministers,

and the court: as well as from individual patrons. He even staged public lotteries' (149).

From 1745 Linnaeus sent no less than nineteen students on long-distance bioprospecting voyages (149). Each of the Linnaean bioprospectors was issued with 'individualized wish lists of plants, animals and technologies that he variously called "orders", "instructions", and "memorials"'(150). The living things which Linnaeus directed his students to seek included, coffee, tea, saffron, various 'Chinese herbal medicines', opium, 'Mongolian rhubarb (at the time a universal medicine)', cinchona, guinea pigs, marijuana, chestnuts, walnuts, sugar maples, almonds, olives, yams, maize, rice, cotton, merino sheep and angora goats (154-155).[31]

While they perhaps seems slightly comic to us now, Linnaeus' plans for substituting imports with home-grown Swedish cash-crops were taken very seriously in his own era. His proposals were respected by the Swedish elite, both in academia and government. When he was awarded the Swedish Academy of Science gold medal 'it was not for his classificatory science' but for these very schemes for side-stepping the need for a Swedish imperialist crusade by collecting together the world's most valuable crops and growing them on a large scale on the Swedish mountainsides (159). His ideas seemed plausible to fellow Scandinavians too. The Danish king closely imitated Linnaean practices and had a specially formed botanic garden send out its own bioprospectors and botanical surveyors 'with the aim of renovating the national economy through the introduction of valuable plants' (Drayton, 2000: 73).

In short, while it is inaccurate to refer to Linnaean bioprospecting as "imperialist", Linnaean botany-as-economics certainly had the same aspirations to achieve national wealth and power as its British, French, Spanish and Dutch equivalents. Systematic and organized bioprospecting, in Linnaeus's original

Swedish version, aimed 'to render ecological divisions – and hence mercantile colonies and free trade – economically irrelevant' and sought to 'short-circuit the economic modernization in the process of being achieved by Holland and England through international trade' (Koerner, 1994: 162).

Britain's Joseph Banks has become known as 'the father of modern plant hunting' (Musgrave et al, 2000: 13) and such like (he was knighted for the value of his work to the British empire). I have no interest in heaping further accolades on a man who inherited half of his sickeningly large fortune from his grandfather's dubious activities in the West Indies and made the other half of it from the collection of exorbitant rates from the peasants who tilled the fields of his estates. However, he is indeed an important figure in the histories of botany, bioprospecting and the British empire. His biography, achievements and ideas have been discussed at length elsewhere.[32] I will confine my account to those matters relating directly Banks's involvement in imperial bioprospecting.

Banks procured plant specimens from around the world in the same two ways as Linnaeus – by having his correspondents send them to him, and by organizing bioprospecting missions on which specific plants, especially potentially economic plants, were sought. However, unlike Linnaeus, Banks never held an academic post. When I refer to the "Banksian school" of bioprospecting I am referring to an informal sphere or network of influence. Through his high social position, as confidant of George III, and his (increasingly formal) role as head of the royal gardens at Kew (which were opened to the public in the mid nineteenth century), his influence on his juniors was arguably actually greater than that of Linnaeus on his. His career has been concisely summarized thus;

> 'Under Banks's careful manipulation Kew was slowly transformed from a royal pleasure ground into a research-oriented botanic garden. He used his broad network of social contacts, his reputation within the scientific community and his friends to ensure a supply of new plants from around the world, backing up this somewhat random strategy by sending educated botanists to remote, unexplored parts of the Crown colonies with specific instructions to find and bring back new material. This latter policy is the reason why so many wonderful garden plants arrived in Britain and why so much controversy has arisen about Banks. For as well as ornamental introductions, the plant hunters sent back economic crops, and Banks quickly saw the benefits of exchanging commercial crops among colonies. His single-handed establishment of economic plant transfers played a vital role in Britain's emergence as a world power' (Musgrave et al, 2000: 34).

Musgrave then goes on to acknowledge that his work 'led directly to the exploitation of human and natural resources… [and that] his plant transfers brought misery to others' but rather pointlessly apologises for him; 'this was not his intention' (34-35).

Banksian bioprospecting, in numerical terms, contributed mostly to horticulture; his 'world-wide plant hunting programme' and his 'policy [of sending] out professional plant hunters… is credited with securing the introduction of over 7,000 new species', most of them decorative (10). This is not insignificant, because, as we saw in Chapter 3, the trade in the decorative plants returned home by the newly professional Banksian bioprospectors was a lively and profitable one and an important episode in the commodification of living materials.

However, it was Banks' role in forming the policy and nationally important role of Kew gardens, especially its work in establishing colonial plantations, that had the most economic, and, as we will see, geopolitical and biopolitical impact:

> 'By the 1780s, Sir Joseph Banks began to turn Kew into "a great botanical exchange house for the empire"...[later] it became a central institution of both Victorian science and the British Empire. It helped entrepreneurs to plant empires of sugar-cane, cocoa, tea, coffee, palm oil and rubber on which the sun has still not set' (Drayton, 2000: xiii).

Not incidentally, imperialist institutions such as Kew, and its equivalents in Holland, Spain and especially France, were, by the beginning of the nineteenth century, already approaching the status of "global" institutions and are arguably among the first to be able to accurately claim this title. It is a common mistake among historians to refer to the "global networks" that the European gardens were the "centre" of. A network in the contemporary sense is defined precisely by its lack of a centre. Kew and its equivalents were in fact the head of botanical and colonial *hierarchies* rather than networks. However, it is no mistake to say that they did in fact have contacts on every inhabited continent and were already global. Banks was arguably one of the first men to be living in a truly "global village". He 'could depend on amateurs at the fringes of British power to supply the King's Garden with novelties. Merchants stationed in Africa, Asia, or the New World, soldiers and naval officers on foreign campaigns, and planters in British colonies, returned seeds of strange plants' (Drayton, 2000: 46). He was, without exaggeration, in contact with 'sea captains on every ocean' (36). By the mid eighteenth century there was already a 'global trade in living things' (108).

No historian has described Kew explicitly as an agent of globalization, but all histories of Kew point to this conclusion. Kew gardens, through its colonial branches, globalized plant materials, botanical knowledge and contributed significantly to the commodification of global biological resources. This is one, but by no means the only, sense in which imperialism should be understood as an early stage of globalization.

It is perhaps difficult for us today to understand the close connection of biological material, and knowledge of it, to national wealth and power, living as we do in a society in which wealth derives more often, and certainly most visibly, from industrial, and even immaterial goods, but it is symptomatic of the widespread recognition in the early colonial age that botanical goods were the source of wealth that 'Governors and other senior colonial officials corresponded with special energy' to Banksian appeals for any and all new or unusual biological specimens (46).

No one was more convinced than Banks that botany could be big business (except perhaps Linnaeus). He was directly involved in three of the four "major" cases of imperialist biopiracy that I discuss in Chapter 5. He personally recruited Anton Hove and wrote his (secret) instructions for procuring cotton seeds in India, which then formed the basis of cotton growing in the West Indies. He authored a "feasibility study" for the transfer of tea from China to India and suggested the mass transfer of cinchona from South America to India, both of which projects were implemented by British botanists decades later, and became major industries. Further, although the scheme was not pulled off, he wrote a "secret letter" to the then head of the Madras botanic garden to expect a shipment of cochineal insects (used to make red dye), biopirated from Mexico by the East India Company (which, to his embarrassment was leaked to the Indian press). He had no involvement in the biopiracy of rubber plants, but if there had been any known industrial use for rubber in the late eighteenth century he would no doubt have been quick to draw up plans for its transfer to a British colony. Depending on one's attitude to the British empire Banks was either an ingenious hero or a dastardly villain.

Banksian schemes were vastly more successful (in their own terms) than Linnaeus' because their central idea was to transplant tropical plants not from the wider world to Europe but from one tropical nation to another. But his bioprospecting method – involving learning the location of plants and their method of cultivation from local experts – and the means to which it would be put – the creation of national wealth and power – were precisely the same as his French and Swedish counterparts. Banks corresponded widely, exchanging, for example, seeds with Buffon, and 'Through Solander, Dryander and the Forsters [especially Johann], Banks enjoyed also a direct connection to the Linnaean circle and Baltic Cameralism' (Drayton, 2000: 95).[33] He 'purchased European books and periodicals extensively… He had at his disposal the most advanced Cameralist and Physiocratic treatises on the uses of botany for economic government' (96). It is likely that the latter, as well as French applications of botanical science to colonial agriculture directly inspired his bioprospecting efforts (97).

Banks was the basis of Gavin de Beer's controversial (1960) thesis that "the sciences were never at war". Banks clearly did make efforts to stay friendly with botanists from other European empires, 'no matter what Britain's relations with foreign powers happened to be at the time', however, as Mackay noted, 'This did not put him above dabbling in plans to filch the commercial products of other countries for propagation within the empire, but it did imply a need for discretion' (1985: 185).

Banks's rise to the very top of the British scientific and imperial establishment was self-funded. Although the sum was equal to a little more than just one years rent from the tenants of his estates his career began with the enormous contribution of £10,000 in 1768 toward (what has become known as) the first Cook voyage. The *Endeavour*, intended to locate the mythical "Southern Continent" and assess its suitability as a prospective colony, carried, in addition to Banks, Royal Society astronomers and two Linnaean bioprospectors (Solander and Spöring). Banks arrived home with 'a new kind of treasure': 'a thousand new species of plants, five hundred fishes, another five hundred bird skins, innumerable insects, thirteen hundred drawings and paintings, and the clothes, weapons, tools, musical instruments, and elements of ritual and language of dozens of hitherto unknown peoples' (Drayton, 2000: 67).

What Mackay refers to as "Cook's legacy" was actually Banks' legacy. Its importance lies not in the value of the biological "treasure" the *Endeavour* returned with, which actually had no significant economic value, but in the provision of 'a model and methodology of scientific exploration which could be drawn upon by subsequent explorers' (Mackay, 1985: ii). Banks' method was indeed drawn on by subsequent bioprospectors, many of whom did return with specimens that went on to have significant economic and geopolitical value.

The staffing of sailing ships with crews of "scientists" was hitherto 'an accepted practice'.[54] 'From the *Endeavour* voyage onwards the ships of discovery carried competent scientific parties intended to augment and extend the observations of the commander... [this was neither entirely unprecedented nor especially British] but from 1768 onwards it became an accepted practice, establishing a tradition running through to Darwin on the *Beagle*' (8). In short, it established the Banksian school of bioprospecting. The voyage's fame put Banks in a position to become 'England's greatest promoter and protector of science' (17).

Although there is no space for the argument here, it would be possible to argue that in this period long-distance bioprospecting was, with Banks as its vocal and institutionally well-placed leader, *the* leading British "science". "Science" needs scare quotes here because the lines between knowledge formation, wealth creation and the military annexation of territory were blurred, if not invisible or imaginary. Bioprospecting was involved in all three. Before long, Banks was consulted as an expert by both monarchical and commercial parties; 'Banks was the government's foremost advisor on colonial affairs in the period 1780-1800 and became the East India Company's acknowledged advisor on all matters related to botany and vegetable products' (22). He established a role 'as a one-man department of scientific and industrial research: to be consulted and employed on practically all matters relating to exploration, science and the colonies' (23).

Banks had intended to travel with Cook again on his second voyage, on the *Resolution*, which departed, in 1772, only a year after the *Endeavour*'s return, but partly as a result of 'the Admiralty's refusal to allow Banks to take with him a pack of greyhounds and his personal orchestra' he decided against the trip and instead sent 'Kew's first official plant hunter, Francis Masson' on the *Resolution*, to South Africa' (Musgrave et al, 2000: 39). This and other subsequent voyages were conducted along Banksian lines.

Banks himself made financial contributions to other voyages, including the sum of £1,200, to the *Investigator*. The latter voyage was in effect intended to conduct research and development for the East India Co, which was seeking '"...such things as will be useful to the Commerce of India..."' (Mackay, 1985: 5). Banks appointed the *Investigator*'s scientific crew, settled their wages, bought their equipment, wrote their instructions and arranged the equipment for transporting and storing plant and animal specimens, (19-20). The ship's miner was to look for coal, salt, copper, gold and

> 'Any new or useful products found by the botanist [Robert Brown] were to be noted; their locations and conditions of growth recorded, and live or dried specimens collected for further investigation [Brown's collections totalled 3,600 species]. The commander too was to have an eye [as Banks put it] for "anything useful to the commerce or manufactures of the United Kingdom", and to watch for valuable harbours and passages suitable for navigation' (cited in Mackay, 1985: 5).

These voyages were made on ships which we might call "Banksian technology". 'On the main quarterdeck of the ship [the *Investigator*] a solid greenhouse was constructed for the sheltering of live plant specimens' (4), 'below decks she [the *Bounty*] looked like no other commissioned ship in His Majesty's Navy. The decks were mounted with rows of garden pots and tubs, and an elaborate system of ventilation and drainage' (123). The *Bounty*, at Banks's direction, was fitted with various botanical and gardening tools, including 'a [presumably wood-powered] stove [which] was to be placed in the great cabin to keep the plants warm on the voyage around the Cape' (134). There is no object more symbolic of botany's imperialist role than a sailing ship equipped with plant pots, heated greenhouses and trained gardeners.[22]

Banks' belief was, in short, that '"furnishing a country with vegetables" was "an Obligation of the First Importance"' (162). What Banks wrote of Dr Johan

Koenig, the East Indian Company's bioprospector in Bengal in the 1780s sums up his belief in the potential of colonial bioprospecting in general; he was confident of his ability '"to repay his Employers a thousand Fold in matters of investment, by the discovery of new Drugs and Dying materials fit for the European market"' (172).

If the Banksian school of bioprospecting can be said to have a unifying ideology it would closely follow the following passage from the pen of the *Resolution*'s botanist, Johann Reingold Forster. As Forster put it, in 1772:

> '"Every true patriot will join in the wish that our East India Company, prompted by a noble zeal for the improvement of natural history… might send a team of men properly acquainted with mathematics, natural history, physic, and other branches of literature, to their vast possessions in the Indies… to gather fossils, plants, seeds and animals peculiar to those regions". Forster reminded his readers that such surveys would inevitably yield new "branches of trade and commerce" to the power which prosecuted them' (Cited in Drayton, 2000: 79).

This imperial-botanical ideology was to become, in the nineteenth century, officially sanctioned and institutionalized as the central task of Kew Gardens. Banksian botanist John Lindley, when asked in 1838 by the British Government to report on the future of Kew Gardens (whose herbaria were aggressively sought by its main rival institution, the British Museum), justified the need for a separate garden in strikingly similar terms to Forster's. Lindley referred to Kew's potential use in '"aiding the mother country in everything that is useful in the vegetable kingdom. Medicine, commerce, agriculture, horticulture, and many valuable branches of manufacture, would derive considerable advantages"' if Kew was set up as the centre of British botany (cited in Drayton, 2000: 157). Lindley appealed to Kew's potential imperial/geopolitical as well as economic benefits: 'If Kew were the national garden it "'would always be able to obtain authentic and official information upon points connected with the establishment of new colonies"' (cited in Drayton, 2000: 157).

As Drayton describes it, the Lindley Report was 'a remarkable appeal to the centralizing enthusiasms of his contemporaries...[it] amounted to the proposal that the informal empire of economic botany which Banks had created around Kew might be made into a formal bureaucratic instrument for efficient Utilitarian colonial government...[a sort of] panopticon of imperial nature' (Drayton, 2000: 157). Although Kew had been targeted as an institution that might be removed from government expenditure, Lindley's Banksian plans were 'fully endorsed' and a lump sum of £20,000 and a yearly £4,000 budget agreed in March 1838 (157).

As we will see in Chapter 5, some of the major acts of biopiracy were organized by Kew in the mid- to late-nineteenth century, and although they were not executed quite as perfectly as Banks would have liked, his successors work (especially William and Joseph Hooker's) and their execution of his and Lindley's ideas for the transfer of economic crops did make significant contributions to the British empire, both in terms of surveying territory that was later to be annexed and contributing to the founding of tea, cinchona and rubber plantations.

The inextricable connection of British botany and the British empire continued into the twentieth century. The last of the imperialist directors of Kew gardens, Thiselton-Dyer, wrote in 1899, '"I cannot control the expansion of the Kew herbarium because I cannot control the expansion of the Empire"... the expansion in the two fields is necessarily correlated"' (cited in Drayton, 2000: 264).

Banksian bioprospecting often needed to be, and was, conducted in secrecy. because, in short, 'Many attempts to procure plants clearly threatened the economies of foreign colonies' (Mackay, 1985: 185). As Raby puts it, European imperialism, 'so devastating to particular places, so amazingly diverse in operation, put into practice on a large scale what the scientific traveller did in miniature' (1996: 251). The above, then, has shown that Banksian bioprospectors had explicitly imperialist intentions. The below will show how their acts of imperialist biopiracy had geopolitical and biopolitical consequences.

The actions of biopirates (which Raby calls in too-neutral terms the "Victorian scientific traveller") whether it was 'beetles or butterflies from the Amazon, or cinchona plants from the Andes, or fish from the West African mangrove lagoons, or orang-utans pickled in alcohol from the Borneo forest, specimens for scientific purposes, or for private collections' (251) were indeed miniature acts of imperial resource extraction.

Geopolitical and biopolitical consequences of biopiracy.

Chapter 3 discussed transfers of small amounts of biological materials – herbaria specimens, zoological remains, plant seedlings and seeds – by individual bioprospectors. There, I discussed bioprospecting/biopiracy in its "non-imperialist" and "minor" sense (although, to repeat, the cases discussed remain significant episodes in the commodification of biological material). In the remainder of Chapter 4 I introduce bioprospecting/biopiracy in its broader, imperialist sense.

The cases discussed here involved much larger amounts of biological materials; many hundreds of specimens either traded in bulk for direct sale or transported for purposes of starting plantations on an industrial scale. Their economic value was such that it can be said to have geopolitical impacts on the fate of nations and empires, and, I will argue, biopolitical impacts on entire populations. When contemporary Bioprospectors and critics of biopiracy refer to the "rape and run" approach to tropical bioresources, to their "mining" and to 'the colonial/neo-colonial model of "Let's take what we need of local plants and wisdom and cart it off to the marketplace", it is more likely to be the following type of biopiracy that they have in mind than the specimen and nursery trade.

If we take "bioprospecting" to mean the work of a specific individual searching for a specific botanical or zoological specimen, on behalf of a specific individual, commercial and/or scientific individual then some of the examples in the following section cannot be defined as bioprospecting in the narrow sense. However if we take bioprospecting to mean broadly "the search for (valuable) biological resources" then much of pre-industrial trade can be considered bioprospecting. Any merchant, trading company, or government seeking to identify new sources of unmanufactured trade goods was engaged in bioprospecting.

However, in the case of biological resources being acquired for the merchant trade it is less clear whether the transfer of goods can be fairly accused of being biopiracy. If, to anticipate one of the examples to follow shortly, an Hawaiian king of the early nineteenth century is paid annually, for a number of years, $300,000 in cash for bulk quantities of sandalwood, is it right to say that the sandalwood was biopirated? No, in the sense that the "government" of Hawaii – in the person of the king – clearly gave permission for the transfer of the wood, No, in the sense that the merchants respected the property rights of the king over "his" wood, No also in the sense that considerable sums of money were expended by the merchants. By the terms of the Convention this was a perfectly legitimate trade, and should therefore be considered extraneous to my thesis. But if we ask "Was the trade of this sought-after fragrant wood exploitative?" we must answer yes, in the sense that the merchants were exploiting the Hawaiian king's lack of ability to travel to China to sell it – and presumably selling the wood for a much larger sum than they had paid for it, and yes also in the sense that the Hawaiian king presumably employed some means of forcing his subjects to labour in the felling and transport to port of the wood.

The whole discourse of opposition to biopiracy is rooted in the enlightened and liberal objection to exploitation in all its forms. Imperialism and colonialism, from our twenty-first century standpoint, is widely recognised to have been, at the crudest level, the mass exploitation of non-European resources and peoples by Europeans. In this sense then, the exploitative – that is, economically inequitable – transfer of resources such as fish, fur, sandalwood, sea cucumbers, breadfruit, coffee, various spices, tobacco, potatoes, soybeans, dates, sago, gutta percha, cochineal, cinchona, tea, rubber and cotton can and should be considered biopiracy in the broad sense, *whether or not they are biopiracy as defined narrowly by the Convention.* In fact, only a few of the above listed resources are *not* biopiracy according to the Convention but given that I have up until now structured my thesis and argument around its terms it was necessary to make this brief justification of my inclusion of the transfer of a few bioresources that were neither bioprospected or biopirated in the strict sense, but which certainly have a place in the history of the generally exploitative colonial practices that the Convention, its architects and signatories seek to put an end to. Add to the economically unjust consequences of these plant transfers their political and biopolitical effects and my inclusion of them here is fully justified.

Biopirates' economic motivations were rarely so explicit as in the case of French botanists' intentional illicit acquisition – what Drayton calls a 'botanical coup' – of various spice-bearing plants in the mid-eighteenth century:

> 'From the 1740s, the agents of the Ministry of the Marine and Colonies and the Compaignie des Indes began, in turn, to give serious attention to economic botany… [the Compaignie] fostered experimental gardens in India, Mauritius and Réunion, for the acclimatization of spices, dyes, and drugs within the orbit of French mercantilism. In 1748, Pierre Poivre, the naturalist and adventurer, proposed to obtain nutmeg and clove plants as part of his secret mission to open a French *comptoir* in Cochin China…' (Drayton 2000: 75)

This was successfully achieved in 1755 (Brockway, 1979: 50) and 'other spices' followed in 1759, and then pepper, vetizer and anonymous 'seed and roots of spice trees' were 'smuggled out of Java' in 1761-1762', and so, in a period in which so much was going badly for French imperial efforts, 'The long projected end to the Dutch control of the spice trade was suddenly at hand' (Drayton, 2000: 75). Although the French did not profit to the extent they had hoped, because of the disruption caused by the Revolution and the Napoleonic wars (Brockway, 1979: 50), this well-known story remains a prime example of how plants were consciously illegally acquired from one empire's territory by (secret) agents of another. The Portuguese wish to identify the source of valuable spices had, it is well known, been the reason they had initially invested in Columbus's first voyage. They never achieved that aim but the biopiracy of spices and their subsequent trade had high geopolitical importance in the eighteenth century inter-imperialist struggles and conflicts.

The transfer of spices – what Braudel has called "royal merchandise" – was a spectacular piece of French daring, and, if the wars of the era had ended differently, may have gone on to have had world-historical significance. Instead, it was the transfer of what we might call "proletarian merchandise" – the potato – that was, I would argue, the most historically significant plant transfer of the colonial era. Of the transfers discussed here 'None was more spectacular in its consequences than the potato which, on the eve of industrialization in Britain had become the necessary sustenance of armies of British working people' (Walvin, 1995: 115). I do not, however, classify it as a "major" case of bioprospecting because its arrival in Europe was not the result of any deliberate institutional or individual project or mission. Despite this, my summary of the geopolitical and biopolitical effects of colonial plant transfers would be incomplete if it were excluded.

The potato, before it was known of by Europeans, was 'the basic foodstuff of the Indian peoples of the Andes… In such stark and inhospitable regions it was the potato that enabled the population to survive...'. The invading, and hungry, Spaniards, in imitation of the Indian populations, quickly began to feed themselves on the potato, and it 'was adopted in parts of Spain by 1569. Its spread to other parts of Europe was slow and fitful. [But] By the 1580s the potato had appeared in parts of Western Ireland… [Details of its] exact arrival there is uncertain…' and subject to 'confusing speculations' (102-104) but Walvin is surely right to deny that the arrival of the potato in Europe should be understood as a happy accident. It was not just "one of those things" that happen in history without cause.

> 'In the tortuous transmission of exotic crops into the fabric of European life, it is all too easy to view the process as the mere accidental by-product of trade and overseas exploration. It was, on the contrary, no mere exchange, no haphazard crossover of peoples and goods between regions and cultures bumping into each other. At the heart of this transfer lay a harsh and ruthless exercise of power and ascendancy. Clearly, the acquisition of the potato was not in itself an act of that violence. But it flowed inexorably from the European conquest of the regions and the people of the Americas' (115).

Walvin goes on to tell how 'this simple foodstuff proved itself to be the salvation of millions' (102), and to argue that the potato was, it seems in retrospect, the British monarchy's best defence against the spread of the French revolution:

> '1795 was the crisis year... Hunger became a major political problem, worse possibly than at any time since the years of Elizabeth I. The poor law system was clearly inadequate... The [wheat] harvests of 1794 and 1795 were disasters... More and more people turned to the potato as a mainstay of their diet... In those terrible years of the mid-1790s, it was hard to distinguish the greatest threat to the status quo; the ascendant triumph of French arms, the strength of domestic British radicalism – or the simple corrosion of hunger among the common people. It was a hunger that ate into the nation's soul... Had more people starved, the British system might not have survived. The French *ancient regime* had

collapsed in the midst of widespread hunger. The British could easily have gone the same way. That it managed to struggle into the next century was in no small measure because people's hunger was partly assuaged by the potato' (114-115).

While I use the term "biopolitics" in a similar sense to Hardt and Negri (2000, 2004), that is, in a more general sense than Michel Foucault used it, the term was originally conceived by Foucault in reference to the increasing concern of European rulers and political elites in the eighteenth and nineteenth centuries with "governmentality", that is, the concern in government with the health, and healthy reproduction, of populations.[30] So in the strictest sense the arrival in Europe of the potato was a biopolitical phenomena. As well as helping to dampen the fires of social unrest in Britain, potatoes, together with maize, as opposed to new medicines or new agricultural tools, were arguably 'largely responsible for the near doubling of Europe's population in the century 1750-1850' (Brockway, 1979: 40).

Whether or not one agrees with Walvin that the potato was the primary factor in the survival of the British monarchy, it is clear that the late eighteenth century period was one in which the potential economic and biopolitical uses of plant transfer and importation were being systematically and experimentally explored, very probably with the effectiveness of the potato as a means by which to prevent entire populations falling into famine in mind. Several schemes involving the transfer of potentially life-saving new foodstuffs were conceived in the period, including the supply to Indians of sago and date palms, and the supply to West Indian plantation owners and their African slaves of breadfruit.

Entire institutions were expressly founded on the promises of bioprospecting/ biopiracy. For example, the Calcutta botanic garden was conceived in 1786, by its first director, one Colonel Kyd, on Banksian lines, as a '"Nursery for rearing and propagating for the publick benefit the productions of other Countries & Climates, and such as may be equally conducive to increase the Commerce and improve the Culture of these provinces"' (Kyd, cited in Mackay, 1985: 176-177). Note just how intimately "commerce" and "improvement" were connected by Kyd. The idea that (early) industry and the "civilizing mission" of Europeans went hand in hand is a recurring one, and the introduction of bioresources was seen an especially promising means by which to promote the two together.

Kyd, after having what Mackay describes as a "revelatory experience" at the Cape, en route to his new post in Calcutta, put particular personal energy into the transfer, propagation and distribution of a the sago palm from (what is now) Malaysia, as a crop with which to feed Indians in times of famine, and with which to demonstrate Britain's declared intention to act like an "improving landlord" and as a benevolent ruler.

> 'Crown and Company came to recognise in the 1780s that economic botany might answer many of their needs… it was in 1786 that Robert Kyd made the moral and political case for a new kind of initiative, urging the Court of Directors to import the sago palm from the Malay peninsula and date palms from Persia, as a means of preventing famine [Kyd, together with Joseph Banks]… promised Yonge at the War Office that the Calcutta Botanic Garden would help to banish famine in India and win the love of the Asiatics for their British conquerors' (Drayton, 2000: 118).

In this sense then, the scheme was ideologically motivated. If it had ultimately succeeded it may have actually had the intended legitimating effects on the Indian population. 'Although Colonel Kyd's plan to propagate the sago and date palms in Bengal reflected a concern for the problems of famine and, therefore, for the indigenous inhabitants of the sub-continent, most of the crops proposed for production in India were to benefit the interest of the mother country' (Mackay, 1985: 180). Kyd's scheme was not brought to fruition but stands as an instructive example of the hopes that bioprospecting held for imperial elites.

A better- known attempt to feed colonial populations on plants originating from other colonies was the transfer of breadfruit plants from Tahiti to various Caribbean sugar plantations, for the purpose of providing a secure food supply for the slaves, after the newly independent United States illegalised all trade with the European powers in the region. This scheme, conceived by Joseph Banks, in indirect response to an 1775 offer by the Society for West India Merchants 'to finance any venture that would import an inexpensive food-producing plant' (Withey, 1987: 429) was the mission of Captain Bligh's *Bounty*, whose crew were famously disloyal.[37] Mackay rather simplistically attributes the haste with which a repeat voyage was planned after the failure of the first to 'Bank's power' and the persuasive charm with which Banks 'prevailed on the government' to partially fund a second attempt, in 1791 (Mackay, 1985: 137). It would be both more sociological and more accurate to attribute the British government's speed in acting on the issue to the strong interest of the West Indian plantation owners and their investors (including Banks himself) in the successful supply of the nutritionally rich but culinarily unexciting slave food. This is signalled by both the names of the ships and the rich rewards the two biopirates who captained them received:

'In terms of what it had directly set out to achieve, the expedition was a great success... Bligh was granted a thousand guineas for his efforts by the Jamaica Assembly and Portlock [who was in command of the *Assistance* alongside Bligh's *Providence*] received five hundred. The plants themselves continued to thrive in the West Indies [they had been planted across the island by October 1793]... To foster the spread of the trees the Jamaican Assembly had appointed a special committee for the management and distribution of the plants [at the end of 1794]. All the species delivered by Bligh were fully established and the breadfruit, in particular, were spreading furiously... Early in 1796, Anderson [the gardener in charge of their cultivation] reported that... for some 18 months he had been gathering fruit of fine quality. By the end of the century, the breadfruit was securely established throughout the British West Indies' (139-140).

Although the plants were successfully introduced, the biopolitical motives that had brought them there went unfulfilled. Withey, with some understatement, notes that while botanists could draw up elaborate and expensive bioprospecting schemes, the slaves were not completely powerless to subvert their plans: 'The West Indian blacks didn't like breadfruit and refused to eat it' (Withey, 1987: 439). The less plentiful and more expensive plantain and yam were preferred by the slaves. Anyway 'by the mid-1790s conditions were returning to the pre-1778 position, and the exigencies of war and Jay's treaty helped to restore trade with the United States' (Mackay, 1985: 140). So the breadfruit transfer didn't have quite the impact on the everyday diet and the culture of the West Indian slave population, or the economic impact that Banks and the Jamaican Assembly had intended. The story is nevertheless exemplary of how the movement of bioresources (in this case literally half the way around the world) commonly occurred in response to particular colonial problems and geopolitical events.

The Tahitians, from whose land the breadfruit plants were acquired, are all but invisible in both Mackay and Withey's versions of this story, so it cannot be stated with certainty that the plants were acquired illicitly, without permission, and without due recompense or not. But it seems at least likely, if not highly probable, that the plants were simply taken without mention to anyone in a position of power in Tahitian society. Even if permission were granted and payment made, the transfer fits into the general pattern of colonial resource extraction, which began in the Pacific almost immediately after Cook and Banks visited the various islands:

> 'the striking point about British activity in the Pacific at the end of the eighteenth century was not that Bligh's voyage was the first attempt to exploit Pacific discoveries for practical ends, but rather how many different forms of exploitation were underway less than a decade after Cook's death' (Withey, 1987: 417).

Other examples of such exploitation, this time by Americans, not Europeans (and are not therefore strictly colonial but were clearly conducted on the colonial model of "Let's take what we need of local plants and wisdom and cart it off to the marketplace") are the trades in sandalwood and sea cucumbers, both of which were found in large quantities on Pacific Islands and had high market value in China. American merchants were quick to exploit these resources, whose trade ignited an economic boom, which soon fell into a damaging bust that was felt by every man on the island:

> 'Various Pacific islands were exploited to obtain sandalwood, often to the point of depletion. Fiji was cut over in the years 1804 and 1810, the Marquesas between 1804 and 1818, Hawaii between 1811 and the mid 1830s. The Hawaiian king traded an annual $300,000 in sandalwood, receiving in return hardware, cloth, clothing, rum, guns, and even a luxury yacht built in Salem, Massachusetts. By 1826, however, the chiefs were in arrears in their deliveries and American traders exacted instead a contract according to which each male Hawaiian was to be taxed' (Wolf, 1997: 258).[36]

Not only economies and individual lives were altered. The trade upset the social and political balance of the islands, and, like the fur trade in north America, militarized local societies. There are few instances in which the imperialist control of biological resources had such clear and dramatic biopolitical consequences;

> 'Another product in demand in China was the sea cucumber… This product had long been supplied by Indonesian and Philippine sailors, but European traders began to organize the trade themselves… The influx of trade goods, including guns, in payment for sea-cucumbers was probably even greater than in the sandalwood trade… Sandalwooding and the trade in sea cucumbers, along with intensified whaling, contributed greatly to the distribution of firearms throughout the South Seas. Where powerful local chiefs

> gained control of the new weapons, they found themselves equipped with greatly increased military potential. Thus European trading spurred the rise, on a number of islands, of small states headed by powerful chiefs equipped with European armament... Five thousand guns were introduced into Fiji between 1828 and 1835, and probably an equal number between 1842 and 1850, in the wake of the sea cucumber trade' (Wolf, 1997: 259).

Even more widespread and penetrating forms of imperialist exploitation of biological resources occurred in pre-Independence North America. The European search for fish, the later, and unexpected fur trade, and the history of the North American Indians are forever intertwined.

> 'Initially...it was not the search for fur but for fish that drove European sailors to move into the waters of the North Atlantic. Fish was one of the strategic commercial items in medieval Europe... In the fifteenth and sixteenth centuries the harvests of herring in the Baltic declined, and fishermen began to explore the cod-filled banks off Labrador, Newfoundland, and New England... At first, landfalls were sporadic... Later, however, the fishermen began to go ashore for the summer... The North American fur trade began when these fishermen started to barter for fur with the local Anglonkins. The possibility of exploiting the "new found lands" for furs was not lost on the royal agents and settlers who explored the coasts of North America' (160).

This trade, this exploitation, had geopolitical importance in that: 'the northern route was long controlled by French interests, while the southern access was held first by the Dutch and – after 1644 – by the English. From the beginning, therefore, the fur trade was carried on in the context of competition between two states' (Wolf, 1997: 161), and it had permanent biopolitical effects: the changing fortunes of this competition significantly

> 'affected… the native American populations that provided them with fur… Everywhere, the advent of the trade had ramifying consequences for the lives of the participants. It deranged accustomed social relations and cultural habits and prompted the formation of new responses… the demands of the Europeans for fur increased competition among the native American groups… The fur trade thus changed the character of warfare among Amerind populations and increased its intensity and scope' (ibid).

The biopolitical character of these social changes resulting from imperialist extraction of biological resources is clear; 'The more successful entrepreneurs and chiefs – those who had links to trading posts – also became successful war leaders. The result was a concentration of horses and valued goods in the hands of the wealthy and successful, producing a differentiation between richer and poorer, between chiefs and their dependents' (Wolf, 1997: 181). Further still, 'Wherever it went, the fur trade brought with it contagious illness and increased warfare. Many native groups were destroyed, and disappeared entirely; others were decimated, broken up, or driven from their original lands…' (193).

In economic terms too, the fur trade was an irreversible event. It led to the subsumption of the pre-Columbian economy under early international capitalism by leading the various Indian societies to rely on European goods; 'arms, metal tools, kettles, clothing, jewellery, and liquor' (166).

> 'Access to European goods and gifts soon altered patterns of interaction both within and between groups... For more than three centuries the fur trade thrived and expanded in North America, drawing ever new native American groups into the widening circuits of commodity exchange that opened up between the incoming Europeans and their native partners in trade (193).

Eventually, Indian societies began to specialize their production to meet changing European demands 'Such specialization tied the native Americans more firmly into continent-wide and international networks of exchange, as subordinate producers rather than as partners' (194).

The fur trade was far from being the only one to have contributed significantly both to the early formation of an international (if not yet truly global) economy and to the formation of international divisions of labour and economic inequalities that persist to this day. Walvin has shown at length how the imperial Navies and the colonial trade in (largely tropical) bioresources were mutually reinforcing:

> 'The profits of this empire – the duties imposed on the global flow of tropical produce – enriched the British nation state – advanced by the instruments of its military might (especially the Royal Navy) was itself maintained by the very process it was crucial in defending:

the conduct and flow of overseas trade and dominion… without [the duties on tea, coffee, sugar and tobacco] the British state would have been greatly diminished, its fiscal strength reduced and its power correspondingly enfeebled' (Walvin, 1995: 195).

Mackay has written of how botanists worked with the 'mercantilist purpose of destroying the monopolies or predominance of rival nations, and substituting Britain's own. *Botany and great power rivalry became curiously intertwined, as nations endeavoured to guard their precious colonial treasures while seeking to filch those of their competitors*' (Mackay, 1985: 125, my emphasis). Schiebinger described the same by noting that 'Mercantilism flourished through *the fecund coupling of naval prowess to natural history*'(Schiebinger, 2004: 8, my emphasis). Bioprospecting, as an important aspect of imperialist economic botany (remember, to the Linnaean school of bioprospecting economics *was* bioprospecting) was largely responsible for establishing what I would argue was one of the ideological and material foundations of European colonial rule. The formula: *economic botany equals economic power.*

Before I go on to show some of the explicitly imperialist, non-scientific, roles that bioprospectors played in the course of their botanical explorations and to present in some detail the story of how William Hooker's search for rhododendron specimens came to lead to the annexation of Sikkim into the British empire I will briefly give two prominent examples of how direct military takeover of large territories was consciously and explicitly motivated by the wish to acquire biological resources.

Guiana, in 1796 and Burma (Myanmar), in 1886, were both brought by force under British rule for their botanical "riches". Guiana had been described as "The Gardens [of Eden]" by Columbus on his third voyage and had 'been part of the

English imagination since Walter Ralegh' had been there seeking gold. 'Ralegh never found the mine that might have saved his neck, or tempted James I to found a new colony. It was instead *the wealth from plants* – cotton and sugar-cane – which two centuries later *led the British to seize Guyana from the Dutch during the 1790s*' (Drayton, 2000: xii, my emphasis). 'In 1885 the London Chamber of Commerce urged the British government to annex upper Burma to secure the area's forest and mineral resources for British rather than French companies' (Abernethy, 2000: 102), and while the Chamber seemed to speak as if this was no easier said than done, their desire was swiftly fulfilled early in 1886.

In both these cases there was no need for deliberate botanical reconnaissance of the type discussed shortly; it was already evident that the territories in question were botanically wealthy and imperial interest in annexing them was already strong. But in several instances imperial governments drew heavily on the work and advice of botanists and bioprospectors in forming their decisions about which territories it should expend military effort on and which should be given less priority. Before introducing these it remains only to note that not only were entire territories or nations treated as worthy objects of war if they possessed valuable biological resources, but the destruction or withholding of access to said resources were understood to be potential *weapons* of war. The naturalist Robert Fortune (biopirate of the Chinese tea plants with which British tea plantations were established in India) wrote, in the mid nineteenth century,

> 'At the time of the last [British-Chinese] war, when the Emperor of China, very considerately no doubt, wanted to conquer the English by withholding the usual supplies of tea and rhubarb, without which, he supposed, they could not continue to exist for any length of time,

we might have returned the complement, had it been possible for us to have destroyed all his bamboos. With all deference to the opinion of his celestial Majesty, the English *might* have survived the loss of tea and rhubarb, but we cannot conceive the Chinese existing as a nation, or indeed at all, without bamboo' (Fortune, 1850, extracted in Short, 2004: 72, original emphasis).

The strategic use of botanists and bioprospectors by corporate and government institutions was a constant of the colonial era. 'The research of local plants and their uses was part of reconnaissance and conquest from the sixteenth century' (Drayton, 2000: xv). For example, the French naturalist Aublet's mission in (then Dutch-) Guiana, in the 1760s 'was to inventory the plants and animals of the region, looking for anything that could turn a profit for France. He was also to chart rivers and waterways for the military' (Schiebinger, 2004: 55). Britain had botanists working on similar tasks in the same region a few decades later; 'In the 1790s, Alexander Anderson, keeper of the St. Vincent Botanic Garden, offered careful political and strategic reports on the Southern Caribbean, and in particular on the Dutch colonies of Demerara and Essequibo', as Drayton put it 'Botany might provide a cover for espionage' (2000: 111).

After describing the many botanical surveys British botanists conducted in the mid nineteenth century, under the supervision of Kew gardens, in its colonies and in the colonies of other European empires Drayton concludes 'The old Cameralist and Physiocratic notion of the scientific inventory of the natural resources of territories for the use of government found new relevance' (201). 'What we might consider today as economic intelligence was processed with system at Kew' (203). And still in the late nineteenth century; 'Economic botany appeared to offer answers to the problem of exploiting the vast chunks of territory which the colonial powers in 1884 had annexed out of greed, and fear of each other, in Berlin' (254-255).

The geographical and botanical surveys of land both home and away were conducted simultaneously: 'Surveying was part of agricultural improvement: side by side with each parliamentary enclosure came the chain and the theodolite. Before territory could be consecrated as private property, or taxed, it had to be bounded, and its advantages assessed' (122). Drayton supports this with a quote from Colonel Kyd to the effect that 'information... on soils, rents, wages and population, as well as indigenous plants' was considered essential for assessing the present and future value of territory (123). And Schiebinger's version of the same is that 'botanists were "foot soldiers" in the "botanical wars" for tropical resources: finding and authenticating valuable plants was naturalists' work' (2004: 46). In short, historians agree that throughout the colonial period botanical surveys had geopolitical as well as economic uses.

The work of the Banksian botanical explorer Francis Masson is significant in two respects. First, he was sent to the Cape and travelled there in the full knowledge that his work was illegal under local Dutch law. The collections of seeds he made were conscious and deliberate acts of biopiracy. Second, the collection of seeds and botanical information was only one half, and perhaps only the secondary half, of his and Banks' goal.

Masson left

> 'London aboard the East Indiaman *Earl of Talbot* in late 1785 and headed for his favourite plant hunting location. He arrived at Cape Town on 10th January 1786 to find the colony a place of suspicion and mistrust. As Britain and Holland were now at war, the Dutch

> authorities had decreed that foreign visitors were not allowed to travel any further than a three-hour walk from Cape Town. British citizens were under particular scrutiny, as they were considered to be potential spies. Masson's passion for discovering plants, his sense of loyalty to his patron and his love of excitement overrode any misgivings he may have had in blatantly ignoring the Dutch edict. In March he sent Banks seed of 176 species' (Musgrave et al, 2000: 50)

What is missing from this version of the story is that Masson in fact *was* a spy.

> 'Geographical, political or military information could easily also be collected along with trees, shrubs, and flowers. It is likely that the decision of the Crown to dispatch Masson at its expense to collect plants in the Cape had some strategic significance... The botanical exploration of the Cape by Masson provided information useful to its seizure by Britain, first contemplated during the American War and completed during the later struggles with France' (Drayton, 2000: 111)

Masson was not the only bioprospector-cum-spy with instructions from Joseph Banks in the region at the time. In nearby Dutch Natal (which eventually, in 1843, became a British territory), the Polish naturalist Au (or Anton) Hove (who was two years later despatched by Banks with instructions to biopirate cotton seeds from India, see Chapter 5) was sent with twin tasks. First, he was to collect seeds and specimens of the local flora. Hove found the land, contrary to previous anecdotal evidence, to be rather barren and botanically uninteresting. Second, he was to survey the region for its potential as a penal colony. Australia was later put to this use by Britain instead, following Banks's advice, which was informed by Hove's unenthusiastic report on the territory's potential.

The 1785 mission 'was shrouded in secrecy' (Mackay, 1985: 33), 'Secrecy, speed, and accuracy were to be the keynotes of the expedition', normal patrol ships were used and stocked in the normal way to avoid 'unnecessary [French, Dutch and Portuguese] suspicion' (35). Once there

> 'Hove's principal task was to assess the fertility of the areas he visited and for this purpose he was to keep a regular journal of his proceedings. If the country was inhabited he was to record the quality of the soil, the types of crops grown and the methods of cultivation. In other regions the landforms, soil, vegetation, minerals and drainage systems were to be observed with care. Wherever the ship touched he was to collect plant and seed specimens which were to be preserved for Banks' examination on the return to England' (34-35).

Natal was ultimately placed low on Britain's list of territories to target, largely because there were few valuable bioresources and little freshwater; it was 'patently unsuitable as a place of settlement, even for convicts' (36).

Perhaps the Banksian bioprospecting mission with the most significant and permanent geopolitical consequences was that of Archibald Menzies on (what has become known as) the Vancouver expedition of 1791-1795. Menzies' favourable report of his botanical investigations in Australia put it high on the British government's "things to do" list and led directly to its (in)famous use as a penal colony. It is astonishing to think that the founding of an entire nation was dependent on the word of a naturalist's somewhat hasty and single-handed survey. The ubiquitous Banks was the architect of the voyage of the *Discovery*, fitted with greenhouses and staffed with a gardener as assistant to Menzies. On the voyage 'great concern was shown for properly evaluating new territories by the employment of trained scientific personnel' (116). Banks' instructions to Menzies 'are a classic statement of the empirical method in natural science... [however,] it is apparent that they were more than a guide for an itinerant dabbler in botany. *They were a directive on the potentialities and value of overseas empire*' (102, my emphasis). His findings, which were 'entered in a well kept journal' were delivered personally to the Secretary of State (103), were that South West Australia was '"an object well worth the attention of government... it offers an eligible situation for a settlement"' (cited in Mackay, 1985: 109). This then, was exemplary of the geopolitical consequences of bioprospecting. Insofar as Menzies' report led to the founding of entire (penal) colonies, altered the fate, and shaped the lives of many thousands of people, its consequences were clearly also biopolitical.

It is J. D. Hooker who retrospectively looks most like a "foot soldier" in a "botanical war". Musgrave somewhat oversimplifies the story when he states that '...the discovery of the Himalaya rhododendrons resulted in a kingdom being annexed into the British Empire' (Musgrave et al, 2000: 9) but the basic outline of the story is that, like Masson, Hove and Menzies before him, Hooker was simultaneously collecting plants and collecting information that directly informed imperialist policy and its execution. Hooker's access to the region – where he ultimately collected little more than a range of new (albeit very popular) horticultural specimens – was secured and backed up by direct military force. And the region in which Hooker collected was invaded shortly afterward by an army using the maps he had made during the course of his botanizing.

As did many Europeans sent by imperial agencies to distant regions of the world, Hooker required considerable multi-tasking skills:

> 'Hooker was promised £400 per annum for two years; he had one preliminary task, to investigate fossil plants for the Geological Survey, and a major commission to collect plants for Kew. Thus financed, he was headed for Sikkim, and the approaches to Tibet. The third year was to be spent in Borneo, investigating the suitability of Labaun for growing crops such as cotton, tobacco, sugar and indigo' (Raby, 1996: 128).

The third part of the original plan was later cancelled (145) but he carried out similar tasks in Sikkim instead.

In 1848 the geopolitical situation in north western India was thus:

> 'Sikkim, a semi-autonomous state, was under a loose kind of British protection (protection, in effect, from the Nepalese); the Rajah had ceded a chunk of mountain land, including Darjeeling, for £300 a year in return for this privilege, and the British had installed Dr Campbell as superintendent of the station, to be responsible for political relations between the British and Sikkim governments… [as Hooker noted] "… British subjects were rigorously excluded from Sikkim; every liberal offer for free trade and intercourse was rejected…"' (132).

The Indian imperial bureaucracy were not in a position, as they were, for example in Australia, to simply do as they wished. Even in regions which they were formally "protecting", access for bioprospectors, or anyone else, had to be negotiated. In today's terms, informed consent was required. Hooker's botanical explorations could not have been possible if he had not had friends in some very high places. Hooker had met the (then-) Governor-General, on his passage to India, and it was he who 'attempted to arrange Hooker's journey' (133). It took even a man of his power several months to secure the necessary permission, and even then he had to resort to aggressive tactics:

> 'Hooker appealed directly to Lord Dalhouise, who in September [1848 – he had arrived in April] demanded that the Rajah give Hooker "full leave to travel to the snowy passes and to grant… every assistance". A rude and flat refusal from the Rajah to the Queen's representative in India provoked the threat of British military intervention, with the result that access was grudgingly granted' (Musgrave et al, 2000: 84-85).

It hardly needs pointing out that "informed consent" given under these circumstances is not the kind of permission that the 1992 Convention stipulates should be given to would-be bioprospectors. All of Hooker's collections from Sikkim made with "permission" of this dubious nature should clearly be considered the most explicit form of biopiracy imaginable. Here we see how cold imperial power was employed to gain access to a weaker population's biological resources.

Further, the mission was "approved", with some restrictions and conditions, which Hooker had no hesitation in disregarding: 'Hooker, the innocent naturalist, collecting plants and taking measurements, made a very thorough exploration of the Sikkim valleys and passes, steadfastly ignoring polite and impolite requests to stop, wholly confident of his rights' (Raby, 1996: 146). His dual bioprospector-and-surveyor role was played with some bravado: 'Hooker's objectives were, partly, to add to his collections, but they were also to map and to measure' (133). If Raby's interpretation of Hooker's *Himalaya Journals* is correct Hooker actually put more effort into the latter task than the former: In Sikkim 'Hooker seems more intent on taking angles and observations than plant collecting' (138), 'his persistence in pushing up remote passes, and insistence on visiting alternative routes, suggests that he had been enrolled as a willing participant in the Great Game' (133).

The details of the fate that befell the over-confident Hooker, and Campbell, who travelled with him, are recounted in some detail in Musgrave et al (2000) and Raby (1996); there is space here only for a summary. During the trip 'an incident that changed the map of India occurred' (Musgrave et al, 2000: 95). In short, the two men were imprisoned in a 'small bamboo hut' (Raby, 1996: 145) for overstepping the agreed-upon geographical limits of their expedition – 'rather than stopping at the border, Hooker became an "illegal immigrant"' (Musgrave et al, 2000: 94). Despite his imprisonment Hooker eventually got 'a letter to Lord Dalhouise, who immediately responded by ordering an English regiment and three guns to the border' (Musgrave et al, 2000: 96), thus securing their immediate release. While 'The Rajah ended up losing some territory' most of Sikkim was left under his control, for now at least.

> 'Hooker clearly thought that a punitive expedition should have invaded and occupied the country; *the naturalist had turned into an*

agent of empire. But for Hooker the botanist, the Himalayan journey had exceeded his "most sanguine expectations", even though some of his collections had been destroyed. He had been able to survey the whole country, and make a map "and Campbell had further gained that knowledge of its resources which the British government should all along have possessed, as the protector of the Rajah and his territories"' (Raby, 1996: 145, my emphasis).[39]

Some time later, Hooker's desire for revenge was fulfilled.

'The British authorities were incensed at the ill-treatment of two important subjects and were determined that there should be some form of retribution... Hooker was asked to use his knowledge of the terrain to draw up a plan of attack... [and in 1850] the whole of southern Sikkim was annexed into India, thus adding another small pink corner to the map of the Empire. The annexed area, the only fertile land in Sikkim, proved to be perfect ground for the future cultivation of tea and quinine' (Musgrave et al, 2000: 94-97)

This episode is significant, then, for three reasons. First, because Hooker's "permission" to bioprospect was given only under military duress. Second, because Hooker was consciously acting as an imperial surveyor. As Raby describes it, his mission was 'part of a slow but inexorable process of domination and annexation' (1996: 146); the maps Hooker made while he was supposed to be bioprospecting were almost immediately put to military use. Third, the acquisition of the tea and cinchona that were planted in Sikkim are two of the "major" cases of biopiracy I present the details of in Chapter 5. Both crops went on to become important colonial bioresources, and both were acquired explicitly and consciously against the governmental wishes of the nations from which they were, to recall Mackay's phrase, "filched".

Conclusion to Chapter 4.

Chapter 4 first presented the ways in which the Linnaean and Banksian schools of bioprospecting understood that the collection and importation of biological resources from around the world could and would have significant economic and geopolitical benefits to their respective nations. It showed that Banksian biopiracy had explicitly imperialist intentions and Linnaean biopiracy was intended to negate the need for a Swedish empire.

The second half of Chapter 4 presented the details of a wide range of cases in which the acquisition of and trade in biological resources did indeed have significant imperialist benefits and consequences (as contrasted to the simply economic and largely non-imperialist consequences of the cases of biopiracy discussed in Chapter 3). Firstly, those in which the trade in and transfer of living materials – sandalwood, sea cucumbers, furs – had economic, and at-once geo- and bio-political consequences. Secondly, those cases in which bioprospectors were also consciously playing the role of imperialist surveyor and in which bioprospectors' reports on the territories they surveyed botanically and geographically both informed imperialist policy and were implicated in the military annexation of territory into empires – Masson's botanical survey of the Cape, Menzies' (very partial) survey of Australia and Hooker's mapping of Sikkim. Again, some of the geopolitical consequences of these cases should also be recognized and understood as biopolitical consequences.

I have yet to fully explicate the biopolitical and contemporary sociological significance of these cases of imperialist biopiracy. I will do so after presenting the at-once economic, geopolitical and biopolitical aspects of the "major" cases of biopiracy (Chapter 5), after giving an account of the exploitation of non-European labour and knowledge during the course of, and as a consequence of, biopiracy (Chapter 6), after a discussion of "linguistic imperialism" and the formation of the imperial botanical archive (Chapter 7), of the ecological consequences of imperialism (Chapter 8) and of the ways in which the imperialist practice and discourse of bioresource extraction/exploitation has become a post-colonial practice and discourse of bioresource management (Chapter 9). The history of biopiracy in terms of its biopolitical effects consists in the intertwining, the combination, and the total result, of all these phenomena.

Chapter 5. Four major cases of imperialist biopiracy:

cotton, tea, cinchona, rubber.

Chapter 5 will discuss four "major" cases of biopiracy (the distinction I make throughout between "major" and "minor" cases of biopiracy is defined in Chapter 3). The plants in question here – cotton, tea, cinchona, rubber – were all illicitly taken by British botanists to British colonies. All four went on to become major colonial plantation crops. The economic gains resulting from the cotton transfer are the subject of an inconclusive debate. The transfer of cinchona was primarily politically motivated; its economic value was real but incidental. The transfers of tea and rubber were industrially and financially significant. All four were biopolitically significant in that the economic system under which they were grown – the plantation system – was the source of considerable human misery and brought with it an entire new way of life for the many hundreds of thousand of people whose labour was exploited by it. There is much more material available on each of these examples of "major" acts of biopiracy than I can present here. I will focus on showing that in each case

a) the plants that were taken were taken illicitly,

b) the transfer conferred economic/industrial, geopolitical and biopolitical advantages on the collecting nation (with the proviso that if a crop became a plantation crop it is automatically considered a case of "biopolitical biopiracy"),

c) the transfer threatened (but did not always significantly damage), the economy or geopolitical status of the host nation or territory.

In the terms of the CBD/CAB, then, I will be showing that in each case, the botanical good in question was not treated as the legitimate property of the host nation, informed consent was not granted to the collecting nation and the considerable benefits accruing from the transfer were not shared with the host nation.

As mentioned above, all four acts of biopiracy were committed by British botanists (employed by Kew in the cases of cotton, cinchona and rubber and by the East India Company in the case of tea). With the exception of the transfer of cotton plants from India to the West Indies, all the cases here were made necessary by the British government's decision to give up its possession of Java for strategic reasons.

> 'If the government had not returned Java to Holland at the Congress of Vienna in 1815, in pursuit of a strong Holland to help keep the balance of power on the continent, Britain would have had the richest island in the East. Java's sugar, spices, tobacco, coffee, tea, cinchona, and rubber might all have been British, instead of constituting its chief commercial competition in these plantation crops' (Brockway, 1979: 188).

If Britain had possessed Java in the nineteenth century it may well have been the Dutch who biopirated tea, cinchona and rubber instead. As it was, Britain established rival plantations of these crops in India, not Java. Before it could do so, however, it needed to locate living specimens or seeds of these cash crops and engineer their safe arrival in areas of India with suitable climates and available labour. Forster's version of the Banksian school of bioprospecting's imperial dream – that botanical surveys and plant transfers 'would inevitably yield new "branches of trade and commerce" to the power which prosecuted them' (Cited in Drayton, 2000: 79) – was, more or less successfully, proven to be a realisable one.

Cotton.

All four of the acts of biopiracy in question here involve "British India". Rubber, tea and cinchona were transferred *to* India, while cotton was transferred *from* India. It is with cotton that we will begin.

Two powerful and well-connected groups, West Indian plantation owners and British cotton manufacturers, had been lobbying, from 1784 onwards, for the acquisition of more productive varieties of cotton plant. The location and procurement of such was the perfect job for imperial botanist Joseph Banks. It was he who eagerly formulated and executed a scheme by which 'the cotton manufacturers of Britain might be supplied with quality raw materials from within the empire, and with the best Indian [manufacturing] techniques, and the West Indian planters might have a new staple' (Drayton, 2000: 115).

There were two possible mean of acquiring cotton seeds. First, Banks could enrol his 'string of scientific contracts in Russia, Persia and India', or,

> 'A more direct method was to despatch someone familiar with cotton, and botany in general, to secure seeds and knowledge of their cultivation, from an area in which the finer types of cotton were produced. Banks clearly preferred the second possibility… [because] such persons could be equipped with a commission or detailed instructions, placing them under direct control of government and ensuring thereby a single-minded pursuit of the object in question' (Mackay, 1985: 146).

As we have seen with other Banksian schemes – the transfer of breadfruit, and Masson's and Menzies' botanical surveys of the Cape and Australia – there was at this time a 'co-ordinated effort to increase the material resources of British colonies' (ibid). Banks was by now an experienced and successful architect of biopiracy.

Banks turned to a man who had worked for him before (in Natal) the Pole Au "Anton" Hove. Hove had a government-approved budget of £300 and was sent off to India in 1787.[40] As a case of explicit biopiracy and "botanical espionage" Hove's mission set a new precedent, not matched in audacity and ambition until the middle of the following century. Banks personally wrote Hove's instructions.

> 'The instructions were an interesting mixture of subterfuge, ingeniousness and scientific data. There were two sets; one marked "Public instructions", the other "private". The former directed Hove to proceed as he had done on the African expedition, collecting exotic plants wherever the ship would touch. His objective, it was stressed, was to collect [ornamental] plants for the Royal Botanic Garden at Kew, and to this end he was to proceed to the Broach district after arriving at Bombay, where he was to live among the inhabitants, and collect plants and seeds which were to be sent to Banks with accompanying lists and descriptions of the soils and climates. No mention was made of cotton. The real objectives were outlined in the private instructions which pointed out that the real purpose of the mission was to procure for the West Indies seeds of the finer sorts of cotton cultivated in the Ahmood and Broach regions. Collecting plants for Kew was merely a front and was to be regarded as strictly secondary.' (Mackay, 1985: 148).

Hove, contravening the etiquette of colonial India, which stipulated that "gentlemen" did not travel alone nor do anything that might look like "going native", initially travelled as modestly as possible so as to avoid suspicion (but only until he fell victim to several robberies, which led him to later employ large numbers of armed guards). To ensure his secret mission was not discovered 'Each parcel of seeds sent back to England was to be labelled with numbers corresponding to remarks about them in a commentary sent under a separate cover. These remarks were to be written in Polish and to be transmitted to Hove's brother in India for translation, before being sent on to England' (ibid). Banks motivated Hove into these dishonest acts by stressing that 'The collection of seeds was of the greatest importance for the foundations of the West Indian plantations' and making the half-promise that Hove might be put in charge of the cultivation of the cotton varieties in the West Indies (Mackay, 1985: 149).

Mackay explains the secrecy of the mission with the understatement that 'The mission was part of an attempt on the part of the British government to capture a part of the commercial advantages of another country… [at the time] the cultivation and manufacture of cotton was in Indian hands' (ibid). On top of this was also the need for the East India Company to be kept in the dark; it was better for both Banks and Hove if the Company remained unaware that plans to found alternative sources of cotton elsewhere in the empire were afoot (ibid). It is clear that Banks himself was somewhat troubled by the deception involved in Hove's mission. Mackay cites two letters from Banks. In one he condemns such practices as immoral. In the other he 'recommended just such an appropriation. Apparently he was prepared to condone such practices, even to be involved in their implementation so long as his own name was not publicly associated with them' (ibid). So, it is clear that the cotton transfer was self-consciously an act of biopiracy that was recognised both to threaten the interests of indigenous Indian cotton growers and cottage industries and to threaten the interests of the East India Company. The latter coveted the industry and was currently working to industrialize it and monopolize it for itself. Banks and Hove had permission from neither party and considered permission unnecessary. No consent was sought or given.

The economic gains derived from Hove's illicit acquisition of better cotton varieties for the West Indian planters are the subject of some speculation. There is neither space nor need here to enter into the debate. What is important is that the biopiracy of cotton was undertaken with clearly financial motivations. These had geopolitical aspects too; as indicated by Banks's efforts to keep the mission secret not only from Indian cotton growers but from the East India Company, which clearly felt that its commercial interests (which were of such scope to render them geopolitically important) were threatened. Even without these economic and geopolitical aspects, the case of cotton remains of high biopolitical significance because entire new cotton plantations were founded with the procured seeds. Although further research would be needed to substantiate and confirm the claim it seems likely that thousands of lives in both India – where competition from industrial cotton manufacturers in north west England, supplied with the new West Indian cotton, gradually destroyed the Indian cotton industry – and the West Indies – where cotton was grown on large plantations, which were infamously run on slave-labour – were altered by the Banksian scheme.

The specimens, seeds, knowledge (as we will see further in Chapter 6), and even technology (in the form of an Indian cotton loom) pertaining to the cultivation of cotton, were all obtained and forwarded to the West Indian planters as planned. Hove 'had made himself fully master of the processes of cultivating cotton, and had take unwearying pains to discover how it was carded, spun and woven. Despite the antipathy of the natives he managed to bring away a loom with a weft on it and a drawing of the process of carding' (Mackay, 1985: 162-163). Hove successfully collected (among other economic plants such as myrrh, mangosteen and various grains that made good animal fodder) '23 varieties of the finer sort' of cotton (160).

> 'Banks thought that the mission had been fully justified... The first instalment of cotton seeds arrived with a letter to Banks in August [1788] and was immediately sent to the West Indies for planting. Another lot arriving in September was sent on to the Board of Trade where the seeds were examined before being despatched to the governors of the West Indies with the request that they be distributed to interested planters. Hove's account of the cultivation of cotton was duplicated and sent with the seeds' (158).

Mackay is reluctant to claim that Hove's collections were of high economic value:

> 'Early reports [on the quality of Hove's cotton collection] tended to be encouraging, but it is extremely difficult to assess the overall value of Banks' efforts... As Edwards and Harlow have pointed out there was a startling increase in the production of raw cotton in the West Indies after 1785 but [Mackay claims] the statistics are confusing since they often include foreign cotton imported through the free ports' (164).

However, despite his doubts, Mackay uses the story as an example of how botanical science and agricultural/industrial prowess could 'fruitfully combine' (ibid).

Tea.

The formation of the lucrative British tea plantations in India was largely attributable to the work of the (aptly named) botanist Robert Fortune, who made two journeys into China, first for the Royal Horticultural Society in the years 1843-1846 and secondly for the East India Company in 1848-1851. His first trip had mixed objectives, the second was much better funded and focused on a sole aim. He travelled with

> '"...the express purpose of obtaining the finest varieties of the Tea-plant as well as native manufactures and implements, for the Government plantations in the Himalayas". Donning his disguise as a Chinese man, he hired an interpreter and set off for the Hwuy-chow district, 200 miles inland from Ningpo... there were none of the hair-raising adventures of the first trip... [but there was] plenty of opportunity for some profitable plant collecting' (Musgrave et al, 2000: 123).

There is little doubt that the successful acquisition of the best tea varieties and their transfer to the already-established, but as yet small and relatively unsuccessful British tea plantations of northern India returned high profits on the £500 investment that the Company made in Fortune's journey. The Company had been trading in large amounts of tea from the mid-eighteenth century, from which it, and the British treasury, who imposed large import duties on tea, had profited handsomely.[41]

Tea 'still came entirely from China' in the last third of the seventeenth century but 'During the first quarter of the eighteenth century, tea replaced silk as the main item loaded on British ships trafficking along the China coast', Wolf then makes no mention of the East India Company nor of Robert Fortune's role in the story when he recounts the biopolitical effects of the Indian tea industry;

> 'From 1840 on, tea began to be raised in Assam… Yet until the opening of the Suez Canal, Indian teas furnished only a fraction of the world's supply… In Ceylon, tea plantations spread with astonishing rapidity throughout the uplands in the 1870s, to a great extent at the expense of the Kandyan Sinhalese peasantry. A large amount of village common land was turned into royal land and then sold to planters' (Wolf, 1997: 339).

The British demand for the tea which caused so much misery and social upheaval was almost insatiable. It was widely believed to be medicinal (and in fact, has begun to be marketed as a "health food" again in recent years), and tea-drinking had the added attraction for the working people of Britain of being a Royal and aristocratic habit whose emulation was nonetheless affordable, especially along the coasts where smuggled tea arrived in large quantities (Walvin, 1995: 10-13, 15).

At both ends of the supply chain it was recognised that 'The advantage to the British of producing their "own" tea within the confines of their own empire, [would be] enormous… [the British] could ensure cultivation, production and distribution through their own companies – from Indian producer to British consumer' (31). But as yet

> 'the Europeans were not able to penetrate beyond Canton to the regions which produced these various teas... Despite – perhaps because of – the massive European demand for tea, the Chinese were insistent that Europeans should not visit the tea-growing regions, or learn anything about the gathering and processing of the leaves... [this] reflected a healthy economic defensiveness – preservation of the secrets of their remarkable commercial success and wariness of outside interests; were the Europeans to learn the secrets of tea-growing and processing they might simply set up their own systems elsewhere. In time, this is precisely what happened' (20).

Joseph Banks, never one to miss a bioprospecting trick, had, in the 1780s 'urged' the government 'to steal the techniques which made contemporary China wealthy at the expense of British bullion: the confection of porcelain and the curing of tea' (Drayton, 2000: 93). His advice had been sought toward precisely that end

> 'in 1788... Lord Hawkesbury asked Banks to draw up a feasibility study... There would be some initial difficulties in acquiring expertise in the skills of cultivating, manufacturing and grading the teas, and these would have to be learned from the Chinese. To this end the mission of Colonel Cathcart to China had instructions to gather information on the growing and blending of tea. To get the

industry on its feet in India, Banks suggested that some Honanese familiar with its production should be tempted into moving to Calcutta, with some of the superior varieties of the shrubs… [however] progress on the introduction of tea was slow. There were great difficulties in procuring suitable plants from Canton…' (Mackay, 1985: 181-182).

In Sweden, at around the same time, Linnaeus attempted to break the Chinese monopoly on tea production by acquiring tea plants from China, "acclimatizing" them to the Swedish climate, and founding a Swedish tea industry at home. The Chinese, recognizing the intentions of Linnaeus' "man in China", simply provided plants which looked like tea but were not (Koerner, 1999: 137).

Tea plants were in fact biopirated successfully from China twice. An 1841 attempt did in fact succeed in obtaining tea plants for north Indian planters (Raby, 1996: 146). However, the varieties that the inexperienced collector had almost randomly acquired were not of high quality so the East India Company decided in 1848 to employ Robert Fortune – a botanist with prior experience in collecting tea plants – to repeat the exercise.

As Brockway puts it 'A large scale effort was needed' (1979: 27) and as Walvin elaborates, 'the extraordinary rise of the tea industry was not merely an accident of empire. Though its origins may have seemed capricious – like most discoveries from the edge of the world – its development and exploitation were deliberate and well-organized' (1995: 12). The biopiracy of Chinese tea plants and botanical knowledge of how to cultivate and process the crop was enabled by the larger geopolitical situation; 'the tea removal was done in the aftermath of war, and the Chinese themselves, under this duress, furnished the expert knowledge of tea cultivation and processing' (Brockway, 1979: 28).

In short, Fortune's mission, was accomplished:

> 'Fortune successfully collected tea plants from the Hwuy-chow district and the Chekiang province. He also gathered specimens from the Ningpo district, Chusan, and the Woo-e mountains and supervised the transfer of 23, 892 young plants and approximately 17,000 seedlings, along with eight Chinese tea growers and their equipment, to the foothills of the Himalayas. Tea plantations were established in Assam and Sikkim and it became one of northern India's principal exports during the second half of the nineteenth century' (Musgrave et al, 2000: 124).

The value of Indian-grown tea imports to Britain rose from an annual figure of £24,000 in 1854 to £200,800 in 1929, and therefore totalled millions of pounds of revenue for the East India Company and (through import duties and taxes on the Company's profits) the British government (Musgrave et al, 2000: 124). These quantities of tea must have cost untold millions of hours of Indian – largely Indian women's – labour and undoubtedly shaped many hundreds of thousands of Indian lives. The economic and biopolitical consequences of the tea transfer were significant and long-lasting. Britain's gain was China and India's loss.

Significant also is the fact that Fortune's successful biopiracy provided the model for Kew gardens to follow in its transfer of rubber and cinchona from South America to India:

'The key factors in successful botanical imperialism were all at hand here, providing a model for Kew to follow in a few years time; a corps of trained botanists supported by the state and ready to cooperate with the government in removing from a weaker nation a desirable plant for development on British soil, under British control' (Brockway, 1979: 27-28).

Cinchona.

The transfer of cinchona trees – the source of quinine, a medicine used to ease the fevers caused by malaria – from their south American environment to regions in the East with similar climates had been conceived by Joseph Banks in the late eighteenth century. Banks 'had the idea of transferring cinchona trees to India years before, but nothing had come of it then' (Brockway, 1979: 112). By the mid-nineteenth century various factors came together to make the scheme more practicable, and, from the British imperial elite's standpoint, necessary.

One of these was the successful biopiracy of tea, as described above, another was that the British government had formally taken over control of India following the First War of Indian Independence. For the first time it seemed possible that Britain might lose control of its most illustrious colony and anything that might facilitate the successful defence of their power was considered valuable. So it was that the newly formed "India Office" made considerable funds available for the acquisition of cinchona seedlings with which India might be provided with a reliable and cheap source of quinine. This, in turn, would supply its military and bureaucratic personnel (but not the Indian population at large), thus making it less unattractive for Britons to take up posts in what to many seemed a dangerously unhealthy climate.

No one stated the importance of cinchona to the imperialist government of India better than one Surgeon-General of India;

> '"...To England, with her numerous and extensive Colonial possessions, it [the cinchona tree] 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 useless but for Cinchona bark and its active principles" (Bidie 1879: 15)' (Brockway, 1979: 103).

The biopiracy of cinchona was politically and militarily, rather than simply economically, motivated.

Further, the transfer was something of an ideological coup. It was widely believed in Britain that quinine had been made widely available to the general Indian public and this was often cited as an example of the benefits that a liberal empire could confer on its subjects. However the belief was nothing more than a myth. While the head of Kew Gardens, Thiselton-Dyer, authored a phrase that was widely quoted in the London newspapers, that '"a dose of quinine can be purchased at every Indian post office"' the Surgeon-General, out in India, complained of how the India Office

> 'was not prepared to expand [production] sufficiently to... meet the whole need of the Indian populace, or even a substantial fragment of it... It was the object of government, Bidie wrote, to get a moderately cheap product in every bazaar of the country. but because of the expense "not one individual out of every 100 who

> suffers from fever is fortunate enough to secure the necessary supply of healing bark"' (123).

There had been some genuine humanitarian intent behind the initial foundation of cinchona plantations in India but ultimately 'the greater half of the quinine produced went to the Government Medical Stores to strengthen the British *raj*...' (124).

Cinchona had long been the 'holy grail of economic botany' (Drayton, 2000: 76). This amounted by the 1850s to a 'race' among British, French and Dutch botanists on behalf of their respective empires to break the Spanish monopoly (208). France had come closest to achieving this aim, which was also militarily inspired, on two separate attempts. First, in 1735: 'Although accompanied by emissaries of the Spanish governor [Marie de] La Condamaine [had] found opportunities to spirit away seedlings of the precious Peruvian *Cinchona*... Despite his care, the plants did not prosper' (Schiebinger, 2004: 38). Second, 'In the name of the King, but on Buffon's recommendation, Jean-Baptiste Le Blond left for the Antilles in 1766, then to French Guiana in 1770, where he was joined by the botanist Nectoux. Their special target was "Jesuits" bark (cinchona), the only known remedy for malaria. That disease was, of course, one of the principal impediments to France's tropical imperial ambitions, not least in Guyane itself' (Drayton, 2000: 76). This mission failed too. Decades later, and in the years immediately before the India Office's multi-pronged attack on the valuable resources of the newly independent South American republics of Peru, Chile, Ecuador, Bolivia and Colombia, Dutch botanists repeated the efforts of their French counterparts;

> 'In 1853-1854 the Superintendent of the Dutch Botanic Gardens on Java, Justus Charles Hasskarl, had entered the same Caravaya region

> [as the subsequent British collectors,] searching for cinchona plants and seeds with even greater resort to subterfuge [than they]. Hasskarl travelled under an assumed name and conducted his business in secret [in disguise] and through bribery. Local indignation was still strong over this episode when [one of Kew's four cinchona-seeking bioprospectors, Clements] Markham arrived in 1860. This made his presence immediately suspect. Hasskarl's specimens all died, except two, before they reached Java, and the seeds he brought out yielded valueless tress' (Brockway, 1979: 114).

The British cinchona-in-India plan started when 4 and a half acres of Ecuadorian land was given as part of debt repayment to Britain, thus forming the Ecuadorian Land Company. This tiny body suggested to the India Office, via a 'memorial to the Board of Trade', that cinchona be grown in India and the Office in 1857 'enthusiastically offered its support' (Drayton, 2000: 209). It sought, and gained, the advice of Dr John Forbes Royle of the East India Medical Board and Dr. Thomas Anderson, superintendent of the Calcutta Botanic Garden. A young clerk at the India Office, Clements Markham, enthusiastically volunteered as both a bioprospector for and a designer of the project, and reminded the appropriate parties that India was spending £53,000 per year on the import of quinine (Brockway, 1979: 113). The Secretary of State for India Lord Stanley was approached and consented to support and fund the scheme.

> 'In 1859 the project got officially underway; Markham was charged by the Secretary of State for India with the collection of seeds and plants of cinchona species, with the help of Kew Gardens. It was

agreed that the expedition's expenses would be charged to the India Office, and a budget was set up at £500 for each [of the four] areas' (113).

Significantly, the project was known to be outlawed by at least one of the governments of the areas chosen for collection. The project was conducted in the knowledge that any resulting fruits were at least frowned upon, and at worst, expressly forbidden. Dr Royle warned that the mission '"could not be adopted without exciting considerable attention, and I think, jealousy, if we consider the late proceedings of the Bolivian government"' (cited in Brockway, 1979: 113). The "proceedings" in question were the recent 'establishment of a [Bolivian] state monopoly on cinchona export' (113).

To avoid the collecting team from having to work covertly Dr Royle had attempted to gain the assistance of British consuls in South America, who approached the relevant governments with cash offers for cinchona seed. This method came to nothing because of, in Royle's words, the '"jealousy" of the South Americans, who would not sell (112). Similarly Richard Spruce, on the ground in Ecuador paid $400 for "collecting rights" to a local wealthy landowner but the government had no knowledge of this "purchase" and so, by the terms of the 1992 Convention, Spruce had no "informed consent" and his collections must still be considered illicit, if not outright illegal (such reasoning is described in Chapter 10 as the institutional critique of contemporary Bioprospecting). Markham's own attempt at biopiracy was initially prevented at Peruvian customs, who '"refused to allow them [the seeds/plants] to be shipped"'. Instead, he travelled to Lima, where he somehow (it is not clear how, possibly by mail) succeeded in having them despatched (Brockway, 1979: 115). There are many more details, twists and subplots to this story, which can be gleaned in full by consulting my main sources – Williams (1962), Brockway (1979). Drayton (2000), Headrick (1988) and Raby (1996). What is important here is that the acquisition of cinchona was consciously illicit and that the transfer of cinchona led to the formation of plantations from which biopolitically significant supplies of quinine were produced.

Brockway summarizes the situation thus:

> 'The legality of the operation in Peru is unclear and seems dubious at best. Taking plants from Bolivia was clearly against the laws of that country, where all export of cinchona was a government monopoly. In Ecuador Spruce and Cross brought out the plants a few months before the Law of May 1861, which made it illegal to export plants. But Cross returned to Ecuador, bringing out a second large batch of seeds that fall. A letter from Cross in Loxa, Ecuador, November 9th, 1861, to the Secretary of State for India shows that the British Government was not deterred by the knowledge it was contravening the laws of the Andean Republics' (Brockway, 1979: 115-116).

The attitude of all involved was that British might was right.

In quantitative terms, the British cinchona industry was a success. 'Four hundred sixty-three seedlings [collected by Spruce] survived, and the [many thousands of] seeds proved to be in good condition, becoming the nucleus of a new industry' in India (114).

'250,000 young trees were planted out in the first 3 years. In the 1870s a third government plantation was established, and named after Hooker. By 1880 there were 569,000 cinchona trees in 847 acres of government plantations. In addition there were 4000 acres planted to cinchona in private hands in South India (Markham, 1880: iii). By 1891 there were an estimated 1,800,000 cinchona trees on the government plantations of the district [of Nilgiri]' (123).

The project had huge geographical reach, and involved many of the leading figures of British natural science;

'The scheme, extended into Sikkim, Ceylon, Madras, Jamaica, and Trinidad, brought Sir William [Hooker] into communication with a wider range of colonial officials, planters, and merchants than ever before. Joseph Hooker swept up his friend Charles Darwin in the excitement, and Darwin wrote to the Superintendent of the Ceylon Botanic Garden to suggest a technique of artificial fertilization [Darwin referred to the scheme, in this letter, as "so important for mankind"]...' (Drayton, 2000: 209).

However, in qualitative terms, 'the great British cinchona scheme was a failure'; 'Markham had collected little cinchona of quality. The cinchonas introduced by Spruce, Cross and others... were similarly poor. British India had received chiefly the inferior red varieties...But because of the personal and institutional reputations at stake the low quinine content of British bark was never published'

(Drayton, 2000: 210). Seeds of the variety of cinchona that yielded the most quinine had been acquired by one Charles Ledger in Bolivia.[42] Ledger

> 'arrived in India bearing seed he had collected in Bolivia. No British Authority would take them. He took his seed to the Dutch who promptly bought 20,000 of them [the species was eventually named *Cinchona ledgeriana*] for introduction into Java where they quickly established themselves as far superior to all others... In 1880 Thiselton-Dyer at Kew had to advise the Colonial Office that it should set about introducing *C. Ledgeriana* to Ceylon from Java [he admitted their superiority]...[but] all the Queen's technocrats could never make British plantations compete with Dutch suppliers of the bark' (210).

That said, Drayton does not claim that the whole project was a fruitless exercise. He agrees with Headrick and Brockway that cinchona was a "tool of empire" (208). Brockway describes the at-once material, ideological and biopolitical significance of the establishment of British-Indian cinchona plantations;

> 'Even in peacetime... the bulk of Indian production for the home market was directed toward the British establishment [and away from the population at large], both military and civilian, enabling the British officer and his Indian soldiers to resist malaria and stay in fighting trim, enabling the British civil servant and his Indian assistants to perform their duties in good health, without the ravages of periodic bouts of fever, and enabling the British sahib to bring his wife and children to live in India... Quinine was one of the essential

tools in attracting to India the large bureaucracy necessary to govern it' (1979: 126).

The plantations, despite not producing the strongest doses of quinine, had effects beyond India, and especially, as Brockway first argued, and as other commentators (including Drayton, with some reservations, and Headrick, with none) have agreed; 'It seems more than coincidence that West Africa was penetrated by significant numbers of Europeans only after they had established a quinine industry... I do not claim that quinine was a cause of this colonial expansion into Africa, but that it was an enabling factor' (1979: 127). To Drayton, if it was not the effectiveness of quinine – which even in its strongest form was not a perfect cure – it was 'the *idea* of quinine' which 'awakened new imperial enthusiasms' in the mid and late nineteenth century (2000: 208, my emphasis).

In sum then, the transfer of cinchona by Europeans from various South American nations to plantations in India and Java was conducted in the full knowledge that those nations stood to lose a valuable and strategic industry, and that removal of plants and seedlings was not permitted. The production on large plantations of quinine deriving from the illicitly removed plants and seeds had significant economic, political – both ideological, geopolitical and biopolitical – consequences across South America, Africa and South East Asia. In turn, the history of European empires was significantly influenced. European biopiracy improved the grip of imperial power in its existing colonies and partially enabled its extension elsewhere.

Rubber.

The fourth and final "major" example of colonial biopiracy was the 1876 transfer of rubber plants from Brazil to Singapore, and from there to Malaya, India and Ceylon. Kew director Thiselton-Dyer recalled the event in these terms; Kew 'transferred the South American rubber plants to the East, with results which have been fraught with "wealth beyond the dreams of avarice"' (Brockway, 1979: 101).

Rubber was in the twentieth century a geopolitically significant crop for the industrialized nations; '…in the great European wars and the global military conflicts of the century, especially in World War II, rubber was more crucial than life-saving quinine. Men could be replaced, but the war machine could not run without rubber' (143-144). Accordingly rubber was economically a very significant crop. However, until Robert Wickham managed to smuggle rubber seeds and seedlings out of Brazil the entire world supply of rubber derived from plants growing wild in the Amazonian rainforest.

The story of the biopiracy of rubber is also a story about the industrialization of agriculture. In the 1850s

> 'The mass of the population throughout the Amazon and principal tributaries put itself in motion to search out and fabricate rubber… A general pattern of debt slavery spread throughout the reaches of the Amazon… No other economic activity in the Amazon basin approached rubber in its deleterious effects on the native Indians. The dislocation of aboriginal life was severe, as traders spread up the tributaries bringing disease, subjugation, and warfare, and demanding that the Indians supply them with rubber. Many groups

> were annihilated; some... survived the destructive contact with reduced numbers and a culture much changed...' (Brockway, 1979: 147-148).

As industrial demand for rubber increased entire populations had their way of life destroyed, and new, alien, ways of life were produced. The "rubber boom" in the Amazon, first, had highly destructive effects on aboriginal ways of life, who were suddenly thrust into industrial labour and the international capitalist economy and, second, only two decades later, were plunged into mass unemployment and economic devastation when the British engineered the collapse of the extremely exploitative Amazonian rubber industry. This was a direct result of British biopiracy; 'The collapse of the wild rubber boom in Brazil [was] a direct consequence of the plant removal' (143);

> 'Arana [one of the most ruthless Brazilian "rubber barons"] had given wild rubber a bad name, and henceforth capital steered toward companies doing business under the British flag, that is, in the colonies of Southeast Asia... Moral fervor made it easier for British investors to cut their losses in the Amazon and turn to the Asian plantations, where a completely different labor picture was presented. The Amazon was finished as far as rubber was concerned' (155).

On the other side of the world, in south-east Asia, tens of thousands of people were employed on plantations of industrial scale under labour conditions which were little better than those in Brazil. These plantations were often run by Chinese entrepreneurs who established plantations with trees derived from Wickham's initial collections, and imported workers from their home country, who were required to labour with no wages until they had earned the "cost" of their transport to south east Asia. The workers were mostly Chinese and were charged $10 for transport to Malaysia, which they had to pay back from earnings of just 2.5 cents a day; 'return home was impossible under these conditions' (161).

> 'Imported men, an imported plant, and imported quinine to control malaria all combined to make the Malay States an embodiment of the ideal colony, and to make rubber the most satisfactory plantation crop in all of British-controlled Southeast Asia... the transfer of the rubber trade from informal empire in Latin America to formal empire in Asia had served Britain very well... her entrepreneurs enjoyed congenial conditions under the colonial governments, with the support of the administrative framework and the courts in making, interpreting, and enforcing land and labor laws favourable to them' (164-165).

Britain was not the only nation to establish rubber plantations south east Asia. The Dutch had theirs on Java, the French in Indochina, and the United States in the Philippines All felled large areas of forest. All produced enormous amounts of raw rubber and raw profit.

Kew sparked this chain of events with just £1500 to pay the collector, the bill for transport and to build a special greenhouse for the saplings; 'a very small sum, which was both literally and figuratively "seed money" for a great new plantation industry' (143). Kew had planned such a scheme from the mid 1850s but two previous attempts had failed.

> 'Success came only in 1876 when [Henry] Wickham chartered an English ship going up the river on a newly opened Liverpool-Manaus run. He filled it with a quantity of *Hevea* seeds estimated at 70,000 which he hurriedly collected with the help of Tapuyo Indians in the forests of the Tapajós basin. At Parà, Wickham successfully hoodwinked the Brazilian customs official and got his cargo out to sea, and to Kew' (156-157).

The story is that Wickham told the customs officials that the seeds were to help decorate the Queen's garden, and that the invocation of "Royalty" was enough to see the plants on their way to Kew. It is possible, however, that Wickham simply offered a generous bribe.

By the turn of the twentieth century there were literally millions of rubber trees in south east Asia where previously there had been none. 'Every one of the millions of trees was descended from the few hundred seedlings that survived the journey from Brazil to Kew to Ceylon and Singapore; and 75% of them from 22 seedlings sent from the Ceylon Gardens to the Singapore Gardens in 1877' (Brockway, 1979: 141). In short, Wickham's mission, which was no more difficult than hiring a ship and a few Indian labourers and blinding a customs official with monarchy (or money), single-handedly changed the course of hundreds of thousands of lives and created a new source of economic power for the British, Dutch and French empires in the early twentieth century. There was arguably no case of biopiracy so direct, so extreme and so economically significant before or since.

Conclusion to Chapter 5.

It is precisely such blatant acts of botanical theft as the transfers of cotton, tea, cinchona and rubber that the CBD/CAB seeks to prevent from reoccurring. The transfers of plant materials discussed above all contravened today's agreement and recognition that bioresources are not "there for the taking" but are the national property of the territory in which they live. If the Convention required back-payments of compensation to be made to the nations who provided the seeds and saplings that Britain took in the colonial era – even at the low figure of 10% or less that is standard in contemporary Bioprospecting agreements – the British bill would, in today's currency, possibly be in the hundreds of millions of pounds, if not more. Even if only the "major" cases of biopiracy are considered, it should be clear from the above accounts that India, China, Ecuador, Peru, Bolivia and Brazil would have made significant profits if the geopolitical situation had historically been such that agreements to share the benefits of bioprospected goods were possible.

These transfers of plants each have a place in the gradual demise of the naked and uncomplicated extraction and exploitation of bioresources and a place in the gradual rise of a more sophisticated, but no less significant management of bioresources (on which see Chapters 8 and 9). Each time a crop went, via an act of biopiracy, from being harvested in the wild or from very small and isolated pre-industrial farms to being harvested from highly concentrated and systematically organized plantations a step nearer to the completion of the enclosure of the global commons – signalled by the Convention's institutionalization of national sovereignty over biological resources – was taken. As I argue further in subsequent chapters the imperialist world in which valuable resources were in the course of being subsumed into various competing capitalisms has given way to an emperial system in which bioresources exist within one global society.

Chapter 6. Imperialist biopiracy; exploitation of local labour and knowledge.

Chapters 3, 4 and 5 took as their foundation those Articles of the United Nations' 1992 Convention on Biological Diversity (which I have shown in Chapter 1 to also be a Convention Against Biopiracy) which regulate the contemporary transfer of biological resources from one nation's territory to another. I describe the latter as Bioprospecting, with a capital B, to distinguish it from the more general, unregulated transfer of biological specimens in previous decades and centuries, which I describe as bioprospecting with a small b. Chapter 6 takes as its foundation the Articles of the Convention that regulate the exploitation of local *labour* in the course of the search for biological resources and the exploitation of local *knowledge of* biological resources. Such exploitation is another aspect of historical biopiracy that the CBD/CAB seeks to put an end to.

Chapters 6 and 7 are connected by their shared foundation on the articles of the Convention requiring that Bioprospectors "respect and preserve" the knowledge of the local, non-scientist, populations of the nations in which they work (see Chapter 1 for the exact text of the Convention). In contrast to the post-colonial intent of contemporary Bioprospectors, Chapter 6 shows, first, how historically bioprospectors have exploited local *labour* in their pursuit of botanical materials, and, second, how historically bioprospectors exploited local *knowledge* in that pursuit. Chapter 7 discusses the extent to which local botanical knowledge was, or was not, incorporated into botanical science and (increasingly global) botanical archives and/or biodiversity databases. That is, it discusses what Schiebinger (2004) has called the "linguistic imperialism" that occurred in tandem with the economic imperialism that we have discussed at length in Chapters 4 and 5.

My thesis is primarily that there has been an historical transition from biopiracy to bioprospecting. While I take the contemporary close relationship between bioprospecting and environmentalist practices to be the most significant aspect of the transition in terms of macro-sociology and social and political theory, it is the change in the practices and attitudes of bioprospectors to the local populations they work among that is the most significant in terms of micro-sociology and everyday social interaction. Historical changes in the treatment of, and attitude to, local labour and local knowledge on the part of itinerant botanists are in many ways progressive (while the macro-social changes, I argue, are not).

The contrast between the practices and attitudes of colonial and imperialist bioprospectors and the post-colonial, even anti-imperialist, practices and intentions of today's Bioprospecting scientists should, by the end of this chapter, be very clear. To recap, contemporary Bioprospectors, especially but not exclusively those of the "Schultes school", had a direct role in the formation of contemporary Bioprospecting policy, as enshrined in the Conevention. They believe that 'investigation of plants used for medicinal purposes by "unsophisticated" peoples can provide us with new biodynamic compounds that may have very important implications in our own society' (Plotkin, 1991: 60) and that 'Each time a medicine man dies, it is as if a library has burned down' (Plotkin, 1988: 114).

Exploitation of local labour.

The first half of Chapter 6 will show

1) That the people that we refer to today as "bioprospectors" historically often did not in fact physically collect their botanical specimens themselves. They used hired local labour to do the hard work of chopping down branches and digging up

plants. Their own role in the actual practice of gathering was often merely to point out the desired specimen. In some cases they simply employed locals to collect whatever plants they could find and bring them back to camp for inspection. Bioprospecting labour was frequently sub-contracted. Invariably the hired labour was financially compensated only at a very minimal level.

2) That colonial bioprospectors often hired very large teams of labourers, whose role in the acquisition of bioresources was very rarely acknowledged by the bioprospecting employer. The attitudes of colonial bioprospectors to their hired labour varied throughout the colonial period; the general pattern was that attitudes were more respectful in earlier historical periods than in later ones. By the late nineteenth century some bioprospectors had become so disdainful of their hired labour that the quantity of botanical specimens collected was counted in "coolie loads".

3) That there were, contrary to the general pattern, some historical bioprospectors who did respect and admire local "pre-scientific" botanical knowledge. One of the two botanists who I cite in this regard – Richard Spruce – can arguably be regarded as the founder of the contemporary Schultes school of bioprospecting, whose students went on to be directly involved in the enshrining of Spruce-esque attitudes of respect to local populations in the CBD/CAB. Schultes was a great admirer of Spruce's ethnobotanical methods and modelled his work on his intellectual hero's, and derived his beliefs from him.

4) That colonial bioprospectors often encountered local resistance to their work. This could take mild forms – such as a refusal by the local population to assist or an unwillingness to take employment as guides or collectors – but there were also stronger, violent forms of resistance. Sometimes resistance was unconnected to bioprospecting work – when the bioprospector was embroiled in some local anti-

imperialist struggle. Sometimes resistance was borne directly of local consciousness that local botanical materials were being sought by an outsider, that is, resistance was spontaneous defence against biopiracy.

First, we will look briefly at how what was true at the general, macro, level was also true at ground level, during the physical act of collecting botanical specimens; 'the old imperialism used the human resources of the tropics to collect the vegetable and mineral ones' (Headrick, 1988: 209). As Schiebinger has put it 'For botanists to be successful abroad, they needed financiers, ship captains, assistants, illustrators, local guides and carriers. When it came to naming plants, however, these support people were often overlooked in favour of more prestigious European-educated males' (2004: 211).

Especially in the Victorian period of "high imperialism" and rigid distinctions of social class it was the

> 'convention that a gentlemen did not carry tools or heavy burdens or betray any other evidence suggestive of manual labour. To circumvent this, the lordly – taking a lead from sportsmen – often resorted to the caddie principle, hiring small boys to take on the obvious drudgery… Even as late as the 1930s Mrs M. L. Wedgwood regularly toured the country in a large car driven by a liveried chauffeur, who as often as not was deputed to do the actual gathering' (Allen, 1994: 139).

But the bioprospector's reliance on local labour to get the job at hand done was not simply a matter of convention, it was a practical necessity. There are many examples of bioprospector's bemoaning the lack of available – or willing – labour, all of which prove the sociological truism that the capitalist depends on the labourer as much as the converse. The botanist F. W. Hostmann wrote to William Hooker in 1840 to explain his decision to cease his collecting activities in these terms; he would have been happy to continue his bioprospecting work 'if only I could have depended on that assistance without which it would be a mere chimera to attempt the exploration of a country like Surinam' (Hostmann, 1840, extracted in Short, 2004: 277).

Local labour and knowledge was exploited by botanists throughout the colonial period. The eighteenth century lady bioprospector Maria Sibylla Merian, working a century and a half before Hostmann, apparently found the labour market in Surinam rather more buoyant than her successor. She could not have had the successes she did without employing – at an insignificant wage – local labour, both physical and intellectual; 'several Amerindians and displaced Africans in Surinam... served as her guides to desirable specimens and provided access to dangerous, often impassable regions' (Schiebinger, 2004: 206). Although Merian did not, as some later botanists did, pretend to have made all her discoveries by her own hard work and intellectual resources, she failed to individually acknowledge the source of her botanical finds and credited only homogenized, anonymous "Indians".

> 'Like Sloane and other male naturalists, Merian relied on Amerindians and African slaves – whom she referred to as "my slaves" (*myne Slaven*) – for aid in finding choice specimens, and for safety in travel. Her slaves hacked openings for her in the forest, dug up roots, helped her tend her botanical garden, paddled her and her assistants upriver, and supplied choice maggots, fireflies, and shells... When writing her commentaries to her plates featuring her

> finds, she added – as was common in this period – "information from the Indians"' (35).

Local labour and knowledge was exploited in some of the "major" cases of colonial biopiracy too, for example, the transfer of cinchona from South America to "British India" was enabled by local labour and knowledge;

> 'With several Indian helpers, Spruce and Cross (two of the four collectors employed by the India Office to identify and transfer cinchona trees for British plantations in India) established themselves in a secluded hut... and found extensive stands of *C. succiruba*, the "Red bark" of commerce, in the bottom of ravines' (Brockway, 1979: 113-114).

For their help in locating these economically valuable and geopolitically significant trees the "Indians" in question (who, after centuries of European presence in the Amazon, are more likely to have been *mestizo*, than "pure" Indians) received little more than the going rate for manual labour in the mid-nineteenth century Amazon, while Spruce and Cross were paid £500 each.

J. D. Hooker, who at one point was employing no less than fifty people to accompany him through the Himalayas in search of rhododendrons, described his '"merry troop"', who ,"except for drunkenness and carelessness, I never had to complain"', thus; '"bareheaded and barelegged, possessing little or nothing save a cotton garment and a long knife, [they] followed me for several months, from the scorching plains to the everlasting snows"' (Hooker, 1848, cited in Raby, 1996: 132). Raby, discussing this passage from Hooker's *Himalaya Journals*, without apparently objecting that they were in actuality doing his bioprospecting work for him, for minimal pay and no recognition, notes that 'At one point he was employing eighteen collectors at Darjeeling, paying them between eight and sixteen shillings per month' (132). In the same work, Hooker complained of the hardship that befell him when, at a later point on his journey, he was unable to find any locals willing to work for such a meagre salary; 'I have been annoyed by the want of a collector: the whole trouble of gathering, drying, etc., has fallen on my own shoulders' (Hooker, 1848, extracted in Short, 2004: 62). However, despite occasionally having to get his own hands dirty for want of willing labour, after his return to base in Darjeeling it 'took him six weeks to arrange, catalogue and pack the "80 coolie-loads" of specimens that were sent back to his father at Kew' (Musgrave et al, 2000: 91). In other discussions of Hooker's botanical adventures it has been noted, with considerable understatement, that 'Hooker had a rather condescending attitude' to his hired help (Musgrave et al, 2000: 85).

The difficulty in securing willing local assistance was apparently something of an occupational hazard for imperialist bioprospectors. In "Zululand" in 1851-52 R.W. Plant reported that, 'Strange as it may seem, I could not tempt the natives to assist me in any way toward gathering insects, shells, etc.: they would or could not conceive any man so foolish as to give away such valuable articles as beads, etc., for the mere trash that I wanted…', and, in a choice example of the pervasive European stereotypes of the day, went on to "describe" how the locals 'set no value on time, and having nothing to care for except their cattle, do not wish to sell their lazy independence for the wages of a white man's servitude' (Plant, 1852, extracted in Short, 2004: 12-13).

Similarly, in the Fijian islands William Milne found that 'It was in vain that I could tempt these people to ascend [a 70 foot tree] for specimens [of fruit]' (Milne, 1856, extracted in Short, 2004: 310). Decades later, in Borneo, F. W. Burbidge, employed by the Veitch nursery to bioprospect for decorative garden plants, after noticing a potentially desirable specimen that 'grew on a dangerous declivity' found that 'not one of our lazy men would venture to get it for us. Such a prize, however, was too lovely to forego, and after a wet scramble among the surrounding bushes, I secured it [myself] in good condition' (Burbidge 1880, extracted in Short, 2004: 91). One can almost picture this oft-recurring scene; a cheeky-faced character, when ordered by his arrogant cane-wielding, red-faced, European "master" to climb a tree or hillside in pursuit of a desirable plant, turns around and shouts, in broken English, "Get it yourself, Sir!"

On the larger imperialist bioprospecting missions the "chief collector" was not, as one might presume, the man history remembers as the discoverer of a new species or the identifier of a valuable plant. On J. D. Hooker's Himalayan trip in the 1840s in northern India, Sikkim, Tibet and Nepal, the party was so large that there was a hierarchy of collectors. Hooker employed a "chief collector", who had his own personal servant, and a team of local "lads" under his charge. While it is Hooker we credit with identifying a large number of new rhododendron species it was actually not he who physically gathered the specimens he took back to Kew. It seems somewhat absurd today but in order to locate a few garden plants Hooker felt it necessary – and financially viable – to employ over fifty men, including seven men just to carry paper for drying plant specimens!

> 'The Victorian scientific explorer may have felt isolated, but he was not alone. This [trip] was a formidable logistical enterprise, because everything, even food for the porters, had to be carried on men's backs. Seven [men] were assigned to Hooker's tent, instruments,

> and personal equipment, seven more to the papers for drying plants. The interpreter, the headman, and the chief plant collector had a man each. There was a bird and animal shooter, collector and stuffer, with four men to lug ammunition; three Lepcha lads, whom Hooker had been training to climb trees and change the plant papers; fourteen Bhutan porters, laden with food: Hooker's personal servant; a detachment of eight Nepalese guards… a nattily dressed havildar in command, plus two porters for their food… The heavily laden party which Dr Campbell saw off on its route along the Goong ridge towards Nepal was fifty-six strong' (Raby, 1996: 133).

While Hooker's somewhat extravagant party was larger than many, it was not uncommon for bioprospectors to employ several men, who, more often than not, would do the work of collecting for the man now remembered as introducing plants to Europe and "to science". While collecting cotton seeds in India in 1787, under Joseph Banks's instruction, for West Indian plantation owners, Anton Hove, after initially attempting to travel alone but suffering several robberies, was for some time 'travelling in a party that was protected by 48 coolies armed with matchlocks' (Mackay, 1985: 151). George Forrest, bioprospecting in Tibet at the turn of the twentieth century, employed '"17 collectors and servants"' (all but one of whom, tragically, were murdered for their association with the local Christian mission by angry local militia) (cited in Short, 2004: 110); on another trip he travelled with what has been described as a 'small army of native workers [employed] to collect for him' (Musgrave et al, 2000: 191). Frank Kingdom-Ward, bioprospecting in Burma had a crew of 'twenty three men, one sheep, and two dogs' (Musgrave et al, 2000: 208). The Cervantesesque Swiss botanist-errant Bossier, travelled around Spain, more modestly with '"a mule and a peasant"' (Boissier, 1845, extracted in Short, 2004: 201). All of these, and many other, local helpers – generically known as "coolies" – guides, collectors, guards, whose labour was exploited during the course of European bioprospectors' travels are now anonymous, their role in introducing new plants to European gardens and herbaria is forgotten, while their employers were credited with the introductions and often made significant private profit and/or made economic or geopolitical contributions to the progress of the British empire.

Bioprospectors divided their hired labour along racial lines; Masson and Thunberg, plant-collecting in the Cape in the late eighteenth century travelled with 'an ox-wagon full of supplies and collecting equipment, a European servant and three Hottentot drivers-cum-helpers' (Musgrave et al, 2000: 41). Hostmann, in Surinam, wrote that he 'carried with [him] an assistant, and a few trusty black servants all used to collect and prepare objects of natural history'. He was 'being guided in these excursions by Bush Negroes and Indians, employing the former in transplanting the collected objects and expecting interesting particulars from the latter as regarding the properties of vegetables' (Hostmann, 1841, extracted in Short, 2004: 273).

Although it is difficult to accurately say to what extent the following attitude toward local help was representative, it seems quite likely that the bold racism in the following passage would not have been as shocking to its original audience as it is today. 'In 1830, [G.W.] Walker was sent to Ceylon (Sri Lanka) as Adjutant-General', while there he botanized, largely, it seems, for pleasure, accompanied by his wife, and relying heavily on local help. His wife, in an account of one of their bioprospecting trips, published by William Hooker, felt it necessary to write in explanation that "coolies" were people, not, as reported elsewhere, horses. After crossing a river Walker's party '"halted for a few minutes to rest our coolies; and while these are taking their rest I might as well explain that they are human beings, employed as porters and chairmen in carrying baggage for their fellow creatures... I have included this explanation in consequence of reading a note by the learned editor of one of the penny magazines, on an extract from some publication of India, in which he tells his readers "that coolies are small horses". He would have been nearer the mark if he had called then "black cattle" – but mine have rested long enough, and I must proceed on my journey"' ([Mrs A] Walker, 1830, extracted in Short, 2004: 52).

Charles Darwin, in the journal he kept on the *Beagle* voyage (infamously) used similar terms: '"I could not have believed how wide was the difference between savage and civilized man. It is greater than between a wild and domesticated animal"' (cited in Raby, 1996: 23).

There are not many examples of bioprospectors who had, in the centuries of European imperialism and colonialism, what we would now take to be "post-colonial" attitudes to their hired labour or their local informants. However, there are a few, and it would be misleading to exclude them. Above I have described the CBD/CAB's formal expressions of respect for local or so-called "pre-scientific" botanical and ecological knowledge as "unprecedented", and I stick to this adjective despite the two examples from the nineteenth century that I give here. This is because Spruce's and Forbes's expressions of respect undoubtedly went against the prevailing attitude of their day – both among botanists and political leaders. The formal commitment to "respect and preserve" local (or as the actual text prefers "traditional" and/or "indigenous") knowledge made by the signatories of the

Convention signals a widespread consensus. It is this consensus that is unprecedented. The views of Forbes and Spruce presented here should be understood as a minority view, and a progressive one, among individuals who had rare experience working closely with members of non-European cultures. Such experience led them to oppose the stereotype, borne of ignorance, held by many of their contemporaries that non-European cultures had nothing approaching "scientific" knowledge.

Richard Spruce greatly valued his hired local labourers and recorded in print how he depended on them not only for helping him in his bioprospecting work, but for his very survival. In regard to their navigation and piloting skills he wrote that; 'it is not safe to venture among the falls with fewer than two oars' and on their hunting and fishing skills; 'I have in the house with me two Indians – a hunter and a fisherman. One at least is an absolute necessity to prevent me from dying of hunger, for here there is nothing to be bought' (Spruce, 1905 [written in 1852], extracted in Short, 2004: 287). When the hunter Spruce writes of here was conscripted into seasonal hard labour by the local government Spruce made an impassioned argument against the "disgraceful" practice (288). His oarsmen, fisherman and hunter all bioprospected for Spruce aside from their primary duties and Spruce approvingly recorded that "often" their collections turned up something new for his herbaria (287). Spruce learnt that he could trust his hired help and came to value their knowledge, to the point of seeking their advice regarding the properties of many plants. His employment of this ethnobotanical method was a great inspiration to a later Amazonian botanist, Richard Schultes. Through Schultes and his students Spruce has indirectly shaped the entire field of ethnobotanical bioprospecting, which in turn, as we saw in Chapter 1, was influential on the wording and formation of the CBD/CAB.

Perhaps the most unequivocal statement of post-colonial, even anti-racist attitudes toward non-European botanists to have survived is that of Henry Forbes. The following passage from *A Naturalist's Wanderings in the Eastern Archipelago*, which describe his nine years (1878-1887) bioprospecting, speaks for itself:

> 'As soon as I was able to follow their discourse with ease, my daily talks with these men [at Genteng, Java] were a source of great pleasure to me. I soon found out that in regard to everything around them, they were marvellously observant and intelligent. Not one or two only, but every individual among them seemed equally stored with natural history information. There was not a single tree or plant or minute shrub, but they had a name for, and could tell the full history of; and not a note in the forest but they knew from what throat it proceeded. Every animal had a description, not a mere meaningless designation, but a truly binomial appellation as fixed and distinctive as in our own system, differing only in that fact that theirs was in their own and not in a foreign language [here Forbes is apparently taking a stab at the Latinization of European botany, of which more in Chapter 7]...
>
> They have unconsciously classified the various allied groups into large comprehensive genera, in a way that shows an accuracy of observation that is astonishing from this dull-looking race. In this respect they excel far and away the rural population of our own country, among whom without exaggeration scarcely one man in a hundred is able to name one tree from another, or describe the colour of its flower or fruit, far less name a tree from a portion

> indiscriminately shown him' (Forbes, 1885, extracted in Short, 2004: 100-101).

Local resistance to biopiracy.

The above accounts of how European's exploited local labour should not be taken to mean that power always worked against the local populations amongst whom bioprospectors moved and worked. In fact there are several examples which, taken together, show that non-Europeans' had considerable power against the intrusions of European bioprospectors in the colonial era. As Abernethy argues, in a Foucauldian manner,

> 'Power is relational… Whether the resources and techniques Europeans deployed proved effective depended to a large extent on the resources and techniques deployed by their subjects to oppose, bypass, redirect, or assist them… explanations of the exercise and transfer of power should not be restricted to one party in a relationship' (2000: 29).

I do not intend to claim here that non-Europeans had such power as to be able to resist biopiracy; in the vast majority of cases bioprospectors were able to procure the specimens they desired without trouble. It was not until the CBD/CAB that there was any means by which host nations or local populations could successfully resist biopiracy, other than active physical sabotage or violent resistance. However, my account would be misleading if it excluded the few cases in which locals demonstrated their anger and sense of injustice against bioprospectors. The latter were effectively representatives of an invading population – agents of empire. In some cases bioprospectors were recognised to be, and treated as, biopirates. Although it was only temporary in effect, imperialist exploitation or resource extraction was on occasion, subject to resistance.

George Forrest described the generalized resistance to his plant collecting work in Tibet. This was perhaps more intense than that experienced by other bioprospectors because Forrest was based at a Christian mission in a nation attempting to resist invasion by Britain. It is nonetheless instructive of the attitudes of non-Europeans toward botanists working in their midst (and vice versa).

> 'Few realise the great hardships and dangers which have to be faced in order to secure new plants for cultivation in Europe. In the warmer regions there is danger from miasma, fever, animals, and snakes. Not infrequently too, the collector has to seek specimens among savage or semi-civilized peoples, who, in most instances, strongly resent his intrusions into their midst; thus seldom a year passes without toll being exacted in one way or another' (Forrest, 1905, extracted in Short, 2004: 107).

Forrest personally experienced the "toll" that could be taken when the French Christian mission where he resided in Tibet – which country at the time was the site of a simmering colonial war between China and Britain and had recently been invaded by the latter – was attacked by '"a large number of armed men"'. '"Our little band, numbering about 80 were picked off one by one, or captured, only 14 escaping… Of my own 17 collectors and servants, only one escaped"' (110). Forrest then spent 'eight days and nights' alone in difficult terrain with no supplies (111).

Richard Spruce, as we have seen, appreciated both the physical and intellectual assistance of the locals he employed as guides, oarsmen, and hunters, and viewed them with a respect uncharacteristic of his day. However, the locals did not view him as favourably as he did them. In fact they plotted to murder him. If Spruce had not known the local Indian language he would surely have been killed. In a lengthy passage from his journals Spruce described how one night he overheard the men he had employed plotting his murder. Their motive was partly to avoid having to undertake a long journey for which they had been paid, and partly revenge against European colonialism; '"I heard them begin to lash themselves into a fury by recapitulating all the injuries they had received from the white men, all of which they considered themselves justified in retaliating on my devoted head"'. They then resolved to steal his canoe, and his belongings and eventually decided simply to kill him. Fortunately for Spruce he managed to move from his tent to his nearby canoe and '"fortified the open doorway [of the cabin]… [and] laid my double-barrelled loaded gun, along with a cutlass and knife, by my side, and thus awaited the attack"', by this means he saved his life. Spruce then writes of how subsequently he '"took care throughout the rest of my voyage that the Indians should never approach me [while I was] unarmed, and I never spent a gloomier time"' (Spruce, 1905 [1852], extracted in Short, 2004: 293-294).

Attempts by Australian aborigines to violently resist bioprospectors were more successful. In central Australia, one of the botanist F. W. L. Leichhardt's party was killed when their camp came under '"a shower of spears"', and two other of his men were seriously injured (Leichhardt, 1844, extracted in Short, 2004: 152-153). The party had recently hunted a large number of local birds.

Local, violent, resistance in Africa was sufficient to prevent the biopiracy of a sacred plant species. W. G. Milne, botanized in the Niger region on behalf of the

Glasgow botanic gardens, with dogged, but unwise confidence. '"About a fortnight ago a man told me that if I went into the bush I would be shot: so you see it is not all plain sailing at Calabar. But I have an extensive field before me, and I am determined to make the best of it, in spite of the natives, as it will not do to let them have it all their own way"' (Milne, 1863, extracted in Short, 2004: 37-38). However, the locals did get "their own way":

> '"While in the act of pulling down some of the flowers [of a 'straggling shrub belonging to Bignoniaceae' which was spiritually significant to the locals], I was surrounded by some hundreds of men, women, and children, shouting and dancing like so many fiends. At first I was inclined to think they were about to hang me in front of their palaver house or heathen temple. On looking round I could see no way of escape, so I held my ground, determined to have some of the flowers; but they were so determined that I should not get them. At last they put me out of the town"' (38).

In Sikkim, J.D. Hooker's foray into contested terrain was impeded and heavily delayed by local sabotage;

> 'Hooker's progress was constantly impeded by the Dewan, who did not want this interfering Englishman back in his country. His agents sabotaged the party's food supplies whenever possible, damaged paths and bridges ahead, and forbade native villagers to sell Hooker provisions... the Dewan's constant interfering meant that an

> expected thirty-day trek from Darjeeling to the Kongra Lama pass took eighty-three days' (Musgrave et al, 2000: 91).

These examples do not exhaust the list of botanists who were the target of local resistance to their work. F. J. H. Mueller, 'Government Botanist of Victoria', was twice attacked by natives on his 1855-1856 bioprospecting travels (Short, 2004: 162). Thomas Lobb's attempts to secure varieties of pitcher plant for the Veitch nursery 'were disrupted by problems with the local people' such that he 'cut short his trip' (Musgrave et al, 2000: 150). Robert Fortune faced 'distrust and dislike' and 'antipathy' from the Chinese from whom he sought tea plants and horticultural specimens – only pressure from the British Consul secured him access to Chinese nurseries (113). And, in what would become New Zealand 'Maori war canoes had to be warned off by cannon fire, and [Joseph] Banks' plant collecting was frustratingly disrupted by the hostilities' (24).

On four continents – Asia, South America, Australasia and Africa – bioprospectors faced violent resistance to their presence and their work. It is not only contemporary critics who see their work as hostile, inequitable and imperialist. It was understood in their own day to be biopiracy and was reacted to accordingly.

Exploitation of local knowledge.

As we have seen in Chapter 3, the gathering of botanical specimens – bioprospecting – began "at home" before it occurred elsewhere in the world. The same is true of the gathering of botanical knowledge (although I will argue in Chapter 7 that this was often was little more than the listing of information). We have seen already that Joseph Banks's botanical education began with him paying local "herb-women" to teach him the names and uses of the plants in the vicinity of his childhood home (Thomas, 1983: 70). But governments and the medical elite were already in the eighteenth century gleaning botanical "secrets" from local experts. In 1739 Mrs Joanna Stephens was paid the huge sum of £5,000 "by Royal Consent" to reveal her closely guarded secret concoction for the dissolving of bladder stones (Schiebinger 2004: 97-98). A Birmingham physician similarly learned of an effective cure for dropsy involving the use of the leaves of the foxglove plant (chemicals found in which have been synthesized and are used in a variety of contemporary medicines) from an anonymous "old woman", who appears not to have shared in any of the benefits arising from her botanical discovery (98). The exploitation of local knowledge by the botanical-medical elite occurred at home as well as in the European colonies. However, the clauses of the CBD/CAB requiring signatory nations to "respect and preserve" local knowledge specify contemporary knowledge "embodying traditional lifestyles", so it is to the converse historical practice – the exploitation of knowledge found among non-European, "pre-scientific" communities by (ethno-) botanical researchers from Europe that we will now turn.

Richard Drayton has argued at length that

> 'the sciences of collection and comparison – among which we may include botany, zoology, anthropology, and geology – depended on Europeans becoming exposed to the planet's physical and organic diversity, and often to the scientific tradition of non-European people. These disciplines needed the world as a whole to make sense... Empire transformed the scope and character of European knowledge, as it brought apothecaries and philosophers into contact with both strange plants and with the science and pharmacy of non-European peoples' (2000: xvi-xv, 45)

We will see in Chapter 7, in relation to Linnaean classification, that it was not only the "scope" and content of European botanical knowledge that was influenced by the formation and survey of empires, but also the very *form* which that knowledge was organized into. As we have seen above, there are one or two isolated examples of how botanists sometimes formed an attitude of respect for non-European knowledge. Generally, though, they felt in a superior position to the mass of humanity (as did their intellectual ancestors in the twentieth century's ecological sciences, see Chapter 9). 'British "improvers" moved, at home and abroad, in the faith that they ultimately knew better than those on the ground. Their confidence depended, in part, on the assumption that they possessed a more profound understanding of how Nature worked' (90). As we have seen in Chapter 1, it was not until the "traditional" knowledge of Amazonian peoples was recognized as having become under threat of both cultural dilution and physical destruction in the very late twentieth century that the serious and widespread expressions of respect for, and valourization of, non-European knowledge by ethnobotanical bioprospectors came to be heard, and came to be enshrined in the CBD/CAB.

To borrow a phrase of Drayton's we can say that both then and now those bioprospectors who took the time to ask the locals about the plants they collected and their uses (which was by no means not all) 'were at work untangling the indigenous and committing the local to the global' (xviii). We have seen above how individual bioprospectors on the ground relied heavily on local labour, both for the forming of their collections, and in some cases, for their very survival. In the following section we will look at how European botanical knowledge (partially) relied for its development on local knowledge that was "bought home from the tropics" (then, in Chapter 7 we will look at how bioprospectors missed the opportunity to incorporate much more non-European knowledge into "science" than they in fact did). In a passage reminiscent of Hardt and Negri's insistence that contemporary global society was and is produced "in common" by "the multitude" and not only by the most visible and most powerful institutions of government and commerce (through emperial sovereignty), Drayton argues that

> 'We may eventually discover that the modern world was produced through the collaboration of the labour, wit and learning of all of the world. Neither the Scientific nor the Industrial Revolutions, no merchant bank or university would have arisen in the West had they depended [only] on the material or cultural resources of the people who lived closest to their headquarters' (xviii).

It is such post-colonial recognition that the CBD/CAB intends to formalize, despite what its critics might say of its failure to sufficiently do in reality. We have seen in Chapter 5 the major contributions of material resources that bioprospectors helped to put into global circulation – contributions of cotton, tea, and cinchona industries.

We will see below that in these three cases (but not that of rubber) local knowledge ("cultural resources") regarding cultivation, harvesting or manufacture was superior to European knowledge of them, and that in the cases of cotton and tea (although only partially in the case of cinchona) local knowledge was successfully transferred along with them.

We now return to the material presented in Chapter 5, with the emphasis on the intellectual exploitation rather than the material exploitation of non-European botanical resources. In each case the "faith" among European botanists and bioprospectors that they "knew better" than non-Europeans is shown to be patently misplaced; the recording of their knowledge was vital to the successful biopiracy of these three major plantation crops.

Regarding cotton, I have shown that Hove's primary task on his long journey around India, as detailed in his "secret instructions", was to acquire seeds of fine cotton varieties. However, these were not to be the "narratively stripped" specimens that made up the majority of botanical material brought home by bioprospectors (see Chapter 7 for more discussion of this term). Hove, under Banks's direction 'had made himself fully master of the processes of cultivating cotton, and had taken unwearying pains to discover how it was carded, spun and woven. Despite the antipathy of the natives he managed to bring away a loom with a weft on it and a drawing of the process of carding' (Mackay, 1985: 162-163). Hove had successfully sought and illicitly removed both material and cultural resources; the knowledge he gained had not previously existed outside of India in any systematic form. Without the attached "narratives" regarding cultivation and manufacture his cotton seeds would have been useless and worthless.

Regarding tea, I have shown already that the undeveloped state of European knowledge of Chinese tea plants in 1757 was such that the representatives of the

Swedish East India Company in China who had been instructed by Linnaeus to procure tea specimens were able to be successfully misled, effectively duped, into returning plants that were not in fact tea (Koerner, 1999: 137). Almost a century later, the Chinese still had their monopoly. When Robert Fortune was eventually – in the aftermath of their military defeat to a now-technologically advancing Britain – able to gain access to Chinese tea plantations, he was surprised to learn that he need not seek both black and green varieties of tea because they both derived from the same plant and took different forms only at the stage of manufacture (Brockway, 1979: 27). In short, Chinese knowledge of tea remained superior to British – despite their consumption of it in enormous quantities – for over a century. The first, failed, attempt to start tea plantations in Darjeeling, involved the payment of 'Chinese horticulturalists to tend' the small quantity of tea plants that had been smuggled out (Raby, 1996: 146). When Fortune was finally able to make the monopoly-busting transfer of tea plants from China to India it wasn't simply a matter of acquiring material specimens, but also cultural/intellectual resources in the form of 'eight Chinese tea growers and their equipment' (Musgrave et al, 2000: 124). Again, then, it was essential to the establishment of the British-Indian tea industry that Chinese agriculturalists and their knowledge be transferred along with the specimens. No exploited knowledge, no new source of colonial profit.

It was humbling enough for Europeans to have to send out bioprospectors to India and China with the specific task of filling in a gap in their knowledge. But it was outright embarrassing to learn the fact – kept out of public knowledge at the time – that the Amazonian population had long-since known a key method of keeping the quinine yields to be had from cinchona trees high. It took Europeans years of experimentation to "discover" this. One of the initial justifications for the biopiracy of cinchona trees from various Andean nations was that the local practice of severely chopping back the trees was "wasteful"; and the common discourse of Europeans "knowing best" was invoked in this regard.

> 'It was the commonly held opinion, first stated by von Humboldt and repeated by Royle, and Markham and Cross, the Kew collectors, and expressed as late as 1931 by the *Kew Bulletin*, showing that it had become accepted as an article of faith in the literature, that intervention by the Europeans was necessary to save the cinchona tress from extinction because of over-cutting and wasteful practices in the Andes' (Brockway, 1979: 111).

This belief appeared to be correct only because of Europeans inability to locate the trees growing wild in the jungles of South America; 'The habit of growth, in scattered clumps throughout dense forests, made it hard for Europeans unfamiliar with the terrain to find the trees, and confirmed their belief that it was scarce' (112). Once the trees had successfully been located, shipped across the Atlantic and established on Indian plantations, 'the Scots gardener in charge of cinchona cultivation in India', William McIvor, began a series of experimental plots of the trees and worked on improving the quinine yield to be gained from them. One of the 'refinements' he made in this regard was the practice of regularly chopping back the trees. He showed that quinine derived from young shoots of the tree was more potent than that derived from older specimens. As Brockway wraps up this story of misplaced European arrogance 'we may conclude that the Andean bark cutters knew what they were doing' in their practice of regularly chopping back the trees (112).

In this case then, although Spruce and Cross both relied on local knowledge in the location of cinchona trees their failure to systematically observe local methods of cultivation and quinine manufacture cost their colleagues in India considerable time and effort. This non-transfer of knowledge is similar to the non-transfer of the knowledge of natural abortificants that Schiebinger (2004) has described. While the latter case is easily explainable, in terms of such knowledge being contrary to the interests of (male) imperialist doctors it is unclear why local knowledge regarding cinchona had to be re-learned by British imperialist botanists in India. Perhaps it was because the political unrest in India in 1858 meant that corners were cut. It was after all not the Kew collectors' decision not to record local knowledge of cinchona but that of Royle, in his capacity as architect of the scheme and of advisor to the India Office (which had recently been formed as a response to revolutionary stirrings among Indian army officers). Perhaps it was simply out of scientific arrogance; the conviction that Amazonian peoples were wastefully and inefficiently acquiring and producing quinine. Or perhaps it was because of bureaucratic miscommunication – it seems probable that one of the four collectors employed by Kew to collect cinchona had in fact observed the locals' practices and also possible that this knowledge was never forwarded to their colleagues in India. Either way, here is an example of how local valuable local botanical knowledge was not, although it could have been, fully exploited by the imperial machine.

Other examples of the non-exploitation of non-European knowledge are detailed further by Schiebinger. The story of how Caribbean slaves' use of abortificants was deliberately not exploited for biopolitical reasons, is especially instructive in this regard, but I have had to exclude it from my thesis for lack of space. Schiebinger summarizes the secrecy with which botanical knowledge was defended against exploitation by the European invaders thus:

> 'Europeans were often curious about Amerindian and slave medicines and eager to learn, but the indigenes and slaves were less eager to divulge this knowledge to their new masters... The guarding of secrets from colonial aggressors occurred worldwide... In eighteenth century Peru, La Condamaine commented that "the naturals," as he called the Incas, had guarded the secret of *Cinchona* from the Spanish for some 140 years (some said for more than 200 years)' (2004: 90).

It is somewhat ironic that once Europeans were finally in a position to wrest botanical secrets from their colonial "subjects" and put them to imperial use, they failed, at least in the case of cinchona, to do so more efficiently.

In short, then, 'inhabitants of the colonies often held knowledge worth recruiting' (75). This wasn't simply a matter of economic gain, in some cases it was a matter of individual survival. Just as the early Spanish colonials learned from the Andean peoples to make the potato the staple of their diet – an innovation borne for them of necessity – the early British colonists of the Caribbean islands relied, from necessity – having never encountered many of the diseases and conditions that they suffered in the tropics – on pre-existing local medicine. When one was suffering from tropical fevers 'racist tendencies were tempered' and Afro-Caribbean doctors were called:

> 'Confidence in African naturalists' cures was so high among whites that when Sir Henry Morgan, lieutenant governor of Jamaica, became dissatisfied with Sloane's treatment of his disease, he sent for a "black doctor."... Despite the Europeans sense of superiority in

> medical matters, one should recall that their cures at this time consisted primarily [as did Sloane's] in bleeding, purging, blistering, vomiting, and sweating patients, and often did more harm than good' (80, 89)

So we have seen above that when Europeans had a specific goal, a specific industrial problem to work on, such as the establishment of plantations of cotton or tea, they were humble enough to seek any local knowledge that might help them to that end. Similarly, if it was a matter of survival, Europeans would adopt local dietary habits and seek local medical advice and cures. Generally, however, Europeans and post-Linnaean European botanists were little interested in exploiting local knowledge for its own sake. They approached the botanical knowledge and practices of the rest of the world from a utilitarian position. For example, many of the world's useful plants are used in construction – plants provide waterproofing and shade – but Europeans had little interest in the very many varieties of plant used for these purposes, consequently they went unrecorded. Beyond the exploitation of local knowledge of the "major" bioprospected plants, as detailed in the above accounts of the transfer of cotton, tea, and (to a limited extent) cinchona, one has to scour the extracts of colonial-era botanist's work very closely to find any examples of bioprospectors who sought local knowledge. Europeans generally undervalued the botanical knowledge of non-Europeans. Their sense of superiority was such that it outweighed their strong imperialist interest in developing useful and valuable products from the world's biological resources. Perhaps if they had more often consulted the locals there would have been more "major" cases of imperialist biopiracy. This then, is something of a contradiction in the history of bioprospecting.

Then, as now, a botanist's career is defined and judged in quantitative terms, not qualitatively. A botanist's career is judged by the number of species they have identified that are "new to science" and by the number of those species to which they give their name. The character, location, and uses (if any) of the plants they identify and name matter little. Imperialist botanists worked at a time when it was not especially difficult to locate species "new to science". One simply picked a suitably remote region and grabbed specimens of everything in sight. Once home, the tedious work of locating already-existing descriptions of ones' specimens began. Often the collection would contain many plants that grew across wide regions and were thus already "known", but invariably the happy botanist would have stumbled across several dozen "new" species, the most attractive of which he would then be at liberty to name after his mother, daughter, mistress, patron, political hero or king. Post-Linnaean botanists, unless they were employed for a specific high-profile mission such as locating tea or cotton plants, felt little – almost no – need to record local names for, or uses of, plants.

Europeans in the colonial era directly sought only that non-European botanical knowledge that they *already knew* had agricultural and medical value for them. As we will see in the next chapter, they generally failed to even attempt to record local names of plants or to learn from alternative botanical classification systems.

Conclusion to Chapter 6.

The first half of Chapter 6 has shown that the men remembered as the collectors of biological resources "new to science" did not always physically collect the specimens themselves, but sub-contracted bioprospecting labour to locals. Often they were paid very poorly for what could be dangerous work. Very rarely was their important role acknowledged in the bioprospectors journals or scientific papers. Both the latter practices are specifically reversed in the CBD/CAB. Bioprospectors today are required to "fairly and equitably" recompense any local labour or knowledge they rely on and are required to recognise them as co-authors on any resulting scientific papers.

Chapter 6 has also shown that the disdainful, sometimes explicitly racist, attitude of imperialist bioprospectors to the local populations among which, or with which, they worked was the rule, but that there were isolated exceptions – as exemplified most notably in the attitude of Richard Spruce (intellectual hero to Richard Schultes and the contemporary Schultes school of ethnobotanical bioprospecting). It was not common, but some botanists in the age of imperialism recognised, in ways similar to contemporary Bioprospectors, that non-Europeans had botanical knowledge that could not fairly be considered "pre-scientific". Chapter 6 has also shown that local populations sometimes recognised the acts of imperialist bioprospectors to be what they were – little more than theft, or biopiracy – and that, accordingly, they resisted them, sometimes violently.

The second half of Chapter 6 has shown that when the imperial economies of Europe benefited from the biopiracy of non-European plants, non-European knowledge of the plants – most significantly in the cases of cotton and tea – was required to put those plants to effective economic use. However, despite their interest in developing useful and valuable products from the plants they discovered in the course of the imperialist takeover of much of the world Europeans often felt it unnecessary to consult the locals about the potential uses of plants. In some cases, most significantly in the case of cinchona, profitable knowledge could have been collected but was not.

Today Bioprospectors are aware that the last vestiges of "traditional" botanical knowledge are under threat to cultural dilution and are accordingly more keen to entertain the notion that "traditional" cultures might know things about the uses of plants that us "moderns" do not. In the historical context of imperialist botanists' disregard for "traditional" knowledge the recording of ethnobotanical knowledge has something of the "just in case" last-minute check-up about it.

To take an extremely cynical view: fifteen years on from the Convention, given that no post-CBD/CAB Bioprospecting project has successfully brought any product with origins in "traditional" knowledge to market, it seems that ethnobotanical Bioprospecting is just that; speculative, almost desperate, prospecting. If valuable new knowledge was to be had among non-European cultures the time in which to seek it was before its dilution; the eighteenth century, not the late twentieth. All of which puts the sudden willingness of the wealthy nations to reward any locals that might help in developing valuable products in a different light. It is easy for the institutions of pharmaceutical and agricultural science and the governments of the wealthy nations to offer to pay (a small fee) for biological resources if they suspect there is not much left worth paying for. However, at the time of the Convention's formation there does seem to have been (as described in Chapter 1) genuine conviction among them that they might still not be too late to uncover some remaining nugget of knowledge among the "traditional" cultures of the world.

This cynical view of the clauses of the CBD/CAB that commit the signatories to respect and reward indigenous knowledge may have some credibility. However, it is, I argue in the remainder of my thesis, not these clauses that are the most sociologically significant. Instead of the clauses which insist on the non-exploitation of local labour and which have the effect of commodifying traditional knowledge, it is those clauses of the CBD/CAB which formalize and legitimate the commodification of biological *materials* and which connect the search for them to ecological and environmentalist practices of resource management which have the most social and biopolitical impact.

Chapter 7. Linguistic Imperialism and the Formation of the Botanical Archives.

Linguistic Imperialism.

I use the term "post-Linnaean botanists" in the latter half of Chapter 6, because the introduction and widespread adoption of the Linnaean binomial, Latinized, classification system (it was employed across all of Europe, except France, from the mid eighteenth century) effectively rendered irrelevant all 'information [regarding] medicinal usages, biogeographical distribution, and cultural valence'; all of this "narrative" was 'stripped from plants in Linnaean binomial nomenclature' (Schiebinger, 2004: 197). Linnaeus, and by default the popularizers of his system in Britain and elsewhere, 'declared all foreign names "barbarous"' (200).

While, as we will see below, the system was conceived as a labour-saving response to the rapidly accelerating import into Europe of previously unrecognized and unnamed plants, a phenomena which required a system that would allow easy classification and rapid, universal, naming of new plants, the introduction of Linnaean classification also had the effect of rendering the recording of local names of plants unnecessary. This was a consequence that no doubt saved a lot of bioprospectors a lot of trouble and gave them a ready-made excuse to simply transport the specimens, but no detailed knowledge of them, home. The French "natural" system (as opposed to Linnaean "artificial" classification, in which plants are classified by counting the number of stamens of each plant's flowers, and are given an entirely fabricated Latin name) classed and named plants, less systematically, and more subjectively, according to appearance. French botanists were less interested in simply accumulating vast list of plants (in the form of imperial *Flora*, of which more below) and more interested in recording knowledge relating to them, or at the very least, their local "natural" name. We might say that Adanson and Buffon had "pre-colonial intent" in naming practices: 'Adanson's inclusive, decentralized nomenclature cultivated a vision of human unity and diversity that prompted him, like Buffon, to adopt names from many of the world's languages' (222). Adanson, who travelled and bioprospected outside of Europe, 'championed a pragmatic, populist approach to naming' and scorned Linnaeus, who did not travel beyond Europe (and only rarely beyond Sweden), pointing out that had he done so he would have learnt that his names for plants were as "barbarous" to other cultures as theirs were to his (221).

The successive botanists of the archetypal institution of imperial/colonial botany, Kew gardens, following Linnaeus's Eurocentricism, 'failed to make adequate sense of the local value or meaning of the things in which it transacted' (Drayton, 2000: 272). It is Linnaean classification that Schiebinger means when she talks of

> 'inflexible theoretical frameworks that made Europeans unable to absorb radically new information... European naturalists tended to collect specimens and specific facts about those specimens rather than world-views, schemas of usage, or alternative ways of ordering and understanding the world... They collected the bounty of the natural world, but sent "narratively stripped" specimens into Europe' (2004: 87).

The diversity of the world's botanical classification systems, such as the Javanese one referred to with such admiration by Henry Forbes (see Chapter 6), were, after Linnaeus' was established as the standard in European botanical institutions – subsumed under a single homogenous one. This was not so much exploitation of local knowledge as one sweeping act of epistemic destruction. Popularizers of the

Linnaean system were cultural and intellectual conquistadors. At first they consciously and violently wiped out any and all unfamiliar botanical systems and nomenclatures and then, once established in power, slowly and invisibly contaminated and diluted what remained of them. Even Forbes, who was so fascinated by the centuries old orally transmitted botanical classification system of one Javanese forest culture did not attempt to record in detail the principles on which it worked. Neither this or any other viable alternative was in a position to compete with the invading one. Linnaean classification, unwittingly perhaps, but no less significantly, became the flagship of European linguistic imperialism. The Linnaean epistemological empire persists to this day.

I would attribute the rapid victory of Linnaean classification partly to its practical use in allowing European botanists to cope with the rapid influx of new plants and partly to its ability to satisfy the bureaucratic desires of its popularizers. I will turn to these latter ideological and political attractions shortly but first I will briefly show that as well as being a practical "tool of empire" and the central component of European linguistic imperialism, Linnaean classification was itself a *product* of empire. What is true of imperialism generally is true of botanical science in the age of imperialism; 'European rule affected more than the colonies. It helped shape Europe's own development and eventually influenced worldwide patterns of thought and action' (Abernethy, 2000: 364). One of empire's enduring legacies was its impact on global botanical knowledge.

One of the primary phenomena through which the European population at large became conscious of the New World was through the dramatic ecological changes it wrought at home. From the eighteenth century, and possibly before then, the European landscape, through the introduction of a wide variety of new plant species, what we might call botanical globalization, was transformed from being generally "wild" and "natural" in appearance to being unmistakably a product of human labour and culture (this process is detailed further in Chapter 8). European ecology was from that time *anthropogenic*; 'Nothing did more to make contemporaries [of the early and middle colonial periods] aware of the fact of change than this constant influx of new flowers; like new trees, new vegetables and new agricultural crops, they helped to create a landscape vastly different from that which men had previously known' (Thomas, 1983: 70). Such dramatic changes in European ecology, agriculture and landscape inevitably had their impact on European botanical knowledge.

There were several pre-Linnaean attempts to classify and list all the world's plants. In the seventeenth century Bauhin's *Pinax* 'encompassed descriptions of some 6,000 species of plants over twelve volumes'. Some of the very first attempts to classify New World plants – most notably the Dutch botanist van Reede tot Drakenstein's mid seventeenth century study of a limited area of the early Dutch commercial empire – in a way that the Linnaean did not, 'carried interwoven with them the botanical and medical knowledge' of non-European populations. But as the enormous breadth of the world's plant life came to be recognized the emphasis shifted from qualitative *knowledge* to quantitative *information*; 'After 1650 botanists had to wrestle with an ever greater tide of novelty' (Drayton, 2000: 17).

What had been conceived as fully "universal systems" 'were rapidly outflanked by the flood of new plants which arrived from distant lands... Conquistadors, merchants, missionaries, and chartered companies transformed Europe's knowledge of the world's plants and animals. Spanish and French churchmen and adventurers revealed the variety of New World nature' (16).

Just as imperial bureaucracy's suffered "information overload", botanists suffered "specimen overload". Before any attempt at meaningful understanding of the natural world (as the product not of divine creation but of spontaneous evolution and as a single ecosystem) could be made it was necessary to identify, order and classify its many thousands of components. Until the late nineteenth century it was this sole task that occupied the time of naturalists. Until the mid-eighteenth century it was not possible to conduct this task in any coherent, systematic, manner. There was not one single unifying classification system but a multitude of competing systems. In a sense, the early bioprospectors had it easy; 'Amassing the material was simple compared with the problem of processing it to serve the ends of science'. In the early eighteenth century,

> 'it was still far from easy for naturalists of different countries to keep in touch with one another and to exchange specimens and books. It repeatedly happened that the same species had different names bestowed on them by different authorities. To add to the chaos, hardly any two persons observed the same system of classification. Inventing systems, indeed, might be said to have been one the century's fashionable amusements… as Thomas Martyn was moved to complain, "the system-madness" was truly "epidemical". Most systems had something to recommend them; the trouble was that none of them had quite enough' (Allen, 1994: 33-34).

The botanical science of the period was constituted entirely by what Allen refers to as the 'threat of being overwhelmed' by a mass of new information seemingly incapable of being converted into meaningful knowledge.

> 'What was needed then most urgently of all was one single filing-scheme that was easily comprehended and capable of commanding universal acceptance. Linnaeus himself conceded that [his system] took too little account of the palpably close relationships between certain families and others, but he felt convinced that his primary task must be to reduce to manageable order the ever more bewildering diversity of nature then being steadily disclosed. Any method which, for the moment at any rate, proved both simple and workable seemed to be thoroughly deserving of a welcome. A move closer to Utopia could be left till sometime in the future, when the flood of undescribed material at last subsided and science needed no longer concern itself with the mere threat of being overwhelmed' (36).

After some initial hesitation, leading European botanists of the day, including most notably, in Britain, Joseph Banks, conceded that Linnaeus's system did help settle the arguments raging over how best to simplify the task of forming a single coherent botanical archive. The early days of European empires had forced the issue. The system that during subsequent decades and centuries of European dominance had such a homogenizing effect on global botanical knowledge – such a strong role in "committing the local to the global" and strengthening European's sense of intellectual superiority – was itself a product of that empire. The sudden awareness of global botanical diversity was a shock to European knowledge; it catalyzed the formation of a system specifically designed to simplify, homogenize and essentially erase all others.

The formation of the botanical archive.

Although working in the field of literary criticism Thomas Richards has made what I would like to argue is a valuable contribution to the history of colonial botanical science (that is, biopiracy). In a book concerned with fictional representations of what he calls "the imperial archive" Richards shows persuasively that from the mid-nineteenth century 'people in Britain began to think differently about what it meant to hold on to an empire'. In and through their fiction they developed 'fantasises about an empire not united by force but by information' (Richards, 1993: 1).[43]

> 'In the fantasy of the imperial archive, the state actually succeeds in superintending all the knowledge of the imperial archive... The problem here of course was that facts almost never added up to anything. They were snippets of knowledge, tiny particularized units responsible for our current idea of information. It took a leap of faith to believe that facts would someday add up to any palpable form of knowledge, and that faith often took the form of an allied belief in comprehensive knowledge. Comprehensive knowledge was the sense that knowledge was singular and not plural, global and not local, that all knowledges would ultimately turn out to be concordant in one great system of knowledge' (6).

Charles Darwin once captured this universalizing ambition in a phrase he noted in his *Beagle* journals; "before long I shall have notion of all" (cited in Raby, 1996: 20).

His contemporaries, I would argue, were driven by similar fantasises; they operated under the sway of a "fantasy of the imperial botanical archive".

Kew Gardens, a state-funded institution, was the centre of the imperial botanical bureaucracy and its bioprospectors were botanical bureaucratic clerks, each working his way through a seemingly bottomless in-tray of plant specimens to file away in the botanic archives. Their "one great system" was Linnaean classification. The botanical bureaucrat's "facts" came in the form of plant specimens; dried pressed flowers in a neat paper package known as a "herbaria" sample labelled with little more than a name, a location within a genera, and the name of the botanist who delivered it to Kew.

Richards argues that 'The idea of the imperial archive was an early version of today's fantasies of a world unified by information. Today it is easy to see that, all by itself, information cannot possibly possess all the powers attributed to it... Data has no inherent function...' (73). Referring to the general imperial bureaucracy he, surely correctly, questions 'whether the data they collected can be called "knowledge"' (4). We can likewise question whether the enormous amounts of botanical data in the form of herbaria specimens and the multi-volume lists of them that constituted the *Genera Plantarum*, *Index Kewenisis,* and *The Flora of the British Empire* can be called "knowledge".

By the turn of the twentieth century the collective work of the botanical bureaucracy had come to a sort of fruition. The erasure of the rest of the world's botanical knowledge took the material form of three successive sets of botanical encyclopaedia. Darwin, ever-present in late nineteenth century natural science, had played a role in fulfilling the fantasy of the imperial archive.

> 'In the last years of his life, Darwin made a generous offer to pay for the compilation at Kew of an index to the names and authors of all known botanical species and genera. [J. D.] Hooker proceeded with the project and in 1895 published the *Index Kewenisis*, though Darwin did not live to see it. The *Index* is still a valuable reference tool, containing 375,000 specific plant names' (Brockway, 1979: 99).

> '[J. D. Hooker, in the early 1860s] had begun working with George Bentham on the *Genera Plantarum*. This *magnum opus* took twenty-six years to complete (the last part was published in 1883), and it became the most outstanding botanical work of the nineteenth century. In 1,681,500 words on 3,363 pages (not including the 200-page index) the authors described all the known members of 200 plant families, all of which had been individually examined' (Musgrave et al, 2000: 100).

With these concurrent and overlapping reference works, 'At last Banks' dream of having a record of every plant known to exist in the colonies was fulfilled, although additions would be requited as more new species arrived' (101). Recall the words of Thiselton-Dyer, Director of Kew until 1905, that, to paraphrase, he could not control the expansion of the Kew herbarium because he could not control the expansion of the empire (cited in Drayton, 2000: 264).

David Prain was Director of Kew from 1905 and oversaw the further updating of these imperialist works. He compiled them into a 37 volume edition, *The Flora of the British Empire*; 'This major undertaking summarizes the knowledge gained by

British botanists over a century and a half of imperial botany under the aegis of Kew Gardens' (Brockway, 1979: 102).[44] Linnaean classification enabled the compilation of a single trans-national, trans-imperial, botanical archive; it was an important "tool of empire". It should be considered a technological innovation. It confirmed European's belief in their cultural superiority; 'Systems of classification, as much as sextants and chronometers, allowed Europeans to perceive themselves as the magistrates of Providence, equipped by their knowledge of its laws with responsibilities over all of Creation' (Drayton, 2000: 45).

Having said all this about their technological/ideological significance, we should be careful about overstating the inherent *economic* value of these *Flora*. To an extent, the claim made by the mastermind of the scheme, J.D. Hooker, that 'these flora had long been in demand by entrepreneurs and officials at home in the colonies' (205) was true.

> 'The specific impetus for a comprehensive guide to the plants of the empire came from the grandiose initiative of a proconsul on the periphery. Sir William Denison, Governor of New South Wales, in 1859 proposed to the [metropolitan] government "a National work on the Astronomical Features, the terrestrial physics, Botany, Zoology, and Geology of the Colonial Possessions of the British Empire"' (204-205).

However, Hooker's argument that 'the immediate classification of botanical specimens was vital to any future colonial progress' (205) looks more like self-interested exaggeration than good business advice. Hooker, in the face of government scepticism that such a costly undertaking was economically necessary 'shrewdly endorsed only a distinct scheme for the empire's plants' (205). The scheme was no doubt vital to the progress of botanical science and to Kew gardens' reputation as a central institution of the empire – capable of handling the day's "big science" projects – but 'there is no clear evidence' as to 'how far…the Colonial Flora's [added] to imperial prosperity… It is likely that the great publishing exercise mattered more for the evolution of contemporary botany than for the growth of the imperial economy' (206).

With funding secured, by the turn of the twentieth century, the state, via Kew gardens, had indeed succeeded in "superintending" botanical knowledge and the formation of an imperial botanical archive. However, I would argue that Drayton's playing-down of the wider economic significance of the imperial botanical archive is something of a diversion.

As we have seen, Drayton recognises the ideological significance that the power to classify inherent in the Linnaean system had for its proponents, for European bioprospectors, and for European imperialists in general. His description of botanists, newly armed with Linnaean classification, as "magistrates of Providence" may be somewhat melodramatic but it is suggestive of the role that these botanists' historical successors in the twentieth century fields of ecology and other "biodiversity sciences" would seek to fill. Yet his work studies imperial botany separately from what Peder Anker has described at length as "imperial ecology" (2000), which I re-interpret as "emperial ecology" (with an "e"). Before concluding Chapter 7 it is necessary for my argument that I connect the material in this section on linguistic imperialism to that in Chapters 8 and 9, which take as their foundation the ecological aspects of the Convention against Biopiracy.

In those chapters I will show, first, how rare was the recognition among imperial bioprospectors and pre-twentieth century botanists that the species they collected and their habitats could ever come under threat of extinction due to man-made causes. Second, I will show, in theoretical terms, how rare was the perception – increasingly widespread today – that the "natural" environment is a thoroughly social object, that "nature" as a category is defunct, and that this phenomena is to a considerable degree the result of the kind of plant transfers that imperial bioprospectors were commonly engaged in. Third, I will return to the argument I began in Chapter 1 regarding the relationship between the botanical/ecological sciences and what is known today in everyday terms as "environmental consciousness" or "green politics". The argument here is that the two were not always as closely associated as they are today and that in fact, ecologists' (genuine, but very new) concern to "preserve ecosystems" masks a concern to *manage ecosystems*, *steer economies and govern societies* according to their own terms, conditions, and technocratic ambitions; that is, to become the proverbial "magistrates of Providence". This argument will move us closer to my critique of the Convention and its entire rationale (Chapter 10). This focuses on the contradiction inherent in the Convention between the (emperial) concern to commodify and efficiently maximise exploitation of bioresources (and knowledge of them) and the (post-colonial) concern to recognise and (more) equitably regulate those same two forms of exploitation.

While Drayton is not incorrect to downplay the wider economic value of Kew's project of compiling the imperial botanical archives in claiming that it was, in the late nineteenth century, primarily of relevance to the "internal" history of bioscience, he implicitly makes the incorrect suggestion that the project as it continued into the twentieth century has no wider economic or biopolitical significance. As the compilation of botanical archives has, in the post-colonial late twentieth century, come to be the allied, but quite different, project of the formation of databases of global "biodiversity" the fantasy of the botanical archive has taken on a much more expansive role than of being a mere means of securing national governmental funding for botany. It has become a means by which ecologists seek to wield political power – via a form of emotional blackmail – over international governmental and corporate institutions. In short, contemporary botanical archives – which the new post-Convention form of Bioprospecting institutions have a central role in constituting and managing – have become a tool of the new hybrid form of (bio)political sovereignty that I, following the arguments of Negri and Hardt (2000, 2004), have come to call emperial sovereignty. Contemporary Bioprospectors have, in this sense, a significant, but largely unrecognized, role in the exercise of emperial biopower.

The botanical archive becomes the biodiversity database.

Linnaeus was described very recently in a *National Geographic* magazine article titled 'The Name Giver' as an 'information architect' (Quammen, 2007). The article describes how Linnaeus had 'believed that every kind of plant and animal on Earth should be named and classified'. The final fulfilment of the Linnaean fantasy of the botanical archive remains to this day the wish of leading biologists. I am arguing that the Convention is a means toward this end. Invoking the now-pervasive notion of the imminent destruction of biodiversity – which has been, as we saw in Chapter 1 a major impetus to the revival of bioprospecting efforts and a major tenet of the 1992 Convention – E.. O. Wilson recently exhorted his colleagues to complete the centuries-long task of bioprospectors; '"Now it is time to expand laterally to get on with the great Linnaean enterprise and finish mapping the biosphere"' (cited in Bowker, 2000: 645). Bowker describes how today the botanical archive has moved on from the mere list-keeping that occupied the time of so many nineteenth century botanists to become a digitised, more flexible, manipuable, useful, database. He describes how there is both *continuity and discontinuity* between the (imperial) botanical archives as described above and today's biodiversity databases (which I argue are an emperial phenomena).

Continuity in that now, as then, 'There are programs afoot to map all floral and faunal species on the face of the earth' (Bowker, 2000: 644) in the form of "All Taxa Surveys", such as that conducted by the Costa Rican "national biodiversity research institute" INBio, which, as we will see in Chapter 10, was intended from the beginning – and in accordance with the Convention – to be funded by the proceeds of Bioprospecting that the American pharmaceutical company Merck would, hopefully, provide.

Discontinuity, or historical novelty, in that today 'The working archive is a management tool' (644), or at least, it is intended to be. Far from being a "dead" list of plants such as the imperial *Flora* that Hooker and his contemporaries worked on, the botanical archive today is intended to be a "live" database with a role to play in "saving" the biodiversity that it lists. As we will see in more detail in Chapter 9, ecologists have long-since sought extra-scientific, explicitly social and governmental roles for themselves. 'We are now as a species taking on the role of managing the planet as a whole – its ecosystems and energy flows', and one prerequisite of any such global or planetary ecosystem management is that the individual components of the global ecosystem cannot merely be listed, but "mapped", and studied as interlinking cogs of the natural-technological hybrid ("cyborg earth") that humanity has collectively produced. It remains true that Linnaean-style 'List keeping is at the heart of our body-politics. It is also, by extension, at the heart of our scientific strategies. Right or wrong, it is what we do' (676). But this "list-keeping" is no longer inspired simply by the imperialist rationale of maximising resource extraction but by the more subtle emperial rationale of sustainable resource management. 'In this new and expanded process of scientific archiving, data must be reusable by scientists. It is not possible simply to enshrine one's results in a paper; the scientist must lodge her data in a database which can be easily manipulated by other scientists' (644).

While there is a discontinuity in what the botanical archive is intended to do and how it is intended to function – which is a vast expansion in the power attributed to it – the acquisition of the specimens that constitute the archive occurs in a pattern continuous with the imperial era. The naming of a new plant and the addition of a herbaria specimen of it to the botanical archive, does add "information" to the (now-global) botanical database, but contributes as little in terms of knowledge now as it did then. As Bowker pithily puts it 'Just as species can be endemic to very small areas, so too can data about species' (650). What botanists claim to "know" to be *species* are little more than a few shrivelled leaves and roots with a few perfunctory details attached. Species are 'really just specimens' (649). This would not be a sociologically significant issue if it were not the case that biodiversity databases today inform national and international policy toward biodiversity and ecological management. Such policies are very far from being mere "science policy". They are biopolitical tools.

With such a powerful role attributed to biodiversity databases, the way in which taxonomical specimens are collected takes on ever more significance. 'The assertion that biodiversity should be seen as an information issue entails that strategies for both data collection [i.e., taxonomical bioprospecting] and habitat management are intimately wrapped up in ontological questions about what kind of a thing biodiversity is' (671). Today, questions about what "kind of a thing biodiversity is" are inextricably questions about what "kind of a thing *society* is".

about what kind of thing *politics* is, and about what kind of a thing *power* is. The historical transformation of what, in the imperial era could still be referred to as "nature", into "biodiversity" – both "information" and commodity – that is, into a social phenomena, runs parallel to the transformation of biopiracy into Bioprospecting. It culminates with the 1992 Convention.

Conclusion to Chapter 7.

The Convention's concern to "preserve" "traditional knowledge" of plant life and ecology is an attempt to correct and reverse the centuries-long involvement of botanical science in linguistic imperialism, just as the Convention's concern to "respect" the local communities botanists work with and among is an attempted corrective to their historical failure to acknowledge their reliance on exploited local labour. Contemporary Bioprospecting projects do indeed conform to these tenets. Local botanical knowledge gathered during Bioprospecting is today acknowledged in scientific papers, provisions for "benefit sharing" are regularly made and local labour is rewarded, all according to the terms of the CBD/CAB. Further, provisions are made in Bioprospecting agreements to divert any financial profits that accrue into "biodiversity conservation".

It is my argument, and my critique of the Convention, that all this is possible only because the individuals and institutions – both "political" and "scientific" – that conceived the Convention have economic and biopolitical interests in securing a ready supply of biological resources that are far more valuable than the relatively small economic and political concessions that inhere in the Convention. To "respect" and "preserve" local knowledge, cultures and environments and to "share benefits" with local communities, institutions or national governments is a relatively cheap ideological and economic price to pay for the archiving of specimens of every species and of all existing botanic knowledge and for the final fulfilment of capitalism's centuries-long ambition; the commodification of the entirety of natural and social life on earth. The global political power – emperial sovereignty – that today supports capital toward this end is the proper target of the critics of contemporary Bioprospecting projects and the Convention.

Chapter 8. From conquest to improvement to management of "nature".

Chapters 8 and 9 take as their foundation the facts that the Convention Against Biopiracy was conceived in terms of a Convention on Biological Diversity and at a United Nations Conference on environmental issues. Previous chapters have taken as their foundation specific clauses of the CBD/CAB. There *are* clauses of the Convention that regulate Bioprospecting to "environmentalist" ends. Article 14.1 requires no damage to be caused to environments in the actual course of collecting (on the damaging practices of historical bioprospectors see the relevant section below). The Convention suggests that benefits accruing from Bioprospecting be channelled to conservationist institutions (for a major example of a contemporary Bioprospecting project that follows this suggestion, see Chapter 10). These are not insignificant, but neither are they fundamental to the following chapters. It is the *entire premise* of the Convention which the following two chapters take as their foundation. As I showed in Chapter 1, the premise is that "biodiversity" is under threat of a range of negative human influences. If there was no perception among the contemporary global political and scientific elite that valuable biological resources were at threat due to human actions and macro-social processes then there could have been no CBD/CAB.

Before I move on in Chapter 9 to show that there were, before the twentieth century, few botanists and bioprospectors who were conscious of the humanization of landscapes, environments and (what we now call) ecosystems, it is necessary to demonstrate how this phenomena – anthropogenic transformation of environments to the extent that it no longer makes sociological sense to speak of any transcendent, untouched "nature" – did in fact occur long before consciousness of it entered mainstream national and international political thought and policy in the mid- and late-twentieth century. It is this which takes up Chapter 8.

The process of the destruction of "natural" landscapes, environments or ecosystems – the humanization or hybridization of the landscape – in today's terms, the globalization of biodiversity – was a permanent, irreversible legacy of European imperialism and colonialism. The ecological effects of European's arrival in the New World were, especially in the early years, unintentional, but it did not take long for deliberate transformation to begin – whether it be the clearing of forests, the large-scale planting of previously foreign crops or decorative plants, damming, canal building or whatever else. Very few immigrant populations 'did not want to remake' the territory they took over (Abernethy, 2000: 187).

In very approximate chronological order, the historical process of "winning over the wilderness", of replacing "natural" landscapes with thoroughly anthropogenic ones, and thus "remaking" them, has several stages. The *hunting* of "vermin" or "dangerous" animals, the *clearing* of forests, and/or the *reclamation* of swamps, the *planting* of agricultural crops, the *introduction* of livestock or other "useful" animal species, the *protection* of any remaining "nature" or (more accurately, but oxymoronically), the *(re)production* of artificially "natural" spaces in national parks and nature reserves. These social-ecological "stages" did not always or necessarily occur according to this chronology.[45]

Hunting and clearing and reclamation are forms of *conquest*. Planting and introduction were intended as *improvement*. Protection, (re)production, and, to an extent, planting, are practised as a *management*. Conquest, improvement and management of non-human goods – land and biological resources – are always also the conquest, improvement and management of men and women, their labour and the products of their labour and through this, of entire societies. The transition from conquest to management is, I argue, definitive of the transition from imperial to emperial society. *The transition from conquest of nature to management of biodiversity runs parallel to, and is the most significant context of, the transition from biopiracy to Bioprospecting.*

In this Chapter I discuss environmental history, the history of the ecological sciences, and the history of environmental politics insofar as they are relevant to the CBD/CAB. I outline the transition from a society in which we lived in struggle against a hostile, impermeable, fixed "Nature" to a society in which we act as engineers or managers of a malleable, fragile "biosphere" consisting of equally malleable and fragile "ecosystems" and "biodiversity". If ecologists and national governments were not concerned with the sustainable management of biological resources and remained interested only in extraction and conquest there would not and could not have been a CBD/CAB.

Conquest of nature as a moral project.

Dunlap has written extensively of how 'the dream of remaking the land' was 'the leitmotif of nineteenth-century settlement' (Dunlap, 1999: 46) and of how, in the colonial period, 'It was conventional wisdom that all was vanishing before the triumphant Europeans' (202). He shows that this was the formative period for the scientific establishment and formalized botanical and ecological knowledge, the time of 'a gradual and never-complete drift of the [European] culture's authoritative knowledge about the world from the general population to a small group of experts' (45). However, he also shows that the latter's concerns with bioprospecting – the collecting, naming, labelling, archiving and putting to economic use of new-found biological specimens – was secondary to the concerns of the mass of settlers (as

Dunlap rather too-neutrally calls the European imperialists and colonists); 'The settlers were not primarily interested in learning in these years, the "conquest" of nature was their principal concern' (45).

Settlement and conquest occurred at first only haltingly, with many failures and hardships in the face of a resilient – and alien – landscape, but as both the numbers of immigrants to the New World and their technological capacities increased throughout the nineteenth century the conquest of the wilderness accelerated, and was realized in rapid bursts. For example, in North America;

> 'In 1860 the frontier line was hardly across the Mississippi, the lumber industry was centred in the Great Lakes region, the plains were filled with buffalo, and there seemed land for all. The census of 1890 showed no frontier; the lumber barons were on the West Coast; the buffalo were bones; and westerners were calling for federal irrigation projects to make farmland from the desert' (90).

Once the limited eastern states had shown what could, with piety, hard work and perseverance, be achieved, the "settlers'" hunting, clearing, and planting transformed the entire North American continent in just a few decades. Smaller areas, most successfully, the islands of the Caribbean, had been socially and ecologically transformed by this process in the previous century. Walvin has shown at length how the biological resources brought home from the colonies transformed the diet, the culture and, to a considerable extent, the economies of Europe. His historical work (like Drayton's) takes it for granted that colonialism was as socially/historically and ecologically significant inside as well as outside Europe. In a reversal of the formula of pre-independence historians of European imperialism Walvin writes of how

> 'The British appetite for those staples [coffee, tea, sugar, tobacco, cocoa] which were disgorged by returning ships in ever greater profusion did more than simply transform the tastes of the western world. In cultivating those crops, vast regions of the world were brought under careful, regulated cultivation. The wilderness was won over and converted to the fruitful and profitable production of crops, many of them not even indigenous to the region. From Java to Jamaica, Virginia to Assam, from Fiji to Malaya, Brazil to Congo, tropical regions were utterly transformed by the drive toward managed tropical agriculture' (1995: 132).

It is indicative of the co-production of both European society and of society globally and of that society and global ecology that Walvin – a cultural historian of European colonialism – finds it necessary also to work as an environmental historian. David Blackburn – an environmental historian – finds the reverse necessary. In his work on the massive, deliberate, transformations of the German landscape in the eighteenth and nineteenth centuries Blackburn describes swamp reclamation projects and irrigation work as forms of "internal colonization" (31, 46-47) and as part of a generalized "conquest of barbarism" ongoing in Europe as well as, as he puts it, "everywhere" (41). Like Walvin, he shows that ecological transformation and social transformation necessarily occurred in parallel; the irrigation projects "created a new world" and "destroyed an old one" in terms both of social and ecological worlds (57).

The changes occurring with ever-accelerating pace from the seventeenth century, in Europe and the colonies, were, in short, biopolitical.

Such European projects "at home" as the reclamation of land from swamps – and phenomena such as the felling of forests, the bounty-hunting of vermin, the enclosure of the commons – and their equivalents across the continents of the new world – the slaughter of buffalo and irrigation of deserts in North America – and the establishment of plantations of cash crops everywhere the Europeans invaded – were not seen simply in coldly practical, utilitarian or economic terms. They were understood at the time as *moral* projects; they were the *improvement of the world*, of both social and "natural" worlds. Conquest and improvement where synonymous then in the same way that improvement and management are today.

Blackburn justifies his book's title – *The Conquest of Nature; Water, Landscaping and the Making of Modern Germany* – by noting that the Germans he writes about did indeed understand their reclamation, river correction and damning projects as the conquest of nature (3). State power and national economic strength were motivations of these projects – which employed many thousands of men, including at times, soldiers, and the best engineers of the times – but these practical aims were dressed in the terms of a moral discourse of progress-only-through-conquest as widespread then as today's discourse of progress-only-through-sustainable management is now. In short, Blackburn demonstrates that 'mastery over nature was supposed to mark the moral advance of humankind (4). Such ambitious and dramatic technological projects as turning swamps into fields or rivers into canals were infused with moral enthusiasm (153).

Although there were political struggles about *how* to best conquer the German landscape there was full consensus that it could and should be conquered; "mastering nature" as a political aim went unquestioned, it became "second nature" (6). Until the mid twentieth century the 'idea that nature should be shackled held sway' (348). Although today there are political struggles about *how* to best "protect" and "manage" the remnants of "nature" we now know as environments, ecosystems or biodiversity there is a very nearly complete consensus that they should and could be managed more sustainably. Even the most sceptical of environmentalists state that 'it is impossible to be anything but *for* the environment' (Lomborg, 2001: 32, original emphasis). It is only a slight exaggeration to say that until less than a century ago it was impossible to be anything but *for* the conquest of nature; almost everyone who was in a position to do so, both in the colonies and at home, "dreamt of remaking the land".

Conquest of nature: Hunting.

Among the earliest tasks of Europeans' global-ecology-changing project was that of clearing the land of unwanted animals. The slaughter of thousands of the larger animals – wolves, bears and deer – needed no financial encouragement. The competition for resources that they represented to humanity had made them, as the expression goes, "fair game" (Thomas, 1983: 273). The first organized attempts at hunting the remaining smaller animals began "at home" with a system of bounty-hunting which was instituted by Parish councils, according to the whims of early Parliament, in the sixteenth century and continued well into the nineteenth. By this time the act of destroying species had lost any pretence at being a necessary and useful agricultural measure and had become plain sport.

> 'An act of Parliament in 1533 required parishes to equip themselves with nets in which to catch rooks, choughs and crows. In 1566

another authorized churchwardens to raise funds to pay so much a head to all those who brought in foxes, polecats, weasels, stoats, otters, hedgehogs, rats, mice, moles, hawks, buzzards, ospreys, jays, ravens, even kingfishers. Many parishes continued to make payments under these and later acts until the nineteenth century, the persecution shifting from one species to another according to prevailing agricultural needs… In the early nineteenth century the focus shifted again and there was a proliferation of sparrow clubs whose members competed to see who could shoot the largest number' (274).

This centuries-long animal-slaying scheme seems alien and cruel to many of us now – we prefer to make lists of the numbers of animals in our countryside that *survive* human persecution rather than the numbers ending up in the hunter's bag. However, Thomas gives numbers of the large numbers or animal deaths that were notched up under this scheme that undoubtedly would have been a mark of pride for those involved in contributing to the tally (274). Thomas's attitude is that if there were sound agricultural reasons for hunting wildlife in this way then the practice should be viewed sympathetically, however – and this applies also to the later and concurrent practices of European big-game hunters in North America, India and Africa – 'pleasure not necessity accounted for the slaughter of many wild species' (275).

However, given the widespread attitude, detailed at length by Blackburn (2006) – especially from the late eighteenth century – that the clearing, planting and transformation of the land was a sign of civilization and progress I would argue that what looks retrospectively to Thomas like plain sport was infused with the same moral fervour and civilizing enthusiasm that swamp-reclamation and enclosure of common land was. As we will see further below. English and Scottish natural history collectors – amateur bioprospectors – certainly justified their often ecologically-damaging work in terms of what Allen has called their 'own insidious brand of the doctrine of Progress' (1994: 141). Across all social classes, animals were pursued. Alongside the aristocrats' ritualized sport hunting – different rituals for the shooting of pigeons, ducks, birds of prey – and the infamously carnivalesque fox-hunting – there was lower-class rat-catching, badger-baiting, weasel-trapping and so on. Between the upper and lower classes there were middle-class bioprospectors who decorated their own variety of hunting with a veneer of scientific respectability (Brandon Jones, 1997: 158). As Allen describes them, natural history collectors, with special energy from the mid-nineteenth century but also earlier, 'continued to fan out across the countryside with their often murderous devices with much the same blind energy and diligence as the excessively house-proud are wont to wield their dusters and their brooms' (1994: 141). At first glance Allen's analogy from the amateur bioprospector to the house-proud cleaner seem rather trivial and obscure, but on second thoughts it is perfectly appropriate. The hunting of animals, whether it be upper-class ritual, lower-class sport or middle-class amateur science, was understood then, and should be understood now, as a form of house-keeping. It was a means of turning a wild inhospitable space into a tidy and civilized one and an early step toward the production of thoroughly anthropogenic ecosystems.

Although Allen is inclined to give the phenomena a somewhat more sociological explanation than Thomas' "it was just sport" they concur on the basic facts of the case, with regard to such animal hunting and its effects on English wildlife (and what we would now refer to as its ecology in general); 'The overall effect of human action, whether deliberate or inadvertent, was to bring about a dramatic reduction in the wild life with which England had once teemed' (276).

Blackburn has detailed that during the same period as the reclamation of the Prussian swamps and their conversion into pasture there was also 'a war against untamed nature… being waged… on another front; the culling or eradication of creatures that directly challenged humans for resources' (2006: 42). He mentions a range of targeted species on which bounties were paid in Prussia similar to that given by Thomas for England; there too, millions were hunted (42-43). Also, like Thomas and Allen, he reminds us of the ecocide of bear, lynx and wolf (43).

The mass hunting of wild animals, whether dangerous, grain-eating, or totally harmless, occurred as broadly and intensively across European colonies as it did across the European mainland. In some colonies ecocides occurred at the same time as in Europe, in others only later, as sufficiently powerful and accurate weapons for the hunting of, for example, buffalo and elephants, were developed. The successful bounty-hunting system was exported to the colonies.

> 'The improvement of weapons and transportation in the second half of the [nineteenth] century made it possible, and profitable, to kill everything, and one result was the slaughter of wildlife on a fantastic scale… [Across both Europe and the colonies b]etter shotguns in the hands of market hunters and an army of sportsmen brought about a dramatic decline in ducks, geese, and shore-birds… The law allowed, and even encouraged this, for the settlers saw wildlife as, at best, a transient resource. Until the twentieth century, regulations on killing things in nature were few, poorly enforced, and applied to only a few species… There were bounties on everything that walked…' (Dunlap, 1999: 50-51).

Aside from direct hunting, another 'method of choice was poison. Strychnine, an alkaloid extracted from an East Indian plant, had become a mass produced and widely available chemical that Europeans deployed to "good" effect' (ibid).

Eric Wolf reminds us that some of the very earliest colonies on the east coast of North America were formed as a direct result of Europeans' unsustainable exploitation of natural resources. Some were little more than temporary ports for European fishermen who had been driven eastward by the over-fishing of European waters (1997: 160). These early settlers soon began to recognise that as well as plentiful supplies of fish, large numbers of furs could be obtained, sometimes by direct, but difficult, hunting, but more often through trade with local Indians, who had expert hunters among them and chiefs who were eager to obtain European metals and metallic goods (166, 183, 189). And so the first forms of New World wildlife to reach the point of near-extinction, to be "cleared", were the luckless North American fur-bearing animals (beavers, otters, seals and so on). One form of over-exploitation was the catalyst for another. As immigrants moved westward there were further waves of ecological civilization and further land-clearing ecocides – of coyotes, wolves, bears, and many millions of buffalo (Dunlap, 1999). Until as late as the 1930s the Australian koala bear, a charismatic animal that is eminently susceptible to calls for conservation, was actively hunted in enormous numbers. Bounties were paid on over half a million koalas in early twentieth century Australia (ibid: 192). As Dunlap has shown in depth, by the end of the nineteenth century, and to a more limited but no less significant degree, at least a century earlier, the wildlife and ecosystems of North America, Australia and New Zealand were drastically humanized, both by the coldly destructive force of hunting as sketched above and the insidious and often uncontrollable introductions of previously foreign species, of which more below.

Before we move on from looking at *hunting* and *clearing* to look at the ecologically transformative aspects of the export of European crop plants and domestic animals to the colonies, that is, of *introductions* and *planting*, we will briefly return to bioprospecting and look specifically at the ecological transformations, in the form of direct damage, caused by bioprospectors themselves.

Ecological damage caused in the course of bioprospecting.

Bioprospectors were, in several historical cases, in fact responsible for significant (although only rarely permanent) ecological damage. By way of defining what is and is not biopiracy the historical sociologist of agriculture Jack Kloppenburg defines what is known as a "non-rival good" – a form of goods whose acquisition is not experienced as a loss by its "owner;

> 'When plant collectors sample a population, they acquire only a few pounds of seed or plant matter. The vast bulk of the material is left untouched in its place. Unlike the extraction of most natural resources the "mining" of plant germplasm results in no significant depletion of the resource itself' (Kloppenburg, 1988: 187).

In theory, if I take living materials such as sea anemones from a beach, ferns from a moor, or orchids from a rainforest, the owner (whether an individual, a local community, or a nation-state) suffers no permanent loss – the anemones, ferns or orchids simply reproduce and are naturally replaced. However, in bioprospecting practice, this rule has on more than one occasion proven to be breakable.

One of the "minor" cases of colonial resource extraction I detailed in Chapter 4, that of sandalwood, caused such an economic boom that there was an attendant ecological bust; the Pacific Islands' supplies of sandalwood were exploited very nearly to the point of extinction in the early nineteenth century (Wolf, 1997: 258). If there were only a few isolated individual collectors there could have been no such extreme depletion of sandalwood supplies and it would have retained the status of a non-rival good, would not have entered capitalist circuits, and would not have taken on the same status as coal or oil – a finite resource. However, in the case of sandalwood Chinese (and their numerous European merchant suppliers') demand outstripped the species' natural ability to supply.

It was not only commercial biological goods that were over-collected by professional hunters or loggers nearly to the point of extinction. We have already seen in Chapter 3 how the 'trade in live and preserved exotic animals originated in the much older sport of wild-fowling and big-game hunting. The hunter's bag became a sought-after – and fought over – source of undiscovered species' (Brandon-Jones, 1997: 158). Species could be, and sometimes were, hunted to ecologically unsustainable levels, both at home and in the colonies. Amateur botany and amateur zoology reached their peaks of popularity at home in the 1850s. These peaks were formed by the sudden availability of affordable glass cases[46] in which to keep plants and marine animals alive and reflected in the increasingly large and active market for cheap editions of books for lay naturalists.

> 'These suddenly swarming book-buyers, then, were the people who rushed off in such masses in frantic search of sea-anemones and ferns. Unschooled in the codes and avid for these untasted pleasures, they succeeded in perpetrating the most extensive damage

– damage which was to be compounded ever further in the years that lay ahead as their conspicuous obsessions passed on to even weaker brethren. Great stretches of the coast were largely stripped of their attractive inhabitants; whole areas were cleared of ferns, helped by professional touts who saw in this an easy means of turning a quick penny, filled up great cart-loads from the wilder parts of Britain, and sent them off to the London markets' (Allen, 1994: 124).

Although the Victorian fashion for the self-stocked aquaria and terraria lasted only a few years the sudden mass consumption of previously ignored sea anemones and ferns was something of an ecological disaster; 'many more years had still to pass before those sections of our native fauna and flora that had been so misguidedly victimized and mutilated… were fully able to recover' (125).

Victorian amateur botanists at home did not give up their weekend bioprospecting trips once the supply of ferns and anemones was exhausted. Fashions for the display of stuffed birds and cases full of bird eggs required the hunting of birds and of bird nests *en masse*: 'In the eighteenth century the first impulse of many naturalists on seeing a rare bird was to shoot it. Enormous depravations were also made to satisfy the growing craze for collections of eggs and stuffed birds' (Thomas, 1983: 275).

Then, as now, technological change enabled, catalysed and encouraged ecological disruption. It was the mid-nineteenth century improvement of both major and minor roads that

'above all, brought the countryside within reach of the towns and touched off the first conspicuous invasion of pickers and uprooters of attractive flowers. Well before the railways arrived, even in the areas that were relatively remote, local botanists had begun complaining of the depredation that had set in from this cause' (Allen, 1994: 109).

After the roads came the railways; 'The [railway] lines fanned outwards, appearing almost everywhere – and altering almost everything. In the space of a few years they destroyed for ever all idea of a pristine, undisturbed wilderness over much of Britain' (Allen, 1994: 110).[47]

In short, technological change in the areas of transporting (roads, railways), displaying (glass cases and tanks), and collecting (firearms, traps, poisons) biological specimens came together in the nineteenth century. Allen analyses the interplay of technology, ideology, amateur botany and British ecology in the Victorian period in these terms:

'Like the accurate breech-loaders, like the entomologists' baits and traps, the botanist's aid to collecting had become by mid-century so readily obtainable, so widely disseminated and so fatally easy to abuse that there was a serious danger that the countryside of Britain would become irreparably injured by the very people who were among its keenest admirers. The advance of technology, as so often, had outstripped the social attitudes appropriate to its use. An endless stream of accoutrements and gadgetry rained down upon the naturalist and tempted him to suppose that he earned the name merely by donning, discharging or deploying them. There grew up a kind of mechanical fallacy: a half-conscious, wholly false analogy

> with the onward thrust of industrialism that was everywhere so triumphant. Natural history thus began to suffer from its own insidious brand of the doctrine of Progress, and collectors continued to fan out across the countryside with their often murderous devices...' (140-141).

As we know, naturalists were also "fanning out" across the wider world and even there, where there was much more ground to cover and far less bioprospectors per square mile, colonial bioprospectors were occasionally responsible for damaging local ecology. There is space here for just two examples; 'In New Zealand the native birds fell to hunting, land clearing, and imported predators, but also to the demands of science and amateur collectors. The huia went extinct amid an undignified scramble for the last specimens' (Dunlap, 1999: 50).

Entire teams of horticultural collectors in northern India, working for British commercial nurseries, toiled greedily in pursuit of fashionable and exotic orchids. Raby cites a letter of J. D. Hooker's which describes how the 'place was swarming' with orchid collectors from rival nurseries, and how the ecological results of their large-scale collections were more like those of a force of nature than of the winds of fashion;

> '"What with Jenkins' and Simon's collectors here, twenty or thirty of Falconers', Lobb's, my friends Raban and Cave and Inglis's friends, the roads here are becoming stripped like the Penang jungles, and I assure you for miles it sometimes looks like a gale had strewed the road with rotten branches and Orchidae. Falconer's men sent down a thousand branches the other day"' (Raby, 1996: 146).

In short then, bioprospecting has to be included in any account of 'ways in which human beings confront their world in order to modify it in their favour' (Wolf, 1997: 386). Although the amounts of material collected are often ecologically negligible this has not always been the case. The architects of the Convention Against Biopiracy were sufficiently aware of the danger of over-collecting to include clauses requiring Bioprospectors to "minimize" the impacts of their collection of the biological resources they are interested in studying and exploiting (Article 14.1).

Forestry: an early example of the management of biological resources.

Europeans' attitudes were in this period beginning to be necessarily rather less reckless toward the acquisition of timber than they were toward other forms of biological resources. Forestry provides an exception to the general chronology of attitudes to the environment outlined above.

The deforestation of Europe had been ongoing for centuries. From the seventeenth century deforestation was starting to reach the point where monarchs were getting panicky about how to continue supplying their nascent industries and increasingly large navies with timber. In an early alliance between science and the military the Royal Society's best minds were encouraged to investigate the problem of the Royal Navy's supply of wood (Drayton, 2000: 52-53). Similarly, in France, Royal academics were employed to solve the growing timber problem – specifically the problem of there not being enough trees of sufficient girth, height and strength for use as ship's masts – and their work marks the landscape to this day.

> 'In the forests of Tronçais in the *department* of the Allier in France, there are still standing oak trees which Colbert planted in 1670 with a view to providing solid masts for the French fleet from the nineteenth century on. Colbert thought of everything except the steamship' (Braudel, 1983: 240).

Braudel claims that the deforestation of certain areas of France was already in the pre-modern period perceived to be so far advanced that 'rational forestry can be detected as early as the twelfth century' and that there was 'already an ancient tradition' which Colbert 'did not begin' but only 'accentuated'. Braudel provides little evidence to back up his claim of French invention and prescience but is fair-minded enough to cite Frederick's Prussia as the home of the ecologically transformative phenomena of rational forestry. 'The forests in the Harz mountains', which were 'princely property', were

> 'Indispensable for the charcoal which fuelled the furnaces of the region. Their reserves of energy were organized at a very early date in order to prevent haphazard and unplanned use of the wood by the local peasants. The first known forestry agreement dates from 1756, when the whole area was divided into sections according to the variable rate of the growth of the trees. The forest was mapped out and plans were devised for floating tree-trunks downriver, for guarding the wood and for inspection on horseback, thus preserving the forest zone and providing for the rational organization of production for the market' (241).

Blackburn agrees that 'Nowhere else in Europe did scientific forestry make such advances as in the second half of the eighteenth century as it did in Germany'(2006: 41). He, as well as Braudel, notes that similar methods were deployed very soon afterward in England and in the colonies. As part of a 1783 treaty with Spain Britain acquired 300 acres of the 'dye-woods of the tropical forests of the Campeachy region of Mexico', of which a diplomatic commentator said that "if managed wisely" it would provide wood "for eternity" (cited in Braudel, 1983: 242).

In the period of conquest of nature, then, there were some experiments in *management*. While they were less directly destructive they were arguably even more explicit signs of the increasingly anthropogenic character of the "natural" world. But these progressive – but no less ecologically transformative – attitudes among the upper echelons of European society were a long way from stemming the general advance of the wood-cutter's axe. The broader picture is one in which the forests of Europe and the world continued to be unsustainably felled until – and in some places, throughout – the twentieth century.[48]

Improvement of nature: Introductions of plants and animals.

Add to the hunting of animals on a mass and organized scale the near-completion of the centuries-long felling of Britain's (and Europe's) ancient forests that occurred in the early colonial period and we have a broad sketch of European's early conquest of the natural world. In the following sections we move from mastery of nature in terms of *hunting* and *clearing* to the (both deliberate and accidental) *introduction* of European species to the rest of the world and to the *planting* of cleared land with previously foreign agricultural crops In Chapter 9 we will move on from the conquest of nature to the management of ecosystems/biodiversity and the attendant epistemological and technological shifts from natural history (concerned with cataloguing and resource extraction) to ecology (concerned with computer simulation and ecosystem manipulation).

The export, or "introduction", of previously foreign plant and animal species to the wider world by Europeans is split for presentational purposes below into three forms. First, accidental introduction of plants and animals. Second, deliberate introduction of animals (these two forms are discussed in this section, the third is discussed in the following section). Third, deliberate introduction of agricultural plants and plantation crops. Together, these are the reverse of the massive influx of new plants and animals into Europe that, as we have seen in previous chapters, was one of the definitive social changes of the colonial era. These three forms of the globalization of "biodiversity" occurred from the Portuguese's first colonial experiments on the Isles of Madeira, on Columbus' first voyage to the Americas, and continue to this day.[49]

Human history is the history of unintended consequences. This is especially true of the history of humanity's relationship with the land, environment, nature, ecology, biodiversity (however we prefer to describe it); history, especially environmental history, is the history of unintended consequences (Blackburn, 2006: 12).

One consequence of the unplanned introduction of foreign species of both plants and animals into European colonies was to make life very difficult for natural historians (and ecologists). They constantly were required to speculate – often they could do little more than this – whether the bioresources they collected were indigenous or introduced. What Walvin says of the contemporary Caribbean, 'what is local and indigenous and what is alien and exotic, is now barely discernable' (1995:

x), has been true for centuries. This problem was experienced by some of the very first systematic bioprospectors in the colonial world. The young Hans Sloane

> 'was well aware that by 1687 neither the people nor many of the plants found in Jamaica were indigenous to that place... According to Sloane, nature itself – the people, plants, and landscape of the island – had been forged in the crucible of Spanish domination... [The Spanish had brought African and Amerindian slaves] and many fruit trees, useful foods, and medicinal plants from South America. These plants "throve wonderfully and now grow [in Jamaica] as if it were sponte."' (Schiebinger, 2004: 29).

Schiebinger steers clear of discussing the implications of the oxymoron inherent in the statement that Caribbean "nature" was, by the seventeenth century, the *product* of the Spanish presence on the islands but is as aware of it as Walvin and many other environmental historians. The implication, as we will discuss further below, is that the "nature" that environmentalists and/or ecologists and environmental policies such as the Convention on Biodiversity seek to "protect" is fundamentally a fictitious object.[50] It is in fact an ideological construct; an appeal to the emotions that helps galvanise support for their ultimately utilitarian, technocratic and self-serving cause The very arrival of "biodiversity" on the discursive scene in the 1980s is in fact a reflection of "the death of nature", and an implicit concession that "nature" , as Frederick Jameson has put it, is 'gone for good' (1991: ix). [51]

Extrapolating from the ecology of the Caribbean islands to that of the wider world, and, like Schiebinger, insisting that ecological change is always biopolitical change, Walvin, who has no special commitment to re-theorising nature as biodiversity or to theories of post-nature, finds it appropriate to put "nature" in scare quotes.

> 'when we turn to "nature", closer scrutiny often reveals a physical world utterly transformed from its original state... Much of the flora and fauna were imported often from the far side of the globe. From bananas and sugar cane to the breadfruit trees, from the dazzling flame trees to majestic royal palms; all were conspicuous by their absence when Columbus first made landfall in the fifteenth century. The greenery of the Caribbean was then transformed by flora and fauna that were alien. But so too was human society in the islands... in time, few regions of the habitable globe remained untouched by the process' (Walvin, 1995: x – xi).

Caribbean "nature" had been "utterly transformed" and for all practical purposes "gone for good" even prior to Sloane's early attempts to collect, classify and exploit it; 'By the eighteenth century there were few unadulterated indigenous plants, humans, or knowledges to be collected in the West Indies: peoples and plants, languages and knowledges had churned, mingled and melded for over two hundred years...' (Schiebinger, 2004: 15). These at-once sociological and ecological transformations, to be sure, had epistemological consequences whose scope is only now starting to be fully understood; 'European visitors had already [in the eighteenth century] altered the ecosystems that were under study, thereby leading to a false view of the homogeneity of plants in the tropics' (227).

The rest of global ecology was certainly "not untouched" by European plant transfers. Several imperialist bioprospectors encountered non-indigenous plants in the course of their botanical surveys. J. D. Hooker came across two common British plants at 13,000 feet up a mountain in Nepal in the mid nineteenth century (Raby, 1996: 137), showing once again the already-anthropogenic state of colonial environments. Writing of his bioprospecting in the Niger region of Africa Milne's judgement is clouded by the recognition that the land he surveyed was not wild; '"I have also observed two species of *Amaranthus*. "Love-lies-bleeding" is one of them, but I am doubtful if this is indigenous, though the natives say so"' (Milne, 1863, extracted in Short, 2004: 38). The fact that not even the local population can distinguish what is local and what is foreign is exemplary here. In 1840s North America the famed botanist Asa Gray struggled to find *any* indigenous plants. He complains that a '"vile foreign weed...for the distance of more than a hundred miles... has taken complete possession"', another was '"met with abundantly"' and to such an extent that he questions whether it any longer should be known as introduced and argues that it should henceforth be considered "naturalized". After listing other similar examples he ends his report of his bioprospecting trip with evident disappointment ;"We collected but a single indigenous plant of any interest"' (Gray, 1844, extracted in Short, 2004: 240). The frustration felt by these and many other naturalists in search of "pure nature" was expressed by Finlayson, in 1928: '"the old Australia is passing. The environment which moulded the most remarkable fauna on earth is beset on all sides by influences which are reducing it to a medley of semi-artificial environments"' (cited in Dunlap, 1999: 159).

Equally as transformative as the accidental spread of European species of plants and animals around the world was the deliberate export, introduction or "acclimatization" of European animals. An entire thesis in social-environmental history could be written of these twin phenomena; only a few examples – the tip of the iceberg – can be given here. My point is merely to demonstrate that conquest of nature was achieved not only by destroying life by hunting but transforming it by (often ill-conceived) introductions of "new" forms of life. The removal or "control" of introduced species in later decades provided employment for the first ecologists and ecological institutions, as we will see in Chapter 9. Methods of ecological management were experimented with and established during the course of early projects to control introduced domestic animals gone feral and enormously damaging. Ecological science, and the entire practice and discourse of ecological management – of which the Convention on Biodiversity (and its regulation of Bioprospecting) is exemplary – was to a considerable extent a by-product of earlier, colonial, introductions. They were an important phase in the transition from conquest /extraction of biological resources to their management/production. This parallels the transition from imperial to emperial society that is the theoretical framework and social-historical context of my thesis.

Dunlap has written of how colonial introductions of animals were the most powerful forces for ecological transformation, as well as the least intentional; 'In both North and South, the large and varied suite of introductions fundamentally changed the face of the land' (Dunlap, 1999: 47). The most prominent of this "suite of introductions" were the agricultural crops that Europeans planted across vast swathes of their colonies on land that had previously been ancient forests or savannahs, and we will return to these in the following section. Equally transformative were introductions of animals, which were very often regretted and required large-scale efforts to de-introduce in later years. Just one of many examples is the introduction of the rabbit from Europe to Australia.

In the early 1860s, after many attempts, Australian colonists established the European rabbit in order to clear the land of local vegetation. This was an important first step toward establishing pasture for sheep. Australians evidently had no knowledge of the Portuguese experience with escaped pet rabbits on Madeira (on which see Menzies, 2002: 384, 399); 'twenty years later the Intercolonial Royal Commission offered a £25,000 reward for a way to get rid of it…' because rabbits had multiplied so quickly and established themselves so widely that vegetable farmers found their crops under constant threat (Dunlap, 1999: 58). Expensive experiments with mass-poisoning and a continent-wide "Rabbit Fence" failed to control the spread of rabbits. Until ecologists in the 1950s introduced the fatal rabbit virus myxomatosis (259-261) there was 'no way to put the genie back in the bottle' (58). However, what was a disaster for farmers was a lifeline for early ecologists, both in Australia and in New Zealand, where work on exterminating rabbits was 'the bread and butter' of researchers in the Ecology Division of the environmental agency in the 1950s (263).

The fundamental transformations of ecology in the colonies was measured by an early ecological study in 1950 of New Zealand mammal species which found that 'more than half [were] from England' (56). Many of these species had arrived there, not, as one might surmise, to help control vermin that was damaging to agriculture, or to provide food or breeding stock, but for short-term economic gain; they had been shipped to New Zealand by the tourist board to attract wealthy visitors to the under-populated and economically poor ex-colony. Sport hunters, it was hoped, would come in their thousands to holiday in forests stocked with European game species (57). In the mid-twentieth century the descendents of the deer that had escaped the sport hunters were wreaking such damage to the forests that ecologists were called in to "control" their numbers. This was achieved only by slaughtering them – at a rate of between 100 and 200 a day – from helicopter gunships (258).

Such animal introductions, and many others that there is no space to discuss here, were encouraged and undertaken by an array of nineteenth century colonial "acclimatization societies". These were formed and run by well-meaning colonial improvers who had little or no sense that their work would have such embarrassingly disastrous and expensive consequences. Dunlap attributes what we now seem as their mistakes to two things; first, their lack of ecological knowledge – and in this Dunlap seems uncritically over-confident in the capacity of ecologists to successfully manage ecosystems – and secondly, and more accurately, to their experience of relatively successful introductions of crops;

> '...seldom had so few done so much over so large an area with so little effort (or understanding)... We now see the acclimatizers as simply reckless, but that is because we have suffered the consequences of their actions, and we see nature in different terms. They focused on species [not ecosystems], which they saw as things living on the neutral backdrop of the world... The centre of authoritative understanding, natural history, was taxonomy, and it treated nature's pieces. Besides, for two centuries the settlers had lived by bringing livestock, grasses, crops, flowers, and fruit, from Europe and elsewhere. Their agriculture and the economy of empire rested on transplanted plants and animals. If so much could be done, what could not? And why should it not? Changing the land was evidence of progress and civilization' (Dunlap, 1999: 55).

Improvement of nature: Plantations and agriculture.

The conquest of nature in the colonial world, whenever it took the form of the enclosure of land for agriculture and the creation of plantations (be they of sugar, tea, coffee, cinchona, rubber or anything else) was also, as we have seen in Chapter 5, a social, specifically a biopolitical process, in the sense that the establishment of plantations destroyed entire ways of life and created entirely new ones. Plantations were experiments in industrial labour management and in the creation of proletariats. Plantations were also among the most visible of the ecological transformations that Europeans instituted. In this section I will outline how plantation agriculture was among the latter stages of the becoming-anthropogenic of non-European nature and among the first in which non-European environments were subsumed under human management regimes on a mass scale. Here, my splitting off of "ecological" issues into a separate chapter for presentational purposes is at its most problematic; it is empirically, historically, sociologically and theoretically impossible to discuss "social" and "ecological" aspects of the conquest of nature separately (Latour, 1993; 2004). Like the early national parks and "nature reserves" (see Chapter 9) plantations have an intermediate place in the historical transition from imperial to emperial society which I am arguing is the foundational context for the shift from biopiracy to Bioprospecting. The establishment of plantations was the end game of the *conquest* of nature, their subsequent operation and the organized extraction of commodities from them was the opening of the era of *management* of the newly anthropogenic landscapes.

Walvin again is the leading authority on this subject. He describes the ecological transformations made during the course of the establishment of Caribbean sugar plantations (but the same applies elsewhere, especially in India and the south east Asian archipelagos), thus;

> 'Within a generation of settlement, maps of the sugar islands showed the terrain dotted with plantations. The vistas of the islands were

> slowly changing. As more and more land was brought into cultivation, the savage beauty of the islands took on an entirely different face. With the bush cut back, burned and reconstituted, where once there had been luxuriant primeval foliage, there was now the more orderly arrangements of man-made systems; of fields, tracks, of buildings and walls – and acres of sugar cane' (1995: 135-136).

The operative sentence in this paragraph is its concluding one; '*But what made everything possible were the slaves*' (136, my emphasis). Walvin recounts how, from as early as the 1540s, the Portuguese in Brazil founded successful sugar plantations in Brazil. By 1600 'the plantation had proved its value' but the Portuguese still 'faced the problem of labour' (134-135) because the local Indian population had been decimated by imported diseases. As everyone knows, the import of Africans and their enslavement was the solution in the Caribbean. British and Dutch plantations in Asia used convict and debt-coerced labour – slaves in all but name. The founders of plantations both 'beat back the wilderness' and 'devised new ways of disciplining labour. Never before had so many people been marshalled so thoroughly to such material effect, by small bands of owners and managers…' (Walvin, 1995: 153). The management of "nature" required the management of thousands (probably millions) of men and women. With the establishment of plantations in the Caribbean and elsewhere Europeans were moving from the basic conquest of nature and society to their co-production and co-management. Blackburn describes this phenomena in terms adapted from Clausewitz; '*raging war on nature was the pursuit of politics by other means*' (2006: 40, my emphasis).

Plantations – including those of cotton, tea, cinchona and rubber which were based on plants that had been deliberately sought for their high economic value by European biopirates – were the most visible signs of the European "war" on non-European land, enduring signs of the humanization of "nature" that occurred in the course of European imperialism. They were also among the most significant institutions of imperial society;

> 'The [Caribbean] islands *were* plantations… their basic social atom was the plantation; their governing and social elite consisted of plantation owners – and the great bulk of the population (imported African slaves) toiled on the plantations… the plantation had, by the late seventeenth century, established itself as the crucial element in the settlement and development of the tropical New World' (136, my emphasis).

The establishment of large-scale plantation in large numbers across North and South America and much of south Asia was among the most significant of the varied phenomena that constitute the history of the globalization of capitalist economy and society.

> 'Regional specialization was not confined to food grains, meat and cotton. To provide tropical products like sugar, tea, coffee or rubber in bulk, *entire world areas were turned into sugar, tea, rubber, or coffee plantations…* the labor force [for each of these regions/crops] had to be sustained in turn by producers who could furnish foodstuffs and other required commodities… Still other regions of

> the world came to specialize not in crops or industrial activities, but in the production of laborers for agriculture and industry' (Wolf, 1997: 314, my emphasis).

A range of commentators agree that the colonial plantation was as sociologically significant in Europe as it was elsewhere; 'Colonial plantations may be seen as outdoor factories, applying principles of industrial organization and production to agriculture long before they were applied to the indoor factories of Europe. In this respect the Industrial Revolution was given a colonial trial run' (Abernethy, 2000: 10-11); 'the rise of cities and the "Industrial Revolution" in the West was inseparably connected to plantation farming, ranching, and forestry economies in every other human community.'(Drayton, 2000: 194); 'The plantation as a form of agricultural organization is a mark of European colonialism, both cause and effect of European expansion' (Brockway, 1979: 46).

The introduction of new crops was the *production* of landscapes and a new ecology and was also always the introduction and the *production* of a new society at both regional – in the Americas, in Asia and in Europe – and global levels. The introduction of new crops was vital to the globalization of capital. On both micro and macro scales it was a biopolitical phenomena. The work of the biopirates who procured the original specimens of plantation crops and requisite knowledge of how to cultivate the plants and manufacture the finished commodities was of world-historical importance, both ecologically and sociologically speaking.

The colonial plantation was a social technology, a machine that worked by combining imported, coerced, labour and illicitly procured biological resources to produce valuable commodities for sale on the increasingly global market. Plantations were the most significant of the technologies that enabled the 'implausible scenario' in which just eight nations 'asserted sovereign rights over hundreds of millions of human beings' and transformed large swathes of forested land into organized, manageable, productive sections. Not least because of this highly efficient machine European imperialism was, as Abernethy succinctly states, '*a kind of global enclosure movement*' (Abernethy, 2000: 6, my emphasis); the subsumption of both land ("nature") and millions of human lives under a single economic system. Dunlap agrees. No-one has made a sounder interpretation of this issue than he; '*Settlement was less an escape from civilization into the wilderness than a way to take nature to the market*' (Dunlap, 1999: 49, my emphasis).

Conclusion to Chapter 8.

Chapter 8 consists of the first half of an argument that the shift from imperialist biopiracy to emperial Bioprospecting must be seen in the context of an historical shift in humanity's relationship to "nature" from one of conquest to one of improvement to one of management. During the course of imperialist biopirates' extraction of biological resources parallel processes of converting wild land into humanized landscapes through the hunting of vermin and predators, felling of forests and reclamation of swamps, were occurring. The actual collection practices of historical bioprospectors were also shown to be ecologically damaging and/or transformative. Also parallel to the practices of imperialist biopirates were the practices of introducing European animal and crop plants to the colonies and elsewhere in the non-European world. The establishment of agriculture along industrial lines on colonial plantations employing slave- or debt-coerced labour was shown to be perhaps the most ecologically and socially significant aspect of the conquest and improvement of the colonies. Many plantations produced commodities which were formed with plants that had previously been deliberately taken – biopirated – from elsewhere in the world.

Collectively these parallel acts of conquest/"improvement" of nature and of society were central aspects of imperialist power. We will complete the argument in Chapter 9 by showing that today management of global biodiversity/ecosystems and management of global society are central and parallel aspects of emperial power. In fact it is no longer possible to speak of two "parallel" but separate processes of management of "nature" and of "society" – there is only a single, hybrid, form of sovereignty over the entirety of life (Hardt and Negri, 2000, 2004). The role of both imperialist and emperial political power is to enable and support the globalization of capital. In both the imperial and the emperial context the search for biological resources was intimately tied to commodification. Imperialist biopirates and contemporary Bioprospectors *do* have quite different attitudes to the populations they work among or with, *do* have different approaches to the distribution of wealth deriving from their work and *do* have different attitudes to the environment in which they work. However, while the architects of the Convention Against Biopiracy *do* have genuinely post-colonial and environmentalist intentions the document that they produced is an effective tool for ensuring that the long historical process of "taking nature to the market" will continue.

Chapter 9. Human ecology and the emperial management of biological resources.

In Chapter 9 I present the work of scholars of the history of ecology – especially Peder Anker and Frank Golley – which show that ecologists have not always held to the "green politics" or even "green consciousness" that is taken to be synonymous with their science today. In fact, ecology began as a thoroughly utilitarian and technocratic "super science" with ambitions well beyond the "conservation of nature". The early ecologists sought to place themselves in the position of engineers of the global ecosystem. While their role as nature conservation advocates is today genuine and to an extent successful, I believe and argue that their role in the constitution of the 1992 Convention – which subsumes all natural resources under national property and management regimes – is expressive of their lingering, often latent, ambitions to take up a prominent place in the dispensing of emperial power and exercise of global sovereignty. Linnaeus's definition of botany and bioprospecting *as* economics takes on a new pertinence in today's post-Convention society.

Here I show how early ecological science developed in a post-war context where funding was most readily available from bodies concerned not with protection of wildlife but destruction of unwanted introduced species and from atomic agencies. It was during the course of such work that ecologists developed methods deriving from cybernetics and involving early computer technology to model and "simulate" ecosystems, which could then, in theory at least, be bioengineered, (re)constructed and efficiently managed.

I then show that the coming together of "green politics" and ecological science occurred from the mid 1960s through to the early 1990s; the period in which appeared a series of alarmist reports beginning with the infamously inaccurate *Limits to Growth* report. These were both symptoms and diagnoses of a (perceived) coming environmental and social-political-economic catastrophe. They were significant also for their establishment of the notion that environmental crises should be managed at the supranational/global level. This was this period in which the new discursive object "biodiversity" came into being, the search for biological resources was given a corporate re-branding as the newly socially-conscientious "Bioprospecting", and global conferences on environmental issues were called. In short it was the crucible out of which the Convention Against Biopiracy was formed. The becoming-anthropogenic of "nature" was completed in this period – not least by way of the CBD/CAB's positing of all biological resources as property – as was the popularization, globally, of the notion that the "biosphere" is a single system that can be, and indeed should be, deliberately managed for the benefit of future generations. The global technocracy which the first ecologists had envisaged was in this period established.

Although I take the post-colonial and environmentalist intent of contemporary Bioprospectors to be genuine, and although I am sympathetic to the argument that to prevent the continuation of imperial-era "theft" of bioresources by the wealthy nations it is necessary to grant them property status, I will go on to argue in Chapter 10 that the new, hybrid, inclusive, and productive forms of (bio)power have no problem practicing what would, in the more self-interest-driven, racist, and destructive imperialist world have been unacceptable practices (compensating local populations for the removal of bioresources, the transparent and respectable employment of local labour and botanical knowledge and consciously avoiding ecologically destructive practices). My critique of contemporary Bioprospecting involves arguing that its proponents do apparently not recognise that however well intentioned they are as individuals their unwillingness to confront the non-democratic status of the contemporary emperial government leaves them in the same social position as their historical forebears. Bioprospectors remain agents of empire.

Early expressions of environmentalist protest.

In contrast to the contemporary ubiquity of passionate pleas made by Bioprospectors that it "may soon be too late" to identify and exploit any remaining potentially useful plant resources, because deforestation and anthropogenic species extinctions will have depleted humanity's remaining stocks (see for example those made by Schultes and by Harlan, cited in Chapter 1) there are very few comparable pleas to be found among botanists of the nineteenth century or earlier. As we have seen in Chapter 3, 'In the eighteenth century, the race to mine Caribbean and South American forests was run against the minimal chances of survival for individual prospectors, [but] today it is run against the [perceived] threat of large-scale destruction of bioresources' (Schiebinger, 2004: 16).

Although my research on this issue has not been exhaustive examples of what we would call nineteenth century "environmentalist" protest seem to be few and far between. Allen, who has conducted much more detailed historical research than I, locates the earliest such examples to the mid 1830s.

> 'On the canals in Yorkshire, Charles Waterton was moved to protest in 1835 [that] "not a water-man steers his boat along them but who has his gun ready to procure the Kingfisher". "If I may judge by the disappearance of the Kite, the Raven, and the Buzzard from this part of the country," he continued "I should say that the day is at no great

distance when the Kingfisher will be seen no more in this neighbourhood, where once it was so plentiful". His was not a lone voice; though there were few enough who troubled to remonstrate like this in print. One who did, Richard Piggott, a Norfolk ornithologist, had his letter to Neville Wood's *Naturalist* in 1838 published under the headline: "Impropriety of Wantonly Shooting Birds", apparently the earliest call for moderation to be accorded such prominence' (Allen, 1994: 128).

As we have seen in Chapter 8, it was the advent of the railways that 'destroyed for ever all idea of a pristine, undisturbed wilderness over much of Britain…[and] brought the first realization of the harm that might occur if such developments were to continue unhindered…' (110). Allen cites two examples of expressions of fear for, and 'uneasiness' about, the fate of British wildlife but shows also that such feelings at this time 'were much exaggerated, for the damage directly attributable to the building of the lines or to the greater number of collectors that they immediately discharged upon the country were as nothing compared with what later years would bring' (110), such as the over-exploitation by amateur bioprospectors of ferns, sea anemones and bird eggs in the second half of the nineteenth century.

In Germany, Blackburn has located a few scatterings of similar protest among the output of early Romantic poets and travellers who were beginning to 'warn about the possible consequences of human arrogance' in the first decades of the nineteenth century, although his reference to these as the 'first "green wave" in German culture' seems somewhat exaggerated (2006: 67-68). It is clear however that by the end of the nineteenth century feelings of regret about the 'sundering of a harmonious natural world' symbolized by the reclamation of Prussian/German marsh lands and the straightening and damning of rivers were felt probably more widely and intensely than they were in Britain or in the colonies (70).

Other than J. D. Hooker's complaint that teams of commercial biopirates in India had "brought down a thousand branches" in a single day in pursuit of orchids (cited in Raby, 1996: 146), I have come across only a handful of imperialist bioprospectors who seem to have had the kind of environmentalist consciousness that the CBD/CAB now requires Bioprospectors to work with. Of his work collecting specimens in Namibia J. T. Baines wrote; 'It was with regret that I broke off a couple of branches about four inches thick, in order to possess myself of a specimen, for, indeed, I am never quite able to get over the idea that the wondrous products of nature ought to be admired rather than destroyed' (Baines, 1866, extracted in Short, 2004: 35).

Elsewhere in the world, French naturalists had expressed concern over the damaging presence of man on the small island of Mauritius in the late eighteenth century, and the German naturalist Peter Kalm expressed dismay over the depletion by hunting of wildlife in North America (Blackburn, 2006: 67). It was from Europeans bioprospecting in South East Asia – where, from the mid-nineteenth century the clearing of the forests and the establishment of plantations was continuing apace – that the most vehement and thoughtful environmentalist protests came. Alfred Wallace was among the first to consider it possible that humanity might cause permanent extinction of species, was conscious that the forests of the then-isolated islands which he explored would eventually be felled, and wrote with what Raby has described as 'a melancholy certainty that paradise was threatened' (1996: 159). This feeling was shared and presciently expressed by the bioprospector Henry Forbes a few decades later;

> 'As in Java the original forest [in Sumatra] is rapidly disappearing: each year sees immense tracts felled for rice fields, more than is actually necessary, and also much wanton destruction by wilful fires... Our children's children will search in vain in their travels for the old forests of which they have read in the books of their grandfathers; and to make their acquaintance they will have to content themselves with what they can glean from the treasured specimens in various herbarium, which will then be the only remains of the extinct vegetable races' (Forbes, 1885, extracted in Short, 2004: 102-103).

It was still many decades before concerns for such remote environments entered public or government consciousness; the European and American political climate was still wholeheartedly in favour of conquest of nature; international conservation and management were both discursively and institutionally absent until well into the twentieth century. Some extremely limited national-level measures were taken in the late nineteenth century. It is to these we now turn.

Early "conservationist" legislation as enclosure of the commons.

There is no space here for a comprehensive history of national conservationist and/or environmentalist legislation. This section is intended to show that early legislation was very limited, unenforceable, was often more concerned with managing the supply of game for hunters than with any preservation for nature "in itself", and most importantly, and in short, that such proto-environmentalism had nothing to do with – in fact was chronologically prior to – ecological science and thought. Finally, in the colonial context, early conservationist legislation was little more than a means by which the State could enclose common land.

Allen dates 'the turning point' toward serious and organized conservationism at 'halfway through the [eighteen-] sixties' when 'the first-ever wildlife conservation body in Britain, possibly the world' – 'A Yorkshire Association for the Protection of Sea Birds' – brought to the attention of Parliament the 'unbearable scale of the destruction wrought by the latest fashion in women's hats – which involved the wearing of substantial portions of the plumage of wild birds, more particularly gulls… Parliament was successfully hustled into the first-ever piece of legislation on behalf of wild life' (1994: 177).[52] What is important here is that with regard to this act regarding the protection of sea gulls 'Hardly anyone took the slightest notice and convictions were almost impossible to secure' (177). This legislation, while unprecedented, was absurdly narrow;

> 'Every other species was being harried, occasionally to extinction, by a ceaseless array of human foes: not only those which came at them with guns, but those who took them alive to supply the gourmet and cagebird markets, or collected or ate their eggs. The Wild Birds Protection Act of 1880 in theory extended the law to cover most of these as well but in practice it proved just as difficult to enforce' (178).

It was not until the 1890s that 'the cause at last acquired a substantial body of militants' (178). This body took the form of the "Amenity Movement", which campaigned for land to be set aside for rambling, hiking and climbing and was borne as much from concerns that ruins and ancient monuments such as Stonehenge should be protected than from any concern among naturalists over species extinctions, habitat destruction or the like. Thomas's account of the same period describes an increasingly widespread perception of a 'need for artificial measures to preserve those wild species on which men depended for food or sport' (1983: 276), and while he gives an example or two of naturalists' involvement in campaigns for such measures they were very far from being the vocal interest group that ecologists of the late twentieth century reinvented themselves as. Allen and Thomas's combined accounts show, in short, that generally speaking 'It was not from the natural history world that the inspiration' for nature conservancy came from but most prominently and actively from the Commons, Open Spaces, and Footpaths Preservation Society (Allen, 1994: 179).

In the United States conservationism began to have mass support and to be implemented by federal and state governments slightly earlier than in Britain. There, unlike in Europe, there remained something that still looked like wilderness. Wilderness in the States and Canada was not yet, as Allen (179) describes it, the 'modernist delusion' that it already was in Europe.[53] Appeals and consciousness-raising campaigns of the type made in Britain were hardly necessary in the States to achieve the protection of animals. Both public and government felt something should be done. 'The slaughter of the buffalo herds in the 1880s became the watershed' – the remaining herds – by now enclosed within national parks (of which more below) and legally protected from hunters (although with only small teams of park rangers to enforce the law) – became a spectacle which thousands of tourists wanted to see – the 'species became an example of heedless destruction of the natural world' (Dunlap, 1999: 123). In 1910 a 'milestone' was reached; the banning of 'interstate commerce in wildlife killed in violation of state laws' (124). Although many predators were still hunted in large numbers this period marks the beginning of the end of the period of unreserved practice of the conquest of nature and the start of the coming to dominance of the discourse and practice of management of biodiversity. Previously, 'The presumption was that wildlife could be killed unless it was protected. Now it was protected unless the legislature set a season or declared a species to be a pest' (124).

Although similar "milestones" were reached considerably later in Australia and New Zealand, the same shift from uncontrolled destruction and conquest to attempts at sustainable management did eventually occur there too. As in Britain and the States, the first legal measures that were anything approaching conservationist in character in the ex-colonies were not the achievements of ecologists or ecological thought. In Australia, the first Acts of government regarding wildlife 'banned "unsporting" methods of taking game but did little more... license laws were more a way of keeping track of firearms than of controlling hunting. Wildlife agencies were small and had few powers...' (67). In short, efforts to ensure a steady supply of game provided the 'legal framework that would become the basis for the management of wildlife in[to] the twentieth century' (69). This remained the case at least until the successful campaign of a local newspaper in the 1930s to have the bounty paid by the Government per head of koala bears removed (192).

European colonization of distant lands had from the very beginning seemed justifiable because those lands were either not inhabited, were inhabited "only by savages" or those lands were being "wasted" or inefficiently farmed. Variants of these ideas persisted throughout the colonial period, and in the mid and late nineteenth century became mixed in with early "conservationist" measures. In hindsight these seem thoroughly ideological.

In India the British rulers believed in the "Myth of the Profligate Native": the local population, lacking the botanical knowledge developed at such institutions as

Kew Gardens and its various colonial offspring, were in no position to efficiently or profitably farm their land, therefore the British could legitimately set it aside for "conservation". The practice of "slash and burn" agriculture was widely, but hypocritically, scorned. The British themselves burned forests and replaced them with plantations of cinchona and tea but the notion of 'The Profligate Native justified the "conservation" of plants and animals, as well as their exploitation' (Drayton, 2000: 234). Burning forests was acceptable if the land was then used for something the colonial administration found useful:

> 'No community had the right to deny access to the environment it occupied, if others were better equipped to make use of it... *Conservation*, for many Victorians [in the colonies], clearly was the task of saving environments from those who lived in them. It *was, in the end, another justification for expanding the power of the state and the technocrat...* Imperial power, advised by science, would decide how nature was exploited, to the benefit, putatively, of everyone' (223, 236-237, my emphasis).

In this sense then, 'Exploitation and conservation were the common ends of policy, not alternatives...' (Drayton, 2000: 235). I would argue that documents such as the Convention on Biological Diversity demonstrate that this is as true today as it was in British India. What the local multitude was told was "conservation" of land was merely a means by which it could be set aside for use by the empire. Colonialism as a whole should be seen as the enclosure of the world's land, its subsumption under capital and the State (Abernethy, 2000: Hardt and Negri, 2000). This is a process whose completion is exemplified by the Convention's contemporary recognition of all natural resources as national property. This is true whether those resources are to be "conserved" or "protected" or whether they are to be extracted or destroyed, and whether or not benefits of resource extraction are partially shared with the locals. Drayton makes quite clear that conservation 'began as Preservation: the claim of an exclusive right of exploitation of a limited natural resource… *Conservation was originally just an act of enclosure by the state*… (234, my emphasis). Today it is an act of enclosure by the institutions of global (emperial) governance.

Dunlap's research on these issues across the ex-colonies of the States, Canada, Australia and New Zealand concurs with Drayton's on India (which draws, in turn, on Grove's (1995) work on the same in Africa). Together they demonstrate that 'In its view of nature – as resources – conservation looked back to the era of conquest. In other ways it looked forward, if not always with a clear view… Conservationism was not environmentalism…' (Dunlap, 1999: 92). This is confirmed by looking at the details of the most concerted early efforts to manage natural resources sustainably, in and through the establishment of the first national parks and "nature reserves".

National parks and the (re-)production of "nature".

The first large government-run national park was Yellowstone Park in the United States (founded 1872). It belonged to a move partly nationalist in inspiration – the idea being that "nature" was part of national heritage and could be a source of national pride – and partly motivated by a wish to 'set aside land for recreation and beauty': Ostensibly national parks 'provided precedent as well as legal and social definition for preserving land for noneconomic uses' (Dunlap, 1999: 118).

It is questionable, however, whether tourism can be said to qualify as "noneconomic use". Parks in New Zealand were 'less a matter of national heritage than of money; from the first, the parks were intended to lure overseas tourists' (119). Although the establishment of parks probably should be seen as a small step away from the uncontrolled conquest of nature, the step toward parks was

> '...hardly a bold one. American park historian Alfred Runte has argued that American parks were "worthless lands", created only where no one wanted the land. This may be debated at the edges, but the core is surely sound, and it holds for other countries as well. [Canada drew]... boundaries to exclude timber and mining lands. [In New Zealand one of the principles of their park system was that]... "no lands shall be included which is of economic value either for agriculture or as having forests containing milling-timber". About Australian parks one commentator noted that until well after World War II parks were selected on the principle that "if the scenery is good and nobody else wants it, then [land] could be a park"' (119).

Neither were these early parks safe havens for wildlife. It wasn't until 1931 that all hunting was illegalized in United States parks. Even then, there was an exemption for "scientific collecting". If there might be useful or potentially profitable life in the parks exceptions to the law would be made (Barrow, 2000: 524); *bioprospecting was never illegalized.* The parks did not at this time have "noneconomic uses". In fact they never have had. To describe Yellowstone Park and its early equivalents as the 'fountainhead' of the environmentalist movement would be, as Dunlap frankly states it, 'bad history' (1999: 118).

As the Australian government sought to ease the unemployment crisis of the Depression era by setting bounties on koala bears – thus providing at least some sort of income for the rural poor – the United States government did the same for coyotes, wolves and other predators, including those in the new national parks. It is here that there begins to be overlap – in two related senses – between ecological science and the national parks. The parks had not initially been the brainchild of ecologists. National Parks were established decades before the development of ecological science and its institutions. Even those parks established during the early years of ecology – the 1920s and 30s – can not be claimed as the domain of ecologists.

When the various American parks eventually came under the jurisdiction of a single state department ecologists were not employed to run them; 'In the early twentieth century the U.S. parks were run by a variety of agencies, seemingly whatever was at hand when Congress established the park. A cavalry troop, for example was in charge of Yellowstone' (122). Having said all this, the running of the parks was by the 1930s beginning to show the influence of ecological thought and practice. Firstly in that it was the recognition that the species living in the parks formed an ecosystem that led to the illegalization of the hunting or predators – an idea that had been considered radical only a decade earlier. Secondly in the growing recognition that "nature" in the parks *needed* to be managed, *could* be managed and needed even to be *produced*.

Up until, and into, the 1930s park managers were still working within the nineteenth century paradigm of natural history. They 'could deal with nature's pieces but not with the processes that bound them together on the land... [they] were lacking understanding of the dynamics of population growth and the environmental factors that governed it' (204-205). While ecologists, especially in England and South Africa, were beginning to understand "population dynamics" and starting to develop the concept of the ecosystem this knowledge had little direct influence on park management practices. However, ideas along these lines were learned the hard way, that is, they were learned by correcting costly mistakes. Mass extermination of predators, in this example, of coyotes, had unintended knock on effects. With large numbers of coyotes suddenly absent, the mouse population underwent – as the phrase has it – an "explosion". Equally suddenly the coyote went from being seen as dangerous to being seen as a "useful" animal, an expert hunter of mice rather than a threat to human life. Protests against the extermination of predators had previously been ignored but in parks overrun with many thousands of mice they suddenly looked rational. 'In May 1931 Park Service Director Horace Albright pledged "total protection to all animal life"… [predators] would be killed only where they were causing "actual damage"', by the mid 1930s his promise had been kept and all predator control came to a halt (215). The ecological consequences of the conquest of nature would be from this point on thought through more carefully. Although they had no training in ecology, from this point on park rangers began to understand themselves as scientists (231). Before long their work would be conducted and informed by professional ecologists. As we will see further below, ecologists were only too happy to take over the work of judging what constituted "damage" to ecosystems and of conceiving and executing extermination campaigns to restore "natural equilibrium".

The second overlap between the running of parks and ecological thought and management practices was in the area of providing a sufficiently "natural" landscape to satisfy the thousands of urban-dwelling tourists who were increasingly visiting the parks on weekends or on vacation. 'By 1920 the pressure on the most popular American parks was such that management was necessary to keep them in anything resembling a "natural" state' (123). The work of the Park Service's Wildlife Division was, according to its Director in 1933, 'to guide the Park Service in the task of restoring nature in the parks, re-creating the landscape as it had been before whites arrived' (Dunlap, 1999: 232). Implicit here then is the notion that nature can be produced, and the concession that what is presented as "nature" to tourists is in fact a thoroughly humanized landscape. There has never been any such thing as a true "nature reserve".

At the very time that "nature" became a tourist attraction "nature" in the sense of "all that is untouched by humanity" was no more. By the time ecologists took over management of "nature" – both within and without national parks – it was already "gone for good". Ecological science, thought and institutions were borne of the recognition that there can be no division of the world into "human" and "non-human" halves. We will now look at how ecologists, from the 1920s sought to assign themselves the role of "the board of directors", first of colonial bioresources, and then, after the granting of the European colonies' formal independence in the mid-twentieth century, as custodians of global bioresources. Both pre- and post-war, ecologists' ability (whether real or merely perceived) to successfully, efficiently and wisely manage ecosystems has elevated them to increasingly powerful roles in the formation and maintenance of institutions of global – emperial – governance. This power is signified not least by the Convention on Biodiversity.

Human ecologists' technocratic ambitions.

While I must, for lack of space, avoid getting into a complicated debate about what constitutes a scientific "paradigm",[54] Dunlap has described twentieth century ecological science as 'clearly a stage beyond' the natural history of previous centuries (1999: 139). The first ecologists themselves certainly believed they were producing something new. If I was asked "What is the difference between natural history and ecology?" I would summarize the difference into three points.

First, natural history was extractive, ecology is managerial. Or, natural historians generally treated biological resources as infinite, ecologists treat them as finite and in need of sustainable use. Some ecologists tend to believe that while natural history was "merely descriptive" ecology is practical and useful. As we have seen in Chapters 3, 4 and 5, however, natural history in the forms of imperialist botany and biopiracy was always already a practical, useful, profitable, science.

Second, natural history, especially before Wallace and Darwin's theories were developed, and to an extent afterward, generally believed "nature" to exclude humanity while ecologists take humanity as just another species (albeit the dominant one). In this respect the replacement of the concept of "nature" with "ecosystem", "biosphere" and "biodiversity" is significant.

Third, natural history was a tool of imperialism, ecological science is a tool of emperial sovereignty. Below, I will explicate these differences and show how the Convention Against Biopiracy is a product and symbol of the replacement of natural historical thought and practice with ecological thought and practice.

The development of ecological science, from the establishment in Britain of the world's first ecological society in 1913 and journals in the early 1920s, through the involvement of post-war ecologists in writing the charter of the League of Nations and directing the early activities of UNESCO, to the involvement of ecologists in the formation of global environmental policy at the United Nations in the 1980s and 1990s, *spanned the collapse of European imperialism*. This was the most powerful influence on the institutional development of ecological science and also a powerful influence on ecological science's content and methods. Within two decades from the 1930s to the 1950s ecologists had lost their imperialist role and sought, with considerable success, to establish themselves at the tables of the embryonic, but fast growing, world government.

It is significant that ecological science developed in Britain before it did in the United States. This is at least partly because, first, Britain had an empire, and the States did not. Government and science in the United States had a less immediate interest in developing methods of biological resource surveys and management methods. Ecological thought in Britain (and South Africa) was a product of colonial rule and answered colonial questions, in the States it was a post-colonial or non-colonial phenomena.

Secondly this temporal difference is significant because the British landscape, British "nature", had long since ceased to be "wild" or "pristine" whilst in the States, with the exception of the eradication of large numbers of predators and buffalo, there remained large areas of undeveloped, unfarmed and relatively untouched wild nature. Or, to put it more accurately, there remained into the twentieth century the *memory* of wild nature. In the States nature still seemed "big" and human power "small". Immigrant Americans (very broadly speaking) had had a shorter period of direct experience than Europeans of the ways in which humanity increasingly had the capacity to dramatically destroy, alter, humanize, manipulate, engineer and manage nature both unintentionally and consciously. Ecological theories that include humanity as a component of "nature", namely, the ecosystem concept, were accordingly slower to be accepted in the States.

One of the founders of ecological theory, A. G. Tansley, wrote in his 1923 book *Practical Plant Ecology* that 'The "belief is sometimes met with… that only perfectly "natural" vegetation is a proper study for ecological study. If this where true, the ecological field in Great Britain would be very small indeed" (cited in Dunlap, 1999: 148). From the start, ecologists knew that to talk of "nature" was misleading; the term needed scare quotes from at least the 1920s. British ecological science, long before some variants of postmodern thought, attacked the conceptual boundary between humanity/technology and nature.[55] Ecology was originally conceived as "human ecology".

Human ecology was profoundly influenced by the social sciences and went on to seek to reshape and reorganize them. Proponents of "Human ecology" would soon come to attempt to establish their new discipline as a kind of meta-social-science. They claimed that their new field was epistemologically superior both to nineteenth century natural history and botany and to the sociological and historical sciences of the day. This was, they believed, because of their recognition that human society is inevitably built on a biological base, whose preservation and careful management is of great importance to the survival – and yes, the evolution – of civilization.

The popularization of ecological thought in the social sciences was astonishingly rapid (more rapid in fact than it was within natural science departments, with the exception of those at Oxford). Only seven years after Tansley established the first Ecological Society its major premises, encapsulated in H.G. Wells' book *Outline of History*, were taught on undergraduate history courses. Via his friend Julian Huxley 'H. G. Wells was much inspired by this new ecological-economic order and wrote extensively on how *a society of tomorrow could be reorganized according to the principles of human ecology*. His writings generated enthusiasm for ecology as a discipline on the cutting edge of social research…' (Anker, 2001: 240, my emphasis).

Wells 'saw his own voluminous *Outline of History* (1920) as an "Outline of Human Ecology. But I did not call it that because the word Ecology was not yet widely understood"' (cited in Anker, 2001: 200). The book was 'the main vehicle for an evolutionary explanation of historical events in the 1920s, and was used by many colleges and universities as the standard (though controversial) textbook in core history courses' (Anker, 2001: 200). Wells explained how human ecologists-as-historians elevated themselves above nineteenth century botany and bioprospectors in these terms; the new historians '"would be related to the old school of historians much as the vegetable physiologists, ecologists, and morphologists are related to the old plant-flattening, specimen-hunting, stamen-counting botanists" (cited in Anker, 2001: 200)!

The ideas of this highly ambitious new science were then further popularized in a 1930 book by Wells and Julian Huxley published as *The Science of Life* (note how no distinction is made between human and non-human life), for which they were paid £10,000. This figure was ten times Huxley's King's College Professorship salary and is a good indication of the level of interest the educated public had in their ideas. The book argued, in short, that '"ecology is really an extension of economics to the whole world of life... Economics, therefore, is merely Human Ecology"' (cited in Anker, 2001: 112-113). As we have seen in Chapter 4, Carl Linnaeus had in the mid eighteenth century understood botany and economics to be as synonymous Wells and Huxley did now in the early twentieth. After the economic and biopolitical successes of imperial botany in bringing new natural resources to the market the idea that botanical science – now in the new form of ecology – could and should be given the job of running the economy had come full circle. Once again, botanists claimed a seat in government.

There was a significant difference, however. Linnaeus believed his botanical work, and the work of his bioprospecting "apostles", had significant contributions to make to the *national* Swedish economy (and Joseph Banks had the equivalent nationalist motivations for the role of botany in the British colonial economy). Wells and Huxley believed and argued, even before the collapse of the rival empires which (formally at least) had divided the world economy into several competing branches, that human ecology-as-economics must be a *global* science. They wrote;

> '"Man's chief need today is to look ahead. He must plan his food and energy circulation as carefully as a board of directors plans a business. He must do it as one community, on a world-wide basis, and as a species, on a continuing basis"... The concept of management was taken to an extreme, with a board of directors planning the business of food and energy circulation on a worldwide basis. This was not metaphorical language: they literally envisioned themselves as being on the board of directors in the economy of nature, managing the circulation of matter and energy for the world' (Anker, 2001: 114).

So there are several significant points here. 1) Wells and Huxley used ecological terms – such as "energy circulation" – derived from small-scale studies of a few lakes in Britain and Kenya – which had only been developed in the previous decade and were very far from being established as accurate or workable (on which, see below). 2) They were already writing as if the mere identification of the "energy flows" of ecosystems gave them the power to effectively and unproblematically (re)engineer and manage those ecosystems. 3) From the very beginning ecologists granted to themselves the right to suggest the future course of social and economic policy (in Britain, the British Empire and beyond). That is, 4) they already believed and strongly argued that this policy should be set and implemented at the global level. 5) They saw themselves also as a "board of directors" – that is, they saw little distinction between political and corporate roles. After a 1931 article by a leading economist, which incorporated many of Wells and Huxley's human-ecological ideas into a "National Plan for Great Britain" and 'took Britain by storm', these ideas were discussed seriously in British government circles (202-203).

In sum, the role of ecologists in contemporary global governance, was one that ecologists from the very earliest days of their science, and before their methods and theories had been fully developed, actively sought. Crucially for my account of the transition from biopiracy to bioprospecting, and of the developments that led to the Convention on Biological Diversity, such technocratic ambitions (which, when Anker's book is read at length appear as nothing short of megalomaniac) were established *before environmentalist thought entered mainstream global politics and gave such ambitions a veneer of legitimacy.* If the concern with "preservation of biological resources" and the associated environmentalist interests had not become a central aspect of contemporary centrist politics and had not become so thoroughly melded with ecological science it is unlikely that ecologists could have so completely fulfilled their original ambitions to become global technocrats.

Anker attributes ecologists' global ambition partly to the use of airplanes in the course of ecological surveys of the colonies, especially in Africa (116). Aeronautic technology surely did help affirm their belief in the need for a macro-level perspective but because Anker's work focuses only on imperial ecology the history of imperial botany is underemphasised in his account. Accordingly, the fact that imperial botanists had travelled far and wide in their efforts to collect, identify and classify the world's plants is somewhat understated by Anker, as is the consciousness among pre-ecological botanists of their having the entire world as their field of study.

It was at the 'grand British Empire Exhibition' of 1924 and the simultaneous fifth International Botanical Conference that ecological science first garnered imperial financial support. Until this point human ecology had only a small number of proponents, some in Britain and some in South Africa, many of whom were meeting for the first time. The exhibition's Department of Botany curated 'a special exhibition in their rooms intended for movers and shakers in various colonial government agencies…' (34) and organized a series of lectures which propounded the central tenets of ecological thought in its early form. At this time ecology was directly continuous with the imperial botany of the previous century. Ecologists, including Tansley,

> 'lectured on the best means of promoting a comprehensive survey of plant communities in the empire. A complete botanical survey of the empire was to include both a full-scale map of all the resources in the colonies and an ecological survey of relations among the species… The focus of this grand survey was the economic aspect of botany; as one lecturer put it, "it is our duty as botanists to enlighten the world of commerce"' (34).

This project to conduct a large-scale "ecological survey" of the whole African continent (which was a supplement – both an extension and revision – to the previous centuries' botanical surveys) was the largest project that ecologists had at this date attempted.[56] The survey's subsequent "handbook" presented the basic idea that 'natural vegetation cannot be utilized for human purposes without the guidance of socially responsible science' (Anker, 2001: 36) and thus made practical the idea expressed by Wells and Huxley that ecologists could and should have an advisory role in government. The handbook also echoes Wells and Huxley in its conception of ecologists as businessmen and both nature and society as corporate "stock".

'"It is hardly possible", the committee explains in the preface, "to conceive a property owner or stores manager carrying on the management of a large estate or general store and yet being unaware of the stock at his disposal, the extent of his supplies, or their nature". The image here is of Britain as the property owner and manager of the colonies who unfortunately is unaware of the natural supplies at their disposal. To obtain such knowledge the Protectorates needed ecologists who could map out the "vegetational assets" available to the Crown. Good management of a colony can only be obtained if the empire's economy adjusts properly to the economy of nature' (36).

It is this notion of "adjusting" colonial society, from above, to the ecologist's (as-yet undeveloped) notion of what "nature" is that the pre-war ecologists took as their definitive project. They sought the naturalization of social organization. There is no speak here of a project to "save the earth", rather the talk is of saving the British Empire from the possible effects of bad management. In its concern with the furtherance of imperialist interests the ecology of this era was certainly not a "stage beyond" nineteenth century natural history. Its recognition that 'Human agency greatly influenced plant communities' (38) *was* novel. So too was its consciousness that the sort of agency humanity exerted over "nature" had significant social and political consequences. Neither, though, were pitched as concerns over the possible *destruction* of environments, ecosystems or "biodiversity". Rather, they were explained in terms of the possible dangers to the imperial economy of inefficient or misguided management. Environments were at the mercy of human action and the role of ecologists was to make sure such action was taken in the interest of the British Crown (38).

Anker goes on to describe in some detail a series of pre-WWII ecological studies which were as convenient to imperialist agencies as those of their botanical forebears had been. Although some of these involved bioprospecting practices that were not much different from those of ecologists' botanical forebears this is not my focus here.

There was the survey of biological resources of African territories in order to settle colonial border disputes. British colonists were commissioned to work on a 1920s project conceived to

> 'establish an exact border between the colonies [of Belgian Congo and British Rhodesia]. The estimation of ecological resources was a crucial part of these negotiations... The aim of the survey... was to get an overview of all the natural resources so that the final border could be fair to both parties... the ecologist was the mediator in the midst of these negotiations' (83-85).

Then there was employment for ecologists to be had in solving social-economic problems – such as the collapse of local fishing industries – caused by the sudden replacement of traditional fishing methods by the use of industrial nets on African lakes. Ecologists – specifically Edgar Worthington and Dick Dent – were called in by colonial administrators to help solve the "fisheries crisis" in Africa, specifically Lake Victoria' (208). 'Worthington was hired to research the economy of nature by a colonial administration that saw ecology as an administrative tool to improve, even save, their political economy' (210). Dent had somewhat limited ambitions for the new tools of ecological management. To him 'ecology was not a descriptive science, but rather a tool to create food chains beneficial to the Kenya Angling Association' (211). Worthington though later went on to direct the International Biological Program (of which more below). Anker shows that in this way 'lakes served as microcosms for global management schemes and vice versa' (209).

There was corporate as well as governmental employment for pre-war ecologists. In 1925 Charles Elton travelled to Canada for the Hudson Bay Company. Elton was employed to study the fluctuations of the remaining populations of various fur-bearing animals and thus 'to improve the company's management of fur resources' (98). In an early example, to be found in the report of Elton's study, of the diagrams whose aesthetics derived from engineering and where much loved by early ecologists, 'the end of the food chain' is a London auction house! As Anker describes it, Elton conveniently found that

> 'The economy of nature was an integral part of the economy of the fur industry and vice versa. The ecologists helped to naturalize and legitimize the division of labor and the profit for shareholders… the paternalistic management of native Canadians and arctic Eskimos by the Hudson's Bay Company during this period was all "natural" according to the science of human ecology' (99).

To fully appreciate this early period of thought and practice, and to fully understand just how closely involved ecologists were in imperial management and just how far removed "environmentalist" concerns were from their work it is necessary to study Anker's book in detail. In short, the passages quoted here should leave no doubt that the early ecologists' primary concern was

> 'to empower the social order of their patrons in various colonial agencies or commercial companies by ordering the economy of nature so that it could serve the social economy of British imperialism. This was achieved by rendering the ecological order of nature into an order of knowledge suitable for managerial overview' (116).

Anker claims that 'The chief research instrument in this process was the airplane' and that 'This aerial view on nature, society and knowledge – the master perspective from above – was at the very core of British ecological reasoning' (116). However, only the first of the three examples given above used airplanes. Although he is aware of it, Anker underemphasises that the botanical sciences had also been imperial sciences. Ecologists were not the only natural scientists to be employed on imperialist projects. Perhaps Anker accepts too readily the claim made by Huxley that ecology was significantly different from the work of "the old plant-flattening, specimen-hunting, stamen-counting botanists". In its concepts and methods it was certainly a development, but in its sources of funding and Banksian willingness to serve imperialist ends it was continuous with its eighteenth and nineteenth century forebears. The international (empire-wide, but not yet truly global) scope and ambition of ecology was likewise continuous with imperial botany. The use of airplanes may have been an affirmation of "the master perspective" that Linnaean and Banksian imperial botanists and bioprospectors had had but it certainly did not create it. Ecology was "managerial" in its outlook in ways botany was not. but it certainly was not the first time botanists had had an "overview" of the world.

Post-war ecology and cybernetics.

A brief look at the equally un-environmentalist character of the post-war, post-imperial ecological projects will suffice to demonstrate that ecological science can not claim "green" credentials until the 1970s. Ecologist's research on projects to exterminate unwanted rabbits and deer formed their "bread and butter" employment in post-WWII Australia and New Zealand (Dunlap, 1999: 263). Introducing fatal viruses and conceiving schemes to shoot deer from helicopter gunships seem today to be the very antithesis of environmentalist projects.

Similarly, in the States, the largest source of funding for post-WWII ecologists was largely from the nuclear power and weapons industry, which is now one of most contemporary environmentalists' primary enemies. This source of funding was a major factor in the rapid expansion of ecological science through United States universities in 1950s and 1960s and was the source of an important new method in ecological research – the use of radiation to track the interconnections of species in ecosystems. The author of the first ecology textbook, used widely on undergraduate ecology courses, E. P. Odum's 1954 *Fundamentals of Ecology*, was directly employed on research funded by the Atomic Energy Commission (AEC), as was Frank Golley, the author of a book (1993) on the history of the ecosystem concept from which the following account is taken. In short, if there had been no nuclear technology the ecological sciences would not have developed or established themselves in the ways that they did. The institutional strength that enabled ecologists to take up prominent roles on some of the earliest global environmental management programs may never have existed without the funding of the AEC.

Writing of American ecologists in the immediate post-WWII period Golley notes that

> 'The major source of their funding was initially the U.S. Atomic Energy Commission (AEC). Ecologists benefited from the cold war and the Korean war as they studied the base-line ecology of nuclear weapons facilities, the effects of radiation on organisms, and the movement of radioactive materials through food chains' (2-3).

Two years after a nuclear test in the New Mexico desert biologists and ecologists from the University of Los Angeles California

> 'studied the distribution of radioactive fallout in vertebrates, insects, vegetation, and soils at the Trinity site... This was the beginning of what became an exceptionally active ecological research area, *radiation ecology*. At the same time, studies [of other radiation-polluted environments were conducted]... From 1946 to 1948 the U.S. government tested atomic explosives at Bikini and Eniwetok atolls in the Pacific ocean. These tests were accompanied by studies of marine ecology' (72).

One of the leading figures in American ecology at the time, and Golley's teacher, E. P. Odum, 'received one of the first contracts to do research at the Savannah River [Nuclear] Plant in South Carolina' (73) and went on to conduct research on the 'application of radioecology techniques to solving problems in basic ecology' (74). Golley summarizes the benefits that such research accrued to ecological science thus;

> 'The officials in the AEC were able to visualize several distinct applications of ecosystem theory to applied problems... The emerging ecosystem studies were directly relevant to those needs, and the AEC provided relatively large sums of money to ecologists to organize research groups and study problems. These groups gradually became permanent organizations... radiation ecology became an applied area of ecosystem studies. In other countries the expansion of ecosystem research was much less active' (105).

Post-war ecology in the States was post- or non-imperialist but it was still far from being environmentalist in orientation and was certainly not funded by agencies with environmentalist motivations.

How then, did ecologists view the fact that their discipline was fundamentally supported and shaped by the U.S. military? At one point Golley makes the wildly implausible suggestion that 'The relation between ecosystem research and the military activity of the United States was never obvious and ecologists seemed oblivious to the connection' (105). At another he rather more realistically acknowledges that at the time 'many American ecologists were unconcerned that their studies were closely linked to military activities. Rather, they tended to accept the cold war as a fact of life and welcomed the opportunities military research made available' (73).

The Cold War and ideas deriving from military research also shaped ecological science in less direct ways, most significantly via cybernetic thought and its use of early computer technology.[57] It was through cybernetic concepts and computer modelling methods that the first attempts by American ecologists to (re-) engineer ecosystems were made. The possibility of managing or (re-) engineering the entire "biosphere" or the global ecosystem (in today's terms, of managing, limiting and controlling global climate change) was first conceived under the influence of cybernetic ideas.

Golley's book details how

> 'During this period of about fifteen years [from 1945], the ecosystem concept became established as a scientific paradigm in ecology. This paradigm described an ecosystem as an ecological machine constructed of trophic levels that were coupled through flows of energy… [in some conditions it could be said that] ecosystems were in a steady state' (Golley, 1993: 104).

The basic image of an ecosystem is one of a machine running according to the principles of thermodynamics. It has inputs and outputs of energy (or, in some variants, information) and it has a steady state or an equilibrium. Too many or too little inputs disrupt the system's stability and can cause the machine to break down. While it would not be accurate to portray the acceptance of this idea as universal or uncontested and it would be false to state that all ecologists hold to a uniform version of the concept this was certainly its ideal type.

Golley shows that disagreements about the extent to which the cybernetic notion of system equilibrium applies have existed within the ecological sciences from the beginning and to the present day. There is a "weak" and a "strong" version of the theory. One of ecology's founders – Tansley – believed in a 'quite modern way' that while ecosystems "tend to" stability they never achieve it (34) and even if they did it is not possible to establish when that stable state exists or existed. Tansley held to a "weak" version of the theory. Golley's teacher – Odum – by contrast believed there was such a thing as observable "steady state" conditions (70). He had a "strong" version of the ecosystem concept. Golley himself sits somewhere in between and pitches his views as representative of the contemporary consensus within ecology. He believes the global ecosystem can and should be studied by modelling 'flows of energy and cycles of materials', retains the 'possibility of feedback loops' (203-204) but is critical of ecologists for their lack of clarity about what constitutes "information" in ecosystems, is wary of too-literal belief in ecosystems as machinic, and believes that ecosystems are 'never stable' (100).

The notion that ecosystems have a "steady state" or an equilibrium has been the source of much controversy. It persists most prominently today – despite coming under heavy criticism from both within and without ecology – in the notion that human society has resulted in "too much" input of certain gases into the biosphere and that to restore the "balance", and to reduce the resultant "excess output" of heat, it is necessary for human society to restrict its production of those "greenhouse" gases. The work of scientists on this issue is today something that almost every global citizen is aware of. Whether one takes the side of the "doubters" (Lomborg, 2001) or the "prophets" of imminent environmental and social crises (Flannery, 2006) almost the entire global population today is familiar with some version of the ecosystem concept. Most research on global climate change – whether conducted by ecologists or not – today relies heavily on this machinic notion of the global ecosystem and on computer simulations of it. Like it or not, the ecosystem concept in both strong and weak forms today has a prominent place in global society and politics.

Golley (whose critique I have chosen to draw on in preference to "external" critiques because he is himself an ecologist) criticises the influence of cybernetic ideas on the ecosystem concept specifically, on ecology in general, and its take up by environmentalists, in two ways. First he argues that while *lake* ecosystems may to an extent operate according to cybernetic principles – and may therefore be susceptible to ecological management – it is too presumptuous to then develop computer models that construct the global ecosystem in the same way (and therefore exaggerate the global ecosystems' susceptibility to management and (re-)engineering). Secondly he argues that the principles of cybernetics were imported into ecology more for social-political-reasons than for scientific ones.

As briefly mentioned above, the ecosystem concept was developed from humble beginnings; the study by ecologists of lakes, both small, in Britain's lake district, and large, on lakes in colonial British Africa such as Lake Victoria. Lakes are especially convenient for ecosystem research because they are relatively "closed systems". Inputs and outputs can be more readily measured in lakes than elsewhere, for example in forests. Such studies are known as "watershed" studies and provided ecologists with their first "experimental" method (this was important in securing for ecology the status as science). By manipulating inputs to and measuring outputs from lakes the "flow" of energy/information and the effects on the lake's "equilibrium" can be studied. Lakes can be experimented with. Other sorts of ecosystems are not amenable to such experimental "watershed" studies because the variables cannot be limited. If ecologists wished, as they did, to be able to apply their science beyond lakes they would need another method. So, the second major method of ecological research was developed; the use of mathematical models or simulations. Here too, variables can be limited and the effects of their manipulation can be measured. This latter approach obviously was greatly enhanced by the increase in availability of computer technology. In fact the possibility of computer simulation, Golley uses the phrase "construction" (97), of ecosystems was conceived long before computer technology made it feasible.

The abstraction and reductionism inherent in such ecosystem research has been the target of much critique. Golley himself is not entirely comfortable with it:

> 'The complex systems, sometimes consisting of thousands of species, were simplified by the theoreticians to sometimes as few as three or more components. The myriad environmental interactions between ecosystem components were reduced to a few flows of energy. The dynamic response of natural systems was made deterministic, being consistent with physical theory. The ecosystem was conceived as a machine, [and] represented as a computer model' (Golley, 1993: 4).

Golley, then, is criticising ecologists for reducing many thousands of variables in large ecosystems to just a few, that is, for uncritically producing computer models of non-lake ecosystems that operate as if they were lakes. This reduction resulted in models of ecosystems that looked as if they could be manipulated in the same ways as lakes, and with the same level of control and likelihood of success. Golley goes on to express discomfort with the ecosystem concept because in it 'Species and individuals were represented as mass, energy, or chemical elements, and their biological reality disappeared except to define the links of feeding. Organisms were expected to act mechanically in predictable ways' (80). The implication is that neither ecosystems as a whole or their organic "components" can be presumed to act as predictably as either ecologists, or later, environmentalists, would like.

Golley goes so far as to concede that this uncritical reductionism was partly accepted by ecologists because of their eagerness to adopt concepts deriving from physics. Ecologists' wish to achieve scientific status led them to import wholesale concepts from other sciences in a way that was itself unscientific. He describes how the import of cybernetic ideas into ecological theory was due more to institutional and social-political factors than to the results of empirical ecological research.

In the immediate post-war period 'essentially nothing was known about the energetics of ecosystems' (82). Into the 1960s criticisms were made along the lines that the main 'weakness in ecosystem study' was the lack of research based on testable hypothesis (85). Such hypotheses that were used in empirical ecological research were 'declaratory statements derived from the thermodynamics, or the operation, of a machine' (82). The 1925 work of Alfred Lotka, which 'explicitly applied thermodynamic theory to ecological systems' was drawn on heavily by 1950s ecologists (such as Raymond Lindeman and Eugene Odum) seeking to establish ecology as a properly scientific discipline. While Odum did not go so far as to directly cite Lotka's analogy between ecosystems and steam engines the chapter of his textbook dealing with ecological "energy" drew extensive rhetorical support from the laws of thermodynamics and arbitrarily turned them into ecological principles. Golley concludes his discussion of this issues thus; 'It is essential for understanding this developmental phase of ecosystem studies to recognize that it began in analogical thought, authoritarian statements, and physical laws – not in questions' or empirical research (82).

These cybernetic influences were mixed in with terms taken from economics – concepts like "resource control", "input-output", "efficiency" and so on (86)

'Fundamentally' the ecosystem theory *was just a theory*; 'it was a mechanical and economic perspective of nature, with energy as the currency of exchange between components' but with no studies that could establish the theory as empirically accurate, this was 'an exciting but ill-defined and poorly integrated body of science' (106).

> '...the choice of aggregating organisms into trophic levels was a double edged sword... In the ecosystem model, species acted abstractly, like robots. This decision cut ecosystem studies off from biology and natural history and linked them more closely to engineering, physics, and mathematics... The choice of the trophic level model meant that the field could profit from advances in systems engineering, information, and computer science. It fit remarkably well with the spirit of the time. The word ecosystem [itself] expressed this spirit' (106-107).

Golley effectively argues that cybernetics had such profound influence on ecology because it 'closely fit the social-cultural environment of post-war America' (106) and not because it provided an appropriate vocabulary with which to describe the actual workings of ecosystems.

> 'The weakness or strength of a scientific concept is usually not crucial, because it is soon revised as scientists apply it in their work. In this case, however, the concepts were not presented in the conventional scientific form. Rather, they were derived from authority figures... The ideas were often presented in authoritarian

> language and, most important, as principles in the textbooks used to train the next generation… In retrospect, I think the fact that the ecosystem concepts were not presented as hypotheses to be tested or questions to be asked was the most serious weakness of the science in this period' (107-108).

There is then an implication in Golley's work that any claims that humanity can and should attempt to (re-)engineer the global ecosystem were based on false premises. The American, cybernetic, concept of the ecosystem that is widely held today – *that the global ecosystem is a machine whose outputs can be intentionally manipulated by humanity* – is shown by Golley to have been the product of a set of American nuclear-fuelled ecological institutions keen to establish both the scientific status of their work and ideas and to demonstrate that their work had socially significant practical potential in the (re-) engineering of ecosystems. British ecologists, as we have seen, promoted their early version of ecology (human ecology) as a body of ideas through which governments and economists could and should manage nature for the benefit of their (soon-to-collapse) empire. Its counterparts in Australia and New Zealand were busily employed in managing "nature" through the mass extermination of rabbits and deer. So we see that ecological science in the pre-1960s period had nothing resembling the professedly "environmentalist" intentions it has come to define itself by in the period since. Ecologists have always sought to engineer ecosystems and to manage nature. This capacity has been the central tenet of ecological thought and its central selling-point from the beginning. But have they always sought to engineer and manage nature in order to "save the world"? No, they have not.

The first few decades of practical work by ecologists were focused on colonial surveys, the management of the colonial "stock" of bioresources, the destruction of unwanted introduced species, and the tracking and measuring of nuclear fall-out. The first few decades of ecological theory were concerned with demonstrating that humanity exists as a dominant species within rather than above ecosystems, that ecosystems can be manipulated by humanity for imperialist purposes, that ecosystems can be understood as machines that need good maintenance and that they can be tinkered with as if they were so much technology. When alarm bells began ringing in the 1960s and 1970s about the possible over-exploitation and drying up of global supplies of biological resources – including possibly as-yet undiscovered agricultural and medicinal plant species – the practitioners of ecology were perfectly positioned to respond. Although they had developed quite independently, the epistemological/ practical potentials of ecology, could be shown to be compatible with the interests of the burgeoning environmentalist movement. Almost immediately, ecologists, now with the added attraction of the political support of many environmentalists, were drafted in by the developing institutions of global government and helped to legitimize their utilitarian and economic interest in the securing of supplies of raw biological resources.

We have seen how in the decades up to the 1960s 'The manager and the naturalist found the ecosystem concept equally attractive [because it] promised a new way to manage complex natural systems' (Golley, 1993: 3). After that time, to the manager and the naturalist we should add the global environmentalist movement and the institutions of global governance. Although some variants of pre-WWII ecological theory had found an interested audience at national level (especially in Britain), and, as we will see below, a few post-WWII ecologists had already risen to important positions at the League of Nations and UNESCO, it was only from the

1970s that ecological theory really moved beyond academic institutions, into mainstream politics at first national and then international level, and ultimately into the consciousness of the global population.

Ecologists take the helm.

Before we complete the chapter by showing the importance of the *Limits to Growth* report for establishing ecologists and ecological theory and practice in the institutions and discourses of global governance it is necessary to briefly show that this was not entirely unprecedented. The global-technocratic ambitions of ecologists had already, to a limited but not insignificant extent, been fulfilled before the calls for preservation of resources took on the urgency they did from the 1970s.

Julian Huxley, who as we have seen above, was a leading popularizer, along with H. G. Wells, of human ecology, was, in 1946, appointed the first Director of United Nations Educational, Scientific and Cultural Organization (UNESCO). Huxley stated the 'general philosophy of UNESCO' as being

> '"a scientific world humanism, global in extent and evolutionary in background"... [he] strongly emphasized biological principles when he outlined the "philosophy of UNESCO" to his political co-workers. The new organization, he argued, should develop into the cornerstone of "a single world government" of the future, after the withering away of nation states' (Anker, 2001: 232).

Such a role as Director of UNESCEO must have seemed a tremendous opportunity to a man, who only ten years earlier, in his 1934 book *If I were a Dictator* argued that *laissez-faire* capitalism and individualism is '"not organic"' and stated that he would 'instead leave social engineering to a board of directors of the economy of nature with a scientist (Huxley?) at the helm' (208). With his appointment ecologists got a first taste of being "*at the helm*" of the "board of directors" of the global ecosystem and of a (becoming-)global society. Anker's phrase is not accidental here – the term "cybernetics" derives from the Greek word "kybernetes", meaning steersman or pilot.[58]

Huxley was also involved in early conservationist organizations, but at this stage they had not yet ceased to have explicitly imperialist institutions. He was a co-founder of the World Wildlife Fund, and in Britain, the Nature Conservancy alongside Max Nicholson and Tansley. Anker puts these institutions in the context of the collapse of the British Empire (which Huxley seems to have considered the possible beginning of the end for the nation-state too). Huxley's logic was, at least according to Anker, that 'while withering away as a political superpower Britain could still claim to be a moral empire through nature conservation' (234).[59]

Nicholson went on to become something of a "green icon" as a result of his prominent claims that ecologists and environmentalists would become (after the British imperialist government) "the new masters of the world". This new role for ecologists would be a mere development of 'the British imperial vision of achieving global control through planning the social system and ecosystem'. In this respect then Anker 'raises the question of whether the environmental debate of the 1960s and 1970s is best understood as the continuation of ecologists' imperialism of the 1930s, perhaps with a more human face' (235).

Another man whose politics were heavily influenced by early ecological thought was Jan Smuts, who, as well as being a botanist (whose early career included bioprospecting projects in South African grasslands), the author of books on his own variant of ecology ("holism"), and South African Prime Minister was first the architect of the League of Nations and then the author of the preamble of the Charter of the United Nations. Smuts too was "at the helm" of the earliest institutions of international governance. As Anker notes, with considerable understatement, Smuts' life and politics was 'full of contradictions'.

Smuts was 'a promoter of international peace and understanding through the League of Nations, but also a defender of racial suppression in his own country' (157). Likewise, he believed in the unifying power of international scientific collaboration but took on imperialist roles, for example, he was appointed head of the British Association for the Advancement of Science in 1931 'so that he could widen the aspirations of the British Association to the entire empire' (158). Smuts used this position to promote his version of ecology, which, like Huxley and Wells', was at-once a science and a political philosophy, as he put it; 'Ecology must have its way; *ecological methods must find a place in human government* as much as in the study of man, other animals, and plants. Ecology is for mankind"' (cited in Anker, 2001: 153, my emphasis).

In his own country Smuts was apparently regarded as a "centre" politician and 'moderate compared to the more extreme Nationalists' who wanted to deny the majority black population all rights to land and political representation. His 'politics of holism… aimed at giving land and rights to people [only] according to their supposed evolutionary development' (Anker, 2001: 164). In short,

> 'Smuts used his ecological theory of holism to defend territorial segregation between white and native "wholes", and argued that evolution of blacks could only occur under white trusteeship. The ultimate goal of this politics of holism was to create world peace by

expanding the colonial policy of the British Empire to a global League of Nations' (127).

Although Smuts was 'known in all diplomatic circles' as a promoter of imperialism and racially discriminative politics, at the conference at which the UN Charter was signed 'none of the ministers or delegates expressed the view that the preamble undermined or was even in conflict with a policy of colonialism or racial discrimination' (189). It is not clear from Anker's account whether the delegates recognised that Smuts intended to use his position of prominence not only to promote his highly paternalistic version of what the UN should be but also to promote (his own peculiarly racist version of) ecology as a mode of international government. [60]

Computer aided ecological science.

Only in the 1960s was it widely recognised that shortages of biological resources might come to slow, or even halt, economic growth. Scientists in the fields of agriculture and plant-breeding in this period achieved considerable improvements in crop yields; this was one means by which the social-political problems represented by potential shortages of bioresources could be addressed. Another was to employ ecologists to model the effects of population growth, including deforestation, desertification and species extinctions, on environments.

From the early 1960s, the early post-colonial era, international scientific projects, specifically the International Biological Program (IBP), with themes such as "The Biological Basis of Human Welfare" were conceived and conducted. It is important to note that the IBP was the result of scientists' self-organization. It was not a UN project, although one on very similar lines, the Man and Biosphere (MAB) project was conceived and conducted in the 1970s (see below). At a preparatory meeting of the IBP in 1961 'a resolution was passed affirming that the program's aim would be "toward the betterment of mankind". The three specific areas for action would be conservation, human genetics, and improvements in the use of natural resources' (111). The 1992 Convention on Biological Diversity should be seen as marking the latest stage of governmental collaboration on such issues that began in the 1960s, or, to put it the terms of my argument, *the subsumption of the global ecosystem under capitalist management regimes began in the years immediately after the collapse of European imperialism.*

One of the seven sections of the IBP was titled "Use and Management". It 'was launched at the first general assembly of the IBP in 1964. Here it was resolved that the program should contribute to "the optimum exploitation, on a global basis, of the biological resources on which mankind is vitally dependent for its food and for many other products' (111). At this point the utilitarian intentions of the project had not been greenwashed as having primarily environmentalist inspiration, but they very soon, after 1970, would be. The project was, however, to be run by ecologists.

Golley sees the project and the decade as significant for ecologists for two main reasons. First, because it ended ecologists' reliance on military funding. It was a period of transition from the funding of ecology by the Atomic Energy Commission to the funding of ecology by the National Science Foundation (NSF), specifically by a program within the NSF of funding for Research Applied to National Needs (RANN). Second, because it was the period in which the first serious efforts to develop computer models of ecosystems were made. These efforts would in the next decade form the basis of the first efforts to construct computer models of the entire global ecosystem, and would, in the late 1980s and through the 1990s to the present, form the primary source of data on global climate change.

Ecologists working on the IBP understood their new funding, totalling $57 million between 1964 and 1974, and still more after that period from the new "Ecosystem Studies" division of the NSF (138), and the governmental mandate for their work that such funding symbolized, as an opportunity to conduct research that would finally provide a properly empirical, and much broader, 'understanding of ecosystems, including man's own' (118). Although, as we will see, the computer models that constituted the central scientific product of this funding were plagued by problems and are not considered successful by Golley, the IBP *is* considered successful in institutional terms. The IBP (or, more accurately, the American research initially conceived as an international project but effectively conducted in isolation) produced 'a new set of academic centers and opened the possibilities for ecosystem studies directly to the universities beyond the earlier connection through AEC national laboratories… [many of the centers] continue activity today' (139).

The 1960s period marked the end of American ecology's military projects and funding and the beginning of environmentalist projects and funding. From 1970 RANN was 'divided into several sections… [including] one focused on the environment' (158). Golley gives details of the projects it funded which show that while ecologists themselves had not appealed to any potential environmentalist applications of their work it was generally of great benefit to ecology that 'The time of the IBP coincided with the development [after 1970] of environmental management programs in the states, the federal government, and in the private sector of the economy' (139).

The period is significant also in that the new sources of funding '*would permit systems ecology to develop its potential organizing and predictive functions*' (119, my emphasis). The development of working computer generated models of ecosystems was the obsession of George Van Dyne, Director of the IBP's "Grassland Biome

Program", which was funded by the NSF to the tune of $400,000 just for the period between April 1968 and June 1969 (later variants of the project received further funds until 1977). He was determined to empirically demonstrate the accuracy of the "strong" version of the cybernetic ecosystem theory. The IBP grassland program was going to be active in a quantitative way' (121). Partly because of the limitations of the early computers he and his team worked with, partly because of scepticism within his staff that his methods could succeed, and partly because of his authoritarian man-management style, his claims for his methods turned out to be 'exaggerated' and his strong 'claims for [the potential of] ecological modeling came back to haunt him' (122). He was asked by the NSF to resign his post in 1974 (128). Van Dyne's intention to produce a working computer model of the entire grassland ecosystem failed (although more successful models of smaller ecosystems within the grasslands were developed).

However, despite all this, Van Dyne's ambitions for ecosystem modelling would eventually be fulfilled. Today, global environmental policy is almost solely informed by the much more sophisticated (although still highly contested) descendents of Van Dyne's prototypes. In the 1970s a computer model of the global ecosystem, despite being a highly experimental piece of software using only five variables, sparked an international controversy by producing predictions – published as the *Limits to* Growth report – of an imminent shortage of resources and possible civilizational collapse. This set the apocalyptic tone of much environmentalist politics and precipitated the flurry of global level environmentalist policy that led to the Convention on Biological Diversity. Apocalyptic environmentalism and the use of computer modelling of ecosystems are inextricably linked.

Golley, as we have seen, is more reluctant than many of his ecologist colleagues to accept the machinic version of the ecosystem concept that came to international prominence in the 1970s and has formed the basis of the leading climate change studies ever since. He takes it to be too reductionistic and is uncomfortable with its aggregating thousands of diverse species into "a few flows of energy". This critique has also been made by some authors influenced by proponents of radical environmentalist discourses such as followers of James Lovelock and/or Arne Naess.

Accordingly, Golley, in a rare case of history being written by the losers, attempts to present an inaccurate history of his science. Specifically, he writes of a decline, after the failure of Van Dyne's first computerized studies, in the popularity of the machinic ecosystem concept and of the use of computer modelling of ecosystems. He presents the first large scale UN-funded ecological research programs as a move away from the use of the methods of Van Dyne's systems research. The examples of studies conducted under the rubric of the UN "Man and Biosphere" (MAB) program that Golley gives did in fact use computer modelling far less, worked at a much smaller scale, and were often involved in solving local problems (for instance, the impact of the skiing industry on the Swiss environment). And so Golley claims that

> 'The consequence of the massive application of staff, funds, and facilities, worldwide [from the MAB program] on this scientific concept during the environmental decade [the 1970s] was a sorting out of useful and effective methods and approaches to the study of ecosystems. The process led to a stage of maturity of the ecosystem concept and the development of normal ecosystem science. It led away from the theoretical, physical, energy theory of ecosystems built on an analytical system base that extended the machine metaphor into nature' (165).[61]

However. as we will see shortly, studies of this type did not make global headlines. This is not to suggest that they were not influential within ecological science, but we are concerned here with how ecological science was understood in mainstream public consciousness. In this respect it was the *Limits to Growth* report whose form of ecological science – the computer model that treats the global environment as a machine that needs fixing – that was by far the most influential ecological science of the 1970s. Small scale studies of Venezuelan soil, ecological surveys in Sierra Leone and analyses of the Swiss skiing industry may have received UN funding, and may have moved away from an unreservedly machinic version of the ecosystem concept, but these changed neither the world nor the global public's understanding of the world. The *Limits to Growth* report, and the computerized climate-change research that has followed in its wake, did.

Before we move on to look at this report, its influence on bioprospecting science, and its significance for the immediate pre-history of the CBD/CAB, only one point remains to be made. In a further example of Golley's revisionism (to be fair, Golley is not cynically breaking the historian's oath but he certainly isn't telling the whole truth) Golley presents the MAB program as marking a shift away from the dominance of ecological science by Britain and the United States and a move toward international collaboration.

> 'UNESCO saw that committees designing and operating MAB had representation from all national perspectives. Although this is one of the costs of working within the U.N. system and reduces efficiency markedly. it also prevents too strong an influence by the economically or militarily powerful nations. When the problems

concern the environment and social systems, this can be helpful' (162).

As we will see, the *Limits to Growth* research and report was conducted outside of UNESCO by an organization constituted by leading business leaders – "the Club of Rome" – which included a leading proponent of cybernetics and of computer modelling of ecosystems (Jay Forrester). In short, the most influential ecological research of the 1970s was not produced by an organization concerned with limiting the influence of the economically or militarily powerful nations. On the contrary.

Golley takes the MAB program to be 'extremely significant because it meant a shift from academic science and individuals to governmental science. This shift permitted direct funding by governments [and] the involvement of governmental agencies in research' (162). In this he is not incorrect, but again he declines to include any mention of the *Limits to Growth* report. He excludes from his account that it was representatives of multinational corporations, with the aid of a leading proponent of the earth-as-machine theory, who had the most prominent role in raising consciousness of the possibility that biological resources could be depleted by humanity. It was these, and not the institutions of the UN, which were the primary popularizers of the environmentalist politics which ultimately led to global environmentalist legislation such as the Convention on Biodiversity.

Planet Management.

The following account draws heavily on a 1999 book by Fernando Elichirigoity, *Planet Management: Limits to Growth, Computer Simulation and the Emergence of Global Spaces*. I have read the book alongside Negri and Hardt's

Empire (2000) and *Multitude* (2004). Their descriptions of the emergence of a form of supranational sovereignty which seeks to manage and produce the entirety of global life are compatible with Elichirigoity's work.

Elichirigoity's book focuses on the *Limits to Growth* project and the Club of Rome, both of which were heavily shaped by cybernetic thinking, inspired by the potentials of computer simulation and took for granted the reality of the global ecosystem as a machine, amenable to (re-)engineering from above.

> 'This project, [based on] one of the first examples of a global computer to analyze the impact of human production and consumption on the planet as a whole, was carried out by a team of computer modelers at MIT. It was sponsored by the Club of Rome, a group of high-level European and American statesmen and industrialists. The results of the modeling were eventually published in 1972 and had a wide impact; more than ten million copies of the report were sold worldwide' (Elichirigoity, 1999: 3)

The *Limits to Growth* report, and its subsequent offspring, had a 'profound' role in the emergence of 'global thinking', in producing widespread consciousness of a coming "planetary emergency" (66) and in promoting the notion that global "nature" and global society, or at least the global economy, can and should be treated as a single object.

No one has been more eloquent or persuasive on the influence of cybernetic thought and the full implications of the take-up of the ecosystem concept by the institutions of (informal) global government than Elichirigoity. His book

> '...discusses the impact of the war on the transformation of knowledge production by focusing on the emergence of systems thinking and Operations Research (OR) and their symbiotic relationship with computer modeling and machinic vision... [and shows that] systems thinking has had a profound impact in undermining the solid distinctions that characterized the modern era, such as those between the organic and the technological realms. This blurring, in turn, facilitates the conceptualization of natural and industrial phenomena as existing within the same field of analysis and intervention. Over time these new modes of looking at the world have encompassed larger and larger areas of endeavor. They have become increasingly embodied in broader and broader areas of knowledge, such as management, biology and ecology. The world we live in today, where the whole planet can be thought of as a system amenable to management, is profoundly dependent on these knowledge transformations...' (3-4).

Among the natural-technological phenomena (cyborgs, or objects amenable to cybernetic analyses) that cybernetic methods and theory, especially, but not exclusively, via ecology, has brought into being are 'disappearance of biodiversity'. It is precisely this that, as we saw in Chapter 1, was the cause of the renewed corporate and governmental interest in bioprospecting, the urgency of calls for bioprospecting action and the heeding of such calls by 157 governments In short, the CBD/CAB is also "profoundly dependent" on the establishment and acceptance of "systems thinking", cybernetic methods and cybernetic concepts across scientific, corporate, national-governmental and supra-national governmental institutions.

One of the five extremely vague variables in the computer model produced at MIT was "natural resources" and one of the apocalyptic conclusions of the *Limits to Growth* report was that biological resources would reach the point of depletion by the end of the twentieth century. Even when the variable for the estimated quantity of remaining "natural resources" was multiplied by four the model predicted that '...the limits to [population and economic] growth on this planet will be reached sometime within the next one hundred years"' (Meadows et al, 1972 cited in Elichirigoity, 1999: 107). The wild inaccuracy of these predictions has been used as an argument against the predictive power of such computer models ever since (for example, Lomborg, 2001), but such arguments haven't prevented some ecologists from arguing that 'These wondrous new playthings of science have much to tell us about our climatic future over coming decades' (Flannery, 2006: 158). This debate will no doubt rage on, and given its character as a debate between believers in alternate religions, will probably never be settled. What is important here is that "natural resources" are taken by all such models to be a constitutive aspect of global society and are taken as something whose continued supply can and should – as the bioprospectors Harlan (1975) and Schultes, (1979) argued in the "environmentalist decade" – be subject to policy making at the global level. Bioprospectors are in this way granted a privileged position in global society.

There is no need here to recount all the events that led to the 1968 formation of the Club of 'forty or so luminaries of the technocratic and business elite of Europe' that came to be known as the Club of Rome. These are all detailed by Elichirigoity. It was the Italian industrialist Aurelio Peccei – a high-level manager of Fiat with a sociological imagination who in 1969 had authored a book belonging to the same genre as Alvin Toffler's *Future Shock* (1970) titled *The Chasm Ahead* – who first 'decided to put together a group of approximately forty friends and colleagues to discuss forming a "non organization" to reflect on world problems… The idea of a "non organization" expressed their desire to build a structure to facilitate discussions without the encumbrance of a plodding bureaucracy' (63). Readers of Negri and Hardt's *Empire* (2000) and *Multitude* (2004) will recognise how amenable such institutions as the Club are to interpretation in terms of the new flexible, hybrid and self-appointed forms of sovereignty that constitute contemporary, emperial, power ; 'capitalist command tends to become a "non-place"' (2004: 101-102).

The intentions of the Club likewise affirm Hardt and Negri's theories on the new forms of global sovereignty and the character of capitalist globalization.[62] An early version of these was presented at a 1970 conference organized by the OECD, and attended by many of the founders of the Club, by Hasan Ozbekhan, 'director of planning at the System Development Corporation (SDC)'. The SDC was 'begun in 1950 at the RAND Corporation' – a research body of the US Navy – and 'originated from a research program exploring how man-machine systems affected collective organizational behavior' (Elichirigoity, 1999: 65). Ozbekhan listed the Club's emperial ambitions as two, one sociological, one political, both global in scope;

> '"a. Contribute toward an understanding of the problems of modern society considered as an ensemble, and to the analysis of the dynamics, interdependencies, interactions, and overlapping that characterize this ensemble, concentrating particularly on those aspects that concern all or large sections of mankind.
> b. To heighten awareness that this complex of tangled, changing and difficult problems constitutes, over and above all political, racial or economic frontiers, is an unprecedented threat to all peoples, and must therefore be attacked by the multinational and transnational

mobilizing of human and material resources"' (cited in Elichirigoity, 1999: 60).

It should be clear that Elichirigoity and Negri and Hardt are writing of the same phenomena – the rise of a non-democratic, supranational, form of power constituted by a hybrid of military, economic and national-government interests, which, unlike the old imperialism's racist and exclusionary forms of sovereignty takes the entire global population as its subject and seeks to manage and mobilize the entire stock of natural resources; 'The objectives clearly suggest how intimately related are the very existence of the Club of Rome and its goals to conceptions of spaces of governmentality larger and possibly different from nation-states' (60).

If there is any remaining doubt that ecological thought and the formation of the emperial institutions that Wells and Huxley had envisaged were thoroughly intertwined by the 1970s this will be dispelled by passages from writings of three of the Club of Rome's members. First Ozbekhan, who in a paper presented to the Club in 1970 entitled "Quest for Structural Responses to Growing World-Wide Complexities and Uncertainties' 'proposed that *the value-base needed for the proposed research rests on notions of ecological balance*' (79, my emphasis). His proposal – implicitly defending a "strong" version of the ecosystem concept – was that ecology provide both the scientific method and the moral intentions of the *Limits to Growth* study. In this Ozbekhan is giving a twin defence of environmentalist politics and the capacity of an ecologically-minded technocracy to implement environmentalist policy.

'"If we extend, as is increasingly done nowadays, the definition of ecology… it becomes possible to say that we are confronted with a problematique which is ecosystemic in character. The normative statement that describes the value-content of any ecosystem is "ecological balance". Consequently it is the idea of *ecological balance* that can, and will, be taken as the underlying value-base of the study; for in terms dictated by our situation the "good" is self-evidently and most generally capable of being defined as the re-establishment of that many-dimensional dynamic balance that seems to have been lost in the modern world"' (cited in Elichirigoity, 1999: 79, original emphasis).

Added to the role originally envisioned by Huxley and Wells – the "taking stock" of biological resources by a "board" of ecologist "directors"– was now the role of "restoring the balance of nature", of providing a "structural response" to humanity's over-exploitation of biological resources and unsustainable interference in ecosystems.[63]

Second, Peccei, in his book *The Chasm Ahead* makes the proposal that humanity, with the aid of cybernetically- and ecologically-informed management techniques, is practically capable of re-establishing ecological balance, that is, that humanity is capable of *steering* not only global society but global ecology;

'"...the cybernetic element in the evolution of our planet is man himself and his capacity for actively shaping the future... Now that he has created forces and cycles which compete and interfere with those of nature itself, but which possess no in-built regulating mechanism, man – to avoid economic, social, political, demographic or ecological debacle, and guide his destiny – has himself to be the

> cybernetic or regulating element of all man-influenced processes" (cited in Elichirigoity, 1999: 70).

Third, the cybernetician Jay Forrester, in his 1973 book *World Dynamics* (absurdly) attempts to wipe out in a single stroke the results of all hitherto sociological research and fully replace it with the capacity of the computer models he was developing at the time to provide "the mental skill" needed to understand human society and its place in the global ecosystem. From the sociologists' perspective Forrester's Darwinian and cybernetic language has a rather terrifying ring to it;

> '"The human mind is not adapted to interpreting how social systems work. Our social systems belong to the class called multiple-loop nonlinear feedback systems. In the long history of human evolution it has not been necessary for man to understand these systems until very recent historical times. Evolutionary processes have not given us the mental skill needed to interpret the dynamic behavior of the systems of which we have now become a part"' (cited in Elichirigoity, 1999: 56).

Elichirigoity shows that Forrester was attributing ontological and even evolutionary significance to computerized models of ecosystems; 'What allows humans to overcome this evolutionary limitation, according to Forrester, is the computer, or more precisely, computer modeling' (56-57). And what is the insight that humanity has suddenly gained by entering this new stage of computer-powered evolution? Nothing other than the claim that world population growth and economic growth will imminently come to a sudden end. In a neo-Malthusian passage that is as poetic as it is surreal Forrester translates from the relatively mundane language of the *Limits to Growth* report's conclusions;

> 'Within one lifetime, dormant forces within the world system can exert themselves and take control. Falling food supply, rising pollution, and decreasing space per person are on the verge of combining to generate pressures great enough to reduce both birth rate and increase death rates. When ultimate limits are approached, negative forces in the system gather strength until they stop the growth processes that had previously been in control... Forces within the world system must and will rise far enough to suppress the power of growth"' (cited in Elichirigoity, 1999: 57).

All three ecologically-inspired members of the Club write in the apocalyptic tone typical of 1970s environmentalist politics. Nothing could be more convenient to ecologists seeking positions of power than the idea that humanity's overstretching of the planet's capacity to support human society is soon to reach breaking point.

Conclusion to Chapter 9.

The first steps toward the management of nature did not involve ecologists. The earliest attempts at environmentalist legislation and the first attempts to manage nature in national parks and "nature reserves" occurred before ecological thought, practices and institutions had been developed. The earliest ecologists – human ecologists – were employed on imperialist projects which were continuous with those of the Banksian school of bioprospecting. Like their forebears they understood their work to be closely connected to the management of national and imperial economies. However, they were already expanding the scope of their ambitions in such ways that took the entirety of the global environment and global economy to be their field of action. In post-war America, the concept of the ecosystem was developed in such a way as to likewise take the entire "stock" of "nature" – conceived in increasingly machinic and technological language – to be amenable to management and engineering. In Australia and New Zealand ecologists were employed in managing animal populations, not with their protection but with their destruction as their motivation.

However, once the potentially powerful management tools of the computer simulation of ecosystems were being developed international ecological research projects were being conducted in increasingly "environmentalist" terms. In the 1970s attempts to predict the consequences of a perceived shortage of biological resources were being made with ecologists' computer models and ecologists were increasingly involved in international policy for the management of global nature, now conceived as a single natural-technological, ecosystemic-economic hybrid. The members of the Club of Rome were living the dream of the early ecologists. Huxley and Wells' vision of ecologists one day taking seats on the "board of directors" of the global ecosystem/economy was, in the 1970s, becoming a reality.

The Club of Rome was certainly not a global government. Neither has UNESCO become the federal world government Huxley imagined it one day might. There are though, despite the lack of *formal* (democratic) institutions of global *government*, very many means of *informal* (undemocratic) global *governance* and very real forms of global *sovereignty*. The Convention on Biological Diversity should, I believe, be seen in the above context. It should be understood as one of the achievements of contemporary emperial power.

Ecologists, environmentalists and Bioprospectors, insofar as their calls for the urgency of identifying new sources of biological resources and for the regulation of the international transfer and exploitation of biological resources have been heeded, have had constitutive roles in the formation of this emperial power. They are taking over the helm from their imperial-era forebears, the Banksian and Linnaean bioprospectors. Both botanists and ecologists have helped steer international politics in such directions that all biological resources – by global intergovernmental agreement – formally have property status. What else is the new-found respect for local botanical knowledge, and historically novel insistence on the (at least minimally equitable) and sustainable exploitation of botanical resources (as enshrined in the CBD/CAB), than an attempt by the institutions of global governance to fulfil both early and contemporary ecologists' dream of achieving the "multinational and transnational mobilizing of human and material resources" without the need for a democratic mandate?

Today's ecologists have simply replaced their claims to (be able to) work in "the interest of the British Crown" with the claim to (be able to) work in the interest of the entire global population. They have successfully pitched what was once an imperialistic concern to efficiently manage the natural resources of the British empire as a humanistic concern to save the global environment from irreparable damage and the global economy from an apocalyptic collapse.

Chapter 10. From (neo-)imperialist biopiracy to emperial bioprospecting.

Chapter 10 will firstly present a comparison between the most historically recent "major" case of biopiracy and contemporary Bioprospecting practices which operate strictly according to the tenets of the CBD/CAB, especially as represented by the flagship project of contemporary Bioprospecting – Costa Rica and Merck's jointly-funded biodiversity conservation program (INBio).

The former case is the enormously economically and geopolitically profitable transfer of Japanese strains of wheat plants from Japan to the United States in the immediate aftermath of WWII. These plants went on to become a major component of the American-led "green revolution" – a period of dramatic increases in agricultural yields in both developed and developing countries.[64] This act of biopiracy is shown to have had world-historical and world-sociological importance in that a reliable supply of wheat (which it ensured for the U.S, Britain, Mexico and India and ultimately many other countries) is an issue of national security and that the new strains of wheat were used as a weapon in the Cold War. This act of biopiracy is described as neo-imperialist. That is, it was conducted in a post-imperial but pre-emperial context. It was neither to the benefit of a formally imperialist nation nor to the form of supranational sovereignty that contemporary bioprospecting benefits (this latter was in only its very early stages of formation in the immediate post-war decades). It did, however, make a significant contribution to the maintenance and extension of the United State's scientific, economic and geopolitical power.

Chapter 10 secondly contains a detailed discussion of the specifics of the most high-profile post-CBD/CAB Bioprospecting project (known as the Merck-INBio agreement). This will show how the commodification of biological resources, their "fair and equitable" exploitation, and their conservation were undertaken and defended as part of the same process. It will show that biological resources were subsumed under the hybrid power of corporate, scientific and governmental management (that is, emperial sovereignty). The Merck-INBio agreement was among the first projects to act explicitly with post-colonial or post-imperialist intent, and with environmentalist aims.[65] That is, it was consciously conceived to mark a historical shift from biopiracy to Bioprospecting.

My main intention in making this comparison of pre-and post-Convention bioprospecting is to clarify what I have meant throughout the thesis by "emperial sovereignty" – the context for Bioprospecting – and what I have meant by "imperialism" – the context for most of the history of biopiracy. The Chapter is intended to provide a comparison between (neo-)imperialist biopiracy and emperial bioprospecting.

Chapter 10 will then briefly discuss contemporary critiques and defences of the CBD/CAB and the Merck-INBio agreement. Defenders of the Convention/ agreement argue that if biopiracy is (realistically) to become a thing of the past it is necessary for biological resources to be granted formal property status. The logic of this argument is that one cannot charge someone with theft if what they are taking is not one's property.[66] Opponents of this logic argue that biological resources – "life itself" – can never be considered legitimate property. Any privatization of biological resources is an appropriation of "the common". Any such appropriation is exploitation. Exploitation can only be opposed by opposing capitalism as a whole.

The section concludes that both arguments have merit and that which of them one defends is dependent on one's approach to contemporary politics. If one is realistic and accepts the reality of capitalist social life one must accept that the granting of property status to biological resources is the only effective means by which to prevent their theft. If one is instead utopian then one must argue for the re-establishment of all biological resources as communal property – the "common heritage of humankind" – and reject the Convention's formalization of the subsumption of bioresources under capital (which I showed in Chapter 3 to be a centuries-old process). This section also shows that many contemporary critiques of biopiracy work with an implicit theory that contemporary Bioprospecting as mandated by the CBD/CAB is a form of neo-imperialism. Referring to the previous definitions I will suggest that critiques of biopiracy should rather be made in the context of political opposition to the new – emperial – forms of power and sovereignty.

A major case of neo-imperialist biopiracy.

Historically, the most recent "major" case of biopiracy (as defined in Chapter 3, major cases are those which are economically *and* geopolitically *and* biopolitically significant) was that of a strain of wheat plant known as "Norin 10" from Japan to the United States in 1946.[67]

This plant, and other similar Japanese varieties, were interbred, by American scientists working in Mexico, with Mexican varieties of wheat plants. The resulting hybrids produced significantly higher yields of wheat. These and subsequent further improvements in yields formed the basis of the "Green Revolution". The economic and political advantages these new strains of wheat gave to the United States were enormous. If Japanese scientists in the immediate post-WWII context had been in a position to further develop the wheat strains that American scientists did, then the modern history of the exploitation of biological resources would have taken a very different course. As it was, the Japanese lost the anti-imperialist war that the Allies had successfully – but with enormous loss of life – waged against it and was in no position to develop further the work that its pre-war scientists had begun.

The details of whether or not the Japanese had given the American scientist Samuel Cecil Salmon – from the U.S Department of Agriculture – explicit permission to take samples of plants from its sophisticated wheat improvement program are murky. What is clear is that if the Japanese could have foreseen the economic value and geopolitical influence that its wheat varieties would come to have, or if they were in a stronger position militarily and economically, or both, they would have taken steps to prevent them from falling into American hands. By the terms of the Convention – which states that transfers of biological materials should be undertaken only with the informed consent of the host nation, and that benefits resulting from such transfers should be shared with the host nation – the transfer of Norin 10 was an act of biopiracy. By the terms laid out in Chapter 3, Salmon's procurement of samples of the Norin 10 wheat plant should be seen as a "major" case of biopiracy. It was in fact the historically most recent such case.

It would be wildly inaccurate to claim that the brief period of American rule of Japan was intentionally used to steal an economically valuable biological resource but it certainly is not inaccurate to claim that the weakness of post-WWII Japan and the American military and political presence there enabled this most recent major case of biopiracy. What had been a successful anti-imperialist war had the unexpected result of a procurement of resources that went on to lend significant power to American neo-imperialism in the Cold War context. The biopiracy of Norin 10 was an unexpected by-product of America's nuclear bombing of Japan. Representatives of the U.S. Department of Agriculture would have been in no position to acquire the plants that became the basis of the Green Revolution without the Manhattan Project and its role in ending the Pacific War.

In his 1997 study *Geopolitics and the Green Revolution* John H. Perkins details at length how

> 'In the thirty years between 1945 and 1975, the United States, Mexico, India and the United Kingdom each traversed a path that took it to a remarkably higher level of wheat yields (per hectare per year). Wheat breeding was a core component of each country's abilities to produce the grain. Although the ingredients needed to produce higher yields were numerous, a key step everywhere was the recognition of the semidwarf genes that permitted a wheat plant to be highly responsive to nitrogen fertilizer. The genetic material containing the semidwarf genes was taken from Japan to the United States and then to Mexico, and then, by different pathways, to India and the United Kingdom. These genes gave rise to a green revolution on a global basis' (Perkins, 1997: 211).

Unfortunately there is not space here to discuss all of the details of this act of biopiracy, nor all of its consequences. While it is of sociological and historical interest in itself my purpose here is merely to show that in distinction to the properly imperialist acts of biopiracy of the nineteenth century, as detailed in Chapters 4 and 5, and in contrast to emperial bioprospecting, as defined by the Convention and practised in the ways described later in this chapter, the transfer of Norin 10 wheat plants from the Japan to the U.S. can be seen as neo-imperialist in its consequences.

The basic idea behind the improvement of wheat yields had been a Japanese one, in the late nineteenth century. The beneficial effects of fertilization – initially through organic manuring, and later through applying artificial nitrogen-based fertilizers – had long been known to farmers all over the world. However, the increased growth of fertilized wheat plants meant they were susceptible to "lodging"; if wheat plants grow too big or too heavy they collapse under the strain – they "lodge". This problem was less urgent in most of the world than it was in Japan because there suitable land for farming wheat was in short supply. One Japanese solution was imperialist expansion into Korea and Formosa (Taiwan). Another was more original and less costly; the development, by increasingly scientific and state-funded means, of "semi-dwarf" varieties of wheat that could produce larger yields but not grow so tall, and be less susceptible to the damage caused by lodging that cancelled out the yield gains made by fertilization. This Japanese idea by which to exploit the benefits of fertilization was already being copied elsewhere in the world before WWII but breeders elsewhere had not been as successful as the Japanese, perhaps because there was greater availability of suitable land and a less urgent need to increase yields (217).

The actual transfer of Norin 10 plants and other similar successful Japanese varieties of wheat that would not lodge when fertilized was the work of Samuel Cecil Salmon, who had been directly involved in government-funded work on improving wheat varieties in pre-war America and during the war period was promoted to the role of 'USDA project leader on wheat'. In this role Salmon 'had the responsibility of promoting the improvement of all wheat in the United States' (217) and was considered the leading expert in the wheat improvement field in America at the time. Perkins tells of how 'When Douglas MacArthur established a national government of Japan by the American Army of Occupation, he created a Natural Resources section. Postwar shortages of food were potentially quite severe in Japan, and [so] the Natural Resources section… requested assistance on wheat affairs from the USDA' (217). And so it was that Salmon travelled to Japan in 1946. There he 'was able to observe many test plots of the 1946 wheat crop. Several varieties caught his eye, one of which was known by the Japanese as Norin 10. Even Salmon did not know just how remarkable it would turn out to be... [However his] many years of experience with wheat varieties were at the right place at the right time. He arranged that samples of several Norin varieties be sent to wheat breeders in the United States' (218).

They arrived there in the summer of 1946 and were distributed to 'seven breeding stations'. While each of these American wheat breeding stations received further shipments from Americans in Japan and Korea, it was the 'four Norin varieties [which] quickly entered into the ongoing breeding work' (218). Over the next decade many experiments in hybridization of Norin 10 and American varieties of wheat (specifically one known as "Brevor") were conducted in USDA breeding programs, most successfully by Orville Vogel at Washington Sate College of Agriculture. By 1962 a variety known as "Gaines" which produced twenty percent more wheat per hectare than any pre-war US variety was made available to commercial growers (222). "Gaines" was a direct descendent of the plants grown from just 100 seeds of the Japanese Norin 10 variety that Vogel had received from Salmon.

The biopiracy of Norin 10 had significant value at the national level, but most significantly for global agriculture, and ultimately for global society, was Vogel's sending of early versions of Norin 10 hybrids to Norman Borlaug at the 'Rockefeller [crop-breeding] program in Mexico'. Borlaug 'started using the material by 1954' (222) and by the 1960s new high-yielding wheat plants developed there were being grown on a commercial scale in Mexico, India and Britain. Since then they have come to form the basis of the wheat industry globally.

Borlaug 'was awarded the Nobel Peace Prize in 1970 for his work in breeding semidwarf wheats, a project begun with seeds from Orville Vogel of the F_2 of Norin 10 x Brevor' (223-224). The Japanese crop-breeders whose work was appropriated in turn by Salmon, Vogel and Borlaug, received neither recognition nor reward. To this day it is not widely recognised that Japan's loss was America's gain. Salmon's sending of Japanese wheat varieties to the States – that is, this act of American biopiracy – changed world history just as significantly, if not more so, than the British biopiracy of cotton, tea, cinchona and rubber in the nineteenth century. The effects of this act of biopiracy can be split into three; economic, ecological, and biopolitical/ geopolitical.

Firstly, it should be obvious that increasing wheat yields is a profitable exercise; the new scientific approach to wheat breeding 'ultimately was intended to lower the costs of production' (52); 'it is possible to think of increased agricultural yields, particularly of cereals, as an ability to form capital – an accumulation of goods devoted to the production of other goods' (12). An exact figure cannot be put on the dollar value of the increased wheat yields deriving from Norin 10 but it is certainly very large indeed and, certainly much larger than the value of any product developed as a result of post-Convention bioprospecting.

Secondly, the "green revolution "which resulted from the new hybrid varieties of wheat was fundamentally dependent on the application of large amounts of artificial fertilizer, which is now widely acknowledge to be environmentally damaging (when the run-off finds its way into rivers and lakes). Given that this practice was taken up globally these effects have certainly been enormous. Perkins acknowledges that to many the "green revolution" is today understood as an 'environmental disaster that left humankind dependent on fertilizers derived from fossil fuels, [with] a narrowed genetic base in its major crop plants, and increased use of pesticides'(258). Shiva's critical work about *Biopiracy* (1998) which also contains an environmentalist critique of the globalization of American and European agricultural practices is exemplary of such views. Although Perkins does not unreservedly condone the social effects and political motivations of the "green revolution" he makes a wise response to these environmentalist critiques. He notes that if the high yielding agricultural practices of the Green Revolution had continued there would have been

> 'incentives for more conversion of land to agriculture and thus increased habitat destruction for wildlife. This is not to argue that the green revolution solved problems in a satisfactory way. If the high-yielding practices are to be rejected on environmental grounds, however, they must be rejected explicitly with a discussion of the full effects of their withdrawal' (Perkins, 1997: 258).

In short, Perkins accepts that the new agricultural practices enabled by the Norin 10-derived wheat varieties were not environmentally unproblematic but believes that given the persistence of poverty and starvation in many parts of the world they were not so damaging as to justify a return to the mass planting of pre-war low yielding varieties.

In the more neutral terms of the effects on the interaction of the environment and society Perkins concludes that without the development of higher-yielding wheat varieties and without their planting on a mass scale globally 'our relationships with nature and with each other would be greatly different. Technologies that enhanced yields change human political ecology, probably forever' (12). And this leads us to the third, and most significant set of effects of the American acquisition of Norin 10 from Japan; that is, its biopolitical and geopolitical effects.

As Perkins argues, it is not possible to make the basic claim that "wheat yield increases have saved lives" and it certainly isn't possible to claim that wheat yield increases have solved world poverty but it is clear that 'In total, the lives of each of us would probably be very different had these yield-enhancing techniques not been developed' (12).[68] Without yield increases there would need to be more land devoted to the growing of wheat, less land devoted to the growing of other crops or other purposes, more people employed in agriculture, less people living in cities, and possibly, at a very general level, less to eat. Perkins is surely right to argue that 'the development of higher yields must be seen as a component of the industrial revolution and the general process of urbanization, which became global in the second half of the twentieth century' (11). Perkins shows that wheat yield increases have biopolitical effects in the sense that they were funded by governments, conducted by scientists and generally a key aspect of social improvement. They have been an important aspect of national government's management of population growth (recall that Foucault's original definition of "biopower" was the power of governments to sustain the lives of populations, in contrast to the sovereign power to destroy life). They are a technocratic tool that has changed society – everyday lives, identities, class structures, demography and so on – in all these (intentional and unintentional) aspects and more.

By the 1960s, if not before,

> '...in America as well as in Britain, [Mexico and] India, plant breeding and the allied agricultural sciences had become an

established feature of government policy. Without any articulate opposition, the support of scientific work had become a feature of what a government needed in order to conduct business in the twentieth century' (85).

This was as true of "government business" at home as it was abroad. In order to gain a full sense of how governments – primarily the American, and to a lesser extent the British – used the new varieties of wheat as a neo-imperialist "food weapon" (to use the phrase of US Secretary of Agriculture Earl Butz) it is necessary to read all of Perkins' book. America's deployment of their new 'food weapon' was *imperialist* in the sense that they actively sought to produce economic and political structures in other nations that were advantageous to it. In the specific sense that the US did not militarily invade or formally govern those nations it was "*neo-*" imperialist.

The US involvement in the revolutionizing of Mexican agriculture serves as the primary example in Perkins account. Mexico was the location of a successful experiment in neo-imperialist influence that was then copied, and further improved, in other nations, notably India. Pre-war,

'Outside of the realms of direct imperialism industrial countries had only vague notions of how to use scientific and economic policy to foster their aims internationally… in 1939, no analytical framework existed to see how agricultural science and technology and modernization of agriculture fit into the overall scheme of international relations and power… [However,] within a period of ten years after 1939, assistance in agricultural science came to be seen by the developed countries as a comprehensive need for all less industrialized countries. Moreover, efforts by industrialized states to help modernize agriculture in less industrialized states came to be seen as a critical component of political relations between nations' (103).

Although the Rockefeller Foundation's role in bringing about the first national "green revolution" was not inspired by a need to stem the influence of the Soviet Union or international communism its work there inspired later American efforts that had precisely that intention; 'Between 1945 and 1955 a series of events, studies, and conceptual syntheses created a climate in the United States that saw plant breeding and all of the modern agricultural sciences as a critically important adjunct in the battle between capitalist freedom and the tyranny of communism' (119). The Rockefeller Foundation's Mexican Agricultural Program (MAP) was conceived before America came to be embroiled in the political and economic struggles of the Cold War, but it demonstrated to the U.S. government the capacity of agricultural science to be a useful 'device' for creating ideological favourable conditions in other nations and for helping foster beneficial anti-soviet alliances (103). The MAP's 'successes, in the context of concerns about the strategic security of the United States, prompted both the Rockefeller Foundation and the U.S. government to launch extensive assistance programs in agricultural development' in many nations across the developing world (117), in the form of President Truman's "Point Four" program – forerunner of the U.S. Agency for International Development.

The exercise of imperialist rule has always required the collaboration of the appropriate elites and power holders in the invaded nation. The exercise of neo-imperialist power was no different. The American reshaping of Mexican agriculture along capitalist and industrial lines could not have occurred so rapidly if the Mexican government had not collaborated with American institutions to this end.

> 'It may be comforting to think that Rockefeller Foundation thinking really was oriented toward the amelioration of poverty of the rural folks of Mexico… What was never spoken in 1943 at the start of the MAP, however, was that its primary Mexican proponents wanted to completely reshape the Mexican economy. In order to create the modern industrial state, labor would have to be enticed off the farm, or, presumably, if need be, forced off by conditions that were so deplorable that leaving would seem a good thing to do… What was also unspoken was the need to extract or entice capital out of agriculture to finance industrial development' (114).

When an institution of one nation initiates such top-down policies with such significant and permanent biopolitical effects in another nation it is behaving as a neo-imperialist force. When the neo-imperialist establishment of successful capitalist agriculture has a potential role in containing the spread of communism, plant breeding programs, and the acquisition of the Japanese wheat varieties which enabled them, take on considerable world-historical and sociological significance. This is precisely the role they came to have;

> 'The MAP's inspiration of similar efforts elsewhere was realized in a particular context: a fear of famine, overpopulation, and the threatened rise of communist governments in areas considered by some to be a strategic threat to the United States and its post-1945

> security arrangements to contain the socialist revolution of the Soviet Union' (117).

Though there is no space here for discussion of the details of the actions of the Rockefeller Foundation and the U.S. government in *India* it should then be clear that, although no-one could foresee it at the time, the biopiracy of Norin 10 from a militarily devastated Japan gave the United States a significant weapon in the Cold War.[69] The neo-imperialist use, in the 1950s and 1960s, of wheat varieties, agricultural methods and capitalist re-organization of international agriculture were all founded on the properties of the Japanese variety of wheat known as Norin 10.

After this period the use of the benefits of agricultural biopiracy in global society and politics becomes less clearly neo-imperialist and begins to take on emperial characteristics. That is, no one country was responsible for the subsequent globalization of the "green revolution" (one advantage of Hardt and Negri's, 2000, theory of emperial sovereignty over theories of neo-imperialism is that, contrary to popular opinion, it is not only, or even necessarily *primarily*, the United States that supports the globalization and intensification of capitalism). Plant-breeding research became a much more internationally coordinated business, much less a matter of the exercise of national (American) political power and rather more a matter of the exercise of new forms of supra-national sovereignty. International institutions for plant-breeding research appeared in parallel with institutions such as the Club of Rome, and the transnational pharmaceutical and agricultural corporations which began to fund bioscientific research on a scale to rival national governments. The new corporate and scientific institutions were no less economically, ecologically or biopolitically influential but from the 1970s their work slowly ceased to be an identifiably nationalistically motivated neo-imperialist project.

> 'By 1970 plant breeding was firmly entrenched in global international relations. Extensive national research organizations in many countries, a collection of prestigious international research stations, and an international coordinating network of supporters, created a complex international nexus within which plant breeding and allied sciences were well supported. Research conducted in this network... led to the high-yielding varieties of wheat and rice that significantly altered regional, national, and international economies' (118).

As we will see further below, the exploitation of biological resources, including, but certainly not exclusively, international bioprospecting, came in the 1980s and 1990s to be primarily funded by private institutions working in accordance with the global-governmental regulations as formalized in the 1992 Convention. The CBD/CAB was a policy document which was formed under the heavy and direct influence of individuals with personal experience of working for the new corporate patrons of bioprospecting projects. Despite continuing efforts by their critics (see below) contemporary Bioprospectors cannot be effectively opposed in the terms of the old discourse of anti-imperialism – not least because the Bioprospectors themselves are critical of imperialist and neo-imperialist biopiracy – but need to be approached as the agents of the new form of global sovereignty that I, following the work of Hardt and Negri, refer to as emperial power.

Minor cases of pre-Convention biopiracy.

Before we move on to look at Bioprospecting in the emperial, post-Convention, context two "minor" or secondary cases of pre-Convention biopiracy require some brief discussion. The first is the biopiracy of agriculturally useful varieties of grass plants taken by Australian scientists from Brazil. The second is the biopiracy of a medicinally useful species of periwinkle plant from Madagascar by scientists working for an American pharmaceutical company. Both cases occurred, like the biopiracy of Norin 10, in a non- or post-colonial context. However, unlike the case of Norin 10 neither of these should be understood as "neo-imperialist" because neither had significant economic value (the biopiracy of the Madagascan periwinkle was worth $100 million over a twenty year period but compared to the profits gained from the imperialist biopiracy of tea, cinchona and rubber and neo-imperialist biopiracy of Norin 10 this is relatively insignificant) and neither had significant geopolitical consequences (unlike all the cases of imperialist biopiracy and the case of Norin 10).

These cases are certainly not historically or sociologically insignificant though. Both mark further chapters in the history of the commodification of bioresources but their primary significance lies in the steps that they mark toward the formation of the global (emperial) regulation of biopiracy, as represented by the CBD/CAB. Both cases provide contrast to post-Convention Bioprospecting practices; the first provides a contrast to the practice of benefit sharing, the second contrasts with the practices of utilitarian preservation of traditional botanical knowledge and utilitarian preservation of biological resources. They mark an interim period in the reorganization of capitalism and in the history of the formation of supranational sovereignty.

As we have seen in Chapters 3, 4 and 5,

> 'Botanists and botanic gardens since the eighteenth century have been collecting at will in the name of science, the spread of new cultivars has been generally thought to be in the human interest, and the developed countries have given little thought to the loss sustained by the country of origin of the plant… ethical attitudes toward wild seeds have been slow to develop' (Brockway, 1979: 35).

As we have seen in Chapters 1 and 2, however, from the late 1980s botanists themselves began to publicly admit that the illicit transfer of plant materials from one nation to another, if it results in economically valuable products and even though the amount of material actually removed is negligible, involves a loss being sustained by the nation in which the plant originated. By the early 1990s the Convention Against Biopiracy was put in place and signed by all of the developed countries (except the United States, however, as we will see shortly, American Bioprospecting institutions have been very careful to follow the Convention and have sought to hold the moral high ground by so doing) in order to regulate such transfers and prevent such losses from being sustained.

Brockway's brief account of one of the very last pre-Convention acts of biopiracy is significant not only for the facts of the case but for the language in which she discusses it and for her proposal of ways in which the transfer could have been made through collaboration and benefit sharing rather than through illicit transfer, appropriation and exploitation. The case is quite simple; 'Brazilian agronomists recently reported that Australia was exporting for sale to the tropical world, including

Brazil, several species of forage grass (genus *Stylosanthes*) which had been taken out of Brazil at some unknown time, improved genetically, and put on the market as Australian grass' (35). Brockway is, to my knowledge, the first commentator on such illicit transfer of plant material to describe it as "piracy" (although it did not gain the fashionable prefix "bio-" until the early 1990s).[70] This case is significant in that the term "biopiracy" was coined directly in reaction to the signing of the Convention by the Rural Advancement Foundation International (RAFI), a group of activists on technoscientific issues which regularly cites Brockway's book in its publications. In short, Brockway's account of this case is the original source of the term "biopiracy".

Brockway recounts how the Brazilian scientists, and later their government, 'resent[ed] the expropriation without recompense or acknowledgement of one of their natural resources. There is no reason to suppose the *piracy* was necessary, that Brazil would have opposed an open and mutually beneficial development of the pasture grasses'. (Brockway, 1979: 35, my emphasis). Brockway was likewise, to my knowledge, the first commentator to suggest that both host nation and collected nation could and should benefit from such international transfer of plant materials if they worked together on bringing a product to the agricultural (or medicinal) market. The injustice of one nation taking bioresources from another, developing a potentially profitable plant – in this case an especially high yielding pasture grass for cattle – and then attempting to sell that plant back to it, is, as Brockway notes 'clear-cut... because the territorial integrity of Brazil was infringed in the deception, and both nations have scientific establishments through which fair arrangements could have been made' (Brockway, 1979: 35). Brockway's account of the biopiracy here then is prescient in its suggestion that both Australian and Brazilian institutions could have benefited from the transfer and development of the bioresources in question. Such benefit sharing would go on to be a central tenet of the Convention Against Biopiracy.

Similarly, the case of the biopiracy of a Madagascan species of periwinkle by a U.S. pharmaceutical company in the 1950s, while significant in itself, is especially significant for its place in the pre-history of the Convention. In 1986, immediately before American pharmaceutical companies, led by Merck, began (in the context of heightened concern over tropical species extinctions) to invest relatively large sums of money on "natural products research" (soon to be known, when tied to such concerns, as bioprospecting) a leading pharmacognosist – Varro E. Tyler – complained of a "lack of interest" in America in his science. His explanation for this was the following; 'the basic reason for the lack of emphasis today on plant-drug research in the United States is that, with a single exception, the [American] programs have not been successful in yielding new, marketable medicines' (Tyler, 1986: 280). Tyler recounts how the National Cancer Institute's (NCI) long-term programs intended to identify potential anti-cancer drugs in the nation's "banked" herbaria specimens was radically unsuccessful; despite having analysed 40,000 specimens the NCI 'did not identify a single agent of general use in the treatment of cancer' (280).

Tyler attributes this not to there being no useful substances present in the tested samples but to the NCI's over-reliance on random screening methods and lack of employment of ethnobotanical research methods (also, the NCI was testing plants only for anti-cancer properties, which Tyler sees as a wasted opportunity to identify other useful properties). However, there was 'a single exception' to this. This exception was used by Schultes – America's leading bioprospector – as an example of the potentially useful plants that could be lost to deforestation and its attendant species extinctions and also as an example of the profits that could be had by pharmaceutical companies if only they would employ ethnobotanists – such as himself or his students – to aid them in their search for potentially useful substances in (especially tropical) plants (Schultes, 1992).

The exception to the general rule of failure of "natural products research" was the successful identification of 'anti-tumour' properties in a species of periwinkle found in Madagascar by the American pharmaceutical company Eli Lilly (formerly Lilly Research Labs) and their subsequent bringing to market of two drugs derived from it (280). Lilly Research Labs discovered the plants' medicinal properties in 1958, and had brought two products to market by 1963; by 1985 profits from the drugs were $100 million (Farnsworth, 1988: 94-95). The science journalist Christopher Joyce (who first reported on the pharmaceutical industry's renewed interest in and funding of natural products research in the 1990s, on Monsanto and Merck's efforts to ensure any benefits accruing from their research would be shared with the nation from which any profitable materials were taken, and on Monsanto's branding of this practice as "bioprospecting"), presents this case of biopiracy by way of contrasting Merck's new practices to the bad old days; 'Madagascar received no royalties' (Joyce, 1991: 38).

Bioprospectors of the Schultes school have been keen to claim this case of biopiracy as an example of the potential value of their ethnobotanical methods. This is despite the inequity inherent in the fact that Eli Lilly made large sums of money from a Madagascan plant species which neither the traditional culture who first knew of its medicinal uses nor the Madagascan government made anything from. Paul Cox, a student of Schultes, cites this case as an advert for his discipline, noting that the medicinal value of the drugs was discovered by ethnobotanists employed by Eli Lilly and not by random screening methods (Cox, 1990: 42). Schultes himself – in a collection of articles on *Sustainable Harvest and Marketing of Rain Forest Products* - cites the use of the periwinkle in traditional Madagascan cultures as an "ethnobotanical technology" and uses it as an example of why ethnobotanical bioprospecting should be funded "before it's too late" (before both biodiversity and cultural diversity "disappear"); 'there are many more ['examples of ethnobotanical technology'] in the world that have as yet never been tapped by science or industry... Time, however is of the essence, for many aspects of aboriginal technology will disappear during the next half century' (Schultes, 1992: 13).

So, this case is prominent in the pre-history of the Convention in at least two senses. First, in the sense that it is one of very few twentieth century examples of a successful and valuable drug being derived from a biopirated plant, and the last to have been so derived before the signing of the Convention. Secondly, in the sense that this case is cited by proponents of ethnobotanical bioprospecting – who, as we saw in Chapter 1 had a direct role in both forming the Convention Against Biopiracy and arguing for the need for such supranational regulation of bioprospecting – as an example of the potential value of as-yet-undiscovered plant species and is thereby cited as a defence of the utilitarian argument for conservation of both biological and cultural diversity. In short, the case of the biopiracy of a Madagascan species of periwinkle was a direct influence on two of the central tenets of the Convention. First, that both traditional medicinal knowledge/technology and global biological resources are of potential use and economic value and should therefore be preserved by supranational regulation and, second, that they can and should be preserved in and through the practices of Bioprospecting institutions.

The Merck-INBio Bioprospecting agreement.

The most high-profile case of post-Convention Bioprospecting is known generally as "the Merck-INBio agreement".[71] Around it all the arguments for and against the Convention's official sanctioning of biological resources as having property status coalesce. The Merck/INBio agreement was the unprecedented first experiment in the new mode of Bioprospecting that the Convention was intended to ensure could be the only form of bioprospecting that was legitimate in the late twentieth century.

If one believes the Convention merely to be a mandate for a new form of internationally organized biopiracy then it is the Merck-INBio agreement that one cites as exemplary. If one believes the Convention heralds an historic transition from (inequitable) biopiracy to (equitable and just) bioprospecting then it is the Merck-INBio agreement that one cites as exemplary. I believe there are strong arguments for both points of view. The "facts" of the Merck-INBio case can be used by both prosecutor and defence. Which side of the argument one makes depends whether one is politically realist or utopian. Once the details of the case, defences of, and attacks on, the agreement have been presented I will lay out these two alternative political stances to post-Convention bioprospecting and will bring my thesis to a finish with my own conclusions. In short I argue that these "alternatives" are not necessarily alternatives. One can accept the value of realist politics for the short term but argue for (what currently seem to be unrealistically) utopian solutions (to the problem of abolishing biopiracy) for the long term. What is most important is that one's view of what is biopiracy and what is bioprospecting should be informed by accurate historical and sociological knowledge of the transition that the Convention represents, and by appropriate sociological theories.

The following account has been distilled from a variety of sources.[72] Although the case has been hotly contested to my knowledge the basic facts presented here are undisputed.

1) INBio, an acronym for the Spanish for "National Institute of Biodiversity", is a Costa Rican conservation institution established in June 1989[73] with three primary, interrelated, intentions;

a) the scientific intention of locating, identifying and archiving samples of all species – algae, insects, plants, fish, birds and mammals –estimated to total half a million species – living within Costa Rica's national parks, which, at over a quarter of the nation's territory, constitute a larger ratio of parks to territory than any other nation's. This attempt to complete an "all-taxa" survey of a such a large area was unprecedented at the time of its conception. This intention of the project alone was estimated to require a budget of $70 million (in 1989), a sum far larger than Costa Rica could afford (Joyce, 1994: 118),

b) the utilitarian intention of 'finding non-destructive uses of wildland biodiversity' in order to help pay for the project's other two intentions (Sittenfield and Gámez, 1993: 69),

c) the conservationist intention of preventing the extinction of any species within its parks.

The three intentions were inseparable. If b) could not be achieved then a) could not be. If a) could not be achieved then it would be impossible to discern if, and to what extent, c) was being achieved.

2) From the beginning INBio was funded by a variety of non-Costa Rican governmental, philanthropic, and environmentalist institutions who were interested in funding worthy conservationist projects in the developing world.[74] By 1990 INBio had received $6 million in direct donations toward its large-scale taxonomical surveying work. The Swedish government, as well as making a direct cash contribution, supported Costa Rica's national parks project, of which INBio was a subdivision, in a 'debt-for-nature swap… that wiped out more than $27 million worth

of Costa Rica foreign debt in return for a government promise to preserve a [further] proportion of its tropical forests' (Joyce, 1994: 118).

3) To these diverse sources of funding was added the American pharmaceutical company Merck (then the world's largest such company), in a deal announced in September 1991. This was the result of a suggestion first made to Thomas Eisner, and via him to the then "senior vice president for medical chemistry" at Merck, Paul Anderson by the American conservation biologist Dan Janzen. Janzen had been working in Costa Rica for many years previously and was looking for further funding for his research there. Eisner was the Cornell entomologist, who, as we saw in Chapter 1, first coined the term "chemical prospecting", enthusiastically promoted the Merck-INBio agreement as a model on which further such prospecting could be funded and conducted (he was by default a leading proponent of the CBD/CAB), and channelled some of his Cornell research budget into INBio. Janzen acted as an intermediary in the negotiations between INBio and Merck (121-127).

4) The deal was this: Merck would (and did) receive botanical, entomological and other samples collected by INBio taxonomists which it would (and did) screen for potentially useful chemicals (the number of samples received has, unfortunately, not been disclosed). In return INBio would (and did) receive $1 million cash and $135,000 worth of laboratory equipment. If Merck developed any marketable (that is, patentable) products from the Costa Rican samples INBio would received a royalty from all sales of those products 'even if' the sample 'served only as a starting point' and wasn't used directly. The precise percentage was not disclosed but Merck have not disputed critics' claims that it was less than 10%. They have stated only that it is an amount consistent with the standard contracts pharmaceutical companies make with their scientists. The standard practice is that researchers who contribute

significantly to developing patentable products receive between 2 and 5% of profits deriving from them.

5) INBio trained local people – who had mostly not had any previous scientific or taxonomical experience – in methods of collecting, labelling and even identifying species. Merck scientists were not directly involved in the actual collecting work.

To clarify then, in this case biological samples would be (and were) collected in one nation and transferred to another who openly had the intention of developing useful/valuable medicinal products from them. Not only did Merck have the informed consent of the host government, the bioprospecting work was itself done by (indirect) employees of that government. If any such products were developed – in fact, they were not – the benefits would be shared with the host nation. INBio would (and did) benefit from their bioprospecting work despite there being no commercially viable products to be found among the samples it provided. The financial benefits of the agreement contributed to Costa Rica's conservationist programs in a way that would (and did) satisfy the requirements of the Convention. Not even its critics dispute that in the terms of the Convention the Merck-INBio agreement included provision for the sharing of bioprospecting benefits, and the directing of those benefits to conservationist aims.[75] In short the Merck-INBio agreement qualifies as a post-Convention (capital-B) Bioprospecting project even though the agreement was made just before the Convention was signed. Such precursors to the Convention as the Chaing-Mai declaration (see Chapter 1) and the pre-Conference preparations and negotiations toward the Convention were known both to representatives of Merck and INBio. The general spirit of the agreement was in accordance with that of the Convention that was signed a little under a year later . The U.S. did not sign the Convention but even if it had done Merck would, in 1991, have had no international obligation to share the benefits of bioprospecting in the way that it agreed to in this case. Merck set up the agreement as it did in the knowledge that it was in no way obligated to do so.

Critiques of the Merck-INBio Bioprospecting agreement.

Critics of the Merck-INBio agreement have interpreted it as motivated primarily by a desire to be seen to be acting ethically and "greenly" and only secondarily by their interest in identifying new sources of medicinal chemicals. Opponents of both the Merck-INBio agreement and the Convention more generally, represented here by their most prominent representatives, Shiva (1998) and RAFI (1994), have argued that the Convention, far from signalling the end of the history of imperialist biopiracy and the beginning of an age of morally just Bioprospecting, merely legitimize a new – neo-imperialist – age of biopiracy.[76]

In contrast, although they do not explicitly critique the Convention or the Merck-INBio agreement Hardt and Negri (2004) make an eloquent defence of both biological and intellectual resources as "common" and outside of the legitimate domain of capital.[77] They, then, as well as RAFI and Shiva, make what I describe below as "the common heritage critique" of contemporary Bioprospecting practices. However, Hardt and Negri's critique is made in the course of opposition to emperial, not imperialist, sovereignty.

Although they are all made in parallel by both Shiva and RAFI their criticisms can be divided into three – *the financial, the institutional and the common heritage* critiques.

1) *The financial critique.* While critics recognise that the Convention (and the Merck-INBio agreement) requires the financial revenues from bioprospecting

to be shared (and that in the imperialist era they never were) they question how the requirement that these benefits be shared in a "fair and equitable" manner should be interpreted. How, for example, to establish whether the $1 million flat fee and the less than 10% royalties given to INBio by Merck is really a "fair" price for the biological resources that Merck received? They argue that the sharing of benefits as currently practiced is not a sufficient improvement on the habits of imperial-era biopirates.

2) *The institutional critique.* Critics have questioned whether there exist effective mechanisms, first, for establishing who is the legitimate recipient of the financial benefits of bioprospecting – whether this should be individuals, a local community, organizations representing "traditional cultures", conservationist institutions, individual national governments or the national governments of all of the territories a particular species is to be found in – and second, they have questioned how, once the legitimate recipient or recipients is established, the benefits should be practically distributed to them.[78] This critique also takes the more general form of an argument which states that no effective supranational institutions capable of enforcing the Convention exist. Again, in the lack of such effective mechanisms for fair distribution they see contemporary bioprospecting as merely a slightly reformed (neo-)imperialist practice.

3) *The common heritage critique.* Critics have opposed the entire concept of granting property status to biological resources and/or granting sovereignty over biological resources to national governments. They see this as the final stage of the enclosure of the commons begun in the age of European imperialism. They insist on the re-establishment of the notion that all biological resources have the status of the "common heritage of humankind".

Criticisms of this kind reject the Convention's attempt to defend national governments against exploitation by formally recognising such resources as national property.

The remainder of the chapter will consist of a discussion of the debate around the Convention/the Merck-INBio agreement. First, from a practical, narrow and "on the ground" point of view I will discuss how the architect of the Merck-INBio agreement – Dan Janzen – understood and defended the project, and how, in contrast, critics of contemporary bioprospecting – Carazo, Shiva and RAFI – understand and attack the project as little more than a continuation of (neo-) imperialist biopiracy. Second, from a more theoretical, broad and academic point of view I will discuss how Jack Kloppenburg proposed and defended exactly the sort of regulation of the collection and exploitation of biological resources that the Convention – and the Merck-INBio agreement – constitute. Then, in contrast, I will present a prominent example of an attack on the subsumption of biological resources under capital; that made by Hardt and Negri. Then I will argue that Hardt and Negri's description of a new form of supranational sovereignty provides a better-informed foundation for opposition to the Convention and contemporary Bioprospecting than does RAFI and Shiva's rather ill-informed and outdated understanding of contemporary international politics as operating according to the old logics of imperialism and neo-imperialism.

Dan Janzen is described by Christopher Joyce as the 'architect' of the Merck-INBio agreement and Costa Rica's 'ecological guru' (Joyce, 1991: 36-37). Joyce is also the author of the 1994 book from which the following account draws heavily, *Earthly Goods: Medicine Hunting in the Rainforest*, a semi-ethnographic study of contemporary Bioprospecting (which neither Shiva nor RAFI cite – much to the detriment of their critiques). What Janzen has to say to Joyce about the agreement can and should be read as a defence of the Convention and also as a proposal-by-example for the sort of roles contemporary ecologists should be playing in the management of biodiversity. The early ecologists, with their dreams of being "on the board of directors of nature" (as described in Chapter 9), would certainly recognise and approve his deeply utilitarian attitude to biological resources. As would the Club of Rome; their appeal to the supranational "mobilizing of natural and human resources" is effectively answered by Janzen, Merck and INBio.

What I have described in my previous work on bioprospecting (Christian, 2003) as a "regretfully realist" attitude among many proponents of the Convention and contemporary Bioprospecting does not apply to Janzen. He is certainly realist. If there can be such a thing he is radically realist. He argues that there are three things that should be done with biodiversity, 'save it, identify it, and use it' (Joyce, 1994: 118). In this he is certainly not (like many of the Schultes school of bioprospectors are) *regretful* that the appeal to the use value of species is the best way to secure funding for their conservation. In fact, Joyce describes how he 'seems to relish' the fact that his, the Merck-INBio agreement's, and the Convention's explicitly utilitarian attitudes to species and ecosystems run counter to the more romantic attitudes of many environmental activists; 'The idea that a biological reserve, a park, a wildlife refuge is actually a commodity, Janzen predicts "is going to make for some unhappy people"' (quoted in Joyce, 1994: 115).

There is much of interest in Joyce's account of Janzen's work in Costa Rica and his role in establishing the Merck-INBio agreement, not all of which can be presented here. To show just how committed he is to saving Costa Rican biodiversity through its commodification – that is, to turning Costa Rica into 'a kind of biological OPEC' (Joyce, 1991: 36) – a few examples of Janzen's attitudes to contemporary Bioprospecting practices will suffice. Janzen describes how '"Getting drugs from plants has been going on for centuries. But this time, we [Merck and INBio] are going to make the forest pay for itself'". With reference to the imperialist-era's aristocratic specimen collectors he states that today '"Biodiversity is no longer the toy of the English rich"' but something that can and should be put to good use (Joyce, 1994: 115). He believes that pharmaceutical companies such as Merck have the capacity to give biodiversity so much value that revenues from it can fund the entire economic development of nations, in much the same way that the OPEC nations have used oil revenues. For example, he was personally responsible for the sign at the entrance to the Costa Rican national park which reads "The forest is the fountain of life *and development*" (115, Joyce's emphasis).[79] The Costa Rican director of INBio – Rodrigo Gámez – made the comparison of biodiversity to oil explicit; '"What we did" says Gámez "is show that a developing country owns its biota, its genetic resources, just as it owns its oil or minerals"' (quoted in Joyce, 1994: 127).[80]

Let us look now at the specifics of critiques of the Convention and the Merck-INBio agreement. These are that made by Mario Carazo, a Costa Rican opponent of the government that legalised the contract (as summarised in Joyce, 1994), that of RAFI's (1994) original critique of Bioprospecting specifically as "biopiracy", and Shiva's subsequent (1998) elaboration of their critique in her book entitled *Biopiracy: The Plunder of Nature and Knowledge*.[81]

As Janzen predicted, the Merck-INBio project did "make for some unhappy people". Locally, the agreement was immediately controversial among Costa Ricans. One Costa Rican, Mario Carazo, a prominent lawyer and environmentalist with contacts in the then Costa Rican opposition party, in an early local version of the financial critique as outlined above, stated that the $1 million dollars flat fee '"is like the little mirrors the Spanish gave to the Indians", while the promise of royalties is just that, a promise' (quoted in Joyce, 1994: 138). While making a comparison between Merck and European imperialists he is arguing that the $1 million price offered by a Merck is little more than a token gesture on behalf of a corporation that counts its profits in billions rather than millions of dollars. Carazo also made the institutional critique, stating that INBio had no legitimate or democratically sanctioned right to '"sell the national patrimony"'. He is arguing here that biological resources – if they can be said to belong to anyone – are the communal property of every Costa Rican, and that INBio's monopoly on their sale is illegitimate. Carazo also objected, in the terms of the common heritage critique, that INBio were effectively privatising and enclosing the Costa Rican rainforest. Such early local opposition to the agreement was unsuccessful however, the government passed a bill in 1992 granting INBio license to fulfil its side of the bargain and provide Merck the samples it sought (139).

Another group of "unhappy people" who opposed the Merck-INBio contract was RAFI. They leant their argument – first presented in a printed communiqué and then more widely distributed through the internet – rhetorical weight by appealing to anti-imperialist and post-colonial political thought in much the same way as Carazo and Shiva. They begin by comparing contemporary Bioprospectors to imperialists and pirates; 'biological bounty hunters are in feverish pursuit of the South's "green gold"' (RAFI, 1994) and by placing their work in the context of the long history of imperialist and neo-imperialist extraction of New World resources 'The resources of indigenous peoples have long been a target of state governments and multinational corporations' (RAFI, 1994). As we have seen in Chapter 1 it is simply inaccurate and unfair to imply that contemporary Bioprospectors are unaware of the possibility that their work could – if appropriate measures such as benefit sharing, informed consent and formal recognition of the role of indigenous labour and knowledge were not taken – appear to be a direct continuation of the history or imperial biopiracy. The authors of the RAFI communiqué either had not taken the time to read the publications of the Schultes school Bioprospectors who were instrumental in producing the Convention or they wilfully ignored their post-colonial intent and the efforts they take, in Plotkin's words to "end the rape-and-run approach" to collecting biological resources. This is perhaps understandable. RAFI's interest is in opposing what they see as unfair and inequitable biopiracy and not in sociological accuracy. It is likely that they are aware of the fact that the individual scientists have a historical and social conscience but do not wish to complicate their argument by saying so. Instead it is easier and more convincing for them to simply conflate their view of the corporate patrons of Bioprospecting with their stated view of the individuals involved. Even this is not wholly accurate, the corporations interested in renewing the search for biological resources – such as Merck – have in fact also taken measures to avoid acting in what may be seen as imperialist ways, or at least, have taken measures to avoid *looking like* they are.

First, they make the financial critique; 'For Merck, the Costa Rica contract bought exceedingly cheap labour and access to unidentified biological treasures (and superb public relations)' (RAFI, 1994). There are two arguments here. First that the specimens that Merck was effectively buying though their contract with INBio were 'exceedingly cheap' – they also use the phrase 'bargain price'. The implication is that if a higher price were paid for them the deal would be fair and equitable Bioprospecting and not neo-imperialist biopiracy. RAFI also recognise that the market for biological resources is a buyer's market – especially given the economic inequalities between rich corporations and poor tropical nations – and that the prices they would be offered would continue to be as relatively small as those offered by Merck; ' some countries may be lured by the promise of monetary gain and could even enter into "bidding wars" with other tropical countries, selling off their biological resources for a pittance' (RAFI, 1994). The argument is that the Convention should have included clauses insisting on a minimum flat fee and minimum percentage for the sale of biological goods and not clauses specifying the 'mutually agreeable terms' of the host and collecting institutions. The implication is that if this had been the case they would not oppose the Convention as a mandate for, or as they put it, a 'boost for', biopiracy.

Second, and quite reasonably, they argue that Merck was happy to act according to the post-colonial intentions of the Convention partly – perhaps wholly – because in doing so they would, in a "superb" marketing ploy, pre-empt any opposition to the deal, appear to be acting in accordance with the environmentalist spirit of the early 1990s, and generally be seen as a moral agent not a cold and heartless corporation. This critique is borne out by Janzen, who 'knew that the green label now carried clout' and in his role as negotiator for INBio argued to Merck's lawyers and heads of natural products research, appealed to Merck's interest in appearing to be involved in "green" causes (Joyce, 1994: 126). Janzen argued in the following terms; '"You wanna be the good guys? Or do you want to be forced into that position? If you are the good guys, you are the first in line and you get to set things up the way that serves you well"' (quoted in Joyce, 1994: 126).

RAFI also made the institutional critique. First by raising the problem that it 'Is often difficult for indigenous peoples' organizations to know precisely with whom they are dealing' (RAFI, 1994), and the reverse problem that institutions wishing to conduct ethnobotanical bioprospecting lack any clear idea of which indigenous people's organizations are the legitimate beneficiaries of any revenues generated from their work. They ask 'Who negotiates on behalf of indigenous peoples? Who decides?' RAFI then broaden this argument to one about the contemporary state of global governance;

'...The Convention offers a multilateral façade for addressing conservation and sustainable use of biodiversity, but offers no multilateral mechanisms for making it work... commercial bioprospecting agreements cannot be effectively monitored or enforced by source communities, countries or the Convention, and amount to little more than "legalized" bio-piracy' (RAFI, 1994).

The implication is that if more effective measures, mechanisms or institutions for a) establishing that the Convention is being followed in all bioprospecting projects, b) for establishing who is the legitimate recipient (they argue that indigenous people's organizations not national governments should be first in line for receiving revenues), and c) for actually distributing the revenues then they would accept the claim that the Convention is a post-colonial rather than a neo-colonial document.

Thirdly, RAFI make the common heritage critique. They take it almost for granted that the Convention's acceptance (in Article 16.3) that the products derived from bioprospecting could be patented in order to generate the (small) revenues that will be (inefficiently) redistributed to the host nation is unacceptable. They simply state, and feel no need to justify or argue the point, that 'There is no reason, at any time, to permit the patenting of living products or processes'. Not only do they believe patents to be philosophically unacceptable but they argue against the realist's acceptance of them as a possible defence against corporate theft; 'The solution for governments of the South is not to adopt industrial intellectual property regimes' (RAFI, 1994). To RAFI biological resources can not be subject to commodification on both philosophical and practical grounds.[82]

Finally we move on to Shiva's critique of the Merck-INBio agreement and the Convention. I will present her argument only briefly because it takes the same three lines as Carazo and RAFI's. First, her version of the financial critique: she points to the disparity between the $1 million flat fee Merck paid Costa Rica and its $4 billion dollar annual profits, noting that the fee is a 'tiny fraction' and 'does not respect the rights of local communities or the government of Costa Rica' (Shiva, 1998: 79). Shiva seems not to know that the government of Costa Rica approved the deal, but her point that the people of Costa Rica were not directly consulted holds; the public 'had no say in the deal and were not guaranteed any benefits'. Her version of the institutional and common heritage critiques are made together; 'those selling the prospecting rights never had the rights to biodiversity in the first place, and those whose rights are being sold and alienated through the transaction have not been consulted or given a chance to participate' (79). Again then, the implication is that if a much higher price were paid and if the Costa Rican public had directly approved the deal and were guaranteed a share of the benefits then the deal (and the Convention which takes such a deal as the model for subsequent Bioprospecting) could not be opposed as a neo-imperialist act of biopiracy.

Immediately after this – and apparently without recognising the contradiction involved – Shiva then elaborates on the common heritage critique and sets up a normative contrast between the inherent "ecological value" of biodiversity (good) and the economic value which the Convention, patents, and Bioprospecting projects put on biodiversity (bad); 'All life forms have an inherent right to life; that should be the overriding reason for preventing species extinction' and not the utilitarian or economic reasons that many ecologists, and all Bioprospectors, today appeal to (81). Shiva's definition of "biopiracy" is broader than that of RAFI and the one I have been using throughout my thesis. To Shiva any act that disrespects or threatens "ecological value" should be considered biopiracy. She goes on to identify capitalism as the root cause of contemporary biopiracy; 'the dominant economic system... has failed to address the ecological value of natural resources... expanding the same economic system will not protect indigenous knowledge or biodiversity' (81).[83] In this, Shiva seems to read the Convention as actually having the effect of expanding capitalist property relations to biological resources and bringing an end to their status as "common heritage" rather than as a document that merely formalizes a state of affairs that has existed in much of the world for many decades, if not centuries. She argues that the Convention should be abolished, that biological resources be granted global communal property status and established as outside of or beyond the capitalist economy; 'We need a transition to an alternative economic paradigm that does not reduce all value to market prices and all human activity to commerce' (81).

This, then, is the very opposite of Janzen, Kloppenburg and the signatories of the Convention's realist acceptance that in contemporary society the commodification of biological resources is the only viable means by which to ensure biopiracy does not continue to occur in the ways it did in the imperialist cases of tea, cotton, cinchona, rubber and in the neo-imperialist case of Norin 10. Barring a global revolution in political and economic thought and practices and the establishment of entirely new institutions of global governance the Convention is the only means by which we can realistically expect to move from biopiracy to Bioprospecting in a context where at least some of the benefits of biological resources can be shared. I will consider this alternative means by which to abolish biopiracy, in terms deriving from Hardt and Negri's work, at the end of the chapter.

The critiques made by Carazo, RAFI and Shiva have an inherent weakness that they all fail to explain or even acknowledge. The weakness derives from a *contradiction in their argument between the premises of the financial and the* *institutional critiques and the premise of the common heritage critique*. They argue that the financial value of the benefits deriving from bioprospecting are so small as to be little more than tokens, and therefore that such deals as the Merck-INBio agreement are no more equitable than the acts that constitute the history of imperialist biopiracy. They also argue that the means by which to establish who are the legitimate recipients of such financial benefits are lacking or inefficient, and therefore that such deals are no more just or fair than imperialist-era biopiracy was.

Implicit in these critiques is an argument that if a larger proportion of revenues from bioprospecting – say 50% instead of less than 10% or a billion dollars instead of a million – was on offer then such deals would in fact be equitable. Implicit also is an argument that if there were more effective institutional mechanisms by which to distribute such revenues to the "legitimate" owners of biological resources – say by dividing the total revenues from bioprospecting between the national population and distributing a proportional share to each citizen or by democratically electing an institution to receive the revenues – then such deals would in fact be just and fair. However, *these arguments contradict their rejection of the very idea of the commodification of biological resources*. They do not see (or do not confront) the fact that if nations wish to have any chance of receiving a fair price for biological resources, or if national institutions/populations are to benefit from the value of their biological resources, then these resources *first have to been given a price and a value; they have to be treated as commodities*. It is contradictory to argue that the price one is offered for a commodity is too low and at the same time to argue that the commodity for sale should never have been for sale in the first place.

Dan Janzen and Jack Kloppenburg recognise this contradiction and accept the reality of contemporary capitalism and contemporary international relations. They may not like it (in fact Janzen is perfectly happy to accept it) but if developing nations (or, for that matter, any other nations) are to stand any chance of benefiting from their biological resources they have to put them up for sale. Next, then, I present Jack Kloppenburg's defence of the commodification of biological resources, which is significant in that Kloppenburg is, like Shiva and Hardt and Negri, but unlike Janzen and most of the signatory nations of the Convention, politically of the left.

Far from arguing for the reinstatement of the notion of biological resources as the "common heritage of humankind" Kloppenburg argues that it is precisely the 'ideological deployment' of the notion of common heritage – which means that plants are freely available to anyone – which has allowed the 'free appropriation' of genetic resources by first European and then American institutions and governments. He recognises the long history of imperialist and neo-imperialist biopiracy, notes that 'Plant genetic resources are a strategic resource of tremendous value' (Kloppenburg, 1988: 190) and sets out a series of measures which would help developing nations make the most of their plant resources and provide them with a basis on which to oppose their theft. These measures are presciently similar to those that would, a few years later, be enshrined in the CBD/CAB.

Kloppenburg starts from the position that bioprospecting, or, in his Marxist terms ,'primitive accumulation of plant germplasm', has been 'one of the enduring features of the historical relationship between the capitalist core and its global periphery. The evolution of access to, utilization of, and control over plant genetic resources is a matter of fundamental importance' (14). He recognises that the history of bioprospecting and plant transfers, quite aside from the geopolitical, biopolitical and ecological consequences has been of world-historical significance; 'It is no exaggeration to say that the plant genetic resources received as free goods from the Third World have been worth untold *billions* of dollars to the advanced capitalist nations' (169, original emphasis).

Not only have these nations profited from Third World plant resources directly, by turning them into medicinal or agricultural products, but they profit from them again when they are sold back to the nations from which they originally derived; 'The germplasm resources of the Third World have been considered a free good – "the common heritage of mankind"...[while] Plant varieties incorporating genetic materials originally obtained from the Third World now appear there not as free goods but as *commodities*' (15, original emphasis). The logical solution, then, is to prevent resources leaving the Third World for free in the first place. Kloppenburg asks that because there is every chance they will end up as commodities anyway why not treat them as such from the beginning?

He recognises that this is not the form of argument usually associated with a Marxist academic nor with leftist politics in general. However, as a sociologist of American agriculture and agribusiness Kloppenburg is more aware than many that the power and profits of (largely American) agriculture corporations derives from their sales of improved crop varieties. He believes that any move to de-commodify agricultural products and to put the products of crop science outside the domain of capital would be bound to fail. He is sympathetic to attempts in the 1970s and early 1980s by some developing-nation governments to have the commodity status of crop plants opposed and overturned by the UN. However, he knew that they had very little, if not zero, chance of success:

> 'it is doubtful that the advanced capitalist nations would agree to extensions in the application of common heritage. The elite and breeders' lines of private-sector seed companies are now private property and capital intends to do all that it can to ensure that they

> remain so… the prospects for actually achieving common heritage status for all types of germplasm are not bright' (288).

Instead, in what was then a novel argument, he argued that the reverse tactic might be more successful. Rather than opposing the commodification of plant resources, the world's economically poor but biodiverse ("gene rich") nations might be better served by *insisting* that their biodiversity, and their local crop varieties, *should* be treated as commodities and be made available to interested scientists/ corporations only at a price.

> 'Common heritage may be intuitively appealing, but, even if achieved, would not necessarily bring material advantage to Third World nations. Recognition of national sovereignty and the creation of compensatory mechanisms, on the other hand, would help redress a significant asymmetry in the economic relationship between the advanced capitalist nations and the less developed countries' (289).

Achieving a more symmetrical situation, in short, 'requires a political strategy other than common heritage' (288). Kloppenburg then makes the following suggestion for the formalization of biological resources as national property and for the exact type of benefit-sharing mechanisms that were put in place by the CBD/ CAB:

> 'Third World nations have little to gain from quixotic pursuit of common heritage in plant genetic resources. But they have a great deal to gain through international acceptance of the principle that

> plant genetic resources constitute a form of national property. Establishment of this principle would provide the basis for an international framework through which Third World nations could be compensated for the appropriation and use of their plant genetic information. Moreover, while capitalist interests are unalterably opposed to decommodifying their breeding lines, there are indications that they would be willing to provide compensation for use of plant genetic resources' (288).

Kloppenburg was right. "Capitalist interests" were and are willing to share some, albeit it relatively small proportion, of any proceeds from resources collected under the Convention's terms.

It would be inaccurate to portray Kloppenburg as fully comfortable with this solution, which is, fundamentally, a capitalist solution and as such is open to all the same objections as capitalism, including and especially the objection that the capitalist profits more than the provider of raw materials (and of labour), thus contributing to and maintaining class inequalities between individuals and nations. He notes that 'A national-property initiative is by no means an ideal solution to the plant germplasm controversy' (288).[84]

Implicit in Kloppenburg's account is the recognition that in a society based on private property all resources must sooner or later come to be privatized, that is, come to be considered legitimate property, including living resources. Aware of the long history of failed opposition to capitalism and the likelihood of the short-term extension and intensification of capitalist social relations he makes no effort to sustain any belief in the possibility of ending biopiracy by establishing an alternative world economic and political system. Instead, the most effective and realistic defence against biopiracy is the one that was taken by the representatives of the world's national governments; the signing of the CBD/CAB. Like the Schultes school of Bioprospectors who played such a prominent role in the formation of the Convention and its arrival on the table of world government Kloppenburg would prefer not to have to argue for the commodification of biological resources; only regretfully does he accept that that in contemporary society everything has a price.

Critics that refuse to abandon the "intuitively appealing" common heritage critique and still seek to oppose outright the commodification of biological resources are not simply opposing the agreement or the Convention, they are, by default, opposing the fundamental logic of capitalist economics. Hardt and Negri show at length that capitalism and the expropriation of the common are synonymous. The CBD/CAB's formalization of the property status of biological resources is hardly an unusual phenomena; 'capitalism sets in motion a continuous cycle of... the expropriation of what is common', throughout the history of capitalism it has been the case that 'the commons', whether it be in the form of the products of cooperative labour or of material resources have been 'expropriated for private use' (2000: 301).

Hardt and Negri's work on capitalism and the emperial sovereignty that sustains it can be read as an extended version of the common heritage critique of the CBD/CAB and the Merck-INBio agreement. Their very definition of exploitation says that 'Exploitation is the private appropriation of part or all of what is common' (149) and their definition of justice is simply that the 'good is what is common' (300). In terms of political action they argue that today the 'primary issue' is that 'nature is ceasing to be common' (2004: 184). My thesis has shown that the Convention is the final fulfilment of a long historical process of the privatization of biological resources; 'privatization... involves expanding the realm of property itself', and as I have shown throughout, 'traditional knowledges, seeds, and even genetic material have increasingly become objects of ownership' (280). This process is not achieved today through old fashioned imperialist rule but through the alliance of both governmental and corporate agricultural, medicinal and ecological institutions and the majority of the world's national governments. The appropriation of biological resources by capital is no longer conducted by imperialist military invasion and political domination but by the varied institutions of supra-national sovereignty working together under the popular, avowedly "environmentalist", rubric of the preservation and efficient management of resources for the benefit of future generations of humanity. Imperialist power supported the territorial expansion of capital, and undertook to manage the populations and resources of newly capitalised societies. In its concern to manage not just limited territories but the planet as a whole emperial sovereignty seeks to manage both human and non-human life in ways conducive to ensuring the continued supply of the resources capital needs to reproduce and survive. Throughout I have been explicating what Hardt and Negri, following Foucault, mean by *'the tendency for sovereignty to become power over life itself'* (2004: 334). What is underemphasised in Hardt and Negri's account is the legitimacy leant to this power by the apparently global popularity of "environmentalist" politics.

Contemporary bioprospectors such as Janzen and the Schultes school and contemporary critics of biopiracy such as Kloppenburg know that the abolishment of capitalism is not a realistic short term solution to the commodification of biological resources. Their support of the granting of property status to bioresources is realistic in that it ensures that at least some benefits from their sale might accrue to their owners. They at least avoid the contradiction inherent in arguing simultaneously against the low prices that are paid for biological commodities and against the entire principle of the commodification of biological materials. But in doing so they forfeit the possibility of opposing capital and the institutions of global governance which exist to support and extend it.

Hardt and Negri recognise that the logical conclusion of the common heritage critique is that the only context in which the acquisition of biological resources from which to develop useful goods will cease to belong to the history of biopiracy is a post-capitalist context. One cannot hope to successfully oppose contemporary biopiracy without opposing contemporary global capitalism. Unlike contemporary Bioprospectors Hardt and Negri refuse to reject the utopian scenario in which the scientific and political institutions of global governance are subjected to direct democratic control. They implicitly argue against contemporary Bioprospectors (and "realist" leftist critics of the biosciences like Kloppenburg) in arguing that the available options for the regulation of the search for biological resources do not necessarily number only one. Rejecting the (realist) option that was taken with the CBD/CAB, that of granting biological resources official property status in order that their owners can at least benefit from their sale, they take the (utopian) option of arguing that 'We need a new institutional mechanism... [to] restitute the common that has been stolen' (298) and arguing in favour of reforming – in fact, for reversing – the policy on biological resources in ways 'based on a recuperation or creation of the common' (302).

Against the economic and biopolitical power of the institutions of global governance – what they define throughout their work as a post-imperialist global "Empire", a society managed by emperial sovereignty – and against contemporary Bioprospectors "regretfully realist" submission to it – they continue to imagine 'the constitution of a society in which the basis of power is defined by the expression of the needs of all' (2000: 409). Through their conceptualization of an international "multitude" of opponents to anti-democratic corporate and supranational governmental institutions they imagine 'a biopolitical unity managed by the multitude, organised by the multitude, directed by the multitude – absolute democracy in action' (410). Against a society based on the wealth derived from the expropriation of the common they imagine 'a new wealth, articulated with the powers of science and social knowledge through cooperation' (411).

Against what Kloppenburg describes as the "quixotic pursuit" of common heritage Hardt and Negri insist that the multitude

> 'tends to mobilize what it shares in common and what it produces in common against the [e]mperial power of global capital. In time, developing its productive figure based on the common, the multitude can move through Empire and come out the other side, to express itself autonomously and rule itself' (2004: 101).

I say "imagine" because they are not unaware that all this remains utopian speculation until 'reappropriation and self-organisation reach a threshold and configure a real event' (2000: 411). Such a revolutionary "event" is considerably postponed by emperial sovereignty's ability to convince the multitude – in and through such policies as the CBD/CAB – that it acts in accordance with environmentalist interests.

Conclusion to Chapter 10.

The first section of Chapter 10 discussed the last major case of biopiracy which it makes sense to discuss in terms of imperialism. It described the American acquisition of Japanese strains of wheat and their subsequent development of the wheat strains that went on to become the basis of the "green revolution" as neo-imperialist in its significant economic, geopolitical and biopolitical consequences.

The Chapter then briefly discussed the details of two minor cases of twentieth century biopiracy both of which, although they were relatively economically and geopolitically insignificant, came to be used by subsequent Bioprospectors and critics of biopiracy as examples of the way the search for and use of biological resources should *not* be conducted in a post-colonial and post-imperialist society. Reaction to these two cases informed the new (emperial) approach to Bioprospecting that was taken by the signatories of the CBD/CAB. In this sense they are important to the history of the transition from biopiracy to Bioprospecting.

Chapter 10 then introduced the major case of post-Convention Bioprospecting – the Merck-INBio agreement. This case is described as being typical of the new anti-imperialist intentions of corporate Bioprospecting science. Critiques of the Merck-INBio agreement, however, are shown to have invoked precisely that history of imperialist biopiracy which I have described at length in previous chapters and which the Convention explicitly reacts against. I then interpreted the critiques in two ways. First by showing that they contain a problematic contradiction. That is, by showing that it is contradictory to argue that the benefits accruing to developing nations from the sale of their biological resources are insufficient and simultaneously to argue that those resources should not be for sale in the first place. Second, I showed that to oppose contemporary Bioprospecting and the Convention in terms of anti-imperialism is to misunderstand the reality of contemporary capitalism and of the contemporary forms of supra-national sovereignty that support it. Opposition to the Convention must take the form of opposition to emperial not imperialist sovereignty. Some aspects of precisely such opposition, as found in the work of Hardt and Negri, are then summarized. I ended by following up on the argument of Chapter 9 by suggesting that opposition to emperial sovereignty lacks the force it might have had if the institutions of global governance had not successfully (but only relatively recently) appropriated popular "environmentalist" discourse and pitched their concern with the management of biological resources as "green".

I am certainly sympathetic to Hardt and Negri's theory of contemporary society, and would defend it as being accurate in many respects, certainly more accurate than theories of contemporary (American) neo-imperialism. However, I do not necessarily believe that their utopian appeal to the capacity of the global multitude to oppose emperial sovereignty can be defended as likely to bring about an imminent end to biopiracy. I believe that their (implicit) rejection of contemporary Bioprospectors' acceptance of the commodification of biological resources is overly utopian and that the latter's defences of the Convention and the kind of bioprospecting projects it legitimizes should not, in the short term, be rejected as politically misguided. I accept that by defending the Convention's formalizing of national government's right to treat biological resources as their property one is siding with un- and anti-democratic forms of (emperial) power and accepting global capitalism as a fact of contemporary life. However, I do not believe that the prophecy of the coming establishment of a radical and global democracy capable of abolishing global capitalism (and with it capitalist policies such as the Convention on Biological Diversity) is a realistic basis on which to oppose the Convention in the short term.

Summary and conclusions.

Chapter 1 detailed the significance of the Convention on Biological Diversity for contemporary bioprospecting practices and presented the Convention as a Convention Against Biopiracy. It presented the pre-history of the CBD/CAB in terms of a nexus of beliefs among bioprospecting scientists, which, slowly but surely, came to enter national and supra-national policy. It showed that the Convention expressed widespread belief that the collection and putting to use of biological resources becomes more important as living species – including potentially valuable but as-yet unexploited biological resources – and cultures with "traditional" knowledge of how to use biological resources – come under threat of extinction (whether this threat is perceived or real). Concerns to preserve and sustainably manage both these resources – now unified by the term "biocultural resources" – were shown to be historically novel. In the context of the history of imperialist biopiracy (as discussed in Chapters 3 to 7) and the history of the conquest of nature in the imperialist era (as discussed in Chapter 8) these concerns must be seen as post-colonial (and/or anti-imperialist). However, the Convention is then, in Chapter 9, put in the context of the early ecologists' technocratic ambitions and increasing concern to manage biological resources and in the context of 1960s and 1970s ecologists' fulfilment of these ambitions and development of computer-aided methods by which to manage the global ecosystem. In the light of this, the post-colonial and environmentalist intent of bioprospecting scientists and national governments, begins to look less liberal and more like a means by which they can ensure for capital a continued supply of the biological resources which their imperialist predecessors took with social and ecological impunity. Although there has certainly been a shift in the actual practice of bioprospecting, the motivation for the collection of biological resources remains the production of commodities. It is a considerable achievement of emperial sovereignty to have been able to formalize and complete the long history of the commodification of biological resources (as discussed in Chapters 3, 4 and 5, but most explicitly in Chapter 3) and at the same time have this be seen (as shown in the arguments summarized in Chapter 10) as the only realistic means by which to prevent the continuation of the history of imperialist biopiracy. To have the subsumption of bioresources and entire ecosystems under capital also be widely understood as an effective means to prevent their further destruction is a further coup for the institutions of emperial society.

Chapter 2 presented definitions of specific contemporary Bioprospecting and Biopiracy (with capital B) and general historic bioprospecting and biopiracy (with small b). It then showed that, contrary to the implications made by critics of Biopiracy today's Bioprospectors are fully aware of the involvement of their forebears in imperialist history and imperialist biopiracy, and that they in fact consciously and explicitly seek to work in a post-colonial and/or anti-imperialist manner. It is shown that this has sometimes put them at odds with corporate institutions who were potentially interested in employing them to locate potentially valuable biological resources. This divergence of interests between funding institutions and individual bioprospectors is shown in subsequent chapters to be as historically novel as the latter's concern to respect the national sovereignty and local population of the countries in which they work. Finally, Chapter 2 presents a review of the literature on imperialist biopiracy and lays out my approach to it; namely that the various emphases of the works reviewed need to be brought together and synthesized if the history of the bioprospecting sciences is to be fully understood. The existing literature on the history of biopiracy suffers from being largely unaware of contemporary Bioprospecting and the historical significance of the CBD/CAB and insufficiently conscious of the continuities between imperialist history and contemporary globalization. Discourses of neo-imperialism are described here as inappropriate terms in which to discuss contemporary forms of power, which I go on to discuss in terms of emperial sovereignty.

Chapter 3 gave initial definitions of "economic", "geopolitical", "biopolitical" and "ecological" aspects of bioprospecting and described how, in many cases these aspects are not always easily distinguishable. Similarly, it argued that the splitting of the study of bioprospecting at home and in the colonies (or wider world more generally) is untenable for anything other than methodological reasons. The impacts of New World plants on European botany and of European botany on the New World are equally significant and occurred together.

Chapter 3 began by showing that before botanists began to travel the globe in pursuit of plants there had existed a tradition of bioprospecting "at home". From the beginning, plants were treated as a valuable resource – to be used in medicine or to decorate the gardens of the upper classes. The search for medicinal plants became an organized activity in the seventeenth century, and has had economic motivations from at least the same period. A lively market in biological resources has existed for centuries. The practice of consulting local people on where to find sought-after plants and on the uses to be made of them also existed from at least the seventeenth century.

Chapter 3 also showed that in the eighteenth and nineteenth centuries botanical "science" was synonymous with the collection and identification of plants. At least three different groups practiced it, apothecaries in search of medicinal plants, middle class amateurs, and a small body of professionals who travelled beyond Europe in pursuit of plants of potential benefit to their national or imperial economy.

Chapter 3 shows how from the mid eighteenth century onward European bioprospectors began to systematically seek plants from around the world (often, but not always in the European colonies). Plants were sought for explicitly imperialist ends (and in this sense bioprospecting was biopiracy) but also for the decoration of gardens. By the nineteenth century the market for plant specimens was international, and thriving. Both wealthy individuals and botanic gardens possessed collections of many thousand specimens which were worth large sums of money.

Chapter 3 also shows that many individuals died in the pursuit of plants and the wealth they could bring, and many valuable collections were lost to shipwreck, theft, or other misfortunes. In a further mark of the increasing commodification of biological resources, both the life and the collections of bioprospectors could be, and were, insured.

Chapter 3 consisted of an account of the increasing commodification of bioresources in the imperialist era in and through the rise of a commercial market for living, mostly decorative, plants in the nursery trade and a market for herbaria specimens among amateur botanists and museums in the specialist specimen dealership. Both markets were fed by professional, but "non-imperialist", bioprospectors. They are significant for their role in the commodification of biological resources (which the CBD/CAB legitimizes and completes) and in creating individual fortunes, but did not have direct imperialist motivations or consequences. In this sense, it is arguable that they escape the charge of biopiracy, even though they did not fulfil the CBD/CAB's requirement that bioprospecting occur only with prior informed consent and that benefits be shared with the host nation.

Chapter 4 begins by presenting the ways in which Carl Linnaeus and Joseph Banks understood botany and bioprospecting to be of potentially enormous value in enhancing the economy, status and reputation of the nation. Both Linnaeus and Banks sent out botanists in pursuit of economically valuable plants. Linnaean bioprospectors sought plants with which to found domestic industries in the crops the

Swedish government spent large sums of money on, thereby negating the need for a Swedish Empire. Banksian bioprospectors sought plants with which to found colonial plantations, thereby providing large incomes and geopolitical power to the British empire. Both Linnaeus and Banks understood botanical science to be a branch of economics and practiced it as such. Banks also put botanical science and bioprospecting to another imperialist use; the surveying of the biological resources of New World territories. Such surveys could, and did, directly inform the practices of both the British government and the East India Company.

In contrast to Chapter 3, the second part of Chapter 4 defined and discussed the biopolitical and geopolitical consequences of bioprospectors whose work *was* closely involved in the exercise of imperialist power, and should certainly be considered biopiracy. Specific cases of the transfer of plants which altered (or were intended to alter) the lives of entire populations – both in Europe and in the colonies – are discussed and defined as biopolitical. Specific cases of botanists' involvement in the survey of territory for purposes of establishing its suitability for annexation into the British empire, and cases of bioprospectors taking on the role of spies are discussed and described as geopolitical in character. Some of the cases of biopiracy discussed here were both geopolitical and biopolitical in character.

Chapter 5 continued in similar vein, discussing the four "major" cases of imperialist biopiracy. In each case the plants in question – cotton, tea, cinchona and rubber – were taken illicitly, were taken by British botanists in the knowledge that the host nation or empire would understand the act of biopiracy to be hostile and counter to their economic interests, and conferred significant economic and geopolitical advantage to the British empire. Each act also had significant biopolitical consequences. It is precisely this type of enormously profitable biopiracy that the

CBD/CAB was formed in reaction to and seeks to prevent from happening in contemporary and future society.

Chapter 6 described and discussed imperialist biopirates' reliance on and exploitation of local labour and local knowledge respectively. The CBD/CAB was also formed in reaction to these forms of exploitation. The CBC/CAB requires Bioprospectors to "respect" local populations in ways that imperialist-era biopirates, with only a few isolated exceptions, did not. Chapter 6 showed, first, that historically biopirates have employed locals to do the actual work of collecting and paid them at extremely low rates relative to the value of the specimens collected, showed, second, that the local labour exploited in the course of collecting went unrecognised in scientific reports, and third, briefly presented exceptions to the general rule that local labour was under-valued and unrecognised, and often treated with explicitly racist attitudes. It showed that just as imperialism and imperialist agents generally did not go unresisted by local populations neither did biopiracy; violent resistance to both imperialist power and to biopiracy was a constant danger to its perpetrators.

Chapter 6 went on to show that despite a widespread belief among European imperialists that non-European populations' botanical knowledge was quantitatively and qualitatively inferior to their own, three of the major acts of imperialist biopiracy could not have occurred without the exploitation of local knowledge of the plants in question. That is, the benefits accruing to the British empire from biopiracy were derived at least partly from the exploitation of local knowledge. This recognition is today enshrined in the Convention Against Biopiracy requirement that local knowledge of the uses of biological resources be both respected and appropriately rewarded. Chapter 6 concludes by noting that despite their generally derogatory attitude to local botanical knowledge imperialist biopirates, would, if it was the only available means to a particular economic end, consult local people. Although the

CBD/CAB marks a shift in attitude to "non-scientific" knowledge and in practices relating to its recording and exploitation, the financial motivations for taking local advice on the potential uses of plants remains little changed.

Chapter 7 introduced and explicated the concept of linguistic imperialism. There it was shown that European botanists, in a practice consistent with their general sense of superiority, generally ignored the diverse range of local botanical classification systems and instead produced their own universal system, the globalization of which eventually eradicated all alternatives. Linnaean classification is shown to be both a *tool* – a technology – and a *product* of imperialism. It was first conceived as a means by which to cope with the "specimen overload" that threatened to overwhelm European botanists as an ever-accelerating flood of previously unknown plant species arrived in Europe. In this sense it was a product of empire. Because it did not require that local names for plants be recorded – in fact Linnaeus insisted that they *not* be included in their new Latin name – the spread of the system had the effect of rendering all non-European botanical knowledge irrelevant. In this sense it was an imperialist technology. The new-found respect for "traditional" botanical knowledge – as expressed by ethnobotanical bioprospectors and enshrined in the Convention – can and should be seen as an attempted correction of this imperialist mistake. Chapter 7 discusses Linnaean classification as satisfying Europeans' – including and perhaps especially European botanists' – desire for universal, comprehensive knowledge and their (biopolitical) ambition (to be found also among the early ecologists in both Europe and the United States) to remake the world in their own image.

The project of compiling imperial *Flora* – encyclopaedic lists of all the plant species in the British empire – which required enormous efforts by taxonomical bioprospectors – is discussed in these terms. Chapter 7 shows that botanists made successful requests for governmental funding of this archiving project by appealing to its imperialist ambition to subsume the entire world under European (capitalist) hegemony. Chapter 7 concludes by anticipating the argument of Chapter 9 that there is direct continuity between British imperial botanists' attempts to list every species within its empire and contemporary ecologists' attempts to compile a comprehensive – "all-taxa" – database of species (as exemplified by Merck and INBio's post-Convention collaborative Bioprospecting project – which is discussed at length in Chapter 10). Contemporary ecologists' are motivated by the desire to be in control of the management of global biodiversity and biological resources in the same way that the early ecologists were and ways similar to those in which the last of the imperial botanists sought to manage the biological resources of the British empire at the turn of the twentieth century. Although the latter's practices were motivated still primarily by their interest in resource extraction there was increasing awareness that this required wise management and new methods. It is in the second half of Chapter 7, then, that I begin to argue in detail that the CBD/CAB should be seen in the context of the history of the ecological sciences and the subsequent rise of environmentalist thought and modes of governance to the global level. As the British botanical archive becomes the global biodiversity database, biopiracy becomes bioprospecting and imperial sovereignty becomes emperial sovereignty.

As the clauses of the CBD/CAB requiring that bioprospectors respect local knowledge represent a correction of imperialists' disrespect for that knowledge the clauses of the Convention relating to respect for environments represent a correction of imperialists disrespect for those environments, or rather, a correction of the imperialists' belief – despite their increasing capacity to conquer the natural world – that biological resources could not be put at risk of permanent extinction. Chapter 8 argues that the Convention must be seen in the context of the long history of the humanization of the global environment that began to have permanent effects in the imperialist era. That history is one of, first, "conquest" – through hunting of predators, felling of forests, and reclamation of swamp land – second, of "improvement" – through the planting of crops and the introduction of animals – and third, of "management" – through the conservation of biological resources and the attempted re-production of "natural" environments. The transition from biopiracy to bioprospecting can make no sense if not discussed in terms of the shift from conquest through improvement to management of "nature" and the final completion of the humanization of environments in the second half of the twentieth century (as recognized by the CBD/CAB). In terms of the history of the biosciences, the transition from wild "nature" to humanized, commodified, "biodiversity" is the context for the transition from natural history to the ecological sciences.

Chapter 8 also shows that ecological damage could be, and was, caused by bioprospectors themselves, both at home and in the colonies; the clauses of the Convention requiring that no such damage be caused in the course of collecting work reacts to this aspect of the history of biopiracy.

In its discussion of the turning over of large swathes of colonial territory to plantation agriculture Chapter 8 reconnects to the biopolitical aspects of biopiracy as presented in Chapter 4. It is well recognised within environmental history that the management of the natural world is always also the management of populations. This recognition is one of the main advantages of the theory of emperial sovereignty over theories of imperialism and neo-imperialism. The new forms of emperial sovereignty do not seek merely to (biopolitically) manage the global population and global society but seek also to manage the global environment and/or the global ecosystem. Although some historians of imperialism now recognise that the European empires sought to conquer and manage the entirety of the environments they ruled over the traditional history of imperialism saw empires as concretizations of economic, social, and political power and not in terms of their power to conquer, improve or manage nature.

Chapter 9 constitutes the first of two chapters presenting my argument that contemporary Bioprospecting must be understood not in the context of competing imperialisms but in the context of a single global society governed by institutions that together constitute a new form of sovereignty. Ecological thought and environmental governance is definitive of both this society and its dominant form of power. Chapter 9 shows how, barring a few isolated exceptions, those ideas and political arguments which we now describe as "environmentalist" did not exist before the twentieth century. They did not even exists in the early work and practices of ecological science. Ecological thought and environmentalist policy came together in the 1970s and almost immediately became central to the (perceived legitimacy of) new institutions of global governance. The CBD/CAB should be seen as one of the latter's most significant achievements. Chapter 9 shows that through pitching the control of biological resources as a response to global environmentalist concerns an alliance of national governments and ecologists in the 1970s were able to fulfil the ambitions of both imperial botanists and imperial ecologists. That is, they were able to commodify the entire global "stock" of biological resources and at the same time to wrest control of their contemporary and future management. They were able also to do this in a way that appeared to be in the interests of the tropical nations in which the greatest quantities of potentially useful bioresources are to be found, in the interests of the most powerful nations and their scientific corporations and in the interests of humanity as a whole.

Chapter 10 argued, then, that to oppose such a widely-agreed upon document as the Convention and/or the form of Bioprospecting it mandates in the terms of opposition to neo-imperialism is to fail to recognise the historical novelty of contemporary forms of power. After presenting the details of a mid-twentieth century pre-Convention act of biopiracy that *was* a form of neo-imperialist resource extraction and which *was* deployed to neo-imperialist ends (the U.S. biopiracy of Japanese wheat plants known as Norin 10) Chapter 10 presents the details and critiques of the exemplary post-Convention Bioprospecting project, explicitly conceived as a collaborative and equitable post-imperialist project – known as the Merck-INBio agreement. After summarizing the three major critiques of the agreement and of the Convention (which are almost identical) the chapter shows that there is a contradiction between the first two critiques and the third critique. There is a contradiction between the argument that the agreement/Convention does not ensure that a sufficiently large share of the financial benefits of Bioprospecting is shared (the financial critique), the argument that the agreement/Convention does not distribute the benefits to a legitimate recipient (the institutional critique) and arguments that state that the agreement/Convention's commodification of bioresources is inherently and always unjustified (the common heritage critique).

In Chapter 10 I express a realists' sympathy with the logic of the Convention that states that if the history of imperialist theft of biological resources is to be brought to an end it is necessary to treat biodiversity as a commodity. If this point is conceded then the financial critique – while well-intentioned – misunderstands the reality of capitalism. It is unrealistic to expect capitalist institutions such as Merck to pay anything more than a nominal fee for the raw materials it is in the business of manufacturing medicines from. If one wishes instead to attempt to continue to oppose capitalism (in the face of its seemingly impenetrable and permanent power over our lives) and oppose the commodification of biological resources by making the common heritage critique then one is wasting one's revolutionary energy by making the anti-imperialist financial and institutional critiques.

So long as the commodification of natural resources is seen as the only means by which to put them to medicinal and agricultural use the long history of biopiracy will continue. If society was such that institutions with the specific purpose of developing medicines and crop plants could be given a global democratic mandate through which a democratically approved research agenda could be established there is a chance that biopiracy could be a mere historical phenomena. Until the people of the world (can) democratically and collectively seize control of the institutions of global governance, perhaps especially including the research agendas of the biosciences, biopiracy will not be stopped. As the imperial biosciences had a significant role in forming, sustaining and managing the European empires, and, through this, in shaping the lives of their large populations, today the emperial biosciences – agricultural, medicinal and ecological – have a significant role in managing the lives of the global population. The bioprospecting sciences and the biosciences more broadly – now with an apparently popular but misunderstood "environmentalist" mandate – increasingly have control of the means of the production of both "natural" and social life on earth.

Footnotes.

[1] In 'Turkey, Afghanistan, Ethiopia, India, Southeast Asia, China, Mexico, Colombia and Peru' (Harlan, 1975: 619). These large-scale, economically and geopolitically significant projects conducted by the U.S. Department of Agriculture have retrospectively been described as major acts of biopiracy and have been discussed in terms of American neo-imperialism (Kloppenburg, 1998; Perkins, 1997). To my knowledge, no detailed study of them exists. Such work would be a valuable contribution to the history of biopiracy.

[2] See Lomborg (2001) for evidence to support the sceptics' argument that it is not, and Flannery (2006) for a contemporary argument in the apocalyptic tradition of the *Limits to Growth* report. I discuss the latter example of the influence of cybernetic thought on ecology and environmentalism further in Chapter 9. It was among the first to popularise the notion that the threat to biological resources posed by population and economic growth could and probably would become a threat to the future of capitalism and human civilization.

[3] Chapter 9 discusses the IBP and its place in the globalization of ecological and environmentalist thought that began – as symbolized by the CBD/CAB – to produce documents and policies of global governance from the 1990s.

[4] The Mexican institution had in fact been initially funded by the U.S. Rockefeller Foundation (Harlan, 1975: 620), one of the most powerful institutions in agricultural research, and with a somewhat controversial history of involvement in the developing world (Perkins, 1997). I discuss this and related issues further in Chapter 10.

[5] Schultes died in 2001. For an obituary and comprehensive bibliography of his works, see Prance (2001).

[6] Historian and anthropologist Eric Wolf's work (originally published in 1982 – before the postmodern turn in anthropology – and reprinted in 1997) constitutes a powerful argument against the fetishization of such terms as "tribal", "indigenous", and "traditional" cultures/societies/knowledge that is to be found within academic, governmental and mainstream discourses. His critique is relevant here in that ethnobotanists (including Schultes himself, who should have known better), the CBD/CAB and some of the leading critics of the Convention – such as RAFI (1994) and Shiva (1998) – all persist in referring to "indigenous" or "traditional" cultures and knowledge as if they had remained untouched by five hundred years of post-Columban history. Not only were many such "traditional" cultures entirely destroyed, those that have survived are very different to those of their pre-Columban ancestors. Wolf shows that "native societies"

> 'have often been treated by anthropologists as if they were repositories of a pre-Hispanic past untouched by three centuries of Castillian domination. Yet these communities were given organizational form by the colonial bureaucracy as integral components of the Hispanic state and its economic system... Indian communities... constitute neither "tribal" remnants of a pre-Hispanic past, nor a static type of peasant community characterized by a set of fixed attributes. They grew up in the tug of war between conquerors and conquered' (Wolf, 1997: 145, 148).

Wolf goes on to show that the same applies in North America. Many of my other sources recognise and affirm this, for example, Brockway (1979) and Schiebinger (2004). As an acknowledgement that continued reference to "traditional" and "indigenous" cultures and/or knowledge represents a peculiar form of denial of imperial history, throughout my thesis I use the terms in scare quotes. Unfortunately, there has not been space to elaborate further on this important issue.

[7] There are countless examples of arguments that the need for bioprospecting is more urgent than ever given habitat destruction and anthropogenic species loss. These include the following. Several of the conference papers collected in Wilson, (1988), especially those by Plotkin, and by Farnsworth

(Farnsworth's is especially interesting because the author had argued only a few years earlier for increased funding of bioprospecting without any reference to biodiversity loss (see Farnsworth, 1984), suggesting that to some bioprospectors at least, the environmentalist wagon provided a welcome lift but was not always considered essential); several of the essays in Akerele et el, 1991 (especially the seven separate pieces by Akerele, Botani, Farnsworth and Soejarto, Hamman, Heywood, Plotkin and Schultes); Balick (1990); Balick and Cox (1996); Bates (1985); Cox (1990); Davis (2001); Eisner (1989); Farrier and Tucker (2001) is interesting especially because the authors recognise that the environmentalist argument in favour of bioprospecting had not always been as prominent before the 1980s as it was thereafter; Grifo (1996); King (1992); Moran (1992); Peters et al (1989) is an oft-cited early example of an argument that deriving non-timber products from forests can help save them from destruction and Brack (1992) echoed the argument (Lybbert et al, 2002, presents a relatively successful recent example of this argument put into practice); Plotkin (2000) is a book-length defence of post-CBD/CAB bioprospecting and an extended advert for bioprospecting's "green" credentials but is also interesting in the authors' regret that the utilitarian argument for preservation of tropical forests is the one most likely to succeed (for an expression of this, see page 22); Posey (1992); Rausser and Small (2000); Reid et al (1993) is a book-length defence of the CBD/CAB and its environmentalist intentions – it also contains the full text of the CBD in an appendix; Schultes (1979); Schultes (1992); Swanson (1995); Tyler (1986); Weiss and Eisner (1998). The few works which affirm the potential of contemporary bioprospecting to benefit both medical science and economic development, but do not connect it to species extinction, are Farnsworth (1990), Simpson et al (1996), Brush (1999), Moran (2000) and Artuso (2002). For an extended pre-environmentalist argument for the potential medical value of bioprospecting see Kreig (1965).

[8] The Merck-INBio agreement is discussed at length in Chapter 10. Around the project all the arguments for and against the commodification of biological resources coalesce. I interpret the project not, as some of its critics have done, as an example of neo-imperialism, but as the exemplary bioprospecting project of a global society increasingly under the rule of emperial sovereignty. Chapter 9 – on early ecologists' global-technocratic ambitions and their fulfilment from the 1970s – supports this interpretation.

[9] Such references to "indigenous" knowledge as a "library" or as "information" have been controversial largely because such apparently well-intentioned humanitarian concerns within the ethno-botanical sciences, and now enshrined in the CBD/CAB, can easily look to outsiders as concerns primarily with the "information" that might be lost and only secondarily with the cultures or individuals themselves (Shiva, 1998: 77).

[10] The Convention, as well as appearing as an appendix to Reid et al, 1993, is widely available on the internet. All italics in my quotations from the Convention are as they appear in the original document.

[11] As well as the bioprospecting of *non*-human biological materials that my thesis takes as its focus there is a second major form of bioprospecting – the collection of *human* genetic material for use in the fields of population genetics and genetic medicine. A major scientific project to collect genetic material from every ethnic group was originally known in the mid 1990s as the Human Genome Diversity Project (HGDP). On this see Reardon (2001), and the brief discussion in Fuller (2002). After several attempts by the scientists and funding bodies involved to quell the controversy that attended the project from the beginning (see Pennisi, 1997) a much-revised version of the project – now known as the "Genograph Project" – eventually got underway in 2005. The Project will not involve medical research, will not "bank" the genetic samples its scientists will collect and will not seek any patents. In this way it avoided the ethical objections attendant to the HGDP. The definition of bioprospecting I use throughout my thesis excludes bioprospecting of human biological materials.

[12] Humanity's search for biological resources continues in and through the space program. On extra-terrestrial bioprospecting – "exobiology" – see Strick (2004). This, then, is a third from of contemporary bioprospecting. This is also excluded from the definition of the term as I use it in my thesis.

[13] Mass-screening methods are an alternative means of establishing the potential medicinal use of plants in which "robochemistry" technology is employed to screen any and all biological materials the Bioprospector can lay her hands on. This method avoids having to engage in the fraught practice of seeking the assistance of "indigenous" healers.

[14] The understanding of historical research and its relation to sociology of two of the leading historians of the twentieth century have shaped my own, see Hobsbawm (1997) and Braudel (1982).

[15] Desmond (1995) is a history of Kew Gardens, which, while it does not attempt to deny that Kew was an imperialist institution, lacks sociological imagination and willingness to criticise. It is more concerned with Kew's "internal" history than Brockway. The hierarchy of colonial gardens of which Kew was the head are relegated to the background of Desmond's account. Desmond emphasises Kew as a scientific institution and pleasure garden and underemphasises its geopolitical and biopolitical significance.

[16] The debate among economic historians on the issue of the net profitability of European imperialism will probably never be settled once and for all. My thesis does not attempt to take a position on it, but see Braudel (1983). Braudel is typically wise on this debate. He seems to acknowledge that cost-benefit analyses of imperial economies suggest that the total costs were higher than total profits but argues at length that imperialism was about far more than the extraction of profits. It was always also about the dissemination of European property relations, law, culture, manners, Christianity; in short, about the extension and intensification of (bio)power; the power to control the ways of life of increasingly larger populations.

[17] On the French equivalent of Kew Gardens and the equivalent but by no means identical work of French botanists and bioprospectors in the imperialist context see Spary (2000). There is much of relevance to my thesis in Spary's work which has had to excluded for lack of space.

[18] In addition to the literature reviewed here there are many works which have informed my background knowledge. For example, Bowler (1992) and Jardine et al (1996) have provided much valuable background material on the general history of the life-sciences. Two works that have informed my background knowledge of the imperialist approach to biological resources are Worboys (1990) and Kumar (1990).

[19] Two broad overviews of the enormous sociological literature on globalization from a critical perspective are Kellner (2002) and Sklair (2002). Both works have large bibliographies of the literature on globalization.

[20] Hardt and Negri in fact undervalue the role of religion, and seem to avoid those arguments that would put their ideas in the context of messianic religion. The relationship between revolutionary political thought and Christianity has been discussed at length by Löwith (1949) and Voegelin (1952).

[21] There is a large body of theoretical literature on the issue. A good starting point is Schmidt (1971). Critical theorists have had considerable difficulty handling the concept of "nature"; as Vogel shows in his (1996, 1998) discussions of the work of Alfred Schmidt and Jurgen Habermas.

[22] The consequentialist argument says that if a bioresource was obtained inequitably but subsequently helped feed millions of people (like the potato), or eased the fever of millions of people suffering from malaria (like cinchona) then the initial injustice is forgivable. This can be stated in reverse; if a bioresource was obtained without permission or payment but no individual, institution or nation subsequently profited, either in cash, knowledge or status from its procurement then, arguably, there is no biopiracy and no injustice.

[23] Lisbet Koerner lists the details of Linnaean bioprospectors' journeys, dates and destinations (1994: 149-150).

[24] If I was pushed to suggest an alternative date as the most significant in the history of British botany I would probably elect the arrival home of the first Cook voyage, an event that doesn't even get a mention in Allen's account. Indeed, his ability to write about Joseph Banks without mention of Captain Cook, Botany Bay, and so on, is symptomatic of the faults of his account.

[25] Although I am persuaded that Drayton is approaching both the history of botany and the history of European imperialism in the most appropriate way he is probably overstating the argument when he claims that 'the world, from the sixteenth century, colonized Britain' (Drayton, 2000: 171). Drayton's

approach to imperialist history – that European history, culture and society were significantly shaped by colonialism and not only the converse – follows that of Bayly (for example, 1989).

[26] For a detailed look at the acquisition and import of animals into Europe see Ritvo (1987).

[27] Drayton notes that 'France had provided the model to be imitated...' in the systematic bioprospecting of "exotic" plants (Drayton, 2000: 108). For detailed histories of French botany in the age of European imperialism see Spary (2000) and Stroup (1990). My research focuses primarily on British imperialist botany simply because the British empire was larger and more economically successful than the French.

[28] Analyses of travel writing in the age of empires are Pratt (1992), Spurr (1996) and Whitehead (1995).

[29] Some of the most prominent bioprospecting journals are those by Bates (2002 [1864]), Wallace (1890 [1869]), Darwin (1901 [1839]) and Spruce (1908). Less prominent, but most entertaining is Waterton (1903 [1802]). Secondary works that have informed my reading of these include Raby (1996), Browne (1983), Young (1985), O'Hara (1995), George (1980), Carroll (2004) and Grasseni (1998).

[30] See Harvey, 1974, for a detailed history of British nursery's funding of horticultural bioprospecting.

[31] Interestingly, given the similar tactic of some contemporary Bioprospectors, Linnaeus advised some of his students to wherever possible avoid the time-consuming scouring of jungles and wilderness and instead to follow busy trade-routes and to head for village and city markets. On contemporary equivalents to this tactic see Hayden (2003) on bioprospecting along roadsides and Martin (1992) on bioprospecting in local marketplaces.

[32] As well as the sources cited throughout the chapter my understanding of the work and life of Joseph Banks has been informed by Mackay (1979), Desmond (1995), Gascoigne (1998) and de Beer (1960).

[33] On Solander see Rauschenberg (1968).

[34] Mackay makes the common mistake of referring to eighteenth century "scientists". Although there was eighteenth century "science" its practitioners did not gain this collective name until the 1830s. On this and more relating to the professionalization of science see Fuller (2000).

[35] Brockway gives the details of Banksian bioprospectors' voyages, destinations, dates and collections, (1979: 84).

[36] Foucault's ideas on biopower and biopolitics are developed through nearly all of his works, see, for example, his essay 'Governmentality' in Burchell et al (1991) and Foucault (1987 [1984]). These ideas have been developed by scholars in many fields, including in works critical of contemporary biotechnology and bioscience, although Foucault did not use the terms in this context. Works that have been especially influential on my understanding of them include O'Neil (1986), Shiva and Moser (1995), Haraway (1997), Rose (2001), Jasanoff (2004) and Hardt and Negri (2000, 2004).

[37] For a history, written for a popular audience, but very well researched, of the voyage of the breadfruit-carrying *Bounty*, and the mutiny, see Alexander (2003).

[38] Control of sandalwood also had geopolitical significant in that 'The Dutch East India Company only took the trouble to hold on to Timor in the East Indies because of the sandalwood it obtained there to use as an exchange currency in China where it was highly prized' (Braudel 1983: 141).

[39] Over fifty years later, in 1903, the elderly Hooker received a 'telegram... from the Sikkim-Tibet Boundary Commission... [which] congratulated Hooker on the value and accuracy of the map he had surveyed and drawn'. (Musgrave et al, 2000: 85)

[40] Hove eventually spent more than seven times this sum, but because of his successful completion of his tasks Banks was able to convince the Treasury to pay his exorbitant bill.

[41] See Wolf (1997: 255) and Walvin (1995: 30), for quantitative figures on the value of tea imports and the tea trade. Walvin notes that in the early nineteenth century 'As much as 5 per cent of the English gross domestic product was involved in tea'.

[42] The Bolivian who sold cinchona seeds to Ledger was subsequently imprisoned for treason (Brockway, 1979: 119).

[43] Another work on the relationship between knowledge, information, the imperial archive and imperialist power is Bayly (1993).

[44] As we will see further in Chapter 9 the first ecologists were among those who worked on still further volumes of the imperial botanical archive, covering those parts of Africa that were ruled by other European nations. Even so, the desire to complete the botanical archives by naming every plant species remains to this day unfulfilled.

[45] There are many instances were the chronology of ecological transformations sketched here collapses or is reversed. For example, some European forests fell under forms of protection from at least the seventeenth century, while unsustainable deforestation practices continue in some parts of the world today. The mass hunting of animals often occurred in two stages, not one. First came the hunting of indigenous species – such as the buffalo of North America – then the hunting of introduced species – such as the rabbits of Australia.

[46] The significance of the "Wardian case" to the history of bioprospecting is well known. The basic principle of the Wardian case is that if plants are grown in an enclosed glass case the water in the soil is recycled, thus eliminating the need for fresh water and solving the problem of transporting living plants over long distances on sailing ships. The success of some of the major cases of biopiracy – including tea and cinchona – and many other minor cases was facilitated by the use of this mid-nineteenth century innovation. In this sense it should be considered an imperialist technology. There are several accounts of its "revolutionary" consequences. For example, see Short (2004: 329-334).

[47] We will return in Chapter 9 to the 'first realization of the harm that might occur' as a result of such major technological change, and early 'uneasiness' about Victorian society's increasing potentials for mastery of nature (Allen, 1994: 110).

[48] See Lomborg (2001) for a balanced discussion of deforestation. Despite the credibility of his figures that globally deforestation is not happening as rapidly as some of the more alarmist environmentalists would have us believe, he skirts the issue on *tropical* deforestation by noting simply that 'quite a lot of tropical forest is disappearing' (113). It is tropical forests which contemporary Bioprospectors believe most likely to contain medicinal chemicals.

[49] It seems that the first wave of the globalization of plants and animals was conducted through the early fifteenth century voyages of Zheng He, as recounted most recently, and controversially, by Gavin Menzies (2002). His intriguing argument that Zheng He reached the east coast of what is now the United States is highly controversial and his evidence is at best inconclusive, although the renowned scholar of Chinese history Joseph Needham was aware of some accounts of Zheng He's voyages that suggested he had, in an usually hot historical period, sailed across the arctic. It *is* clear though that Zheng He's various voyages did involve both the export and import of plants and animals. Chinese bioprospecting is a phenomena that deserves further attention and research.

[50] Bruno Latour's work (1993) argues in theoretical terms that the modernist deployment of a category for "nature" as split off from "society" was useful to both European science and imperialism and that the splitting off of "science" and "politics" is as untenable today as the category of "nature" is. See Latour (2004) for his more recent work on this and related issues.

[51] There is a scientific debate about at what point the "death of nature" occurred. If we take the "death of nature" to mean the moment at which "nature" came under significant human influence and can no longer be said to be "outside" of society there are at least two views. Either, it was with the industrial

revolution in Europe and the sudden increase in quantities of carbon dioxide entering the atmosphere, or with the beginning of human agriculture and the attendant sudden rise in quantities of methane entering the atmosphere. This is a debate about when to mark the start of what geologists have come to refer to as the "Anthropocene". On this see Flannery (2006: 64). In sociology and environmental history a broad range of works have discussed the significance of "nature" or the environment no longer being a non-social category. Just two examples other than those cited throughout the chapter are; Merchant (1982) and Raffles (2002). Merchant's takes a feminist perspective. Raffles' work deserves a detailed discussion for which there is unfortunately no space here. In it he shows at length how the Amazon forest, despite being routinely invoked by environmentalists as a symbol of "wild" and "pure" "nature", is as humanized and managed as any other environment.

52 It is actually inaccurate to claim this as the first conservationist legislation. Allen seems to be forgetting several Acts regarding forestry and the establishment of a royal prerogative on the felling of oak trees. However, it was the first such Act specifically regarding animal life.

53 See Latour (1993) on the entire notion of "nature" as a "modernist delusion", and Worster (1985) for further discussion of the American discourse on "wilderness".

54 On Kuhn's history of science in terms of "paradigms" see Kuhn (1996) and, for a powerful critique, Fuller (2000).

55 A few examples (from a broad range) of discussions of the hybridization of humanity and machine and/or environment and technology, which are generally postmodern and known generically as "cyborg theory", are; Haraway (1991, 1998), Wark (1994), Luke (1997) and the various essays collected in Braun and Castree (1998). Generally it seems that cyborg theorists are not aware of the early ecologists' recognition that environments already in the early twentieth were thoroughly humanized and that technology and "nature" were already amenable to analysis as a single system. Accordingly they are unaware of the early ecologists' technocratic ambitions to steer and engineer the global ecosystem.

56 At the time of the 1924 Empire Exhibition the only survey that had been conducted along ecological lines – with attempts to show the relations among species rather than simply classifying and listing them – was that of the delegates from the Union of South Africa whose 'presentation was a minor shock to established British ecologists, who realized that they could not take for granted that they were the leading ecologists of the empire' (Anker, 2001: 35).

57 The influence of cybernetics on ecology and other academic fields has been profound. Mirowski (2002) has written at length on the mutual influence of post-WWII economic theory and cybernetic theory. On the military origins of cybernetic thought see Haraway (1981-82) and Pickering (1995).

58 Huxley's Directorship was controversial from the start. In one of his first acts in the role he 'hired the philosopher Arne Naess (the cofounder of Deep Ecology) to study the semantics of the ambivalent word "democracy" as it was used in different political systems... to many delegates of the United Nations it was rather shocking to read about Leninism as one possible interpretation of democracy, and despite a high demand UNESCO never reprinted the report. The general uproar was rather damaging to Huxley, whose democratic views became suspicious, and the organization was forced to fire their leader and focus on less controversial topics, such as fighting illiteracy'(Anker, 2001: 233).

59 This is a logic that seems to have been revived in contemporary Britain, as demonstrated by Tony Blair's efforts to position Britain as a "world leader" in forming policies aimed at tackling climate change.

60 There is no space here to discuss the British human ecologists' flirtation with ideas about eugenic population control but Anker shows that. at least until they became associated with Hitler, the British ecologists did not reject such ideas.

61 Golley's invoking of Kuhn's (1996 [1962]) work on scientific paradigms and "normal science" is problematic but this is a distraction from my argument here.

[62] Hardt and Negri (2001, 239) write of how '...capital has globalized the system of sovereignty without identifying itself with any single nation-state... capital has no country and in fact resists the control of nation-states'.

[63] Note also that Ozbekhan *asserted* the "loss of the balance of nature" that the *Limits to Growth* study would then go on to present as scientific finding, suggesting that the habit within ecological science, described by Golley, of presenting conclusions *before* conducting research had spread beyond ecological "scientists".

[64] The "green revolution" is not to be confused with the rise of environmentalist politics. In fact the heavy use of artificial fertilisers and pesticides in the practices of the green revolution has been the target of environmentalists – including the leading critic of biopiracy Vandana Shiva – and now faces a backlash in the form of the rise of "organic" agriculture.

[65] Juma (1989) is an excellent source on post-imperialist Bioprospecting. However, both the practices of, and debate on, contemporary Bioprospecting were dramatically altered shortly after its publication by the 1992 CBD/CAB. To avoid confusion I have, with some regret, excluded Juma's work from my thesis.

[66] A detailed discussion of the whole issue of commodifying species in order to prevent biopiracy and as a means to ensure their preservation is Freese (1998). Unfortunately, this work only came to my attention at a very late stage of my research.

[67] Previous to the biopiracy of Norin 10 the United States, via the Office of Foreign Seed and Plant Introduction of the USDA had biopirated over 30,000 samples of plant materials from its inception at the turn of the twentieth century until WWII. Although it had 'many failures' and the vast majority of the seeds it collected found no commercial use, it had succeeded in introducing soybeans to American Agriculture in the 1920s and had developed new varieties of grapefruit and avocado from samples of plants taken from other nations. Brockway puts these acts of biopiracy under the same 'neo-imperialist' heading as I am putting the transfer of Norin 10. See Brockway (1979: 43-44). However, further historical research on the Office of Foreign Seed and Plant Introduction would be required to substantiate this claim of economic and geopolitical significance and also to provide the details of any biopolitical consequences these transfers may have had. It seems that very little historical research on what appears to be a major institution of twentieth century biopiracy has been conducted. However, see Kloppenburg (1988) and Harlan (1975) for limited accounts.

[68] However, if distribution was differently organized there would be no starvation. Poverty and starvation are (social-political) problems of distribution not (economic-technological) problems of production.

[69] The relative success or failure of this "food weapon" is another debate, and is outside the boundaries of my thesis.

[70] My research began with a brief study of the historical phenomena of piracy and "profiteering", which showed that piracy was a significant source of profit not only for individuals but for states, see Pérotin-Dumon (1991). In this, "biopiracy" is an apt term for the imperialist acquisition of valuable biological goods.

[71] Only two other examples of post-Convention Bioprospecting come close to rivalling the Merck-INBio agreement in ambition and significance. The first are those Bioprospecting projects conducted by a small pharmaceutical company known as "Shaman Pharmaceuticals", which was started by students of Richard Schultes in the early 1990s with the specific aim of developing drugs from ethnobotanical leads and sharing the benefits with the individuals and communities whose advice was taken. After gaining contracts from Eli Lilly and Merck to identify chemicals for use in anti-diabetes drugs, producing a considerable quantity of intellectual property, and incurring the wrath of the anti-biopiracy campaign group RAFI, the business quietly dissolved in 2000, having developed no marketable products. On this see RAFI (1994), Sheldon and Balick (1995), King et al (1996) and Carlson et al (2001). The second was the bioprospecting project jointly operated by the United States' International Cooperative Biodiversity Group (ICBG – a body co-funded by the NIH, NSF and USDA

to promote drug discovery and conservation as compatible aims), the University of Georgia, a small British biotech company (Molecular Nature Inc) and the Mexican government (whose then-President Ernesto Zedillo is said to have been persuaded of the potential value of bioprospecting projects to the Mexican economy). The project, like Shaman Pharmaceuticals' business plan, and the Merck-INBio agreement was specifically designed according to the model set up by the CBD/CAB. However, like both of these two Bioprospecting plans, it failed to result in any profitable drugs being developed. In fact, after being branded as biopiracy by RAFI and other activist groups, and achieving local notoriety at a time of political unrest in Mexico, the project was disbanded by mutual agreement of the Mexican government and the ICBG less than two years into a planned five year program. On this see Hayden (2003), RAFI (1999), Anderson (2002) and Nigh (2002). The high hopes for "conservation and development" through post-Convention-style Bioprospecting came to nothing in these two cases. The Merck-INBio agreement also failed to result in any profitable drugs being brought to market, but the Costa Rican conservation program did at least receive $1 million.

[72] My sources on the Merck-INBio agreement are Eisner (1989), Blum (1993), Joyce (1994), the essays collected in Reid et al (1993), especially that by Sittenfield and Gámez, RAFI (1994), Kaiser (1997), Shiva (1998) and Hayden (2003).

[73] This was only one year after the term "biodiversity" had become the fashionable new replacement for the increasingly defunct concept "nature".

[74] Joyce lists the original contributions, as well as a relatively small sum from the Costa Rican government, as being received from 'The MacArthur Foundation, the U.S. National Science Foundation, the Pew Memorial Trust, the W. Alton Jones Foundation, the government of Sweden, and environmental groups like the Conservation Foundation [and others]' (Joyce, 1994: 118). The coming together of a range of private, philanthropic, governmental and environmentalist institutions toward a common end is indicative of the formation emperial sovereignty and the inadequacy of opposing contemporary bioprospecting in the terms of opposition to neo-imperialism.

[75] The clauses of the Convention regarding traditional knowledge do not apply in this case; there are no "traditional" cultures residing in Costa Rica's national parks.

[76] Kloppenburg (2000) also sees post-Convention Bioprospecting as biopiracy but is slightly more subtle than RAFI and Shiva.

[77] My thesis has excluded discussion of marine bioprospecting – the search for biological resources in the oceans – because large parts of the oceans remain "the common heritage of humankind". That is, all resources taken from seas which are 250 miles from land are still considered "there for the taking" (except those fish "stocks" subject to international quota and those considered endangered). Marine bioprospecting is not regulated by the CBD/CAB and as such is outside of my field of research. But on this see Rehbock (1979), Vanderpool (1983) and Anderson (1995). For the discussions of "common heritage" that have most directly influenced my understanding of the concept see Chemillier-Gendreau (2002), Brush (1996) and Kloppenburg (1988).

[78] The institutional critique is made in various forms by Posey (1990), Castillo (1992), Nabham et al (1996), Patel (1996), Brosius (1997), de Koning (1997) and Takeshita (2000). In different ways these works raise the question of (whether and) how to put a value on indigenous knowledge and of how to ensure that financial benefits from bioprospecting are indeed returned to those whose advice was taken during bioprospecting projects. Together they constitute a heated debate on the whole issue of converting knowledge into property. See also the works critical of the premises of the CBD/CAB that I have cited throughout. Two useful discussions of the broader issues surrounding intellectual property but which do not directly discuss bioprospecting and the Convention are Croskery (1989) and Fuller (2005). For a history of industrial espionage and the commodification of knowledge in terms of a history of intellectual property see Ben-Atar (2004).

[79] Janzen's belief in the potential for revenues from Bioprospecting contracts to contribute to nations' economic development has, so far at least, turned out to be false. No medicine derived from a developing country's plants has been brought to market, or even patented in the post-Convention decade. This renders somewhat moot the financial critique of contemporary Bioprospecting. For

arguments that contemporary Bioprospecting is not likely to provide substantial economic revenue to developing nations see Firn (2003), Macilwain et al (1998) and Mulligan (1999).

[80] The 1999 annual "Human Development Report" of the United Nations Development Programme recognised the parallel between "biorich" and "oil rich" nations; 'In the same way that many Arab states benefited from industrialization's thirst for the petroleum that lay beneath their land, so now biorich countries could have the chance to benefit from biotechnology's demand for the rare germ plasm found on their land' (UNDP: 1999: 70).

[81] RAFI is a charitable organization active in raising public awareness of the activities of agricultural, medical and other technoscientific corporations. At the time it made its criticisms of the CBD/CAB and the Merck-INBio agreement it was known under the title Rural Advancement Foundation International. Today it is known, as "the ETC group" (pronounced "the etcetera group").

[82] For just one example of many objections to "patents on life" see Fowler (1995). RAFI sometimes have a tendency to imply that the Convention mandates such patents. It does not. It mandates patenting of medical products which may or may not derive from the collection of biological materials and "traditional knowledge" of them, but not patenting of biological material itself.

[83] In this Shiva is ignoring the major environmentalist disasters that occurred in the former Soviet Union. She identifies capitalism, rather than industrialization more generally, as the root cause of environmental crises.

[84] Kloppenburg also anticipates the institutional critique of such an initiative; 'A principle problem with establishing a compensatory framework for plant genetic resources is that they are distributed unequally within the Third World' (1988: 288), and that it would therefore be difficult to establish who has the most legitimate claim to any benefits that were accrued. His proposed solution was a multilateral institution that would redistribute the revenues gained from the sale of samples, while the Convention set up a bilateral distribution system, which, as its critics reasonably argue, is far from perfect. Kloppenburg proposed the extension of already existing international herbaria or "gene banks" or the creation of a new, fully comprehensive international "Plant Gene Fund" paid for by the 'advanced industrial nations' who would buy the rights to utilize the samples contained within it; their fee would then be distributed to the nation or nations in which it was found (289). This idea still has some merit, but in a global society where the institutions of global governance have no direct democratic mandate it would be as imperfect as the contemporary bilateral redistribution mechanisms.

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