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The Coal Crisis in Appalachia: Agrarian Transformation, Commodity Frontiers and the Geographies of Capital

BENJAMIN J. MARLEY

Capital’s commodity frontiers strategy has at once woven together regional differences within an expanding world-system and remade the productive and reproductive activities of humans and the rest of nature. The development of successive commodity frontiers gave way to long waves of economic expansion that have been pivotal to accelerating accumulation and transcending capital’s recurrent crises. In short, commodity frontiers are constitutive of world-ecological moments premised on booms and crises of accumulation. In this paper, I examine the coal commodity frontier in Appalachia, to illustrate the region’s history as one of succeeding frontiers in and out of the region over the long twentieth century of American capitalism. I argue that the origin of Appalachia’s coal frontier was decisively made through the nineteenth-century agricultural revolution expressed outside of the region. Appalachia’s full-fledged development was an outcome of capital’s under-reproduction strategies. The crisis of the region’s frontier turned on a lack of surplus from under-reproduction strategies, competing coal basins, economic diversification and competing energy sources. I find that the commodity frontier concept not only illuminates regional political economies and ecologies of difference, but also explains the production of nature of historical capitalism.

Keywords: commodity frontier, coal, world-systems analysis, historical geography, environmental history

Coal in truth stands not beside but entirely above all other commodities. It is the material energy of the country – the universal aid – the factor in everything we do. With coal almost any feat is possible or easy; without it we are thrown back into the laborious poverty of early times. With such facts familiarly before us, it can be no matter of surprise that year by year we make larger draughts upon a material of such myriad qualities – of such miraculous powers.

– Stanley Jevons, 1865

Coal has always cursed the land in which it lies. When men begin to wrest it from the earth it leaves a legacy of foul streams, hideous slag heaps and polluted air. It peoples this transformed land with blind and crippled men and with widows and orphans. It is an extractive industry which takes all away and restores nothing. It mars but never beautifies. It corrupts but never purifies. . . . [T]he curse of coal [is] a crown of sorrow.

– Harry Caudill, 1962

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INTRODUCTION

The inception of capitalism did not emerge from the smokestacks of the fossil-fuelled Industrial Revolution of the long nineteenth century (Wallerstein 1974). Rather, the origins of capitalism were found on the early sugar, silver and fur commodity frontiers of the long sixteenth and seventeenth centuries (Mintz 1985; Tomich 1994; Dunaway 1996; Moore 2000, 2010a). Transformations in the capitalist world-system unfolded through these early frontier movements, an environment-making project that joined together the work of human and extra-human nature. Fuel frontiers such as coal, but also timber, profoundly reorganized world production and accumulation (Ponting 1991; Smil 1994). Neo-classical economist Stanley Jevons’ quote above illustrates the significance of coal to Great Britain’s economy and modernity writ large. Coal as a commodity has certainly brought wealth and economic growth, but as mid-twentieth-century writer Harry Caudill’s quote suggests of Appalachian poverty, it has brought greater socio-ecological problems for those who work and live near the mines, revealing the dialectical nature of modernity and its dark side.

This paper seeks to move beyond the energetic fetishism evident in Jevons, Caudill and, more recently, Klare (2001), Heinberg (2005), Altvater (2007) and Malm (2012), to reveal the historically grounded socio-ecological relations behind coal. To be clear, coal’s emergence as a resource in this account must be understood within the wider conditions of human development and ecological processes. Coal, then, as a socio-ecological relation within a contradictory totality, has engendered both a virtuous and vicious cycle, a ‘dialectical dance’ (Ollman 2003) of the work of historical natures (White 1996). Capturing the story of coal through the concept of the commodity frontier is useful for understanding the appropriation of land, dispossession and displacement, the exploitation of cheap labour and how value-in-nature (including humans) co-produced cheap energy. In particular, the coal-fields of central Appalachia represent an exceptional and instructive account of the modern commodity frontier.

Coal extraction in Appalachia begins in the nineteenth century and extends into the present. This history has been characterized by a series of booms and crises that reconfigured relations of production and reproduction. From the early anthracite coalfields of Pennsylvania to the heart of Appalachia’s central coalfields, coal as a socio-ecological relation has restructured regional political economies in relation to a changing world-ecology. As a frontier, the region figured significantly in, first, Great Britain’s dominance in the long nineteenth century and, second, the rise of American capitalism through the long twentieth century (Chandler 1972; Podobnik 2006; Mitchell 2011). Focusing on the production of nature through capital’s commodity frontier strategy enacts a new way of viewing the exploitation of paid work and the appropriation of the unpaid re/productive unpaid work of nature (including humans), and how those socio-ecological relations are bundled with historical waves of accumulation. Coal as a commodity is part of an environment-making project in service to capital accumulation that is co-produced through historical geographies of concrete configurations of human and extra-human natures. The socio-ecological relations making up Appalachia’s commodity frontier reworked regional ecological conditions of

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1 The commodity frontier concept speaks to world-systems and commodity chain analyses (Bunker 1984; Barham et al. 1994; Tomich 1994; Bunker and Ciccantell 2005; Moore 2010a) and is well suited for synthesizing the historical regional political ecologies of booms and crises in the expansive nature of capitalism.
production and reproduction. This occurred most immediately through the socio-spatial organization of production and was articulated through the expansion and contraction of the world-ecology.

This paper examines the history of booms and crises in mining in Appalachia. Situating the coalfields of Appalachia as a commodity frontier, I seek to elaborate its origins, development and the ongoing crisis. In particular, Appalachia’s rise and demise as dominant commodity frontier can be measured by not only its coal production, but also capital’s ability to appropriate surplus from the unpaid work of humans and the rest of nature. I build off Araghi’s (2003, 120) notion of ‘underreproduction’– a dialectic between the exploitation of labour power and the appropriation of the rest of nature (including human work), a process that generates massive surpluses for capital and cuts ‘into the subsistence requirement of labor power’ and extra-human natures. I argue that the origins of Appalachia’s commodity frontier pivoted on agrarian change in and out of the region, and that the development of its frontier was constituted in the deepening and expanding under-reproduction of human and extra-human natures. Its crisis lay in the inability for capital to appropriate sufficient surpluses from labour and the rest of nature resulting from the historical under-reproduction strategies of capital. Further constituting the coal crisis in Appalachia is the rise of a new coal frontier, the Powder River Basin (PRB), economic diversification within the region and an emerging natural gas revolution. The socio-ecological conditions that enabled millions of tons of coal to be extracted for over a century soon found the continuous under-reproduction of human and extra-human natures accelerating towards crisis, beginning with a reproduction crisis and then an eventual regional accumulation crisis: not a crisis condition that turned simply on the exhaustion of ‘peak coal’, but a process that unfolded through the broader totalities of ecologies of energy, politics and power in and out of the region. Appalachia’s coal crisis and the attendant movement to the PRB as the largest coal-producing basin in the United States (US) signified the end of Appalachia’s commodity frontier position within the world-economy (Marley and Fox 2014).

The paper begins with a discussion of commodity frontiers, and how the term can be useful for understanding not only the development of specific commodities, but also the ways in which the expansionary nature of capitalism is constituted in ‘place-specific commodity production’ (Moore 2000, 411). From this angle, the concept commodity frontier enables a new understanding of the socio-ecological changes and the cascading contradictions that give rise to the geographical movement of capital, labour and resources. I then define the geographical contours of a complex, heterogeneous region called Appalachia. The main sections of the paper examine, first, how agrarian frontiers in the American West conditioned the emergence of a coal commodity frontier in Appalachia. In particular, I examine how Appalachia’s agrarian economy was exhausted and superseded by an agricultural revolution that had far-reaching world-ecological consequences. Following this, I historicize the rise of the coal frontier as a project that rewrote the rules of production and reproduction in the region, and how its development was premised on under-reproduction strategies. Then the paper analyses Appalachia’s coal crisis as a process bounded by richer sources of coal and natural gas in relation to a changing regional political economy. Appalachia’s coal crisis is not simply an absolute or physical exhaustion of coal deposits; rather, the crisis is multilayered and complex. Finally, the paper concludes with a wider discussion of how Appalachia’s coal frontier extends our understandings of the commodity frontier concept and how energy commodity frontiers in contrast to early modern frontiers are unique.

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COMMODITY FRONTIERS AND CAPITAL’S UNDER-REPRODUCTION STRATEGIES

Many social scientists have utilized a commodity-based approach to understand the uneven development and reproduction of capitalism through time and space. For example, Stephen Bunker (1984, 1985) examined modes of extraction in the Brazilian Amazon, focusing on rubber, timber and other natural resources. Sidney Mintz (1985) and Dale Tomich (1994) each have studied the centrality of sugar in the making of sugar plantations in the periphery and industrialization in the core. Paul Gellert (2010) utilizes ‘extractive regimes’ to examine the extraction of multiple resources in post-war Indonesian development. Jason Moore has examined the all-important silver frontier of Potosí and the sugar frontier of Madeira that constituted the origins of the early modern capitalist world-system (2009, 2010a).2 These studies have illustrated how commodity production has been generalized historically and geographically and has engendered a changing global division of labour, and how certain commodities have been historically central for capitalism.

Commodity frontiers are regions where minimal capital investment can consolidate and accumulate great quantities of land, labour and resources. They are formed as a way of mass-producing one commodity in order to supply cheap inputs for capital, including cheap food for lowering the reproduction costs of labour. For example, the agricultural frontier of the American Great Plains, discussed further below, supplied cheap food to an expanding global proletarian class that was filling the mills, mines and factories. What makes frontiers possible is capital’s ability and capacity to appropriate the unpaid work of nature (including humans), coupled with the exploitation of cheap labour. These rising frontiers temporarily ratchet down the system-wide ratio of capitalized to uncapitalized nature (Moore 2010b).3 Declining frontiers signal increased levels of capitalization and therefore higher costs for producers in the short run and for capital in the long run. The increasing system-wide cost of capitalist development has been a secular problem for capital (Wallerstein 1999), a problem that is often temporarily resolved through spatial fixes in the form of commodity frontiers (Harvey 1982).

Frontier movements incorporate complex ecologies and consolidate the work of humans and the rest of nature, engendering a process of ecological simplification centred on one or two commodities. Based on the socio-ecology of specific commodities (e.g. sugar, silver, timber and coal), commodity frontiers develop their own particular sets of contradictions (Bunker 1985; Moore 2009; Gellert 2010). If these contradictions are not attended to effectively, they often result in regional crises (e.g. the 1930s Dust Bowl). The exhaustion and succession of commodity frontiers are formed in regions with low capitalization that are rich with strategic resources. Appalachia is a case in point. Commodity frontiers, then, are the geographical expressions and fixes of capital’s need for cheap commodities – an environment-making process in which capital flows in and out of regions, weaving together rising and falling frontiers.

What makes the commodity frontier concept useful to social scientists? First, commodity frontier analysis turns the linear modernization model on its head, explicating how regions

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2 Liam Campling (2012) has examined the shifting tuna commodity frontier in the Indian Ocean over the nineteenth and twentieth centuries.

3 Capitalized nature refers to increasing mechanization, wage-work and greater use of inputs, such as energy and raw materials, leading to an increased cost of production (i.e. labour and land).
are tied to the world-economy and how, in turn, those regions become underdeveloped (Dunaway 1996). Second, commodity frontiers allow researchers the ability to track the economic expansion and contraction of capitalist development through the inherent unevenness of commodity production in different places. Commodity production and exchange highlight the importance of uneven development of historical capitalism. Third, the world-systems conceptual toolkit is relatively abstract (e.g. long waves and unequal exchange), and thus commodity frontiers enable researchers to situate abstract processes within concrete place-based commodity production (Moore 2000). In doing so, commodity frontiers give us a starting point in the ongoing dialectic of local–global processes, in which local production conditions are shaped by and, in turn, shape the world-economy. A fourth reason why commodity frontiers are useful is that they allow social scientists to take seriously the different biogeophysical characteristics of commodities, which pose as opportunities and barriers to capitalist development (Bunker 1984). I would add a fifth and final reason for employing commodity frontiers, that of analysing the continued under-reproduction of human and extra-human natures through regional commodity production. The development of commodity frontiers transforms regional political economies into export zones of the world-ecology and, in the process, often exhausts the conditions of re/production (O’Connor 1998). Commodity frontiers are not simply the expression of market forces or increased urban consumption (Cronon 1991) but, rather, rising frontiers are constructed through the crisis of preceding frontiers, pivoting on declining or stagnating labour productivity within the exhaustion of a broader regional totality.

The incorporation and development of commodity frontiers entails a rewriting of the productive and reproductive activities of human and extra-human natures, a fundamental environment-making reconfiguration of how humans and the rest of nature are organized regionally. Frontier movements enact a double movement, at once alienating labour, and thereby deepening market dependence and, second, appropriating the productive and reproductive activities outside the immediate spaces of commodity production in service to capital accumulation. To be sure, there is an ongoing dialectical process of dispossession and capital’s ability to appropriate the unpaid work of humans and the rest of nature. Capital’s reorganizing project appropriates the productive and reproductive work of regional natures through multiple under-reproduction strategies.

I want to clarify conceptually the notion of under-reproduction in relation to the rise and fall of commodity frontiers, as this forms the basis of the argument of the paper. Under-reproduction here is defined as capital’s ability to cut into the subsistence needs of humans and extra-human natures through not ‘paying’ for the socially necessary levels of reproduction. Historically, the under-reproduction of labour power, Araghi (2009, 122) argues, unfolds through a number of axes, including ‘gender, race, geography, and ecology’. I would add another: frontiers – the under-reproduction of labour power and the wider ecologies of reproduction also unfold through expanding frontiers, expressed in crises of accumulation and crises of reproduction. In this sense, under-reproduction strategies (e.g. wage repression, forced underconsumption or inadequate housing) unfold through the socio-ecological relations of historically concrete natures. Capital’s under-reproduction strategies turn on the paid and unpaid work of humans and the rest of nature, a project that exhausts earlier forms of production and reproduction. For example, found throughout the rich forests and coves of central Appalachia, wild ginseng was an important source of supplemental income that paid off the debts of farmers and miners (Hufford 2003). Often, the children of miners hunted ginseng to be sold locally, and then, on the world market, that paid for school clothes
and books (ibid.). Capital, then, appropriated the reproductive work of humans and the rest of nature that had subsidized the low prices farmers received for crops and the low wages paid to miners. Indeed, a semi-proletarianized labour force was developing in the midst of agricultural decline. Capital’s insatiable appetite for privatized land enclosed rural Appalachia’s commons, undercutting its ability to squeeze greater surplus outside the immediate spaces of commodity production.

Under-reproduction strategies operate from the scale of the body to the regional frontier scale, exhausting labour forces, both in the physical and effective demand sense, and the broader regional ecology in which it unfolds. The main aim of this paper is to reveal how the coal industry carried out these strategies as a multi-scalar contradictory process constituted through competing energy sources and emerging frontiers. To recapitulate, I argue that capital’s many and varied under-reproduction strategies gave way to a fully developed Appalachian commodity frontier, and that these strategies also exhausted the socio-ecology of a regional political economy, leading to a reproduction crisis.

Are commodity frontiers something only of early modern capitalism? Simply put, no. Capital’s long waves of accumulation have been premised on successive frontier movements and are tightly bound with rising core nations. To be clear, commodity frontiers are not simply the movement of capital to less capitalized regions. Nor should frontiers be understood as developing through a single source (i.e. coal) in successive waves. Rather, emerging commodity frontiers are formed in and through the exhaustion of former frontiers as part of a recurring pattern of development, expansion and crisis. Further, and as argued in this paper, agrarian frontiers conditioned the emergence of a coal frontier in Appalachia, suggesting the interconnectedness of resource systems and frontier-making processes. Capital’s under-reproduction strategies figure significantly in this relation. Before arguing that Appalachia was indeed a commodity frontier, I briefly describe the geographical contours of the region.

A Region Divided: The Geographical Contours of Appalachia

Stretching from New York to Mississippi, encompassing 13 states and over 200,000 square miles, Appalachia is one of the largest classified regions in the US. Home to arguably the richest temperate hardwood systems in the world, comparable only to those of eastern China, Appalachia’s vast mixed mesophytic forest covers almost 80 per cent of the region and has an exceptionally diverse ecology (Yarnell 1998; Hufford 2006). These forests have undergone manifold transformations, tied to land speculation, blight, external declining timber frontiers, fires and storms, and railroad expansion, and the region itself is a timber frontier (Davis 2000). The region’s historical natures began with ancient geological and climatic processes, spanning

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4 By the early nineteenth century, ginseng was traded on the world market, fetching nearly US$1,000 for farmers (Dunaway 1996, 186).

5 In relation to capital’s under-reproduction strategies, a semi-proletarian class emerges in the nineteenth and the first half of the twentieth centuries. For work related to semi-proletarianization, see Wallerstein (1976), Koo (1990), Bernstein (2009) and Gürel (2011), I briefly touch upon how capital’s under-reproduction strategies conditioned and structured the development of a semi-proletarian class in central Appalachia.

6 In this account, exhaustion does not mean the physical depletion of resources. Rather, exhaustion connotes a region’s inability to reproduce the conditions of accumulation in relation to other more competitive regions. Competitiveness, then, is a key driver in exhausting the conditions of production. In this case study, I seek to demonstrate how emerging agrarian frontiers in the American West succeeded the less competitive agriculture zones in Appalachia, causing a broader exhaustion of agricultural systems in Appalachia.

7 See the Appalachian Regional Commission: http://www.arc.gov.

8 Appalachia contains “40 dominant canopy species, 40 woody understory species, and more than 1,200 herbaceous species” (Hufford 2006: 49).
over millions of years and eventually forming through the work of mountains, forests, rivers, plants and animals, including humans (Yarnell 1998). Although often thought of as an untouched region, its culture static in time and space, Appalachia’s socio-ecology has been one of constant change.

Since the inception of the Appalachian Regional Commission, a regionally based federal–state partnership coordinating development projects, in 1965, there has been ongoing debate about the geographical boundaries of Appalachia, with political and financial implications. The consensus in the literature is that Appalachia is divided into three subregions – northern, central and southern – each with distinctive historical ecologies (Widner 1990; Bradshaw 1992; Isserman and Rephann 1995; Billings and Blee 2000). From the northern Rust Belt to the central coalfields to the southern Sun Belt, the region’s diverse economies unfold through its rich and biologically diverse ecologies. This paper focuses predominately on the central coalfields as its forms the heart of the commodity frontier.

AGRARIAN TRANSFORMATION, APPALACHIA’S COAL FRONTIER AND THE LONG TWENTIETH CENTURY

The rise and demise of Appalachia’s coal frontier was a cumulative, yet cyclically punctuated project, formed through ‘internal’ under-reproduction strategies and a complex set of contradictory relations that had extended well beyond its geographical confines. The historical narrative discussed here serves the purpose of structuring the origins, development and crisis of the coal commodity frontier in Appalachia. The following section examines how this commodity frontier was both a product and producer of far-reaching environmental transformation, tied to agrarian change, political ecology of development, an expanding world-economy and competing fuel frontiers over the long twentieth century (1840s–2000s).

Agrarian Transformation and the Origins of the Coal Frontier

Capital’s frontier movements have often entailed the interaction of native and settler populations, a project of dispossession and displacement co-producing profoundly new ways of organizing the productive and reproductive activities of humans and the rest of nature. In the case of Appalachia, it has been one of successive commodity frontiers, from deerskins to timber and agriculture, and finally to coal, fundamentally transforming ways of living and working, beginning in the early seventeenth century (Dunaway 1996). The origins of the coal commodity frontier pivoted on agrarian transformation in and out of the region, articulated to the world-economy and an emerging US economy.

The dispossession of indigenous Appalachians began no later than the early 1700s, a project that accelerated through competition among European countries to conquer and control resources of the new world. Appalachia’s regional agrarian capitalism had been fully submerged into the capitalist world-ecology by the 1840s (Dunaway 1994). As the cotton fields of southern Appalachia greatly expanded during the mid-eighteenth century, along with improved roads and transportation networks, central Appalachia was converted into a supplier of meat and produce. The commercialization of the region’s agrarian systems included the increasing sales of livestock – cattle, mules, horses, hogs and most especially sheep (Davis

9 Central includes Kentucky, Tennessee, Virginia and West Virginia. Northern includes New York, Pennsylvania, Ohio and Maryland.
Just as the ‘sheep were eating men’ centuries ago in the rise of agrarian capitalism in England, the introduction of sheep raising, among other livestock, entailed a reordering of Appalachia’s agro-ecosystems that was a spatially expansive and energy-intensive process in which livestock consumed more than half of the corn produced in the region (Dunaway 1994). During the winter, livestock stayed close to the farmstead; and in the spring, animals roamed free. Farmers used the steep topography as fencing to contain their animals. In the summer, drovers from Virginia, Kentucky and Tennessee herded hogs, cattle and mules hundreds of miles to Atlantic ports, resulting in weight loss, and therefore loss of money (Yarnell 1998). In 1860, the region exported more than a million hogs, over 400,000 cattle, and almost 100,000 horses and mules (Dunaway 1994, 367). The advancing of agrarian capitalism in the region tied its productive activities to the cotton fields of the Deep South and then entered into the transatlantic economy.

Appalachia’s agrarian economy was inherently more complex than this suggests. In fact, sharecropping and non-farming activities became the dominant mode of agrarian livelihoods. Beginning in the late 1700s and accelerating in the first half of the nineteenth century, elite landowners and absentee speculators with an eye on large tracts of timber and rich salt deposits (two emerging industries) quickly controlled more than half of the land in Appalachia, dividing up large-scale farms into plots consisting of 50 acres or less (Dunaway 1996). A growing number of farming families rented from landlords who provided the means of production in the form of land, livestock, seed, garden plots and even whiskey (ibid.). While producing for both the market and landlord, tenant farmers and their families were often ‘food-deficient’, lacking an adequate diet (ibid., 101). Poor, landless farmers roamed the countryside year on year, searching for a better life for their families. It was a difficult proposition at best, given that speculators and landholding companies controlled most of the land, such that sharecropping conditions failed to improve. While some have claimed that the agrarian economy was self-sufficient (Bidwell 1916; Bidwell and Falconer 1941), most agree that farming families in the antebellum period partly relied on cash crops and livestock tied to the world-economy, but were also engaged in local trade through bartering and small-scale monetary transactions (Salstrom 1994; Dunaway 1996; Billings and Blee 2000; Davis 2000). As noted earlier, ginseng as a highly valued good figured significantly in local market transactions. A large and abundant variety of wildlife also enabled families to hunt, selling raccoon, rabbit, fox and bear skins as supplemental income (Salstrom 1994). While the history of capitalism has been one of recurring enclosures and dispossession, it has also enjoyed the continued unpaid work of humans and extra-human natures, but especially women, who tended the garden, raised the family, performed household chores, and hunted ginseng and other wild plants (Davis 2000).

Profound agrarian transformations were also unfolding nationally and globally, in which a new agricultural revolution was emerging. Though geographically concentrated in the American Midwest and the Great Plains, the new agriculture revolution was a product and producer of global agrarian change. In the midst of the Great Irish famines of the 1840s, the 1846...
Corn Laws were signed to liberalize trade in grains, especially wheat (Weis 2013). While Ireland continued to export livestock, meats and oats for an expanding horse population in urban centres, nearly a million of its inhabitants died and another million migrated, mostly to the US (Peet 1972). In the US, ideals of Manifest Destiny and a series of land acts giving free land to settlers, most significantly the 1862 Homestead Act, had captured the hearts and minds of impoverished and landless farmers, both of which emigrated in great numbers from Kentucky, Tennessee and Virginia (Cronon 1991). Supported by government policies, land speculators were equally hopeful for new investment opportunities, much to the chagrin of Southern Planters (Post 2011). The enclosure of free or cheap land was made possible through a recurring project of dispossessing Native Americans and the extermination of the bison population that had sustained the Great Plains people (White 2011). Above all, the mid-nineteenth century agricultural revolution was a violent world-ecological moment constituted in far-flung colonial projects, free-trade policies and economic opportunities, giving way to unprecedented economic growth and the rise of the first food regime (see Table 1).

The rise of a new agrarian frontier in the US would have significant implications for farmers in Appalachia. Livestock, an important cash ‘crop’ for Appalachian farmers, were moved to the new agrarian frontiers in Texas, Kansas and throughout the High Plains, whose extensive open spaces allowed massive feedlots that had not been seen on eastern farms (Cronon 1991). The rich complex ecology of the prairies gave way to cattle ranches that eventually linked up with Chicago stockyards, a spatially shifting commodity chain undercutting Appalachian farmers (Weis 2013). Between 1860 and 1880, the price of livestock in Appalachia had dropped from US$32.01 to US$25.01 per head (Salstrom 1994, 15). What exacerbated this drop in price is that farm sizes were becoming smaller and smaller as the salt, timber and coal industries began to expand. Additionally, Tennessee, Virginia and West Virginia enacted new enclosure legislation that prevented livestock owners from free-ranging their cattle and hogs (Salstrom 1994). Meanwhile, farmers on the Great Plains were able to produce livestock on larger economies of scale that were simply not possible on eastern farms, and were able to take advantage of Chicago’s new supremacy in the west.

Differences in levels of mechanization and soil fertility between the agrarian regions further widened the productivity gap. While sugar and cotton plantations devoured the nutrients of the soil in the plantation South, livestock further degraded central Appalachia’s soils. It was not for nothing that Marx suggested that the fertility of the soil was determinate in agricultural productivity (1981, III). The significantly richer soils of the Midwest and the Great Plains were put to work by farmers utilizing the mechanical reaper and the thresher as

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<th>Date</th>
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<tr>
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13 During this period, between 30 and 60 million bison were killed (Weis 2013, 65).
14 From 1850 to 1880, the average farm size decreased from 350 to 173 acres (Salstrom 1994, 15).
early as 1840. A simple reaper yielded ‘ten to twenty times more than manual tools’ (Mazoyer and Roudart 2006, 360). The thresher also increased labour productivity, doubling the cultivated area and thereby reducing the amount of necessary farm labour (Mazoyer and Roudart 2006, 364). For eastern farmers in Appalachia, the thresher was not worth the monetary outlay, as it was limited in its potential to increase average farm output (Salstrom 1994). Eastern farmers, most of whom were involved in commercial markets, could no longer compete against the rising agrarian frontier. Facilitated by new farm equipment, along with new transportation networks, including steamships and railroads, and coupled with free-trade policies, ‘world crop cultivation increased by 50 per cent between 1840 and 1880, with North America and Australia accounting for half of this expansion’ (Friedmann and McMichael 1989, 100). In 1850, the US exported 5 million bushels of wheat; in 1900, it exported 200 million bushels, cutting the price of wheat by half (Mazoyer and Roudart 2006, 369). The price of wheat was so low that European countries could not compete. Ireland’s wheat production dropped from 272,000 hectares in 1847 to 18,000 hectares in 1887 (Peet 1972, 6). Many British grain producers were displaced as overproduction caused the depression of prices, with the effect of ‘freeing’ farmers to work in mines and factories (Hobsbawm 1999; McMichael 2013). The new American agrarian frontier eclipsed Appalachia’s agrarian economy, becoming the ‘breadbasket of the world’ that supplied cheap food, especially meat and wheat, to the ‘workshop of the world’ that had effectively contained political discontent among Britain’s industrial working class (Weis 2013).

Agrarian capitalism in the US entered a new stage in the nineteenth century, with far-reaching consequences. In the case of Appalachia, agrarian livelihoods were rapidly exhausting, making it difficult to compete on the expanding world-economy. Farm productivity continued to stagnate or in some cases decline throughout the rest of the nineteenth century in Appalachia, prefiguring a new extractive economy in the form of timbering and coal mining (Salstrom 1994). Nineteenth-century agrarian transformation, then, became a decisive world-ecological pivot in which farmers regionally and globally were competing in the world-economy, and those that were displaced became part of the flows of the global labour force, while cheap agricultural surplus flowed to the mills, mines and factories of a rapidly industrializing capitalist world-system. The development of agrarian capitalism ‘relates an ever growing part of society from the direct production of means of subsistence, transforming them . . . into “free hands” and making them available for exploitation in other spheres’ (Marx 1981, III, 921). It is here, on the new agrarian frontier, where we find the impetus of a new fuel frontier forming in Appalachia, part of the US’s expanding food–fuel complex.

The Rise of a Fuel Frontier: Appalachia’s Coal Commodity Frontier and Capital’s Under-Reproduction Strategies (1880s–1930s)

Capital’s successive historical industrial revolutions have pivoted on recurring agricultural crises and revolutions (Bairoch 1973; Moore 2010b). The second industrial revolution, too, was premised on an agricultural revolution resolutely found in the new agrarian frontier. The US auto-centric development resulted in a spatially extensive, yet land- and soil-intensive, agricultural revolution that conditioned the second industrial revolution of the steel, auto and petrochemical industries. The long twentieth century of American capitalism was not only premised on cheap meat and grains, but also on cheap fuel emerging from the coal frontiers of Appalachia. Coal-fuelled railroads carried corn-fed cattle, ‘in which the logic of capital . . . bounded together far-flung places’ (Cronon 1991, 224), appropriating the unpaid work of humans and the rest of nature along the way (White 2011). From this angle, then, cheap food
from the Great Plains coupled with cheap fuel from central Appalachia constituted American capitalism’s new food–fuel complex, compelling a new industrial revolution and propelling successive waves of accumulation over the twentieth century.

The age of coal in the US developed much later than in other nations, as its abundant forests fuelled early industrialization. In 1850, the US ‘was burning ten times as much firewood as coal’ (Barnet 1980, 76). In 1885, coal finally replaced wood as the leading energy source in the US, forging a new technological matrix of iron, coal and steam that enabled ‘far more rapid increases in economies of scale than had been possible with wood’ (Shifflett 1991, 27; Bunker and Ciccantell 2005, 161). World coal production in 1800 was around 10 million tons; in 1900 it jumped to 1,000 million. Throughout this period, the three largest coal-producing countries, in ascending order, were Germany, Great Britain and the US, which nearly doubled the production levels of Great Britain by the close of the nineteenth century (Podobnik 2006).

Prior to the ascendency of King Coal in central Appalachia, Pennsylvania was the dominant coal-producing state. In 1825, Pennsylvania produced 313,169 tons of coal; 25 years later, the state produced 6,474,469 tons of coal, a combination of anthracite and bituminous coal (see Table 2). Anthracite coal, the oldest form of coal, found only in Pennsylvania, burned at extremely high temperatures, allowing for the production of high-quality iron that the lower-quality British coal could not furnish (Chandler 1972). Up until 1850, the US still imported British coal, but the combination of high-cost transportation and high-quality domestic coal resulted in Pennsylvania becoming a dominant coal-producing state (ibid.). Additionally, labour productivity in mining per worker in the US was 47 per cent higher than in Britain, owing partially to thicker coal seams in the US (McCloskey 1970, 293). By the late nineteenth and early twentieth centuries, coal mines in Britain were in trouble due to a combination of thinning coal seams, increasing miners’ wages, the Eight Hours Act that limited the working day, and an emerging coal frontier in the US (Greasley 1990). Imitating Britain’s massive industrial expansion, the US also mined and consumed great quantities of cheap coal to fuel, most importantly, its steel industry, but also New England’s stagnating textile economy. The ‘steel city’ of Pittsburgh, the smokiest of all industrial cities, utilized coal as an input for its emerging steel industry, consuming ‘3 million tons of coal, 5 per cent of the

<table>
<thead>
<tr>
<th>Year</th>
<th>Pennsylvania</th>
<th>Kentucky</th>
<th>Virginia</th>
<th>West Virginia</th>
<th>Tennessee</th>
</tr>
</thead>
<tbody>
<tr>
<td>1800</td>
<td>87,250</td>
<td>100</td>
<td>18,000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1825</td>
<td>313,169</td>
<td>6,700</td>
<td>66,720</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1850</td>
<td>6,474,469</td>
<td>75,500</td>
<td>138,017</td>
<td>0</td>
<td>60,000</td>
</tr>
<tr>
<td>1875</td>
<td>35,564,590</td>
<td>265,710</td>
<td>88,706</td>
<td>1,120,000</td>
<td>360,000</td>
</tr>
<tr>
<td>1900</td>
<td>137,210,241</td>
<td>5,020,686</td>
<td>2,393,754</td>
<td>22,647,207</td>
<td>3,509,562</td>
</tr>
<tr>
<td>1925</td>
<td>198,745,168</td>
<td>54,714,932</td>
<td>12,532,786</td>
<td>122,380,959</td>
<td>5,454,011</td>
</tr>
</tbody>
</table>


15 Anthracite is considered hard coal, whereas bituminous is considered soft coal.
16 This calculation is based on the quantity and quality of coal land, which in the US case was much more favourable than in Britain (McCloskey 1970).
national total’ (McNeil 2000, 68). By the end of the century the US had surpassed Britain in steel production and productivity (Hobsbawm 1999, 159).

To be sure, as Table 2 illustrates, Pennsylvania’s dominance as the most productive coal state in the US for a century and quarter is unquestionable. However, it would be short-sighted to focus on annual coal production without examining the broader socio-ecological relations of production and reproduction in which coal mining unfolded. Here, I argue that beginning in the late nineteenth century, central Appalachia – Kentucky, West Virginia, Tennessee and Virginia – became the coal commodity frontier not simply based on the amount of coal produced but on capital’s ability to appropriate the unpaid work of human and extra-human natures and the exploitation of miners through strategies of under-reproduction. This is not to dismiss the hardships of Pennsylvania coal miners and their families, but to say that the under-reproduction of coalfields in central Appalachia was more generalized, with long-lasting deprivation.

From its beginnings, the coal industry in Appalachia has been an economy of booms and busts, overlapping with, and sometimes counter to, the growth and contraction of the US and the global economy. Paradoxically, the early years (1880s–1930s) were considered a slow progression towards the industrialization of mining that was plagued with overproduction (Simon 1980). Even the low organic composition of capital in the coal sector often led to overproduction and low coal prices. In the highly competitive coal industry, low coal prices conditioned and structured labour relations such that mine owners would pursue under-reproduction strategies. These under-reproduction strategies, discussed throughout the rest of paper, constituted the development, and eventual exhaustion, of the coal commodity frontier.

Following the Civil War, the construction of rail transport, and the switch from wood- to coal-fired railroads, facilitated a massive boom period for the coal industry (Bunker and Ciccantell 1999). Between 1860 and 1873, state–private partnerships laid down seven times as much track than in the previous three decades (Moore 2002, 178). Four railroad lines connected central Appalachia to the rest of the nation: the Chesapeake and Ohio (O&C), the Norfolk and Western (N&W), the Louisville and Nashville (L&N) and the Southern (Shifflett 1991, 29). The construction of the railroads served to overcome the historical barriers of transporting low-value bulk commodity coal while serving major industrial centres (Chandler 1972; Bunker and Ciccantell 1999; Goodell 2006).

The expansion of rail transport into central Appalachia allowed its coal operators access to the Great Lakes markets, which up until then had been supplied by Midwest coal. Economic historian Ronald Eller (1982) provides a number of reasons for Great Lakes markets shifting to operators in Kentucky, Tennessee, Virginia and West Virginia. First, railroads charged lower freight rates with longer hauls. Second, the soft coal bituminous seams in Appalachia were relatively easier to access, thereby increasing labour productivity. Third, the United Mine Workers of America (UMWA) in the northern coalfields successfully increased mine wage rates, driving up the cost of production. Fourth, and related, miners’ wage rates were considerably lower in the central coalfields, allowing a lower market price for its coal. Lastly, it was relatively inexpensive to set up mining operations in the central coalfields, in some cases costing only US$20,000 (Eller 1982, 130). With the opening of the Great Lakes markets, coal production in central Appalachian increased from four per cent in 1880 to 40 per cent in 1930, while coal production for Midwest operators fell from 78 per cent in 1880 to 46 per cent in 1930 (Simon 1980, 56–7).

17 These states had been historically relegated to eastern and trans-oceanic trade (Dunaway 1994).
But what exactly were the mechanisms and relations that made this initial transformation possible? In short, land, labour and capital. Central Appalachia was once again experiencing another round of changing landownership. Politicians and boosters alike throughout the coalfields continuously advertised to capitalists and labour the beauty, wealth and opportunities embodied in the mountains (Shifflett 1991). The forerunner, West Virginia, began a frenetic promotion as early as the 1860s; Kentucky, Tennessee and Virginia soon followed by hiring geological surveyors to promote their mineral wealth (Eller 1982; Pudup 1995; Dunaway 1996). In 1880, Civil War Confederate General John Imboden bought 47,000 acres of land and mineral rights in Wise County, West Virginia, leasing and selling to the Virginia Coal and Iron Company (Shifflett 1991, 31). Beginning in the late nineteenth century, the Rowland Land Company was one of the largest absentee landholding companies in southern West Virginia, a company that presently provides permits for mountaintop removal operations (Wishart 2012). Railroad companies such as the N&W owned and leased hundreds of thousands of acres for the extraction of timber and coal (Lewis 1995, 299). Again landownership became a source of wealth for landlords and a source of exclusion of landless farmers. Northeastern and international investors bought up land in Virginia, West Virginia, Kentucky and Tennessee for next to nothing, in some cases as low as 25–50 cents an acre (Gaventa 1978; Reece 2005; Eller 2008). Absentee landownership was among the highest in Appalachia in comparison to the rest of the US, a recurring pattern dating back to the late eighteenth century and continuing up to the present day. Landholding companies and coal companies soon signed mineral contracts with farmers, known as ‘broad form deeds’, giving companies the right to mine subterranean minerals (Withrow 1971).\(^{18}\) Legally sanctioned by the Kentucky courts, the broad form deed allowed coal companies to survey and mine the farmers’ land at will, without paying taxes or reclaiming the land. Along with court decisions, the landlord class facilitated the movement from agriculture to mining. Landless farmers represented more than half of all of the agricultural sector, and those that owned land were relegated to the least fertile land (Dunaway 1994; Salstrom 1995). Further, the declining fertility of the land, partially due to livestock rearing, and the incorporation of highly fertile western lands, compelled landowners and impoverished farmers to wholesale thousands of acres to railroads, investors and U.S. Steel’s subsidiaries (Eller 1982).

Inequitable landownership throughout the coalfields coupled with the new western agrarian frontier exhausted the conditions of re/production of Appalachian farmers, structuring and supplying a cheap semi-proletarianized labour force to the coal and timber industries. Facing a subsistence crisis, farmers turned to mining and timbering employment in droves, creating a new semi-proletarian class. In the late nineteenth century, central Appalachia progressively moved away from agriculture and into mining and timbering (Lewis 1993; Salstrom 1994). In 1920, West Virginia had 24.3 per cent of its working population in agriculture, ‘down from 64.2 per cent in 1870’ (Lewis 1993, 299). In part, the reconstruction of American capitalism following the Civil War was a condition and consequence of the restructuring of the Appalachian economy as a major coal exporter. The development of giant corporations with vertically integrated systems of production and exchange required large quantities of inputs such as coal to produce iron, steel and electricity. Dispossession and displacement of farmers was at once a regional and global phenomenon unfolding through a changing world-ecology that fed into the agriculture–mining–industry complex.

\(^{18}\) In 1983, the Appalachian Land Ownership Taskforce (ALOT) conducted a study on landownership in Appalachia. The study found that the majority of land in Appalachia was concentrated in the hands of coal and landholding companies (ALOT 1983).
If cheap labour was essential in the formation of the coal commodity frontier, where did this labour pool come from? Besides the landless farmers of the region, the boom in the coal industry brought immigrants from England, Scotland, Ireland and throughout Europe to the coalfields of Appalachia (Corbin 1981). Many miners arriving in the US from England had mining experience and were quickly promoted as mine bosses (Andrews 2008). Other labour migrants included African-Americans from the plantation South who moved to the coalfields to escape the oppression of Jim Crow (Corbin 1981; Lewis 1987; Trotter 1990). West Virginia established a Commission for Immigration to recruit and entice coal companies to import workers, especially from the South, as a major source of cheap labour (Cook 2000). By 1920, there were 88,076 African-Americans in the central coalfields; 69 per cent of this population lived in southern West Virginia (Lewis 1987). In the late 1920s, African-American miners made on average less than US$20 a month compared to foreign and white miners (Trotter 1990, 108). As an accumulation strategy, the coal industry recruited cheap foreign labour with the intention of extracting greater surplus, with the effect of depressing the wages of the predominately native white population.

Wages were based on piece-rates; the more coal you mined, the more money you made. Earnings for miners were highest in Indiana, Illinois and Ohio. In 1929, the average hourly pay for a miner in Illinois was 79.1 cents; the average hourly pay for a miner in Tennessee was 43.6 cents (Fishback 1992, 91). West Virginia had the lowest wages and highest injury and death rates in the nation (Corbin 1981). However, the softer and larger coal seams allowed exceptionally hard-working miners to earn more than miners in other states (ibid.). In doing so, miners compromised their well-being, a dangerous safety concern exacerbated by callous operators. In 1930, a spokesman for the coal industry remarked that labour costs constituted 65 per cent of companies’ total operating costs (Salstrom 1994, 84). Be that as it may, during this period coal operators accrued massive profits, averaging 20 per cent, ‘and one-fourth of the operators averaged 25 per cent’ (Eller 1982, 154). Indeed, wages continued to climb, but coal companies often cut miners’ wages at will, sometimes reducing pay by half per ton produced (Simon 1980). In addition, company check weighmen consistently cheated miners of their payload (Fishback 1992). Operators, then, were cutting into the subsistence requirements of miners by direct wage theft.

The early years of coal mining are characterized as the hand-loading era, when mining was a craft occurring on a slow but increasingly industrial scale. Primitive mining technology consisted of a pick, shovel, hand auger and sticks of dynamite (Dix 1988). During this period, mining was something of a craft that required certain skills associated with knowing the subtleties of the mine shaft, when a roof might collapse, how to approach picking the coal and the knowledge associated with the sounds of mining (ibid.). It took many months, and even years, to learn the craft of mining and eventually earn the title of miner. Inexperienced miners would learn the craft of how and where to make cuts from experienced miners. They were also responsible for kneeling stooped over to separate the overburden from the coal. A miner worked in a room with one or two hand loaders extracting coal, while the loaders would hand shovel the coal into the carts (Dix 1988). During this process, the miner would

19 In 1880, West Virginia’s African-American mining population was 4,800 and had increased to over 40,000 in 1910 (Trotter 1990, 10).
20 Calculation is based on the hours spent in the mine, including travel time to and from the face of the mine (Fishback 1992).
21 Identifying miners’ wages during this period is difficult at best, because their pay was based on the weight of coal. Wages for miners in Kentucky and Virginia seem to have been similar to those for miners in West Virginia, as opposed to the higher-paying northern coalfield mines.
educate the loaders on the labour process of mining coal, while emphasizing what dangers to be aware of. Thus, knowledge was passed down from miner to loader, and eventually the loader would transition into the role of a miner, educate his loaders and the cycle would continue. The coal industry, like other industries, would eventually restructure the labour process to de-skill miners, thus making them relatively interchangeable.

While the labour process would remain an intractable issue between miners and owners, the working conditions in the mines were downright horrific. It was not for nothing that Lewis Mumford (2010, 70) stated that the mine, 'is the first completely inorganic environment to be created and lived in by man . . . Here is the environment of work: dogged, unremitting, concentrated work. It is a dark, colourless, a tasteless, a perfumeless, as well as shapeless world: the leaden landscape of a perceptual winter.' In some cases, men mined in water up to their knees, or mined while they were stooped over and/or on their knees for 10–14 hours a day (Long 1991). Mine conditions varied considerably. Certain mines were prone to flooding and methane explosions, while other mines had considerable adverse conditions, such as crawling to narrow, unforgiving dark spaces (ibid.). Coal dust was a major concern that more often than not contributed to pneumoconiosis, or black lung disease. The companies and the federal government ignored the many respiratory problems associated with mining, dismissing the prolonged, painful deaths of thousands of miners. While the British government was compensating miners for respiratory diseases as early as the 1930s, the US government did not legislate a compensation law pertaining to black lung until the late 1960s, with the Coal Mine Health and Safety Act of 1969 (Salstrom 1994). Even after legislation was passed, miners still had to go to considerable lengths, jumping through hoops to obtain compensation for black lung disease. The risks of mining were real – plagued with fires, blowouts, flooding, cave-ins and injuries that crippled miners for life. In many cases, coal companies did not compensate miners for life-crippling injuries. Instead, the collective community of miners gathered donations for the miner and his family, illustrating how commodity frontiers rewrite the rules of reproduction (Andrews 2008). Mining was not for the weak at heart. The forced under-reproduction of miners via lack of compensation for respiratory diseases, injuries and deaths incurred in mining was formative in the development of Appalachia’s commodity frontier.

Outside the mines, by the 1920s, coal camps were commonplace among the hollows of the mountainous landscape. During the coal boom, almost four fifths of the West Virginia miners lived in company towns; in Kentucky, over two thirds of its mining force lived in company-designed towns (Eller 1982, 162). Privately owned industrial towns consolidated the power of coal operators over miners and their families. The companies owned the homes, the streets, the schools, medical facilities and the notorious company store, forcing miners to sign ‘yellow-dog contracts’ that prohibited workers from joining or even supporting unions (Banks 1995, 339). The companies also forced miners to sign housing leases that reinforced the paternalistic nature of the towns, including direct deductions from pay cheques for monthly rents, and prohibiting both harbouring ‘persons objectionable to the company’ and the right to reside in the house after a miner quit or was fired (Banks 1995, 340). Designed to concentrate labour around the companies’ mines, the conditions in the towns were abysmal due to lack of investment by the companies (Lewis 1993). Public health and sanitation were

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22 Some of the worst mine disasters in US mining history occurred in the central coalfields. In 1907, 360 miners in a West Virginia mine died after being trapped following a mine explosion. From 1902 to 1927, mine explosions became commonplace: 'Switchback (1908 and 1909), Jed (1912), and Eccles (1914), Layland (1915), in West Virginia; Pocahontas again in 1906; Browder (1910) and Happy (1923) in Kentucky' (Shifflett 1991, 103).

23 The era of the company towns runs from the 1880s to the 1950s.
often compromised when the companies failed to supply clean water and construct sewer systems, resulting in increased communicable and venereal diseases (Shifflett 1991, 56–7). While miners and their families lived in substandard housing, the rest of the US was developing into a suburban nation of Levittowns. Forced under-reproduction of miners and their families constituted the development of Appalachia’s coal commodity frontier and lowered the system-wide cost of reproduction for Americans outside Appalachia.

A debt-labour led regime of accumulation was most apparent in the practices of the company town. Deductions from miners’ pay cheques included rent, medical bills, funeral expenses and goods from the company store (Gaventa 1982, 89). In many cases, the store prices were twice as high as those for comparable goods outside of the coal camps (Andrews 2008). Because wages were low and the cost of goods was high, miners and their families had to take loans from the company, forcing miners into debt. In some cases, to pay off debts, the wives of miners slept with the managers and owners of the mines. This was known as *esau scrip* (Kline 2011). Other strategies of social reproduction included owning a few animals or even a garden, a practice that the companies allowed, as it subsidized the low wages the miners were receiving. At times, the company store was more profitable than the mining operations (Simon 1980; Cook 2000), incentivizing companies to reproduce coal camps and the accompanied monopoly power that came with them. When miners frequented shops outside the company store, they were fired and blacklisted, preventing them from obtaining a new job. Under these conditions, miners, like the tenant farmers in the nineteenth century, travelled year on year from town to town in the hope of a better life. In this relatively totalizing socio-ecology, the under-reproduction of coal communities was a central movement in the formation and development of the commodity frontier.

The First World War increased the demand and price for coal, allowing for unprecedented growth in and out of the industry. In order to meet this demand and counter recalcitrant striking miners, coal operators began mechanizing the mines through new extractive technologies such as the undercutting machine, which was like a horizontal jackhammer, delivering 200 picks per minute (Long 1991). During the war years, coal for steam purposes rose from less than a dollar to as much as US$7 per ton (Eller 1982, 154). In 1917, the Federal Fuel Administration stabilized coal prices around US$3 per ton (ibid., 151). Still, even with federal price stabilization, mine operators were able to accrue significant profits. The US even exported coal to Britain, as its mines were under attack by German forces (Podobnik 2006). In 1923, the central coalfields had hit their zenith; more than 700,000 miners worked in over 12,000 mines, producing over a billion tons of coal. Northern miners, however, were feeling the pinch of competition from southern miners, whose increased labour productivity, coupled with cheap higher-quality coal, forced more than 200,000 miners to leave the coalfields for steel mills in Ohio and automobile factories in Detroit (Eller 1982, 156).

However, the good times were short-lived, as a string of warm winters decreased the demand for coal, and on the heels of the great boom of the First World War, more coal was mined than industries required, leading to overproduction by as much as two thirds (Salstrom 1994). In addition, increasing competition from oil and natural gas captured a greater share of the energy market. As early as the 1920s, oil and gas were demanding a greater share of the energy market (Salstrom 1994). At the turn of the century, oil was 30 per cent cheaper than

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24 In contrast, northern miners resided in one town for an average of 5 years (Shifflett 1991). To be sure, company towns varied in the level of development, infrastructure and civic institutions, some being markedly better than others.

25 Prior to the First World War, 41 per cent of coal production came from undercutting machines (Salstrom 1994). Following the First World War, 70.7 per cent of coal was mined from undercutting machines (ibid.).
anthracite coal, but still considerably more expensive than the bituminous coal found in the central coalfields (Podobnik 2006, 75). In 1923, coal provided roughly 63 per cent of US energy; in 7 years, coal’s share of US energy dropped to 55.7 per cent (Salstrom 1994, 88). During the early 1930s, coal production declined in all the central coalfield states (Milici 1997). However, throughout the Great Depression production began to climb, producing more coal than during the First World War. The rise of American capitalism and its insatiable appetite for fossil fuels produced such a demand that it temporarily offset the effects of competitive fuel sources. Oil as a fuel would not retain its true dominance in the energy markets until the post-war golden age.

In sum, the first period of coal mining in Appalachia (1880s–1930s) dramatically changed the socio-ecological organization of production away from largely tenant farming towards coal mining that was made possible by concentrated landownership. While the coal economy experienced upswings and downswings throughout the Great Depression, and then another major upswing with the Second World War, it was clear that King Coal and his frontier had arrived in the central coalfields. Capital’s regional under-reproduction strategies had enabled the exponential growth of the coal economy and the fostering of national industrial development. Those same under-reproduction strategies, however, came at a significant cost that enfolded a socio-ecological reproduction crisis for working-class families and their environment.

A Socio-Ecological Reproduction Crisis in the Coalfields

After the coal boom of the Second World War, a new era arrived in the coalfields. A combination of increased mechanization in mining, class compromise between the UMWA and the industry, and the rise of oil as a fuel commodity constituted a growing reproduction crisis among residents in Appalachia. The reproduction crisis in central Appalachia was not a product of a crisis in the coal industry, but a crisis arising from within the coal communities as a result of changing conditions of production.

While the rest of the US economy was experiencing the golden age of American capitalism, and manufacturing was truly at its peak after the Second World War, the coal industry was in an economic downturn. During the 1950s, the coal industry went through a long slump that resulted in the Great Migration out of Appalachia. Between 1940 and 1970, over 3 million people left Appalachia for greater economic opportunity in industrial cities such as Detroit, Chicago and Cleveland (Eller 2008, 20). In West Virginia, the population ‘declined from 2,005,552 to 1,860,421’, representing a 7 per cent loss (Rice and Brown 1993; cited in Perdue and Pavela 2012, 372). In West Virginia, coal mining declined by 70 per cent between 1950 and 1970 (Maggard 1994). Appalachia had poverty rates as high as 60 per cent in the early 1960s, while for the rest of the country poverty was around 30 per cent (Ziliak 2012).

Perhaps more than any single factor, mechanization of the mines had led to profound changes both in and out of the mines. Capitalists have long since introduced new machines of production to replace, de-skill and discipline labour. Mechanization began as early as the First World War, a process that eliminated old forms of mining knowledge and increased the dangers of underground mining. When UMWA President John L. Lewis signed the National Bituminous Coal Wage Agreement in 1950, mechanization in mining became generalized. The National Bituminous Coal Wage Agreement was a national contract agreed upon between the union and industry that favoured the elimination of small coal operators and the promise to increase wages. This incentivized large-scale operators to adopt machines and new forms of production.
extraction, notably a form of surface mining known as contour strip-mining (Montrie 2003). The practice of contour strip-mining did just that. It involved the terracing of mountainsides, scraping away the overburden to reveal horizontal coal seams. Strip-mining increased tenfold during the Second World War due to the development of ‘diesel-powered earth-moving equipment, giant screw-like augers, and more powerful explosives’ (Eller 2008, 36). An entrepreneur with modest means could obtain a loan to enable him to utilize surface mine machinery with minimal capital investment (ibid.). Although investments were relatively minimal, the industry was taking major steps towards an increasingly capitalized nature. While an underground operation would require 40 miners, a surface mine frequently had ten or fewer miners (Montrie 2003). The replacement of living labour through mechanization in the form of contour strip-mining meant that more coal could be extracted with less labour. Surface mining productivity dramatically increased, surpassing the productivity of underground mining – a pattern that would continue to the present.

Technological innovations throughout this period meant massive increases in labour productivity. One of the largest changes that increased labour productivity was the continuous miner, a machine that could be operated by a five-man crew, using a rotating toothed wheel to cut coal seams and transfer it directly to buggies that drew the coal to the surface (Brisbin 2002). In 1945, a single miner was producing 5.57 tons of coal a day; the same miner was producing 10.05 tons in 1957 (McGinley 2004, 6). The result was that from 1950 to 1959, mining employment decreased from 416,000 to 180,000. By the close of the 1960s, the mining labour force had eroded to around 125,000 due to increasing productivity from improved mining technologies. New coal technologies of extraction brought about a reduction in the number of miners and the elimination of incentive-based production, and constituted a new spatial organization of production and supervision (Brisbin 2002). Despite these changes, President Lewis upheld his promise to increase wages and improve benefits for miners, but this came at a high cost.

Mechanization of the mine may have increased coal production with a smaller labour force, but it was apparent that the environmental costs were adding up. Increasingly capitalized natures often correspond to greater environmental transformations. Well before the anti-mountaintop removal movement began, the anti-strip-mining movement included miners, hunters and local residents who were fighting to protect the land, water and soil (Montrie 2000). Strip-mining required the clear cutting of large tracts of forests and the elimination of thousands of years of rich soil, resulting in the pollution of streams and clean drinking water, and the dispersion of large wildlife populations (Montrie 2003). Ginseng and crawdads were harder to hunt as complex ecologies were transformed into simplified landscapes. Strip-mining, then, cut into the reproduction strategies that the residents of Appalachia had utilized well before industry developed, reconfiguring the socio-ecology as a relatively dispossessed and dependent population longed for stability.

Aside from mechanization, competing sources of energy such as oil challenged coal’s role in the Fordist regime of accumulation. Beginning in the 1930s, and then accelerating during

26 Contour strip-mining would soon be modified into the modern-day mountaintop removal mining, beginning in the early 1970s.
27 Surface mining far outstripped the productivity of underground mining as early as the late 1950s. In 1958, the average strip-miner produced over 21 tons of coal a day, whereas the average underground miner produced 9 tons a day (Montrie 2000, 82).
28 For example, mountaintop removal mining operations require large quantities of capital, requiring rapid turnover time and high returns. A dragline can cost more than US$20 million (Marley and Fox 2014). The use of hydraulic fracturing in the production of shale oil and gas also requires a large capital outlay.
the post-war era, the US economy was experiencing a fundamental shift in its food–fuel complex. Oil became pervasive and was used in electricity generation, the expanding chemical industry, modern warfare and, perhaps most significantly, in agriculture and transportation (Heinberg 2005). Oil-fuelled farm equipment and oil-based petrochemicals underwrote a new agricultural revolution that produced a new wave of large-scale monocultures, animal feedlots and a thriving chemical industry (Weis 2010; Rosset et al. 2000). The Midwest and the Great Plains had developed into a full-fledged industrial farming frontier, exporting surplus food as ‘food aid’ and preventing the spread of communism in the Global South (Friedmann 2005). Massive federal credit was extended to facilitate a housing boom in the form of suburbanization, underwritten by cheap food and cheap oil, which became a ‘financial and ideological anchor of capitalist social reproduction’ (Huber 2011, 39). Suburban living and automobile ownership were the symbols of the ‘good life’, embodied in the rising white middle class. Capital’s new food–fuel complex fundamentally constituted the growth of the US economy, while Appalachia’s coal frontier was rapidly fading. Modern America and the world-economy were moving beyond coal as a principal energy source, leaving coal-dependent communities in the dust (see Figure 1).

Decaying communities dotted the hollows of Appalachia as operators abandoned company towns. Left in the wake of increasing mechanization in the mines and the rise of oil and natural gas, coalfield residents faced a reproduction crisis (Marley 2013). In contrast to the national average, Appalachians had higher rates of poverty, job turnover and unemployment (Isserman and Rephann 1995). Between 1950 and 1960, farming employment declined from 706,000 to 336,000 (PARC 1964, 23). The region also had on average lower incomes and education attainment, and less urban growth (Widner 1990). In 1960, 60 per cent of housing units in Kentucky ‘lacked indoor plumbing’, whereby raw sewage was regularly dumped into waterways, and the value of housing was ‘27.7 per cent below the national average’ (Eller 2008, 32). In the wealthiest and most powerful country in the world, Appalachians faced deep

Figure 1 World commercial energy production, 1800–1997

Note that the US was the number one oil producer in the world until the second half of the twentieth century. Its largest reserves were centred in Texas, Oklahoma and California.

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29 Between 1945 and 1955, automobile registrations doubled (Huber 2013, 73).
and lasting deprivation that, according to the Appalachian Regional Commission, was comparable to that of 'Third World' countries (PARC 1964).30

Despite a rise in coal production, mine employment dropped significantly throughout this period (1940s–1970s), forcing coal communities into a reproduction crisis. This suggests that increasingly capitalized natures in the form of mechanization of the mines in conjunction with competing fuel sources such as oil can have deleterious effects on coal-dependent communities. This period reveals the full-fledged expression of capital’s under-reproduction strategies as increases in depopulation, unemployment and environmental transformation. While mine employment increased significantly in the 1970s due to an oil crisis and expanded steel production, population loss and significant environmental degradation would continue with a new round of mechanization, leading to what is referred to as mountaintop removal (Chomsky and Montrie 2012).31 Transformations in technologies of extraction have been integral to the making and remaking of Appalachia’s commodity frontier. Technological developments must, of course, be understood in a broader totality that takes seriously the competitive pressures that coal companies face not only from miners and other coal-producing regions, but also more concentrated energy sources. Appalachia’s commodity frontier was entering its final stage as the dominant coal-producing region.

KING COAL’S CRISIS: THE RISE OF THE POWDER RIVER BASIN AS A COMMODITY FRONTIER?

The crisis of Appalachia’s commodity frontier is signalled in its increased labour costs, its declining or stagnating labour productivity, and the exhaustion of its ability to appropriate high returns from its under-reproduction strategies. While the ascendance of King Coal pivoted on agrarian exhaustion, its decline was unfolding through an expanding coal basin, namely the PRB, climate change policies and cheap natural gas.

King Coal’s reign came to an end in 1988, when the PRB, located in Wyoming and Montana, surpassed Appalachia as the leading coal-producing region in the US (Source Watch 2013). In 2007, the PRB produced as much as 436 million tons of coal, more than doubling West Virginia’s production, and more than all of Appalachia combined (ibid.). Peabody Coal has been one the leading companies in the PRB, producing 130 million tons of coal a year.32 Important to the development of the PRB was the rewriting of the Clean Air Act, resulting in ‘stricter sulfur dioxide emissions standards for coal-fired power plants’, which, in turn, advantaged western coal, which had much lower sulphur levels (Bell and York 2010, 122). The operating costs for Arch Coal, one of the largest coal companies in the US, are considerably lower in the PRB in comparison to its eastern operations (Marley and Fox 2014). Large-scale open pit mining, as opposed to mining mountains in Appalachia, is predominately used in the PRB, where the coal seams measure 100 feet thick (EPA 2004). The thinning

30 The Appalachian Regional Commission was created to study the economic conditions in Appalachia and to resolve the intractable poverty plaguing rural areas (Bradshaw 1992).
31 In 1970, there were 45,261 mining jobs in West Virginia that produced 143,132,282 tons of coal; in 2002, there were 15,377 mining jobs that produced 163,896,890 tons of coal (Burns 2007, 41). In 2003, of the 56 million tons of coal produced through surface mining, 46 million tons were produced using mountaintop removal mining (West Virginia Coal Association 2003). By 2000, nationwide UMWA membership was 20,522 (Burns 2007, 58). Over half of the regional mining labour force vanished between 1979 and 2003 (Moody 2007, 70).
Appalachian coal seams measure less than a foot in most cases. To be sure, the Appalachian coal seams were never 100 feet thick; in fact, 10–12 foot seams were considered hitting ‘gold’.

Mining in the PRB typically uses a non-union workforce and engages almost exclusively in surface mining. The return on investment in strip-mining is double that of underground mining (Barnet 1980, 80). In the eastern coalfields, underground mining still accounts for half of all mining (McIlmoil et al. 2013). Productivity per worker hour in the PRB is 39 tons, compared to West Virginia’s 4 tons (Goodell 2006). West Virginia’s labour productivity peaked in 2000 and has steadily declined since (McIlmoil et al. 2013): ‘The decline in labor productivity implies that Central Appalachia is becoming increasingly more costly to mine, and therefore that the most accessible, lowest-cost coal reserves are being mined out. This may be the greatest challenge to future coal production in Appalachia’ (McIlmoil and Hansen 2009, 3). By 2011, Wyoming’s production accounted for 20 per cent of the US coal output, while all of central Appalachia’s coal production accounted for 17 per cent (EIA 2013). Since 1997, coal production has declined by 29 per cent in West Virginia, 37 per cent in Virginia, 44 per cent in Kentucky and 55 per cent in Tennessee (McIlmoil et al. 2013, ix). Increasing and decreasing levels of productivity translate into differences in prices for the two basins. Coal prices are considerably lower for the PRB, in contrast to the higher prices of Appalachian coal (see Figure 2).

This, however, is not simply a reflection of the difference in labour productivity. Rather, differences in the biogeophysical characteristics of coal exist between the two basins that account for the price differences. The PRB contains mostly sub-bituminous coal, used for electricity production, whereas central Appalachia contains mostly bituminous coal, which is

Figure 2 Average mine prices for the four major coal basins, 1984–2011

Source: McIlmoil et al. (2013).
CAPP, Central Appalachia; PRB, Powder River Basin; NAPP, northern Appalachia; E. INT, eastern interior.

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divided into steam and metallurgical coal, used for electricity and steel production, respectively. Sub-bituminous coal does not burn nearly as hot for steel-making or as efficiently for electricity production as bituminous coal, and thus, requires a greater quantity of coal for a similar output. However, what disadvantages Appalachian coal, among other factors, is that the sheer amount of sub-bituminous coal mined from the PRB and its lower transportation costs more than make up for its inferior qualities (Barnet 1980; Goodell 2006; McIlmoil et al. 2013). From 1979 to 2010, transportation rates in the PRB decreased by 45 per cent while Appalachian rates increased by 30 per cent (Considine 2013, 520). The PRB represents a potentially new commodity frontier that continues to exhaust the coalfields of Appalachia. It provided an estimated US$107 billion to the US economy in 2011 (ibid., 529). While companies often operate in multiple coal basins, the continued decline in labour productivity in central Appalachia and the inability of companies to appropriate surplus from their under-reproduction strategies signal a growing problem for coal operations in the region. Economic diversification, too, may signal a decline in coal country.

Central Appalachia is often characterized as a mono-economy. However, in the past 30 years it has begun to expand into mostly the service sector, with greater participation of women in the workforce. Jobs in retail, including food services, and health have increased significantly as another round of rationalization in the mines has left hundreds of thousands of miners unemployed (Maggard 1994; Miewald and McCann 2004). Wages in food services and health are among the lowest of all sectors. For example, in 1987 the average miner in West Virginia was earning US$36,400 a year, whereas in the service and retail sectors, in which women constitute the majority of the working population, the average yearly earnings were US$15,000 and US$13,000, respectively (Maggard 1994, 23–4). Even though women have entered the formal workforce in greater numbers in Appalachia, intractable poverty continues throughout the region. As might be expected, women continue to shoulder a greater portion of the unpaid work of socio-ecological reproduction in the household even as they work more hours in paid jobs, revealing what Scott (2007) calls ‘dependent masculin-ity’, whereby the precariousness of men’s employment is ‘made up’ through women’s ‘supplemental’ paid and unpaid work.

A tourist industry has also emerged that has marketed romantic notions of rural life that take advantage of the region’s wealth, beauty and wilderness to promote activities such as white-water rafting, climbing and rappelling, and all-terrain vehicle (ATV) tours. Currently, the number of jobs created in West Virginia from the coal industry is 22,000, while in tourism 72,100 jobs have been created (Blaacker et al. 2012, 395). In southern West Virginia, the state has constructed over 500 miles of ATV trails across public–private lands, including nearby mining properties, known as the Hatfield–McCoy Trails (Burns 2007). Drawing in tourists from all around the US, the Hatfield–McCoy Trails network has generated commerce, requiring lodgings, restaurants and general stores. However, local residents who regularly utilized these trails prior to the construction of the trail system complain that they now have to pay US$26 a year where access had previously been free (Scott 2010, 130). Kentucky also has a thriving ATV tourist industry that began in the late 1970s. However, it is estimated that for every US$500 spent by tourists, only US$60 enters the local economy (Fritsch and Johannsen 2004, 43). Without mentioning the environmental consequences associated with ATV riders

33 Mine employment in West Virginia stands at around 21,000, making up 3 per cent of the state’s total employment (Blaacker et al. 2012, 386). In 2004, the West Virginia the coal industry contributed US$3.5 billion to the gross state product, less than retail trade (US$4 billion), health care and social assistance (US$4.8 billion) and government (US$8.4 billion) (Bell and York 2010, 121).
and large numbers of tourists, tourism is a leading industry in all of central Appalachia that unfortunately usually only provides seasonal low-waged jobs (Maggard 1994).

The region’s diversifying economy is at once an opportunity and a constraint for workers and the coal industry. In a very real sense, the expansion of the service economy has allowed women of all kinds the opportunity to earn a wage and support themselves and their families. However, earnings from most service-sector jobs often fail to pay a living wage, forcing women to engage in legal off-the-books work, including housework, gardening, childcare and aluminium recycling, for which, according to one study, the estimated income for a month of 90-hour working weeks came out at US$168, or less than US$2 an hour (McInnis-Dittrich 1995, 404). When these activities did not pay the bills, women engaged in illegal activities such as selling drugs, prostitution or bootlegging (ibid.). Both men and women are now travelling 30–40 miles to work at Wal-Mart or fast-food restaurants, revealing the lack of adequate well-paying jobs.

These labour-market transformations do not go unseen by the coal companies. When wages are considerably lower outside the mining sector, companies can repress wages by the sheer fact that jobs paying a living wage are few and far between. In fact, companies have launched political–ideological campaigns that promote coal as symbolically representing the entire economy of central Appalachia, even while coal’s economic impact continues to decline (Bell and York 2010). In place of a diversifying economy, these totalizing campaigns – for instance, the ‘War on Coal’ – promote a hegemonic discourse that favours the region’s historical–cultural heritage over job growth in other sectors as alternatives. From this angle, then, there is a both a material and ideological contradiction unfolding through the changing regional economy, evident in both the crisis of coal and the emerging industries.

Following this, growing concerns about climate catastrophe and the emergence of what some have called a ‘natural gas revolution’ pose a greater challenge to the long-term viability of the coal economy in the region. The emergence of natural gas as a competitive energy source for electricity generation has exacerbated the crisis in the coalfields, as coal-fired power plants switch and convert to cheap natural gas (see Figure 3). In fact, between 2007 and 2011, coal-fired power plants have been retired in record numbers, occurring mostly in central Appalachia, a trend that is projected to continue even if natural gas prices do not remain low (McIlmoil et al. 2013, xix). While natural gas is certainly gaining a greater share of the electricity generation market, the sheer volume and cheapness of PRB coal is likely to remain central to electricity generation in the near future, especially since natural gas prices have historically been more volatile than coal prices (Considine 2013).

President Obama’s recent climate change legislation to make cuts in carbon emissions from existing power plants of the order of 25 per cent over the next 15 years was met with a backlash from the coal industry and coal-supporting politicians, arguing that the newly imposed regulations would eliminate coal-mining jobs, drastically impact coal counties and states, raise electricity rates and threaten US energy security (Ward 2014). In response to pressures from the federal government, and to a lesser extent the climate change movement, the coal industry has continued to expand its ‘clean coal’ projects, spending tens of millions of dollars on television advertisements and public relations (Fitzgerald 2012, 440).

The discovery of the Marcellus Shale, along with the Bakken Shale, as a viable energy resource is linked directly to the emergence of new technologies of extraction, namely

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34 Key environmental regulations that are likely to impact the demand for coal include: the Cross-State Air Pollution Rule, the Mercury and Air Toxics Standards, the Stream Protection Rule and USEPA’s involvement in permitting surface coal mines in Appalachia (McIlmoil et al. 2013, xviii).
horizontal drilling and hydraulic fracturing, and a financial environment that has raised the economic feasibility of natural gas extraction. Between 2000 and 2010, shale gas production increased 12-fold, and in 2012 US domestic gas prices hit a 10-year low (Wang et al. 2014, 1). Oil and gas production in the Bakken Shale are breaking records, extracting over one billion barrels and a billion cubic feet per day, respectively (EIA 2014a,b). As higher-grade coal deposits are exhausted and mountaintop removal mining runs its course, natural gas is surely going to figure as an important competing energy source.

This section has sought to explicate the recent changes unfolding in relation to the coal crisis in Appalachia. Unlike the reproductive crisis faced by Appalachians from the 1940s to the 1970s, and arguably up to the present, I have illustrated how the coal industry operating in Appalachia faces daunting barriers to profitability. Not only has natural gas become cheaper, but also coal is likely to become much more expensive as ‘diseconomies of scale’ afflict the central coalfields. Competition among coal, oil and natural gas is likely to accelerate large-scale surface mining in central Appalachia, as this poses the most cost-effective means of extraction (Wishart 2012). Appalachia’s ongoing coal crisis has pivoted on the rise of the western coal basins, namely the PRB, a diversifying regional economy that provides alternative jobs, albeit often low-paying, and natural gas technologies coupled with climate concerns have expanded a potential energy revolution.

Figure 3  Electricity generation by fuel, 1990–2040

Source: Energy Information Administration, 2013.
CONCLUSION: LESSONS FROM THE FRONTIER

This study has examined the rise and demise of Appalachia’s coal commodity frontier over the long twentieth century of American capitalism. The origins of the eastern coal frontier lay in the rise of a succeeding agrarian frontier, surpassing Appalachia’s agrarian role in the world-ecology. The nineteenth-century agricultural revolution constituted the rise of Appalachia’s coal frontier by way of US land policy, technological change and another round of violent dispossession that yielded to a favourable agro-ecology. In this way, we can see how agrarian change is linked to energy change and how energy systems are dialectically bounded to food systems. While most historical studies of energy have narrowly focused on long centuries of energy transitions (Heinberg 2005; Podobnik 2006; Huber 2009; Mitchell 2011), this study has illustrated how energy systems, specifically coal, were intricately linked to agricultural changes in and out of the region. There is, then, great opportunity for future research to examine the long-run patterns of historical change of what might be called capital’s food–fuel complex. Certainly, the rise of agro-fuels linked to climate mitigation and peak oil has caught the attention of agrarian scholars (Altieri 2009; Holt-Giménez and Shattuck 2009; McMichael 2012). However, most of this work has failed to grasp the historical long-term connections of food–fuel complexes and the economic, political and ecological implications.

A second lesson from the coal frontier is the ways in which under-reproduction strategies constituted the rise and proliferation of King Coal’s dominance throughout central Appalachia. Low levels of capitalization in the region meant that capital had greater potential for appropriating the unpaid work of human and extra-human natures and to exploit cheap labour. Capital’s under-reproduction strategy through frontier movements meant a reconfiguration of the organization of production and reproduction that decisively cut into the subsistence needs of humans and the rest of nature: in this case, outright wage theft, through denying miners benefits for injuries and diseases from mining, and the debt–labour relations of the company store. These spaces of appropriation and exploitation enabled coal companies to accumulate large surpluses, offset the costs of production and generate economic booms. The mining boom set off industrial development in Appalachia that resulted in an eventual reproductive crisis that was evident in the 1950s Great Migration and the long-term intractable poverty that plagues the region.

Another lesson from the coal frontier is that other energy sources, such as oil and natural gas, are often cheaper and cleaner substitutes for coal. Energy substitutability and competition, then, poses almost insurmountable challenges to the coal industry, especially with growing concerns about climate change and revolutions in natural gas extraction (hydrological fracturing) and transportation (liquefied natural gas). Oil’s greater versatility compared to coal allows a more generalized and dependent economy based on petroleum products. Natural gas is gaining a growing a share of the electricity generation market, as cheap gas and new environmental regulations on carbon-emitting power plants force utility companies to convert from coal to natural gas power generation. The lack of versatility of coal along with its high carbon content makes it highly problematic for long-term use compared to other energy sources.

Lastly, as this paper has demonstrated, the geographies and ecologies of difference in relation to regional commodity production matter. Differences in ecological conditions and relations enable and constrain capital’s ability to appropriate and exploit the bounty of wealth found in a given region. In the case of the mid-nineteenth century agricultural revolution, land was appropriated through dispossessioning Native Americans and converted into an emerging agrarian frontier that surpassed Appalachia’s role as a supplier of cheap meat and grain.

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Ecologies of difference were also evident in hard coal found in Pennsylvania and soft coal found in central Appalachia, a major shift to soft coal mining and consumption that unfolded through a region with low capitalization and relatively cheap land.

Future research utilizing the commodity frontier concept is well positioned to give seriously consideration to the ecologies of difference, and the ways in which capital appropriates and exploits the historical geographies of uneven development. Capital’s historical frontier strategy has been one of geographical movements weaving together rising and declining frontiers, a process premised on the remaking of productive and reproductive activities of humans and the rest of nature. The historical development of capitalism through regional frontier crises points to the inherent geography of capital’s expanded reproduction and the production of nature. The larger question remains: are there any frontiers left or has capital exhausted this frontier strategy as a method of accumulation?

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