

‘Amsterdam is Standing on Norway’ Part I: The Alchemy of Capital, Empire and Nature in the Diaspora of Silver, 1545–1648

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In the first of two essays in this Journal, I seek to unify the historical geography of early modern ‘European expansion’ (Iberia and Latin America) with the environmental history of the ‘transition to capitalism’ (northwestern Europe). The expansion of Europe’s overseas empires and the transitions to capitalism within Europe were differentiated moments within the geographical expansion of commodity production and exchange – what I call the commodity frontier. This essay is developed in two movements. Beginning with a conceptual and methodological recasting of the historical geography of the rise of capitalism, I offer an analytical narrative that follows the early modern diaspora of silver. This account follows the political ecology of silver production and trade from the Andes to Spain in Braudel’s ‘second’ sixteenth century (c. 1545–1648). In highlighting the Ibero-American moment of this process in the present essay, I contend that the spectacular reorganization of Andean space and the progressive dilapidation of Spain’s real economy not only signified the rise and demise of a trans-Atlantic, Iberian ecological regime, but also generated the historically necessary conditions for the unprecedented concentration of accumulation and commodity production in the capitalist North Atlantic in the centuries that followed.

Keywords: environmental history, transition to capitalism, political ecology, world-systems analysis, historical geography

In history up to the present it is certainly an empirical fact that separate individuals have, with the broadening of their activity into world-historical activity, become more and more enslaved under a power alien to them . . . , a power which has become more and more enormous and, in the last instance, turns out to be the world market . . . [Thus,] the transformation of history into world history is not indeed a mere abstract act on the part of the ‘self-consciousness,’ . . . or of any other metaphysical spectre, but

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Very special thanks go to Diana C. Gildea, Richard A. Walker and Henry Bernstein for encouraging this project at more than one decisive juncture. Thanks also to T.J. Byres, Carole Crumley, Jessica C. Marx, MacKenzie Moore, Jeff Sommers, Dale Tomich, John Wing, Wendy Wolford, and two anonymous referees for invaluable commentary and discussion. This essay is dedicated to Giovanni Arrighi, who helped me learn how to write world history as if the world depended on it.

a quite material, empirically verifiable act, an act the proof of which every individual furnishes as he comes and goes, eats, drinks, and clothes himself.

– Karl Marx and Friedrich Engels (1846, 55, 58)

INTRODUCTION

It is said that one cannot be in two places at once. It is a truism. But is it true? ‘Amsterdam is standing on Norway’ – a popular saying in the Dutch Republic of the seventeenth century – is a curious expression, but one that ably captures the essential point. Amsterdam, the crown jewel of seventeenth century capitalism, was built atop a veritable underwater forest of Norwegian origin (Sögner 2004, 47).¹ To set foot on an Amsterdam wharf was, in a quite tangible way, to stand on Norway. But there was more to it than this.

To be sure, to say that Amsterdam stood upon Norway suggests a kind of colonial relation – not nearly so pronounced as in sixteenth century Poland (Malowist 1959), and yet not so very different either. To identify natural resource flows implicates a certain logic of ‘ecological’ imperialism (Foster and Clark 2004; Bunker and Ciccantell 2005). And to highlight ecological imperialism brings one on to the terrain of early modern environmental history (van Dam 2001; Richards 2003). It is my intention to push these three moments – roughly, a critical economic history, historical sociology and environmental history – towards a higher synthesis. I will argue that the rise of capitalism is best understood through the emergence of a peculiar kind of *place*, one in which the production of nature (capitalism as world-ecology) and the production of capital (capitalism as world-economy) were two sides of the same coin. The endless accumulation of capital and the endless conquest of nature reveal distinct moments of a singular world-historical process. *Capitalism as world-ecology*, then, signifies a patterned and expansionary matrix of nature-society relations that responded to – and variously enabled and constrained – the gravitational pull of world accumulation (Moore 2003b).

In what follows – the first of a two-part essay in this *Journal* – I seek to unify the distinctive (yet overlapping) concerns of the historiography of ‘European expansion’ (Iberia and Latin America) and the ‘transition to capitalism’ (northwestern Europe).² The expansion of Europe’s overseas empires and the sharply uneven (and exuberantly combined) transitions to capitalism within Europe were differentiated moments within the geographical expansion of commodity production and exchange – what I will call the *commodity frontier*.

Part I is developed in two movements. Beginning with a conceptual and methodological recasting of the historical geography of the rise of capitalism, I offer an analytical narrative that follows the early modern ‘diaspora of silver’ (Stein and Stein 2000, 40). This account follows the political ecology of silver production and trade from the Andes to Castile in Braudel’s (1953) ‘second’ sixteenth century (c. 1545–1648), revealing Philip II’s bid for world power as an ecological no less

¹ Sögner (2004) credits the expression to Holger Jacobaeus (1650–1701), a Dane who lived in Leiden and later became rector of the University of Copenhagen.

² Vast literatures both. For starters, see respectively Davis (1973), Parry (1966), Boxer (1969), Tracy (1990), Hilton (1976), Aston and Philpin (1985), Brenner (2001) and DuPlessis (1997).

than social project. Silver appears as a double optic, on the one hand offering a vantage point on flows of capital and imperial power, on the other, a window on the production of nature. Where economic history and historical sociology have privileged the former, and environmental history the latter, the full complexity of the multi-layered and cascading transformations of capital, empire and socialized nature come into view only by drawing these two moments together in dialectical unity.

In the next instalment (Part II), we will see how the socio-ecological contradictions of the Castilian project linked up with the rise of the Dutch to world hegemony. The rise of the United Provinces to superpower status was premised on a global ecological revolution of unprecedented scale, scope and speed. While this ecological revolution found expression from the Spice Islands to northeastern Brazil, its epicentre was an extended North Atlantic zone, one whose global reach would stretch to the iron smelters of the Ural Mountains, the sawmills of Finland and the cod fisheries of the northwestern Atlantic by the end of the eighteenth century.

This was far from the precipitation of a narrowly Smithian logic, with rising demand driving the geographical expansion of a reified 'Europe'. Rather, on display throughout the early modern era was the logic of the commodity frontier (Moore 2000b, 2007). Ecological contradictions mobilized by the expansion of commodity production and exchange implied and indeed necessitated regional ecological crises. These were resolved, recurrently, through renewed geographical expansion. The precise contours of this epochal shift in the geography of civilizational expansion will be elaborated in what follows. We may cut to the heart of the issue from the outset. There is no question that for several millennia, Afro-Eurasia's civilizations had practiced *resource* frontier expansionism as a means of attenuating regional ecological crises (Hughes 2001; Elvin 2003). By the 1450s, however, Europe began to diverge sharply from this pattern. Commodity production and exchange, a long-standing aspect of civilizational expansion, was fast becoming an end unto itself. *Commodity frontiers* increasingly supplanted resource frontiers. Global expansion rather than regional accretion became the first, best response to socio-ecological problems. And where expansion once eased tensions engendered by demographic pressure, an ascendant capitalism turned this logic on its head. Always before, commerce followed people. Now, people followed the commodity.

Such expansion did not spring forth from a fully formed capitalist order but, rather, was a condition of its very birth. What took medieval Europe centuries – settler expansions, mining booms, forest clearance – early capitalism achieved in mere decades. Everything moved faster. The socio-ecological exhaustion of established production zones – in metallurgy, forestry and sugar planting above all – was now overcome in rapid succession. Freiberg would give way to Potosí (silver), Neusohl to Falun (copper), Madeira and São Tomé to Pernambuco and Bahia (sugar), Stavanger to the abundant forests of Danzig's vast hinterland. Driven by an unstable confluence of inter-imperialist rivalry, social conflict and capitalist competition, the genius of early capitalism's commodity frontier strategy was to sacrifice extra-human nature on the altar of abstract social labour and the law of value. The goal was to maximize labour productivity by treating uncaptialized

nature as a substitute for machinery.³ At every turn, land (forests, silver veins, fertile soils) was organized by empires, planters, seigneurs, yeoman farmers and many others, *as a force of production in servitude to the commodity form, as a mechanism for maximizing the productivity of labour*. There was a new valuation of nature taking shape in these centuries, one that had everything to do with the law of value. The productivity of labour, not land, would shape the (bio)rhythms of accumulation.

This logic underpinned the emergence of capitalism as a new sort of place in the history of humankind. And so we might ask: Could the early modern Dutch merchant or the Castilian *hidalgo* be in two places at once? Yes and no. To be sure, one could hardly walk down the streets of Potosí and Amsterdam on the same morning. And yet, over the course of the long sixteenth century (c. 1450–1640), it was increasingly the case that whether one happened to be frequenting the markets or prowling the bawdy houses of Potosí or Amsterdam, one inhabited different places and the very same place, *all at the same time*. This was the place of Braudel's 'vast but weak' capitalist world-economy (1961).

Here was a place to be reckoned with. A big place for sure, and a place full of many other places without a doubt, but is this not true even of small towns and neighbourhoods?⁴ Perhaps not fully modern (what is?), but unquestionably a place that was *increasingly* modern in a powerfully geographical sense; namely, one in which local history is transformed into world history – not as 'a mere abstract act . . . but [as] a quite material, empirically verifiable act'. After 1492, developments on one side of the Atlantic were ever more crucial to those on the other. They were, in the language of climatology, 'teleconnected' (Bjerknes 1969). The teleconnections might be strong and immediate; operate subtly, so as to obscure their full significance; become weaker or more forceful over time, depending on regional location and global shifts. For all of our qualifications, these connections were at all turns in motion after 1450. *This* is amongst the irreducible geographical facts of the modern world.

THE GREAT FRONTIER AND COMMODITY FRONTIERS: EUROPEAN EXPANSION OR CAPITALIST ADVANCE?

How this curious sort of place, the capitalist world-economy, came to be is a matter of some debate. My position can be stated simply. Capitalism, if by this we mean a

³ The 'natural fertility of the soil can act like an increase of fixed capital' (Marx 1973, 748).

⁴ 'Place has to be one of the most multi-layered and multi-purpose words in our language' (Harvey 1993, 4). Although my angle of vision differs from Harvey's, he is quite correct in steering for the middle ground between unyielding universalism and particularity, 'that opaque world of supposedly unfathomable differences in which geographers have for so long wallowed' (1993, 5). As Taylor puts it, 'place can exist at different scales. This is not always the way that place is interpreted. There is a widespread tendency to equate place with local . . . There is good reason why places are often viewed as local, "humanizing" space is most easily accomplished through micro face-to-face contacts. But there is no need to limit place-creation to this one process, especially in political studies where the imagined community of the nation with its homeland place is central to so much research . . . Providing place with the same multiple-scale property [relations as space] means that relations between place and space can be explored beyond the local up to and including the geographical limit of the whole Earth as both place and space' (1999, 98–9). From a much different geographical perspective, but making the same argument about place as irreducibly multi-form and also multi-scale, see (Tuan 1977, esp. 194–260).

historical system premised on endless accumulation, emerged out of the global conquests of the 'long' sixteenth century. It was, in other words, inseparable from Webb's 'Great Frontier', an epochal movement of geographical expansion that Webb (1964) believed was limited to the New World, but which in fact also included northern Europe. The point can hardly be overemphasized. *Capitalism did not form within Europe and then expand.*

There is no denying that early capitalism was a ramshackle affair. If a broadly capitalist logic of ceaseless accumulation had scaled the commanding heights of the European economy by the sixteenth century, such command was, for the moment, exercised on exceedingly weak foundations. One is tempted to say that this was because capitalism had yet to plumb the depths of everyday life. This is the Braudelian distinction between capitalism as a shadowy and 'relatively autonomous' zone of financial accumulation and an essentially unchanging *biological ancien régime* (Braudel 1981, 1982, 1984; Arrighi 1994, 26). It is a distinction with deep roots as well in many Marxist conceptions of merchant capitalism, what Banaji calls a 'schematic and overstated' contrast between capitalism as commercial system and mode of production (2007). But I think Banaji gets the problem inside-out. It is not so much that merchants were spearheading the transformation of commodity production in fifteenth century Europe. Rather, the merchant-banking houses of south Germany emerged through, indeed *owed their very existence to*, active involvement in commodity production – for instance, the great Hungarian copper mines of Neusohl (Banská Bystrica) (Vlachovic 1963; Moore 2007, chapter two).

Early capitalism reworked material life in ways fundamentally different from the feudal era. Part of this was the sheer scale of transformation. Possibly more significant than scale, however, was *speed*. The one reinforced the other. In the century or so after 1450, we see remarkable ensembles of technical innovations and geographical shifts: in silver mining, from the *Saigerprozess* of the Saxon Erzgebirge to mercury amalgamation in the Americas; in sugar production, from edge-runners and small-holding in Madeira to the two-roller mill and large-scale slave production in São Tomé; in forestry, the appearance of sawmills in timber zones, beginning in fifteenth century Germany, moving in truly revolutionary fashion to Norway after 1500; in ironmaking (and everything demanded iron), the diffusion of blast furnaces, making possible not only rising production, but also making necessary constant revisions in the geography of leading iron centres; and in shipbuilding, new ships (caravels) that emerged to transgress and then govern oceanic spaces. Nor should we forget the crucial instruments that would bring bourgeois order to time and space. 'The clock, not the steam engine', Lewis Mumford (1934, 14) reminds us, 'is the key machine of the modern industrial age.' Was it coincidence that precisely in the 'middle of the fifteenth century . . . spring-driven clocks and watches appeared' (Mokyr 1990, 50)? It was also a century of revolutionary advance in mapmaking. The cartographic revolution launched in Portugal during the 1430s had found its way to the Low Countries a century later, culminating in Mercator's famous projection of 1569 (Brotton 1998).

The stage for this remarkable efflorescence had been set by the crisis of feudalism. This is a major story in itself, and one that pivoted on the ecological moment of Bois' declining rate of feudal levy (1978). Five centuries of feudalism's 'uncontrolled expansion had been purchased on credit using as collateral Europe's natural

resources, which were being rapidly depleted' (Bowlus 1980, 94). The central problem was the soil exhaustion engendered by feudalism's class contradictions. Around 1300, agricultural innovation (such as it was) and geographical expansion – the chief means attenuating these class contradictions – were unable to keep pace with population growth and the rising demands of the states and seigneurs. As I have argued elsewhere (Moore 2002a; Moore 2003a, 102–19), feudalism's fate may already have been sealed prior to 1348. Less certain, however, was the nature of the social system that would succeed it. More than any other event, the Black Death at once signed feudalism's death warrant and favoured a capitalist rather than tributary solution to Europe's crisis.

The long fourteenth century crisis (c. 1290–1450) not only eviscerated the apparatus of feudal domination by removing the demographic surplus that was its foundation. The crisis had also worked powerfully to change the balance of class forces in the western European countryside. These now favoured peasant, not lord. The states and seigneurs strove mightily to reimpose serfdom, but to no avail. This contracted the surplus available to the states and seigneurs, who responded by trying to win in battle what they had lost in the class struggle, inaugurating a long century of endless warfare (North and Thomas 1973, 80–1; Wallerstein 1992).

As a general rule, 'European' expansion would thenceforth privilege commodity relations. In putting it this way, I have stuck to the convention – the 'expansion of Europe' in the traditional scheme of things is set into play with the colonial and mercantile advance into the Americas, Africa and the Indian Ocean. But is this perhaps an instance of confusing the parts for the whole? On the one hand, it is certainly true that the new empires of western Europe vigorously pursued coercive-intensive strategies that aimed at controlling the extra-European world. That they did so largely in the fashion of long-standing 'redistributive' empires, especially in South and East Asia, is hardly in doubt (Pearson 1987). But were not these movements of 'European' expansion also directed towards frontiers *within* Europe, now propelled by the competitions of capitals alongside the rivalry of empires? Was not this intertwining of capitalist and territorial power among the hallmarks of the rise of capitalism, a transition marked by the long-run extension of commodity relations within and outside the European theatre? From this line of questioning, I have come to doubt that the geographical expansion of European power is best characterized as, well, *European*. By the 1450s, the recovery from the long medieval crisis had set new dynamics in motion. The extension of the geographical arena for commodity production and exchange was now in the vanguard. This was the road to surplus accumulation at the dawn of the modern world.

This new road to accumulation – the endless accumulation of capital – was blazed by the commodity frontier. To say that European expansion was in part driven by a relentless search for raw materials is in itself hardly a novel contention. If, in its crudest expression, the thesis is easily rendered a straw man, its kernel of truth nevertheless deserves to be woven into a more dialectical accounting of capitalism as world-ecology. We might fruitfully conceptualize the political ecology of the rise of capitalism in terms of a dialectic between the ever-mounting material-throughput demands of an ever-growing mass of capital *and* the ever-mounting biophysical degradation that ensues through the endless accumulation of this capital.

Pivoting on this commodity frontier strategy, the uneasy fusion of merchant-finance capital, commodity production, seigneurial power and imperial projects that accompanied, and indeed enabled, the first tentative advances towards the capitalist mode of production after 1450 effected two world-historical ruptures of signal importance. In the first instance, as we have argued, ecological wealth – from forests, fields, mines and labouring classes – would be extracted in the quickest way possible (extracted, we should note, from these agrarian spaces and conveyed into urban-centred production and accumulation). Waste was of little concern so long as it failed to enter the register of profitability. Second, the acceleration of socio-ecological contradictions within regional production complexes gave rise to recurrent movements of geographical expansion. The rapid movement of ecological overdraft with successive commodity frontiers undermined the socio-ecological conditions of production and therefore the conditions of profitability – *typically within 50–75 years in any given region*. These conditions were not simply biophysical; scarcities emerged through the intertwining of resistances from labouring classes, biophysical shifts, capital flows and market flux. Once the extraction of this regionally delimited ecological wealth faltered, this modern instantiation of the 'metabolic rift' compelled the search for new commodity frontiers (Foster 1999; Moore 2000a).⁵

In commodity frontiers as ecologically diverse and geographically distant as North Sea fisheries, Norwegian timber, Brazilian sugar, Peruvian silver and Polish cereals, a succession of commodity regimes ascended to strategic primacy in world accumulation over the course of 50–75 years, only to meet with relative decline just as rapidly. (Regional booms therefore did not lead generally to the absolute collapse of commodity production – as was the case in Europe's long fourteenth century crisis. Rather, regional sugar, or timber, or silver complexes became, at best, second-tier producers – Potosí produces silver even today.) Thus Antwerp's, and then Amsterdam's, successively more expansive metabolic rifts during the long sixteenth century, and the commodity frontiers they entrained, cannot be comprehended solely in terms of rising demand for raw materials and grain. The emergence of the modern world market not only entrained rising demand, but implied an ecological regime that undermined the socio-ecological conditions to satisfy this demand. To stay ahead of the curve, capitalism needed a geographical dynamism that consistently identified and enclosed new greenfields, and it amply rewarded those agencies who succeeded in doing this. Otherwise, the regional exhaustion that invariably issued would generate rising prices for food and raw materials at a system-wide level, squeezing manufacturing by driving up the cost of subsistence (for the labouring classes), the cost of inputs (for manufacturers), or both. It is this geographical dynamism of early capitalism that explains a big part of the difference with feudal Europe. Feudal Europe came to an end because it could not secure external frontiers faster than it exhausted the socio-ecological bases of production (Lewis 1958; Moore 2002a).

This expansion was fundamental to the consolidation of the system within Europe, no less than outside it. The full import of these regional transformations can

⁵ In this way we can see the complementarity between two sometimes warring camps within Marxist ecology – O'Connor's emphasis on the 'second contradiction', where capitalist development undermines its socio-ecological conditions (1998), and the Foster's theory of metabolic rift, where the town-country antagonism creates nutrient exhaustion in the countryside and pollution in the cities.

therefore only be assessed in the light of an ecohistorical matrix that compelled ceaseless efforts to reduce turnover time in concert with maximal resource-extraction, accelerating the rise and demise of raw material zones beyond anything known in previous modes of production. The upshot was a succession of commodity frontiers in many basic sectors of the European economy – from forest products to grain, from metallurgy to whaling.

Thus early capitalism as a whole developed so rapidly *because* it generated successive local ecological crises, not in spite of them. These contradictions developed most rapidly and most extensively in those regions entirely new to commodity production (such as the New World), or in those places where the ‘natural economy’ was historically predominant (such as northern Europe, the focus of Part II). In these zones, the implantation of commodity production latched on to indigenous ecological wealth (including local supplies of labour power), drawn into the circuit of capital as a ‘free gift’ (Marx 1967, III: 745). The ensuing rapid commodification of land and labour pushed these regional ensembles of Polanyi’s ‘fictitious commodities’ (1957) to breaking point. The stage was set for the rapid exhaustion of land and labour, establishing a remarkably consistent cyclical phenomenon of boom and bust. Thence the search for new frontiers began anew, and with it the cycle of expansion, crisis and expansion.

This was the foundation of an ecological regime predicated on the spatial fix of endless conquest. By-passing the empowered peasantries of late medieval western Europe, the recurrent extensions of commodity frontiers in the Americas and in northern Europe satisfied capitalists, nobles and Crowns, although never all equally. In this fashion, feudalism’s tendency towards a declining rate of seigneurial levy (Bois 1978) was at first greatly attenuated by – and combined with – commodity-centred expansion. Over time, it was largely displaced. Global expansion enabled a way out of premodern cycles of boom and bust whereby commercial efflorescence invariably gave way to demographic–ecological crises. The emergent capitalist world–ecology would consistently export those crises by extending its hegemony through the endless commodification of nature. By 1492, it seems, Europe’s ruling strata had discovered not just America, but a new and radically transformative political ecology of expansion.

Here was an epochal transformation of time and space indeed, some three centuries before the Industrial Revolution.

POTOSÍ, CASTILE AND THE REMAKING OF TRANS-ATLANTIC ECOLOGY

If early capitalism was a place, the tasks of unravelling its mystifications necessarily involve a ‘dialectical tacking’ between inside and outside, large and small, and the manifold ways in which these were reworked. Such a dialectical tacking brooks neither nomothetic conceit nor idiographic temptation. We are dealing with totality and we are dealing with fragments; the challenge is to resist the temptation to ‘becom[e]’ mired in the vastness of particularisms . . . without incarcerating complex and contradictory social experiences within the prison house of . . . “epochal labels”’ (Pred and Watts 1992, 2).

It turns out that this sort of argument has been easy to advance and difficult to realize.⁶ The early modern 'diaspora of silver' offers a signal opportunity to advance this approach. In what follows, I track American silver from its motherlode at Potosí after 1545 to Castile, tacking back and forth between unstable articulations of commodity production, colonial rule, peasant agriculture and imperial projects on both sides of the Atlantic. The story of American silver – around which swirls, to this day, one of the great historiographical debates of the past century (Hamilton 1934; Flynn and Giraldez 2002) – only superficially turns on the role of monetary circulation. My approach takes the mining pit rather than the countinghouse as its point of departure. Here, we find the motive tension of the rise of capitalism in the ecological contradictions of the value form itself, tearing apart the 'natural distinctiveness' of particular commodities (and the socialized natures implicated in these) in favour of their 'economic equivalence' (Marx 1973, 141). We begin and end with the transformation of production, and therefore begin and end with the production of nature in a thoroughly modern sense. At its core, this was the tendency to treat nature as a 'free gift', through which ecological wealth is extracted in unsustainable fashion, a contradiction resolved and extended through successive moments of geographical expansion. The extraction of silver from the Andes was made possible by an ecological revolution of a strikingly modern cast. Spanish Peru after 1545 was reshaped to serve Castile's imperial ambitions, and the faceless logic of accumulation for accumulation's sake. It is a story of capitalist dynamism attended by all manner of human and ecological devastations – widespread deforestation, the destruction of indigenous agriculture, catastrophic flooding, the spread of famine and the imposition of structural food insecurity, not to mention the wholesale resettlement of more than a million souls into Spanish-style towns, the first of modernity's strategic hamlets.

And this is where the discussion of American silver often ends. But the transformation of the Andes was part and parcel of the transformation of Europe. In this essay (Part I), we take up this trans-Atlantic dialectic against the backdrop of Spain's imperial project. Far from vanquishing its rivals, Spain's permanent war strategy accelerated its own decline, fuelled the rise of its chief rival, the United Provinces, to world power, and hothoused the extension of commodity production and exchange throughout the North Atlantic. The environmental history of the capitalist North Atlantic, the subject of the next instalment of this argument (Part II), is explicable only in terms of the 'diaspora of silver', the transformation of silver as the chief representative of value, and its epochal role as a 'highly energetic solvent' (Marx 1973, 507) of seigniorial and peasant forms of production.

The Rise of Potosí, 1545–71

The discovery of Potosí in 1545 ranks amongst the signal events in modern world history. It was not simply that the Cerro Rico was an 'unparalleled geological fluke' (Bakewell 1988, 16). This it surely was. The Cerro Rico was the world's greatest silver deposit (Cunningham et al. 1996, 374). But Castile's stroke of geological good

⁶ Several promising efforts suggest themselves: Pred and Watts (1992), McMichael (1990) and Tomich (2004). Elsewhere, I have argued for a production of scale method, developing what I have called a 'shifting unit of analysis' approach (Moore 2002b).

fortune went even deeper. Potosí's dramatic ascent owed as much to Europe's expansionary political ecology as it did to geology. When the Spanish stumbled upon the Cerro Rico, here was a moment of 'Discovery' in its distinctively modern sense. It was an act of appropriation that rested upon the peculiar crisis-creating and crisis-fixing strategy of early modern capitalism, the commodity frontier. The crisis of Central European silver mining – following the great metallurgical boom of 1450–1530 – was the first precondition of Potosí. The great wave of European silver mining had already crested by the 1530s. The decline of Saxon and Bohemian silver mining was *reinforced* by the rise of Potosí; it was not a consequence of it (Moore 2007, chapters two and three).

The relocation of silver mining to the New World offered a near-perfect combination of favourable ecological and social conditions, fabulously rich ore deposits and accessible sources of cheap labour power. If Europe's mining complex faced formidable obstacles at home, in the New World it could play a decisive role in fundamentally reshaping the hemisphere's socio-ecological order. At the core of this hemispheric reconstruction was city-building, the lynchpin of Spain's colonial strategy. This approach, 'the direct opposite of the British gradualistic model, permitted Spain to conquer and control an entire continent in a few years with a very small occupying force' (Portes 1977, 61). The Spanish colonial city was the vanguard of imperial advance. 'From it the Spaniards moved out to a hostile environment to conquer, control, and indoctrinate the surrounding populations. Conquerors lived, by and large, in the city, while the conquered remained in the countryside' (*ibid.*; also Mumford 2004).

On the mining frontier, this urban-imperial logic was carried to new heights. At once dominant and dominated, mining boomtowns ruled over the surrounding countryside, even as they were subordinated to broader imperial and economic structures. They were the organizing centres, not only of underdevelopment in the economic sense, but of a profoundly unequal ecological exchange between American peripheries and European cores, enabling (and enabled by) a new, multi-layered and globalizing town-country antagonism. The mining frontier thereby created an increasingly serious rift in the metabolism between the country and the city – Foster's metabolic rift (1999) – within Latin American regions, and at the scale of the world-economy. Nutrients flowed from country to city within the New World, and thence from urban centres in the periphery to the core. But it was not merely 'nutrients' that flowed in the form of food, fuel and raw materials. These flows were mediated and enabled by the mobilization of labour power. The new commodity regime exhausted labouring bodies long before it exhausted extra-human nature. And it was the progressive exhaustion of the human and extra-human conditions of production that made for recurrent pressures to extend the catchment zone.

Nowhere did the socio-ecological contradictions of this commodity frontier strategy appear more starkly than in Potosí, located in the Viceroyalty of Peru (present-day Bolivia). The New World accounted for 74 per cent of the world's silver production in the sixteenth century (Barrett 1990, 225). The largest producer, Potosí's output dwarfed that of Zacatecas (Mexico) by a factor of seven (Brading and Cross 1972, 571; Garner 1988, 911). Almost overnight, Potosí emerged as one of the European world-economy's largest cities – with 120,000 in 1610, it was bigger than Amsterdam (80,000), London (130,000), Sevilla and Venice (both

150,000) (Kamen 1971, 21; Bakewell 1988, 191). Together with the mercury mines of nearby Huancavelica, Potosí's silver complex pioneered a rapid expansion of commodity production throughout the Viceroyalty of Peru and the nascent world capitalist system, with profound implications for the health of land and labour alike.

In the quarter-century following the 1545 discovery of silver on the Cerro Rico, mining and smelting remained largely under Indian control. Indians mined silver ore, much of which found its way into Spanish hands as tribute. These in-kind tributary payments were then sold back to the Indians, who smelted the ore in thousands of *guayras*, small wind-ovens designed for the high altitude. 'It was a pleasant sight in those days to see eight, ten, twelve or fifteen thousand of these Fires burning all at the same time' (Vega 1608, 347; also Espinosa 1628, 623). Subsequently, the Spaniards acquired the pure silver through the market, where their purchasing power was augmented by control over the highly lucrative coca leaf trade (Cobb 1947, 117–99; Cole 1985, 3–4).

Transaction costs remained high, but the arrangement worked so long as ores remained rich. In the first two decades after Spain's formal enclosure of Potosí, the ores were extraordinarily rich. By the 1560s, however, *guayra* smelting faltered, as the yield on Potosí ore fell by 98 per cent from two decades earlier (Cobb 1947, 124). Fuel costs began to rise, and silver output fell by two-thirds between 1546 and 1571 (Bakewell 1987, 239). As surface deposits were mined out, the work became more arduous and less remunerative for Indian workers, who increasingly decided the game was not worth the candle. Thus did 'Spanish mine owners [find] themselves confronted by a labour shortage that had very little to do with the number of Indians living in their midst'. By 1561, 20,000 Indians lived in Potosí, but just 300 worked the mines, 94 per cent fewer than a decade earlier (Cole 1985, 4). 'In short, the pillage/conquest economy established after 1532 had reached its limit' (Andrien 2001, 49).

Potosí and Spain: Agrarian Crises and the Political Ecology of Empire, 1550–1630

Potosí's crisis did not go unnoticed from above. Spain's imperial ambitions fed on American silver. '[I]t was the swelling flow of New World silver that made Philip [II] think he could conduct war both in the Mediterranean against the Turks and in the north against the Dutch' (McNeill 1982, 109). Philip may have taken too seriously the motto he emblazoned upon Potosí's second coat of arms: 'for the wise King this lofty mountain of silver could conquer the whole world' (quoted in Rudolph 1936, 536). The contraction of silver production was a very serious matter, all the more so as it was linked up with two developments – the fiscal crisis of the Empire and the agro-ecological crisis of the motherland.

We begin with the 'enormous increase' in Spain's military outlays after 1566 (Parker 1974, 561). This was closely related to the deepening fiscal crisis within Castile, which paid the lion's share of Spain's imperial adventures (Kamen 1994). Philip II tripled taxes and thrice declared 'bankruptcy' – in reality converting short-term into long-term debt by issuing the bonds known as *juros* – between 1557 and 1577 (Parker 1974, 568–9; DuPlessis 1997, 50–3). Indeed, the very bankruptcy that precipitated the 1557 financial crisis – visiting ferocious devaluation upon South German capital and east-central Europe's bourgeoisies more generally

– was made possible by the flood of American silver pouring into Sevilla in the early 1550s. Philip was no longer beholden to the Fuggers and could dispense with their services.

As if to go from bad to worse, Philip's financial woes were rooted in the progressive dilapidation of the real economy. If Spain's agrarian crisis is well known, its political ecology has been underplayed. Europe's agrarian crises of the seventeenth century appeared first in Castile. From the 1550s, Spain's agro-ecological contradictions accelerated, bearing strongly upon the timber crisis of Spanish ship-building, as we shall see (Wallerstein 1980, 146; Phillips 1986, 1987; DuPlessis 1997, 50–3). Da Silva cites a 1609 source that expresses the growing concern: 'The insatiable farmers were *exhausting the fields*' (quoted in da Silva 1964, 244, emphasis added). This was almost certainly connected to the peasantry's escalating indebtedness. De Maddalena sees a 'heavy increase in the mortgages on peasant property' by the early seventeenth century (1974, 299), but for Elliott, the 'dispossession of the peasantry' begins even earlier, from around 1550 (1968, 290–1).

That there was a political ecology to this dispossession seems altogether clear. Between 1570 and 1630, 'little by little, almost everywhere people [in Castile] became obsessively worried that the land could be exhausted'. Growing concern over the 'decrease in yield' and the 'search for new lands' was, da Silva argues, '*actually parallel*' (1964, 244, emphasis added; also Elliot 1968, 115). The search for new lands led in short order – and apace with the monetization of the social economy – to renewed nutrient depletion and thence renewed movement onto new lands. It was, in a narrow sense, a replay of the agrarian dynamic characteristic of feudal expansion. By 1550, and emphatically by 1590, the crisis was unfolding within an entirely new web of relations – the contradictions of Spanish agriculture were dialectically joined to the extraordinary reorganization of colonial Peru, whose surplus could now be transformed into capital and exchanged for food, timber and raw materials on the other side of the Atlantic. (Thus were Baltic timber and Peruvian silver at once unified and dissolved through the alchemy of the modern world market.) The superficially medieval logic of Castile's agro-ecological crisis was turned inside-out, linking up with the world market to expand (rather than contract) the reach of commodity production and exchange.

The crises of Castile and Potosí were, therefore, differentiated moments in a singular process. I would emphasize two movements. First, declining agricultural productivity and the renewed search for untapped arable land within Castile was eased partly by grain imports. By the 1590s, these were flowing in from as far afield as the Ukrainian steppe (Stradling 2004, 18). These flows were possible because of American silver, which meant that reliable grain supplies demanded a steady supply of silver from across the Atlantic. Given the progressive exhaustion of domestic agriculture – and rising cereal prices even beyond silver's inflationary impact (Elliott 1968, 292–4) – the Iberian ecological regime also called forth new breadbaskets. Among these was Sicily, formally within Philip's patrimony, where the shift from sugar to wheat mattered less than the expansion of monoculture. If sugar in the Atlantic islands 'had killed wheat', in Serrão's memorable phrase (1954), now wheat in the seventeenth century Mediterranean killed olives, then forests. Sicily's wheat revolution propelled 'deforestation and soil erosion in the uplands, malarial marsh formation in the lowlands . . . [and] reduced the island's peasantry to misery . . .

[The new regime denied] the island's interior both the capital needed to increase output without mining the soil and the physical security needed to permit cultivators to live near their fields' (de Vries 1976, 52).

So long as the expansion of arable land sustained a rising population, the inhibiting impact on the Castilian 'home market' was limited. But the expansion of arable was, it turned out, insufficient. For Braudel, 'the reclaimed land often gave an inferior yield' (1972, 426); Weisser sees a 'severe downturn' in yields in Toledo and Segovia between 1600 and 1640 (1982, 153). Even a seemingly modest decline in yields, say from 1 : 4 to 1 : 3.5, represented a dangerous contraction in agriculture's capacity to feed the country, a fact made biblically clear by the plague of 1599–1600 (Elliott 1968, 294; Parker 1979, 39). Removing nearly one-sixth of Spain's population, the plague inaugurated a long-run demographic stagnation and agricultural retrogression – part of a Mediterranean-wide movement that Braudel calls 'an agricultural revolution in reverse' (1972, 427). On the feudal model, this entrained rising tax burdens on the direct producers, further squeezing the surplus available for reinvestment – at the same time, given the interpenetration of agro-extractive ecologies in the Iberian ecological regime, Spain's agricultural revolution in reverse amplified the search for new commodity frontiers in cereal agriculture. It was, then, not merely that Spain was a 'conveyor belt' for silver as it moved from the Cerro Rico to Amsterdam; it was a conveyor belt for the geographical expansion of the commodity system as well.

There was, then, a decisive agro-ecological moment to the deindustrialization of Castile. This is not to deny that American silver raised production costs for Castile, or that Dutch manufacturing prowess allowed its textiles to penetrate the Castilian market (Anderson 1974, 73). The question is one of relative causal weight in which the political ecology of the situation remains salient. Segovia's thriving textile industry (second only to Cordoba's) virtually collapsed in this period, its output falling three-quarters between 1570 and 1600 (Kriedte 1983, 73). Was this not related to the agro-ecological retrogression, and the escalation of tax burdens? Between 1559 and 1598 'the burden on the ordinary taxpayer in Castile increased by some 430 [per cent], at a time when nominal wages had risen by only 80 per cent' (Kamen 1994, 486; also Weisser 1982, 153). The collapse of the home market, amplified by declining agricultural productivity – amongst the lowest in Europe to begin with (Kamen 1994, 487) – meant that Philip II's imperial projects could be sustained only through reckless borrowing. Taxes on the peasantry could be ramped up, but only so far and no further. When Charles V abdicated in 1556, the Crown's '*juro* debt . . . , or annuity payments on loans made largely for the war effort', amounted to 68 per cent of 'normal Castilian revenue' (Kamen 1994, 481). Upon Philip's death in 1598, *juro* debt was eight times the Crown's annual revenue. Precisely who owned the debt? The Genoese above all, and it was Genoese capital that financed commodity production throughout Europe (Braudel 1972, 501–2; Braudel 1984, 157–74, 208–9).

The creation of the public debt, as Marx notes, was a decisive moment of primitive accumulation (1977, 915). This was not only because the *juros* accumulated by Genoese bankers were tradable, and this power granted the Italians unusual freedom after 1566 to export silver directly from the Peninsula. It was also because the Genoese had reoriented their 'surplus capital' from the American trade towards the bond market (Arrighi 1994), thereby opening the door for Dutch capital.

The rise of the United Provinces and the decline of Spain were therefore intimately connected. And it was the conflict between the two that drove Spain to make Peru (one colony) do what the Netherlands (another colony) would not – pay up. Which brings us back to the trans-Atlantic environmental history of Castile and Peru. The Crown's creditworthiness turned on its revenues from the silver mining frontier. These revenues could be sustained only by a constant effort to intensify and expand the imperial division of labour – one that for all its premodern appearance ultimately lived or died on the production of a handful of strategic commodities, silver above all. And this was possible only through recurrent waves of environmental transformation, governed by colonial rule, and driven by the conflicts between states and the competitions of the modern world market.

Spain is Standing on Potosí: The Political Ecology of Underdevelopment, 1571–1630

It was in this context of a threefold crisis – within Peru, within Castile itself and within the European dependencies (above all the Netherlands, as we will see later) – that the Crown convened a 'special junta' in 1568 to address the emerging crisis, empowering a new Viceroy, Francisco de Toledo, to implement a sweeping reorganization of the Peruvian mining frontier (Assadourian 1992, 56–8; Mumford 2004). Toledo's challenge? Find a cost-effective and therefore profitable solution to the problem of declining silver output.

He was successful. Silver output skyrocketed by nearly 600 per cent between 1575 and 1590 (Bakewell 1987, 242). Potosí's revival depended upon two decisive innovations. First, smelting gave way to mercury amalgamation, a technique that mixed pulverized ores with mercury to extract silver. Second, the 'arms length' system of *guayra* production was displaced by a system of rotating forced labour drafts, called the *mita*. The first presupposed the second. The perfection of an amalgamation process adapted to Andean conditions preceded by just a year Toledo's proclamation of a geographically expansive *mita* in 1572. Mercury amalgamation made possible the extraction of silver from low-grade ores. Its profitability, however, turned on the availability of a huge and tractable labour supply. Some three million Andeans would work the mines before the abolition of the *mita* in 1819 (Ferry 2000).

The silver that gushed forth from Potosí's open veins over the next half-century was crucial not only to Spain's tragi-comic path of (semi-peripheral) development and Peru's socio-ecological immiseration, but also to the primitive accumulation of capital on a world scale. But Galeano gets it wrong when he calls the exploitation of Potosí an act of plunder, and that this plunder was the 'most important means of primitive accumulation' (1973, 28, emphasis added). Potosí was a pillar of world accumulation precisely because it was not, after 1572 at any rate, premised on plunder, but rather represented a highly prefigurative moment of capitalism's audacious mixing of *productivity* and plunder. It was this dialectic, not plunder alone, that enforced a rapacious consumption of Peru's 'original sources' of wealth (Marx 1977, 638), human and extra-human nature.

Far from merely a consequence of the boom, this rapacious consumption of land and labour was the basis for Potosí's renaissance, and the prime mover in its relative decline after 1620. The course of events in Potosí captures what seems to be the basic socio-ecological pattern of metallurgical commodity frontiers in the early

modern period. In the early stages, high-yielding ores translate into high wages and decent working conditions (this was the *guayra* phase in the period immediately after 1545). But sooner or later ore quality declines. When this happens, profitability begins to hinge more and more on two things: (1) rising capital intensity, manifest not only in surface infrastructures but also deeper mines; and (2) driving down the wage bill for labour power. While technological and social innovations could temporarily check rising costs, they could not do so indefinitely.

Three key movements loom large. First, although mercury amalgamation produced silver with greater fuel efficiency than smelting, this was outweighed by the rapid expansion of output. Demand for energy, whose primary sources were wood and a native grass called *icho*, rose sharply. Over time, it became more costly to secure fuel. Second, Potosí's expansion after 1571 was premised on cheap labour, made possible by the *mita*. The *mitayos* were treated as expendable, given the most dangerous work and were progressively exhausted as mine work grew more dangerous after 1580. Finally, the *mita* itself undermined its own conditions of reproduction, as colonial rule, monetization and the forced labour drafts dissolved village life throughout the Andes.

We may examine these movements in their respective turns.

First, relative to smelting, mercury amalgamation was a 'cold' rather than 'hot' technology. But this distinction takes us only so far. Yes, amalgamation reduced the fuel needed to produce a kilogram of silver, but taken on a per capita basis, silver was by far the most fuel-hungry of any commonly smelted metal in this era (Moore 2007, chapter two). The fuel-economy of mercury amalgamation is easily overstated. Because amalgamation enabled such a large increase in output over so short a time, the consequence was *more*, not less, deforestation.

Mercury production demanded a considerable volume of charcoal, resulting in deforestation around the mines at Almaden (Spain) and Huancavelica (Peru) (Parsons 1962, 200–1; Brown 2000, 467). By 1580, Capoche reports on the 'excessive price of wood, in relation to the cost of everything else' around Huancavelica, to which timber was brought in regularly from a distance of 'twenty-five to thirty leagues' (1585, 117). Once the forests were gone, *icho*, a coarse grass, was dug from the ground to burn for refining mercury ore (Cobb 1947, 62). A rather significant part of the vaunted fuel efficiency of amalgamation was a strategy that mobilized increasingly distant forests, but concentrated their material and energetic yields in established zones of commodity production – a common enough strategy within Europe, as we will see in Part II.

At Potosí, the amalgamation process itself demanded fuel at nearly every step. Ore had to be roasted, and once amalgamated, the spongy mass of mercury and silver that resulted was heated again, to 'sever the mercury from his friend the silver' (Espinosa 1628, 626). Only then could the journey from rock to ingot be complete (*ibid.*, 626–8). The energy requirements took up a sizeable share of the workforce. By 1603, when we find 'growing scarcity and cost of fuel' around Potosí (Bakewell 1987, 214), we find 3,000 workers engaged in the wood and fuel trades, relative to 4,600 working underground in the mines (Anonymous 1603, 122). And the number of workers in the wood and fuel trades refers only to those observed *in Potosí* – in seventeenth century Europe the rule of thumb was 'five forest workers and haulers for every worker' at the smelter (Sundberg 1991, 9).

Construction and fuel needs devoured the forests around Potosí. The timber hinterland was progressively enlarged, at each step exerting upward pressure on the cost of production. 'Trees were . . . stripped quickly from areas around large mining centers, in some of which – the high Andes and the dry Mexican plateau – they can never have been plentiful. *Timber then had had to be brought in at great cost over great distances*' (Bakewell 1987, 218, emphasis added). Wooden axles for the *ingenios* – 20 feet long and 20 inches square – were imported from Andean valleys far below, sometimes as distant as 200 miles away (Sauer 1981, 50; Bakewell 1984, 24). By 1714 Potosí, even as its mills declined from 120 to just 40, was drawing timber from the Paraguay mountains (Espinosa 1628, 624; Frezier 1717, 83, 145–6).

Deforestation weighed particularly heavily on highly vulnerable mountain ecosystems, which suffer from high rates of soil erosion and enjoy only a 'fragile stability, easily upset by unintentional human action' (McNeill 1992, 352). By 1603, Potosí's footprint was readily visible:

Even though today, *because of all the work done on the mountain*, there is no sign that it had ever had a forest, when it was discovered it was fully covered with trees they call *quínoa*, whose wood they used to build the first houses of this settlement . . . On this mountain, there was also a great amount of hunting of *vicuñas*, *guanacos* and *viscachas*, animals very similar to the rabbits of Spain in their fur and meat, but with a long tail. There were also deer, and today not even weeds grow on the mountain, not even in the most fertile soils where trees could have grown. This is the most frightening, because now the mountain is covered with loose gravel, with little or no fertile land, crossed with sterile mineralized outcroppings. (Anonymous 1603, 114–15, emphasis added)

The silver commodity frontier degraded bodies much as it denuded the landscape. This is our second movement of expansion and exhaustion. Drawing workers either from outside the commodity economy or only loosely articulated with it, mineowners found themselves in a favourable position not only to enjoy the fruits of cheap labour, but also to exploit these workers with little regard for their health (Tandeter 1981, 104). In itself, the death and bodily damage suffered by Indian mineworkers, much like slave mortality on the sugar plantations of contemporary Bahia, posed no real *short-run* threat to profitability in the early modern world-economy. In certain respects, the 'brutal relationship' between the *mitayos* and colonial entrepreneur was even more dangerous than under slavery (Stern, 1982, 84; Schwartz 1985).

Potosí's revival after 1571 was driven by the exploitation of tailings, ore that resisted the smelters. But these were gone by the end of the 1570s. The solution? Dig more tunnels – 5,000 by the start of the nineteenth century (Galeano 1973, 33). And dig deeper, up to 300 metres into the earth. Work-related fatalities and disease escalated sharply. Mineowners increasingly disregarded colonial prohibitions and imposed fixed quotas, dramatically extending the working day. In the 1570s, the colonial state forbade more than two trips a day for *apiris*, who carried the ore to the surface. By the 1580s, *apiris* were carrying as many as two dozen loads of 25

kilograms upwards some 300 metres. Mine shafts often flooded, forcing miners to work 'knee-deep in water', rendering them susceptible to all manner of respiratory diseases. Rest periods – originally two weeks for each one worked – were increasingly disregarded (Cobb 1947, 86–9; Cole 1985, 23–5). By 1600, 'the proprietors decided they were losing time changing shifts, so they started keeping the workmen underground continuously from Monday evening to Saturday' (Rowe 1957, 174). The mines had become a 'harsh executioner of Indians, for each day it consumes and destroys them, and their lives are made misery by the fear of death' (Capoche 1585, quoted in Bakewell 1984, 145). Notwithstanding the increasingly brutal labour regime, geology proved stubbornly resistant. Yields continued to decline. By the mid-1580s, 'workers were taking out only half the amount formerly produced' (Cobb 1947, 77).

Finally, we turn to the *mita*, and the town–country antagonism it implied. The contradictions that flowed from the point of production were attenuated by the imperial refashioning of Andean political ecology. The late sixteenth century silver boom presupposed a radical recomposition of Peru's socio-spatial division of labour, one that favoured the maximization of commodity production in Potosí, and the progressive commodification of internal and external nature (land and labour) throughout the region. All of Peru was to be at the service of Potosí.

Our attention goes first to labour recruitment. This was the pivot on which the region's new town–country division of labour turned. Needless to say, the Indians were not in a hurry to work for the Spaniards. The solution was found in the *mita*, a rotating annual labour draft. An institution rooted in the Incan empire, the Spaniards reinvented the *mita* to serve thoroughly modern ends. Imposed in 1572, the new *mita* conscripted one in seven adult males for work in the mines, textile workshops 'and any other task . . . deemed worthy of the state's patrimony' (Stern 1982, 82). While there were many *mitas*, Potosí's was by far the largest and most expansive. In the 1570s, it mobilized some 13,500 workers annually, drawn from a region that stretched some 800 miles north to south, and as much as 250 miles east to west (Bakewell 1987, 222).

This large-scale mobilization of bodies was predicated on the large-scale reorganization of space. The *mita*'s immediate precondition was the Empire's reorganization of village life throughout the Andes. Beginning in 1567, the colonial state initiated the 'wholesale resettlement of the native population' – perhaps as many as 1.5 million people, roughly the population of contemporary Portugal – into 'Spanish-style towns' (Rowe 1957, 156).

These nucleated villages (*reducciones*) effected three major socio-ecological transformations, reinforcing their obvious advantages for tax collection and political control (Gade 1992). In the first instance, the concentration of Indians into more densely populated encampments provided fertile epidemiological terrain for Eurasian diseases (Andrien 2001, 57). Second, large-scale resettlement often entailed the removal of Indians from lands prized by Spanish colonials (Ramirez 1996, 71–2). Third, the *reducciones* undermined older practices of 'verticality'. Verticality involved 'working as many different microenvironments as possible' so as to minimize vulnerability (Stern 1982, 5). Throughout the Andes, the close proximity of distinct regional environments – 'the coast, the piedmont, the altiplano highlands, and the tundra steppe (puna)' – encouraged highly interdependent agro-pastoral linkages.

Potato cultivation in the highlands, for instance, was nourished by fertilizer (guano) supplied by coastal communities, which in turn consumed highland foodstuffs (Murra 1984; Larson 1988, 19–20; Godoy 1991, 400). Throughout the Andes, there had evolved a ‘synchronized [pattern of] ecological relationships between coast, piedmont, highland, and puna’, constituting ‘a finely calibrated system of food transfers’ (Wolf 1982, 59, 134–5).

Verticality may have been ecologically sound, but it was hardly conducive to the demands of the silver revolution. Such finely calibrated transfers, governed by relations of tribute and reciprocity, would have to give way to the cash nexus. The *reducciones* were therefore established on a mono-zonal rather than multi-zonal basis, eliminating ‘agricultural outliers in a variety of ecozones’ (Gade and Escobar 1982, 434).

The *reducciones* insisted on a new agro-ecological order corresponding to the labour demands of the silver frontier. At its centre was common-field agriculture, a cultivation system that emphasizes agro-pastoral linkages, access to commons and community regulation of landholding (Thirsk 1964). Where verticality presumed exchanges across ecological zones, such that farming and herding were geographically discrete, common-field agriculture sundered such exchanges by stressing agro-pastoral integration. From the standpoint of the colonial state, the great advantage of the common-field system was its geographically expansive character, emphasizing land as a means of maximizing the productivity of scarce labour in place of older, intensive land-use practices. Its adoption was accelerated by Viceroy Toledo’s 1575 ‘edict mandating a plow and oxen for each Indian agglomeration’ (Gade 1992, 469). This technological introduction promised an important change in Andean socio-ecology, shifting from a labour-intensive to a land-extensive approach – one also linked to the sharp reduction of agricultural diversity that pre-Conquest peasants deployed as a safeguard against crop failure (Zimmerer 1996, 44–55).

The livestock–plough system was complemented by, and indeed made possible, the invasion of Europeans’ favoured crops, wheat above all. Commercial production dates from the late 1530s. If the common-field system reduced necessary labour by cutting supervision costs, and the livestock–plough system effectively substituted land and animal power for human labour, wheat offered an additional labour-saving (but land-consuming) bonus. Relative to indigenous crops, wheat demanded little labour and enabled plough agriculture by tolerating the new animals’ grazing patterns (Godoy 1991, 407). In contemporary Europe, the chief ecological trade-off was its tendency towards low yields and soil exhaustion; wheat ‘devours the soil and forces it to rest regularly’ (Braudel 1977, 11). It was the colonizers’ great fortune, however, that American soils attenuated this tendency. Initially, wheat cultivation in Peru supported seed/yield ratios between three and six times higher than Europe’s average, liberating still more labour from the demands of food production (Slicher van Bath 1963, 330; Super 1988, 20–2).

Providing the administrative and spatial framework for the *mita*, the *reducciones* established the conditions for yet deeper transformations of land and labour in the service of capital. While it is customary within environmental history to explain these transformations as primarily market-driven (e.g. Worster 1990; Cronon 1991; Richards 2003), our story of the silver frontier so far suggests that the geographical

expansion of the commodity system was predicated on a wider ensemble of socio-ecological relations. Foremost among these was power of the state to create and sustain the conditions for expanded commodification. This was no mere 'Smithian' dynamic (*pace* Brenner 1977). Yes, colonials established commercial agriculture in response to commercial opportunities, especially those arising from the mining frontier. (How could it be otherwise in a region where something like one-third of the silver produced stayed put? On this, see Assadourian et al. 1980, 24–5.) But such commercialization presupposed the disrupting effects of Europe's social and biological expansion, which transformed indigenous society in ways that encouraged a significant (if still partial) turn towards commodification.

We can identify three main sources of disruption linked to the silver frontier's commercializing impulse: land expropriation; stock raising and the imperial moment of Crosby's 'Columbian Exchange' (1972); and the spatio-temporal dynamics of the *mita* itself. The first, as we have seen, was the colonial state's relocation of native communities. This often amounted to outright land theft. Concentrating scattered Indian settlements, the *reducciones* opened up vast new expanses for colonial agriculture and stock raising (Ramirez 1987, 598). And this was only the beginning. In the half-century after 1570, land appropriations escalated still further. Was it happenstance that the turning point in Peru coincides with a seigneurial offensive in Spain that led to the widespread dispossession of small cultivations and rising concentration of landownership? The mechanisms of dispossession were different, but in Peru and Castile alike the number and size of large estates increased several times over (da Silva 1964). And since landholdings were useless without labour, the colonial state in Peru mobilized an agricultural *mita* five times larger than in New Spain (Assadourian 1992, 61) – reflecting the two regions' differential silver output. By 1630, haciendas 'dominated [supply for] the urban and mining markets' for maize, and presumably wheat as well (Assadourian 1992, 62; also Stern 1982, 109).

This dual process of land clearance and land appropriation – whose greatest impetus was the mining frontier – was undoubtedly made easier by rapid depopulation owing to Eurasian disease (Smith 1970). But depopulation cannot be explained solely in terms of the initial epidemiological onslaught. Among the factors driving prolonged demographic decline was the proliferation of Old World animals deliberately introduced to aid the colonial project. Large Eurasian animals were the indispensable sources of power for colonial agriculture, manufacture and extraction. They provided crucial industrial inputs for mining, especially tallow and leather products. Eurasian livestock were unusually effective conquerors; in any given region, they might occupy anywhere between two and ten times the land taken up by settlement and cultivation (Cronon 1983, 139; e.g. Stern 1982, 35–6; Stavig 2000, 100–1). Here was a situation that invited still greater European encroachment, as animal populations grew quickly and intensified pressure on grazing lands (Ellenberg 1979). Thus did Eurasian livestock enter into competition with the overall *system* of indigenous cultivation, dramatically undermining the latter's' socio-biological reproduction (Waman Puma 1615, 885; Crosby 1972, 98–9).

Potosí's voracious appetite for labour, satisfied in large measure through the *mita*, was a third source of disruption. Knitting together the region's pueblos in a new town-country division of labour, the *mita* created a favourable disease environment.

Moreover, by extracting hypothetically 'surplus' labour from the villages, the labour draft undermined socio-ecological reproduction over the short and long run. First, the *mita* often withdrew labour at 'crucial moments in the agricultural cycle', further destabilizing labour-intensive cultivation. When *mitayos* returned, many were too sick to return to farming, or found their fields 'deteriorating or unworked' (Stern 1982, 87–9). But many did not return. There was a long-term haemorrhaging of labour, as *mitayos* left permanently for the mining centres and haciendas (Newson 1985, 56). This rendered the *mita* progressively more burdensome for those who remained. Between 1581 and 1609, villages within the Potosí *mita* lost one-third to one-half their population, with even sharper declines in some locales (Barber 1932, 105; Cobb 1947, 79–81; Newson 1985).

Village depopulation, the formation of a mining proletariat, and declining ore quality in Potosí combined to favour the gradual substitution of cash payments for labour service, significantly altering the relation between indigenous society and the land. In 1606, silver payments satisfied some 20 per cent of the *mita*'s obligations; by the 1620s, 30–40 per cent of the labour draft had been commuted to cash payment (Cole 1985, 37; Andrien 2001, 62). The indigenous political class (*kurakas*) responded to the *mita*'s disruptions by turning to commodity production. European crops such as wheat and barley were especially favoured (Spalding 1975, 111). While some *kurakas* grew rich, in general commodity production was associated with rising indebtedness and land alienation (Ramirez 1996, 119). The political ecology of colonial taxation therefore favoured a radical simplification of pre-Conquest agriculture, favouring Eurasian cereals over those 'diverse [American] crops [such as the potato] that were hardy and rarely failed completely' (Zimmerer 1996, 55). This was fraught with unhappy implications for indigenous society's socio-biological reproduction, reinforcing a chronic and 'acute insecurity of food supply' in colonial Peru (*ibid.*) that rendered Indians all the more vulnerable to disease and suppressed fertility (Stern 1982, 151–2; Newson 1985, 56). The increasing frequency of famines and the generalization of malnutrition that ensued (Cook 1981) expressed the dietary moment of what we might call *disarticulated* primitive accumulation in the Americas. An ecological surplus was extracted from the bodies and fields of the indigenous peasantry in a way that paralleled the extraction of surplus labour, in both instances for the benefit of accumulation centres abroad rather than the creation of a home market.⁷ This was the 'disarticulated' – and therefore *intrinsically globalizing* – nature of the New World's metabolic rift in the transition to capitalism.

Potosí's production peaked in 1615, although its relative decline would not become fully evident until the end of the century (Bakewell 1975). The Cerro Rico's output was essentially unchanged between 1640 and 1715, when it would be eclipsed by New Spain (Garner 1988, 903). New Spain's silver frontier was different of course, and this is after all the point. The commodity frontier worked its magic not merely by plundering but producing; every stop on the tour was linked to new organizations and techniques of production. As for Spain, to which we return presently, the silver that flowed from the plunderous and productive occupation of Peru would allow for a different sort of commodity frontier within Europe.

⁷ The European peasantry was also subjected to a similar logic of dietary immiseration, albeit with less gruesome consequences (Moore 2003a).

EVERYTHING RETURNS TO THE FOREST: SPANISH IMPERIALISM
AND THE LIMITS OF MEDIEVAL POLITICAL ECOLOGY

American silver and European timber were dialectically bound. The ability to secure cheap and reliable supplies of timber was a crucial factor in Spain's struggle for world power, and its silver fleets went far in the delivering these supplies. Both movements entailed heavy demands on the forests, as we have seen in the Andes, and as we shall see, in Europe as well.

One could neither move capital nor project military power without access to gigantic volumes of forest products. Not merely theoretical access, but practical access was required, and this necessitated a new way of seeing the forest. At its centre was the optic of forest-equivalents. Such talk may seem shamelessly anachronistic. But in fact the notion of forest-equivalents dates, at the *latest*, from the seventeenth century. Addressing the 1669 Forest Ordinance in France, Brown puts the issue squarely before the bar, 'In order to secure the full benefit of the device it was found necessary [by the French Crown] to divide the . . . forest, not into *equal*, but into *equivalent* portions – subdivisions, not of equal area, but of equivalent produce' (1883, 45). The Ordinance itself reads as a spectacularly modern text, mandating 'trigonometrically measured lots [*sic*]' and providing guidelines so that inspectors might render these lots 'more regular', within a 5 per cent range of error (Anonymous 1669, 103–55). My point is not to suggest that these measures were generalized across Europe – Spain's version of Colbert's Forest Ordinance would not arrive until 1748 – but rather to identify such measures as expressive of an emergent logic premised on the radical abstractions of the law of value, then in formation.

'Whenever West Europeans reached the huge forests of Norway, Poland and the New World,' Braudel observes, 'such forests, if they were accessible by sea or river that is, immediately joined the category of capital goods' (1982, 241–2). So let us turn from American to European political ecologies. This will allow us to take a step back to consider the bigger picture of capitalism as world-*ecology* – that is, the material life of the world-economy. Deforestation certainly occurred in Spanish Peru. And deforestation, along with all manner of other environmental transformations, was linked to rising costs in the mining sector, a situation the colonial state sought to attenuate through the progressive extension of the town–country division of labour.

But this dynamic was hardly unique to the colonial world. While the theory of 'sequential overexploitation' is one readily applied to the extra-European world – where overexploitation and relative exhaustion in one region gives rise to a frontier movement that promises low-cost land and labour (Gadgil and Guha 1992) – the same logic was at work *within* Europe, and *between* Europe and the colonial world. Silver nourished the arteries of territorialist power, feeding Spain's imperial ambitions, which in turn fed the appetites of capital accumulation. Spain's imperial project presupposed the capacity to transmute silver into military power, and this entrained widespread material transformations.

The twists and turns of the struggle for empire within Europe turned crucially on the cascading and geographically uneven transformations of local and distant environments. Silver is one optic through which we can bring these uneven transformations into focus. The failure of Charles V to transform the European

world-economy into a world-empire had, by 1559, given birth to a geopolitical gridlock that would be codified at Westphalia in 1648. With silver shipments made into a steady flow of ready cash thanks to the magic of Genoese finance, Spain after 1571 – when the restructuring of Peru reached critical mass – had become at once vastly more powerful than its European rivals and progressively less able to dominate them.

The socio-ecological implications ran this way. Spain was powerful militarily but its economic base was weak. Aggregate productivity was low, in agriculture but also in manufactures, and this meant that Spain's cost of waging war was higher than its rivals, the Dutch above all. This was bad enough in any era. In the era of the 'military revolution', it was nothing short of disastrous. The cost of war was skyrocketing, and this favoured states that were able to pursue a capital-intensive rather than coercive-intensive strategy of statemaking (McNeill 1982; Tilly 1990; Parker 1996). The balance of power meant that small military-territorial gains were won at great expense – what Jones describes as a quantum leap in the 'amalgamation costs' of state formation (1982).

Rising amalgamation costs signified escalating pressures on local political ecologies across Europe. In highlighting the Ibero-American moment of this process in the present essay, I wish to argue that the trans-Atlantic linkage was both historically and logically necessary for the unprecedented concentration of accumulation and commodity production in northwestern Europe after 1600. Consider, for starters, the escalating concern over forest management in England (Albion 1926), France (Bamford 1956), Sweden (Heckscher 1954), Germany (Fernow 1911), Portugal (Devy-Vareta 1986) and Spain (Goodman 1997, 1998) during the sixteenth and seventeenth centuries. There was in every case inexorable (if cyclical) pressure for renewed geographical expansion of timber sources in response to local overexploitation. Such expansion unfolded differentially – sometimes within the territorial state, sometimes through colonial expansion, sometimes through the world market. (The most successful states, such as Britain, were able to take advantage of all three, which explains something of the geographical origins of the Industrial Revolution.) But such expansion ultimately depended on the capacity of the states (and not only the states) to fork over the dough. And *this* depended in great measure, between 1557 and 1648, on access to American silver, itself won through a colonial political ecology that insistently pushed outward the commodity-centred divisions of labour in Latin America, *and a semi-colonial political ecology that did the same in the capitalist North Atlantic*. Silver, then, was implicated simultaneously in a territorialist dynamic for Spain and a commodity-centred dynamic for the 'vast but weak' capitalist world-ecology. Given the shaky foundations of its real economy and its forest regime in particular, Spain's imperial strategy depended on reasonably quick victory – perhaps a 20 years' war rather than an 80 years' war. The famed Armada, whose defeat in 1588 marked the beginning of the end of Spain's ride as a great power, was constructed not merely from domestic timber but also from Baltic supplies, purchased at 'outrageous prices with ready cash' (Pollitt 1971, 13). If it had landed, its first order of business was to torch England's timber reserves (Gron 1947). But the Armada did not land, and Spain did not break the back of English power, with decisive implications for the war in the Low Countries.

The early modern military revolution implied, among a great many other things, a geometric expansion of shipbuilding. (In an era when specialized warships were rare, there was of course tremendous overlap with commerce.) Over the course of the long sixteenth century, Europe's shipping grew fivefold. Perhaps more (van Zanden and Horlings 1999, 36; Ozveren 2000; Maddison 2002, 59). The relationship between shipbuilding and forestry may be read in two major ways, one in terms of material flows rather directly, another as an index of forest exploitation. In the first instance, the relationship between deforestation and shipbuilding should not be overstated in its formal dimensions. Shipbuilding's timber requirements were quantitatively modest but qualitatively demanding. This was true, above all, for masts and the large trees necessary for hull construction. In quantitative terms, shipbuilding's greatest demands upon the forest stemmed not from the need for construction timber at all, but from iron manufacture. A 400 ton vessel, whose lifespan was not much more than a decade, might need as much as 100 tons of iron – whose manufacture consumed no less than 90,000 tons of wood carved out from 750 hectares of forest (Braudel 1972, 303; Moore 2007, chapter two).

The expansion of shipping is also an index of systemwide demands. This is partly because everything these vessels carried derived from the forest in one way or another. Even textiles depended on wood dyes and potash for bleaching, and cereals derived from extensive agriculture always represented some measure of subtraction from the forest. (This would only change with synthetic nitrogen in the twentieth century, and only by substituting fossilized trees for living ones.) Shipbuilding was also revealing of system-wide movements because it did not unfold across a geometric plane – the implicit logic of too many forest crisis arguments (e.g. Malanima 2006) – but within a *geographical* world. Forests of whatever size were constituted not only by a vast range of topographies, but equally by historically and geographically specific complexes of actors. Shipbuilding therefore confronted multiple competitors with keen interests in securing sylvan wealth – peasants hungry for fresh land, ironmakers, glassworks and many others.

The crucial issue pivots on the ecological *regimes* that mediated access to the timber. These regimes were systemic and regional both. For the moment, we focus on the latter. These regional ecological regimes encompassed juridical frameworks, class relations and business organization no less than the infrastructure, tools, financing and labour power implicated in cutting and moving timber (of whatever sort) from the forest to the point of consumption. Nevertheless, the very selectivity of shipbuilding timber demands, in concert with the urgency of those demands, meant that it played a role in the enclosure of European forests (and the frontier movements associated with it) out of all proportion to its material throughput. There was, then, unrelenting pressure to extract as much as quickly as possible, and then to move towards greener pastures whenever relative overexploitation created problems. To say shipbuilding was to say commodity frontier.

The big obstacle in the way of a vibrant shipbuilding sector in Spain was its essentially medieval political ecology. There was no dearth of forests in Spain. In this respect, Spain was certainly better off than the ascendant Dutch (McNeill 2004, 397; also Albion 1926, 169). But Spanish Absolutism had all manner of local custom to contend with; a difficulty reinforced by a lack of navigable rivers that drained to

the ocean.⁸ The Dutch, meanwhile, had three things the Spanish did not – peat, easy access to rivers and oceans, and the commodity frontiers of an extended (and expandable) North Atlantic. The genius of Dutch capitalism was to systematically combine geographical good fortune with bourgeois ingenuity.⁹

In Spain, even from the late fifteenth century, pressures were coming from all directions that drove up the cost of shipbuilding timber. One source was the low productivity of Spanish agriculture. Exhausted land was abandoned, and new lands cultivated. Not infrequently, these new lands were claimed from forest. The arrival of Spain's agro-ecological crisis, which hit home with a vengeance in the 1570s (da Silva 1964), had been delayed by carving out new arable land from the forests earlier in the century. The previous century had been one of 'rapid deforestation' throughout the peninsula (Hamilton 1938, 177). In 1520, wood was so scarce around Medina del Campo that the chronicler and Court historiographer Antonio de Guevara complained that 'the firewood cost us as much as the stew in the pot' (Guevara 1520, 93). 'The supply of firewood and charcoal was running short in much of Castile' at the close of the sixteenth century (Sella 1974, 393; also Manuel 2000, 390).¹⁰ By 1612, in the northwestern province of Galicia, home to strategic timber reserves, a Crown official

identified one of the principal causes of forest depletion to be 'the practice in this kingdom [Galicia] of making clearings in the oaks in order to burn them and sow wheat. And at times it happens that in burning the cleared section a league or more of the forest is burned.' Seeking to rectify this, he approached the peasant farmers. They said that 'unless they make the clearings they will have no ground for sowing, and they will perish'. (quoted in Goodman 1997, 83)

The situation was much the same in Guipúzcoa as early as 1580 (Goodman 1997, 94).

Shipbuilding also had to face down competing industries. Vizcaya, home to Bilbao's shipyards, was dominated by 'the most important' ironmakers in Spain (Goodman 1997, 91). Already by 1547, Philip, acting as regent in the absence of Charles V, mandated tree planting around Vizcaya's shipyards. The preamble to the 1547 decree expressed concern over what it saw as mounting timber scarcity driven by the region's shipbuilding industry (Goodman 1998, 90). Was this mere alarmism? This is possible, although it seems insufficient as an explanation. Philip's decree occurred on the eve of a prolonged 'state of crisis' in Spanish shipbuilding, beginning in the 1560s (Phillips 1986, 22). In the 1610s, a Crown forest inspector complained that Vizcaya's ironworks consumed so much charcoal that 'this [situation] had to be watched because it could cause shortages *for everything*' (quoted in Goodman 1997, 91, emphasis added). It was not that the trees did not exist in Vizcaya's hinterland, just that

⁸ The two were interconnected, as the failed project to render the Tagus navigable from Toledo to Lisbon demonstrated (Elliott 1963, 293–5).

⁹ For the moment, we will leave aside the political ecology of Holland's late medieval crisis (Brenner 2001), a story to which we will turn in Part II.

¹⁰ By the 1670s, there was serious talk in Madrid about moving the Court elsewhere. The supply of woodfuel, drawn from a 20-league radius around the city, had reached a critical situation (Goodman 1997, 69–70). Even on a conservative estimate of a league as 2.4 miles, this meant that firewood was scarce within a zone that comprised nearly 23,000 square miles!

they were 'too far from the coast – 10 leagues or so – to transport [sufficiently] cheaply' (Phillips 1986, 263). As if this were not bad enough, Spain's iron sector found itself undercut by the forest-rich Swedes at this very moment (Heckscher 1932) – financed, as we shall see in Part II, by the Dutch (Barbour 1950, 36–37). And from the 1620s, we see a rising number of conflicts between the Crown, seeking to protect shipbuilding timber, and the metallurgical sector, the charcoal burners and owners of forges above all (Goodman 1997, 82, 88, 92).

Around Barcelona, the problem was not iron but glass. A quite modest glassworks operation could strip the surrounding forests in no time at all. The Catalonian situation reminds us that it was not necessarily the absolute shortage of timber at play. Rather, the chief difficulty was the political ecology of this ramshackle thing we call 'Spain' – an idea rather than an established territorial fact, Kamen reminds us (1994). In Catalonia, where Philip's galleys issued from the Barcelona shipyards, 'the forests were being consumed to supply fuel for furnaces for glass manufacture' (Goodman 1998, 92). Here was the Castilian replay of Central Europe's 'battle for wood' a century earlier (Westermann 1996). Barcelona's municipal council called for shutting down the glassworks, with few results. The crux of the matter was this. Philip II simply could not do as he pleased. He acted within the constraints of Spain's ecological regime, within which the hold of Spanish Absolutism was far from absolute, throughout the peninsula, and especially beyond Castile. 'The complex of medieval "liberties" presented a singularly intractable prospect to the construction of a centralized Absolutism' in early modern Spain (Anderson 1974, 65).

It was the very persistence of these medieval liberties that resulted in a critical mass of 'grants of privileges . . . to monasteries and individuals', such that the Crown could no longer easily harvest the timbered lands surrounding Barcelona. Instead, shipbuilding timber was trucked in from thirteen leagues distant (in Montseny and Arbúcias), 'bringing great increases in transport costs'. This distance, about 30 miles, represents an upper limit to the overland transport of large timbers before the nineteenth century. It must have been costly indeed, no small matter for a Crown that lived on the brink of bankruptcy. By 1586, the fiscal crunch was so severe that shipbuilding timber, including precious masts, was rotting in the Montseny forests as workmen awaited the royal paymaster. The scenario would repeat itself in 1589. Nor would the Crown's woes diminish thereafter. 'Later [in the early seventeenth century] when the sources of pine masts at Arbúcias seem to have been exhausted, searches further afield reached out to the extensive pine forests of the Pyrenees.' Predictably, this entrained still higher transportation costs. The masts 'reached Barcelona with difficulty' (Goodman 1998, 93, 95).

Spain was facing multiple episodes of relative deforestation that throttled domestic industry. Crucially from our point of view, this forest clearance was sufficient to provoke a 'sharp rise in the prices of forest products in the first half of the seventeenth century' (Hamilton 1938, 177). The general situation was bad enough. A more serious threat to Spain's imperial ambitions was the rising cost of *shipbuilding* timber. Around Bilbao, 'the long timbers needed for masts and spars had been used up by the *early* sixteenth century' (Phillips 1986, 23, emphasis added). Goodman thinks there was never an absolute shortage of masts, even if they were not quite up to par with Baltic supplies (1998, 89). But these local supplies were

difficult (and costly) to reach – the crucial variable. Rising local costs meant that by the early sixteenth century, a growing volume of masts and naval stores were imported from the Baltic (Phillips 1986, 23, 49, 80). Castile was importing lumber from Flanders – probably of Baltic or at least German origin – by 1534 (Klein 1919, 321). By 1575, the commander Escalante de Mendoza observed that ‘most of the materials used in construction were of native production, *with the conspicuous exception* of masts and spars which were . . . imported from Prussia by way of Flanders’ (quoted in Usher 1932, 203). By the end of the century, Braudel reports on ‘marked deforestation in the western and central Mediterranean . . . notably in Sicily and Naples[,] the very place where one of the great shipbuilding efforts for Philip II’s navy was centred’ (1972, 142). Having decimated his Neapolitan supplies, Philip went global. In the 1580s, Philip ‘tried to buy, or at any rate marked for felling, trees in Poland’ (Braudel 1972, 143). Ozveren believes the Barcelona shipyards had in any event entered a period of ‘irreversible decline’ by the 1590s (2000, 22). Was this not principally a symptom of rising timber costs? By 1630, the situation had gone from bad to worse, ‘The Spanish yards were [by] then dependent upon [Baltic] imports for tar and pitch, for masts, for hemp’ (Usher 1932, 203).

It was a disastrous situation for the material basis of Spanish power. After 1570, Spanish shipping entered absolute and not merely relative decline. Iberian and Italian fleets shrunk 17 per cent, while the British and Dutch fleets expanded nearly threefold (Maddison 2002, 59). The decline of Iberian shipbuilding was even greater than these figures suggest. Castile, for once both wisely and quickly, externalized production to Havana, which became by the mid-seventeenth century ‘the busiest site of shipbuilding in the Spanish empire’ (Ozveren 2000, 30). By the 1640s, American-built vessels constituted ‘at least’ 40 per cent of the Spanish fleet, three-quarters of which were built in Havana (Ozveren 2000, 35). Another third was foreign-built, probably of Dutch origin (Parry 1966, 249).

Spain’s shipbuilding crisis was but one expression of a bigger problem. Silver allowed Philip to pursue an endless war, buying ships, guns and men even as the Castilian ecological formation withered in its capacity to supply these. It is clear that Castile was deindustrializing (Cipolla 1976, 234–6; Kriedte 1983, 73–4) – if not in absolute terms (although this was often the case, as in shipbuilding), then certainly in *relative* terms. (And isn’t this the decisive variable at the end of the day?) The political ecology of such deindustrialization is much less apparent. When Perry Anderson (1974, 71) cogently opines that it was American silver that allowed Spanish Absolutism ‘to dispense with the slow fiscal and administrative unification which was a precondition of Absolutism elsewhere’, that ‘the colonies, in other words, could act as a structural substitute for provinces’, would it be imprudent to say much the same about the Empire’s trans-Atlantic ecological regime? That the colonial reordering of Andean political ecology enabled Castile’s agro-industrial complexes to reproduce an essentially medieval mode of producing nature, the ecological complement to those enduring ‘autarchic patrimonies’ such as we found in Barcelona?

SPANISH DUSK, DUTCH DAWN, 1566–1648

Spain’s deindustrialization was hardly self-contained. The Low Countries, centred first upon Antwerp and after 1585 emphatically in Amsterdam, had developed in the

century since 1450 as a pivotal node in the integration of the European world-economy – between eastern and western Europe, and between the North Atlantic and the Mediterranean (de Vries and van der Woude 1997; Spufford 2006). The northern Netherlands, what would become the United Provinces, emerged from the depression of the 1550s as a leading contender for world economic primacy. If the rise of this 'model capitalist nation' has been well-studied (Marx 1977, 916), the ways this capitalist transformation worked its way *through* environmental history remains unclear. We will take up this part of the story in Part II. For the moment, the point I wish to underline is the role of the conflict between Spain and the emergent Dutch Republic in motivating commodity-centred ecological contradictions – liberating and constraining in various and successive turns – on both sides of the Iberian Atlantic.

Spain and the Low Countries were closely intertwined. The Low Countries had been an important part of Charles V's dynastic patrimony, and upon his abdication in 1556, Philip retained formal political control, at least for a time. Whatever modest differences in economic development existed to begin with, the gap widened considerably over the first sixteenth century (1450–1557). Shipbuilding, alongside metallurgy and textile manufacture, was the era's leading value-added sector (Bunker and Ciccantell 2005). Spanish decline, and Dutch ascent, was evident in all three. The Dutch innovation was to secure the fruits of metallurgy (Swedish iron, Andean silver) through its superior access to ready cash, in turn secured through its superior productivity in shipbuilding and textiles. From the standpoint of world trade, Spain began to look more and more like a colonial exporter, sending bullion and wool (but increasingly fewer *woolens*) northward to the Netherlands in exchange for textiles, metal goods, grain and, as we have just seen, naval stores (Boxer 1965, 24; Anderson 1974, 75).

Of course, the Dutch were not *producers* of this exported grain and naval stores. But they were the producers of the means of production – that is to say, ships – that enabled Baltic grain and timber to materialize in Castile. For good measure, the Dutch also produced half the Baltic's textile imports and a growing share of Spain's (Wilson 1957, 41). Dutch capital could therefore pursue a high productivity strategy in shipping and shipbuilding, and consequently dominate the carrying trade between northern and southern Europe, a key source of hard currency surplus (silver) for the Dutch (Barbour 1950, 52). The Low Countries accounted for nearly 85 per cent of this trade in the mid-sixteenth century (Braudel 1984, 207). As we shall see in our next instalment, Dutch success in this arena was a product of its catalytic role in remaking the extended Baltic, especially its Danzig–Vistula axis. The Vistula Basin differed from Potosí rather more in form than substance. It was far more than happenstance that the second sixteenth century witnessed three monumental episodes of environmental transformation crucial to the rise of North Atlantic capitalism. The remarkable geographical expansions of the second sixteenth century – remarkable precisely because they responded to an underlying slowdown of world accumulation after 1590 – deprived large stretches of the Andes of its woodland and even its coarse grasses, launched the destruction of Brazil's Atlantic rainforest, and initiated a comparable evisceration of the Vistula's forests (Moore 2007).

The ensuing Dutch revolt – the Eighty Years' War (*c.* 1566–1648) – brooked no de-linking with Iberia (Boxer 1965, 23–4). Spain and the Netherlands 'were neither

willing nor able to break off relations' (Braudel 1984, 208; also de Vries 1976, 119–20). Spain's embargo of Dutch trade after 1621, it is true, significantly dented the Republic's shipping. But it seems to have been a case of cutting off one's nose to spite the face; the Dutch were hurt but not undermined, while Spain's capacity to secure vital food and raw materials was seriously shaken (Israel 1977). Simply put, Spain could not do without naval stores and grain; the Dutch, without Portuguese salt (Israel 1982, 210–11, 413). The grain situation became increasingly dire as the second sixteenth century wore on. Spain 'was at the mercy of foreign grain, hardly any of which, by the end of the sixteenth century, came from the Mediterranean' (Braudel 1984, 208; also Israel 1982, 52–3). By the 1590s, Dutch exports of Baltic grain, not only to Spain but to the Mediterranean as a whole, provided a crucial 'lever' to subordinate southern Europe to its accumulation regime (de Vries 1976, 120).

There was, it appears, a conspicuous gap between the military capacities of Spanish Absolutism and its socio-ecological base. Philip II's imperial project founded on the effort to subordinate the eminently modern Low Countries – 'home to the most advanced centres of urban industry in Europe' (Mandel 1963, 5) – to the centralizing imperatives of Spanish Absolutism. But in terms of commodity production and business organization, the Dutch had gone far – and the Spanish had not – during the first sixteenth century. The fiscal demands of Habsburg imperialism, even before Philip, had already 'gravely strained the traditional loyalty of the Netherlands' (Anderson 1974, 70). Charles V's conflict with France drew heavily on the Low Countries, but did so by 'assign[ing] a larger and larger role to the [Dutch and Flemish] States in the collection and management of finance' rather than by 'increasing Habsburg control' (Darby 2001, 15). Philip was therefore already on shaky ground when he moved 'to make the Netherlands a net contributor to imperial finances' in the 1550s (de Vries and van der Woude 1997, 371). This was an explosive situation to be sure. Even if we do not wish to characterize the Dutch revolt as modernity's first 'bourgeois revolution' (Mandel 1963, 5; Anderson 1974, 75), it is nevertheless evident that the stage was set for a clash pitting the precociously modern military apparatus of Spanish Absolutism against the precociously modern capitalist agencies of the northern Netherlands. And, much to the detriment of Spain, the former fed the latter. Fielding 60,000 soldiers – Spain's 'Army of Flanders' (Parker 1972) – required a gigantic stream of silver to flow from Seville to Antwerp. Most of this silver did not stay in Antwerp but rather flowed into the Republic, just as it had earlier coursed through Spain and into Genoa and Flanders (de Vries and van der Woude 1997, 371).

The connection with developments in Potosí can now be viewed more clearly. Spain exerted relentless pressure in the colonies to sustain and maximize silver production. This was effective so long as Spain was able to deploy its greatest asset, military power, against relatively weak adversaries. Thus, *for a time*, the territorialist refashioning of the Andes in the interests of maximizing silver output – combined with a mix of socio-technical innovations clustered around the amalgamation process – allowed Spain to 'jump scale' (as geographers say) and sustain a permanent war economy in the midst of domestic socio-ecological exhaustion. Bolstered by American silver far beyond the strength of any single power, the Spanish Habsburg regime sought to deploy its military capacities against the Republic (and not only

the Republic). As it turned out, Dutch capitalist prowess could be translated into military power more readily than Spain's military prowess could be transmuted into capitalist power. The Dutch were able to hold the Spanish at bay, reproducing a long-term situation – over the course of the second sixteenth century – in which European geopolitics at once reinforced the primitive accumulation of capital in the colonies (and the semi-colonial North Atlantic), and pushed forward the expanded reproduction of capital in the northern Netherlands. Locked in struggle through to Westphalia in 1648, the political ecology of world power propelled Europe's powers ever outward in search of mass commodities and the capital they generated.

All of this suggests an elementary but rarely analysed dimension to this world-historical geography. Not only were the economies of Peru, Spain, the northern Netherlands and the Baltic intertwined, *so were their ecologies*. These respective political ecologies were increasingly occupying, and indeed producing, the same *place* – the place of the capitalist world-ecology. Where one moment (the 'economic') ended, and another moment (the 'ecological') began, became increasingly difficult to discern.

CONCLUSIONS

In this emergent capitalist world-ecology, 'everything conspired against the forest' (Braudel 1981, 364). The Andean mining frontier consumed forests (and their functional equivalents such as *icho*), and its silver precipitations flowed to Castile in massive convoys built of wood, which upon arrival disgorged their treasure into private and public coffers, fuelling among other things Spain's imperial ambitions. Such ambitions motivated substantial shipbuilding and ironmaking within Spain – and this intensified the battle for wood beyond the capacities of the forest regime to deliver the goods. It was the progressive exhaustion of Spain's forest regime – *not* deforestation as such – that undermined the Empire's capacity to make its own iron and launch its own vessels. Even these activities depended upon imports of quality timber (such as masts), and especially grain, from northern Europe. In the same breath, the enormous silver inflows enabled the Crown to dispense with the kind of internal restructuring – of the state machinery, the ecological regime and the social economy – necessary to sustain its permanent war strategy. Thus, the 'crisis of the seventeenth century' hit earliest in Spain; its essentially medieval agriculture reproducing the ecological crises of the seigneurial-agrarian cycle in a manner strikingly reminiscent of the fourteenth century crisis. Within Spain, only the southern frontier zone of Guadalquivir escaped this fate, precisely because it *was* a frontier zone – even as the silting of the Guadalquivir River 'destroy[ed] the commercial prosperity' of Sevilla (Elliott 1968, 293; de Maddalena 1974, 300).

But this was no feudal crisis. Things were now quite different. Spain's 'agricultural revolution in reverse' was neither isolated nor universal. Spain's agro-ecological woes were teleconnected with the colonial ecological revolution in Peru (and not just Peru), and – as we shall explore in Part II of this essay – also to the second phase of the Dutch agricultural revolution, to the 'economic regression' and agro-ecological crises of Poland, and thence to the rise of the global North Atlantic. From the standpoint of *modern* environmental history, what differed in this seventeenth century 'crisis' – a crisis in but not of the system – was the *uneven articulation*

of capitalist and medieval political ecologies. As such articulations go, it was creative. It was destructive. It was globalizing. How little things have changed.

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