

The Comparative Sociology of Environmental Economics in the Works of Henry Carey and Karl Marx

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Abstract: Sets out the views first of Henry Carey and then of Karl Marx on the significance of resource scarcity for the economic development of advanced capitalist societies. Concludes that both emphasised reproduction costs, pointing the way to an economic theory consistent with environmental sustainability. Carey, however, stressed material flows, while Marx paid more attention to the role of social relations in the efficient use of natural resources.

Introduction

Few economists would seem as dissimilar as Karl Marx and Henry Carey, yet, in a strange way, they shared certain characteristics. Both worked for the *New York Tribune*. For a brief period before the Civil War, Marx and Engels wrote the bulk of the articles for the paper, while Carey supplied the editorials on economic subjects.

Both saw themselves as engaged in changing the course of world history. Marx was working for a proletarian revolution to usher in a socialist world, while Carey was doing his utmost to undermine the British in order to make the US into an autarkic, *laissez-faire* economy. In fact, each saw himself as manipulating the *Tribune* for his own purpose. Carey even made sure that Marx's articles went to a Czarist agent before publication and probably engineered Marx's separation from the paper.

Carey sent Marx copies of his books to show how he had used Marx's work. Marx was insulted that Carey never mentioned him by name, but instead only referred to a writer for the *New York Tribune*.

Although Henry Carey and Karl Marx proposed very different visions of an ideal economy, they both shared a similar understanding of the nature of environmental limitations and the requirements of economic sustainability, although, not surprisingly, neither credits the other.

We cannot know today if Marx and Carey took ideas directly from each other, but the protectionist, *laissez-faire* regime that Carey favoured and the socialist environmental model that Marx envisioned drew upon similar environmental analyses. Justus von Liebig was the key figure in this nascent movement, although Liebig himself drew upon Carey to give economic content to his analysis.

Central to the Marx-Carey-Liebig analysis was the realisation of the necessity for a metabolic balance between these materials taken from the earth and those deposited back on the earth. The modern agricultural system had broken the cycle of nutrients, which is necessary for sustained ecological health. Carey, Marx, and Liebig all agreed that the cycle had to be made whole again by closing the material loops, although they disagreed about the root cause.

For Carey and Liebig, long-distance trade made any metabolic balance virtually impossible. Carey blamed the pernicious influence of England for this evil, which ensured that the agricultural nations of the world would impoverish themselves by continually exporting their fertility to England.

Marx attributed the imbalances to the capitalist system rather than trade. For the most part, Marx did not follow up his charge with a detailed analysis of the exact decision-theoretic mechanisms that lead to the breakdown, of the sort that would appeal to a modern neoclassical economist. Nonetheless, nothing that he wrote would be inconsistent with at least one line of modern environmental economics: since capitalism fragments the decision-making process in such a way that environmental costs are external to the profits of the capitalist, no mechanism exists to constrain these externalities.

Both Marx and Carey saw their respective environmental analyses as a major prop for their specific political agendas. For Marx, since environmental problems were the natural outcome of the market, these environmental failures would contribute to the ultimate downfall of capitalism. Carey blamed environmental problems on a particular type of market, namely, the regime of free trade dominated by Great Britain. For Carey, environmental failures were convincing evidence that trade with Britain was self-defeating for the US as well as Britain's other trading partners.

For Marx, socialism had the potential to transcend environmental disruptions since, under economic democracy, society as a whole would make economic decisions. For Carey, the solution was a *laissez-faire* economy with production for local markets.

Marx's environmentalism was more nuanced than was Carey's. In Germany, which formed the centre of Marx's political analysis, the influence of Ferdinand Lassalle was strong within the workers' movement. The only economic idea associated with Lassalle was his so-called iron law of wages, which he falsely attributed to Marx. Based on that idea, Lassalle concluded that workers could not hope to improve their lot through a direct confrontation with capital. Instead, workers had to pin their hopes on collaborating with the government.

The iron law of wages drew a great deal of support from Malthusianism. As a result, Marx was wary of directly attributing problems to scarcity. Nonetheless, he saw environmental problems as creating a major contradiction for capitalism.

Much of Marx's research on rent theory and the origin of his thinking on the organic composition of capital occurred after the Civil War created a cotton famine in England, which brought enormous hardship to both Marx and Engels, not to mention the working class as a whole. Nonetheless, for political reasons, Marx did not want to emphasise the importance of scarcity.

In an earlier work, I proposed that Marx used the organic composition of capital as a subterfuge to allow him to show the damage that scarcity creates for capital without acknowledging scarcity directly. I showed that virtually all of Marx's illustrations of the organic composition of capital related to cotton (Perelman 1987). Because of this tactic, Marx's environmental analysis remained submerged.

Carey's ultimate objective was the creation of the society quite like our own - except he thought that the market would find uses for all waste products, returning them back to the cycle again. Writing before toxic wastes became so prevalent, his theory was not as ludicrous as it might seem today.

Commerce versus Trade

The driving force of Carey's economics, aside from an acute self-interest, was his intense hatred of everything British. His unrestrained antagonism toward Britain led him to fashion an economic analysis somewhat similar to that of the modern

dependency theorists. A dichotomy between trade and commerce was central to Carey's system of economics.

For Carey, trade meant the long-distance exchange of goods, which generally entailed one party selling raw materials to another party - usually meaning Britain - which would then work these materials into finished goods. In contrast to trade, commerce is a system of exchange in which buyers and sellers are in close proximity. For Carey, trade was always exploitative. He wrote: 'The words commerce and trade are commonly regarded as convertible terms, yet are the ideas they express so widely different as to render it essential that this difference be clearly understood' (Carey 1858a, i, p. 210). Carey charged that the ultimate object of the British was trade. The British intended to compel 'the rude produce of the earth to be sent to England, there to be subjected to those mechanical and chemical processes required for bringing it to the form in which it was fitted for consumption' (Carey 1858a, i, p. 412). This arrangement would necessarily lead to a decline in the potential of any country that would allow itself to become engaged in trading with England.

According to Carey, commercial relations are necessarily harmonious:

The nearer the consumer and the producer can be brought to each other, the more perfect will be the adjustment of production and consumption, the more steady will be the currency, and the higher will be the value of land and labor. The object of protection is to accomplish all these objects, by bringing the loom and the anvil to take their natural places by the side of the plough and the harrow, thus making a market on the land for the products of the land. (Carey 1851, p. 190)

Carey found support for his belief in the efficacy of commerce in the deepest recesses of the human mind: 'The first desire and greatest want of man, is that of association with his fellow-men' (Carey 1858a, iii, p. 58). Elsewhere he wrote: 'All men ... desire to maintain commerce *with* each other - exchanging ideas and services, or commodities, in which the services are embodied' (Carey 1858b, p. 57).

From his belief in the innate drive toward commerce, Carey jumped to the conclusion that 'Every act of association is an act of commerce, implying the production and consumption of two services, neither of which would have been produced, had the demand for them not arisen' (*ibid.*, p. 61).

From here, Carey made one of his great leaps of logic, proclaiming: 'The treasures of nature are boundless ... requiring for their full development only the carrying into full effect of the idea expressed by the magic word - ASSOCIATION' (*ibid.*, p. 51). Carey's antagonism toward trade is somewhat reminiscent of the contemporary preference for local business over national chain stores.

Carey's legacy was ambiguous. For him, commercial relations were necessarily harmonious, allowing society to transcend any seeming ecological limits. In this sense, Carey stands opposed to modern ecological economics, both as an advocate for the corporate sector, which hardly existed in his day, and as a firm representative of the view that markets have the potential (so long as they are local markets) to avoid, and even repair, ecological problems. In the end, what drove Carey was his passionate hatred of England rather than an appreciation of the environment.

Carey versus British Political Economy

Carey integrated his advocacy of commerce, as opposed to trade, within a larger polemic against British classical political economy. In opposition to the rent theory

of British classical political economy, Carey insisted that progress in technology and social organisation (i.e., association) could overcome scarcity. Carey specifically took issue with the Malthusian idea of society having to resort to increasingly poor soils over time. Instead, he read history as evidence that societies always moved from poor soils to richer ones (Carey 1837-40, i, p. 38; 1848, p. 77).

Such a vision of the world would seem to make Carey an unlikely proponent of sustainable economic processes. However, Carey realised that careless economic activity could destroy the environment. In particular, he took issue with Ricardo's notion of the indestructible nature of the soil (Ricardo 1821, p. 67). According to Carey, the productivity of the soil varies with its care. He noted that many societies had thoughtlessly ruined their supposedly indestructible soils.

Carey believed that the intensification of commerce promotes improvement in the soil, while trade inevitably leads to a destruction of the soil. Just as Ricardo warned that British prosperity hinged on a willingness to freely trade grain, Carey insisted that compliance with the British policy on trade would lead inevitably to disaster. Trade with Britain would consign the US to dissipate the fertility of its soil, while diverting industry from developing its potential.

Carey alleged that the 'English system' sought 'the annihilation of commerce among the people of other communities; and here it was ... that it went far beyond any others which had been devised' (Carey 1858a, i, p. 411). He called upon the people of the US, as well as those of the other affected nations, to break loose from the English, whose ultimate program was to destroy the potential of their suppliers. In effect, the British said to 'the farmers of Brazil and the United States':

Cultivate your rich soils, and leave us to our poor ones. Labor being cheap with us, we can manufacture more cheaply than you do. *Do not*, therefore, *once and for all* build mills or furnaces; continue year after year to expend your labors in carrying goods back and forth; continue to exhaust your land; continue to have no combination of effort among yourselves; and you will grow rich. The time, however, will arrive when you will be forced to cultivate the poor soils, and then you will be troubled with overpopulation. Wages falling *you may then be enabled to accumulate the capital required for entering into competition with us*; that is, the poorer you become, the greater will be your power. (*ibid.*, iii, p. 66)

Unlike the modern dependency theorists, Carey did not suggest that Britain would become stronger by developing an increasingly superior capital stock, only that British trade would impoverish its partners. Carey was willing to go to great lengths to struggle against what Marx characterised as Carey's belief in 'the diabolical influence of England on the world market' (Marx 1977, p. 705) - so much so that a close friend reported that Carey told him 'that the material prosperity of this country would be more fully promoted by a ten years' war with Great Britain than it could be made in any other way' (Atkinson 1889, p. 82).

Carey's ideas about the importance of protecting the fertility of the soil resonated in Europe, where his prestige was far greater than in the US, although a few people, such as E. Peshine Smith and George Waring (Waring 1857), echoed his idea. Justus von Liebig, the pre-eminent theorist of plant nutrition who was also celebrated in England, gave a great deal of credence to Carey's historical analysis of agriculture (Liebig 1859, Letter XI).

Carey challenged British political economy in other respects. He vehemently denied Ricardo's notion that the interests of one group within society might conflict with those of another. At one point, in discussing Ricardo's analysis of the role of landlords, Carey famously burst out: 'Mr. Ricardo's system is one of discords ... its whole tends to the production of hostility among classes and nations His book is the true manual of the demagogue, who seeks power by means of agrarianism, war, and plunder' (Carey 1848, pp. 74-5). Marx playfully interpreted this passage to suggest that Carey had anointed Ricardo 'as the father of communism' (Marx 1963-71, p. 166). At times, Carey did sound as if he shared an analysis similar to that of Marx, describing how one group of people unjustifiably lived at the expense of the rest. For example, in denouncing the English school of political economists, he charged:

the whole basis of their system is conversion and exchange, and not production, yet neither makes any addition to the amount of things to be exchanged. It is the great boast of their system that the exchangers are so numerous and the producers so few, and the more rapid the increase in the proportion which the former bear to the latter, the more rapid is supposed to be the advance towards perfect prosperity. Converters and exchangers, however, must live, and they must live out of the labor of others. (Carey 1851, p. 46)

Carey, of course, was not Marx. Carey's exploitation was the exploitation of the rest of the world by British merchants and traders. Indeed, the economy, as Carey would have it, was a natural system of harmony, except for the imperialistic machinations of Britain. In fact, the previous citation came from Carey's aptly titled work, *The Harmony of Interests*.

Carey assumed that merely avoiding the entanglements of trade would suffice to ensure harmonious development. If, instead of trading with Britain, the US would wisely engage in intensive domestic commerce, the people of the US could constantly recycle their organic materials back to the soil. The productivity of the soil would actually improve, while protection from British factories would allow domestic producers to take advantage of new technologies that depend on economies of scale.

Carey's Harmonious Theory of Value

Like the classical political economists, Henry Carey placed value theory at the centre of his economics, but Carey's approach to value was unusual. Like E. Peshine Smith, another writer whose theories were closely intertwined with his own, Carey put value theory in the context of natural processes (Smith 1853). For both Smith and Carey, wealth was the ability to control nature; value was a measure of the difficulty that nature presents in obtaining those goods that constitute wealth.

Unlike the value theory of classical political economy, Carey's value theory was dynamic. Where the classical political economists treated value as reflecting the cost of production, Carey treated value as the cost of reproduction. In Carey's words, 'value ... is simply *our estimate of the resistance to be overcome, before we can enter upon the possession of the thing desired*. That resistance diminishes with every increase in the power of man to command the always gratuitous services of nature' (*ibid.*, i, p. 148). In other words, the value of a newly produced good reflects the difficulty of reproducing it in the immediate future.

In contrast, the production costs of classical political economy are historical. The difference between the two approaches is not trivial. Because technological progress is continual, for Carey the difficulty of reproducing goods is always declining, so long as a society increases the intensity of commerce. As a result, the reproduction cost of a good in a commercial society is less than its historical cost.

Here Carey comes eerily close to the ideas of modern ecological economics, which sometimes advocates pricing goods at the cost of reproduction. Of course, modern ecological economics does not presume that reproduction costs would necessarily be falling because of technological advances, but rather that reproduction costs should include the efforts required to restore the damage done in the process of production. Carey may have prompted Marx to incorporate reproduction in his theory of value.

Carey used his dynamic theory of value to explore and the relationship between environmental economics and the distribution of income. In that regard, Carey is still in the vanguard of ecological economics, although his conclusions again point in the wrong direction.

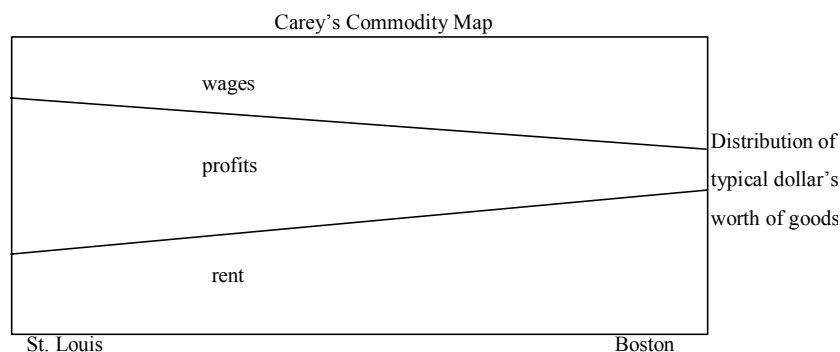
For Carey, the dynamics of reproduction costs create a continual redistribution between the classes, since wages and rents continually rise while profits decline. For Carey, this process of redistribution leads to an increasingly harmonious society. Labour supposedly becomes ever more prosperous, while capital continues to fall behind - at least relatively, when measured in terms of capital's share of the total product.

Carey's theory of redistribution concerns the returns to capital as a share of the sales price of a typical product. According to this logic, the share of capital in the national product should also fall, although Carey does not explore that implication.

Carey's Commodity Map

In effect, then, Carey insisted that extensive trade with Britain would preclude the US from enjoying the bounty of future technological progress, while preventing the country from enjoying harmonious class relations. This approach allowed Carey to deny the likelihood of class conflict, while justifying his deep-seated antagonism toward Britain.

To illustrate his theory, Carey drew what I think of as a commodity map of the US (see Carey 1858a, iii, p. 187).



The map is a rectangle. The height of the rectangle represents the value of a dollar's worth of a typical commodity. The horizontal axis represents both geography and progress over time - more on that later.

Inside the rectangle is a cone, except for the tip, which is missing. The base of the cone covers most of the left-hand side of the rectangle. If the cone were complete, its tip would fall to the right of the right-hand side of the rectangle. The truncated tip covers a smaller portion of the right-hand side than the base covers on the left-hand side.

The cone divides the income from the sale of the commodity into rent, profit and wages. Everything above the top of the cone represents wages; below it, rent. The cone itself represents profits. So, as you move from left to right, profits fall, while wages and rents increase.

The left-hand side of the figure supposedly reflects conditions in the westernmost settlements of the US; the right-hand side, conditions along the northeastern seaboard. The rest of the graph is supposed to represent the gradations as one travels from West to East.

You can also read the horizontal axis as representing time, since Carey believed that the natural progress of the US, in the absence of a trading relationship with Britain, would carry the economy from a state of natural resource exploitation, common to the West, to a more integrated society, similar to that of the industrial regions of the eastern seaboard.

In the West, the economy is simpler and the division of labour is less refined. Think of the production of cattle. A couple of workers can manage a huge herd of cattle. Land is virtually free. Most of the returns from cattle production come in the form of profit.

Carey's West was more an exporter of grain than of cattle. The shipment of this produce without a replacement of the fertility extracted by the crops was bound to deplete the soil. Carey denounced the rapid westward movement in the US, seeing in that process:

[A] waste of capital, in the form of physical and mental power, not exceeded by any country of the world, with the slightest claim to be held as civilized. Farm after farm is cleared, and State after State occupied, to be then in part abandoned because of the growing necessity for robbing the earth of the soil, to be sold in distant markets. Mills follow mills, and furnaces follow furnaces - ruining, in quick succession, all who undertake such works. Employers and workmen spend years in acquiring skill - to be then turned adrift. (Carey 1858b, p. 150)

In contrast, in the East, a multitude of workers combine their efforts within a refined social division of labour to work raw materials up into ever more refined products. Wages and rents form a much larger portion of the value of products, while profits supposedly shrink into insignificance. In this sense, Carey contended that disappearance of profits, along with the growth in prosperity, proves the ultimate harmony of classes.

Carey also suggested that the commodity map represents the path of the rate of profit as the economy approaches a locally integrated production process. The sum of the returns from each commodity should reflect the distribution of the gross national product.

What would really happen to the rate of profit? We cannot know for certain, but Carey suggested that the capital-output ratio might fall because of the

more rapid physical turnover of materials, allowing for a higher throughput. However, Carey's theory also implies that capitalists should be suffering continual capital losses of their investment as new technology lowers the cost of reproduction.

Carey's idealised vision of the Eastern economy also suggests environmental, as well as social, harmony. Waste materials return to the environment in a closed circuit. The soil becomes increasingly productive. The close proximity of producers and consumers minimises transportation costs. The entire economy evolves into a 'green industrial district'.

Given this potential, Carey ruled out the possibility of Malthusian scarcity. In 1835, he calculated that earth could comfortably support a population of 30 billion with rising living standards (Conklin 1980, p. 265).

Carey does not invoke increasing returns to scale as such. Instead, he predicts that rising population will necessarily create more intensive association and commerce, leading to any number of efficiencies, including lowered transportation costs and more effective re-use of waste materials.

Unlike Alfred Marshall's industrial districts that specialise in a particular industry, Carey's industrial districts would produce the entire gamut of human needs (Marshall 1920, p. 271). Notice also that, although high population density can allow for increasing returns to scale, restricting production to a single locality limits potential increasing returns.

Corporations and Associations

In a sense, Carey's vision of the future of the US based on what he saw in the East resembles the relatively closed, traditional Oriental ecological farming systems, but with a twist. Instead of relying on traditional technologies, Carey's vision of an associational economy would be continually discovering new and better methods of production.

Unlike the modern Greens, Carey contended that traditional methods of production were wasteful. In contrast, modern methods, bolstered by a continual influx of new technology, would create a truly ecological form of production. Despite many similarities with ecological economics, the world Carey foresaw is even closer to the modern corporate dream of market-driven ecological efficiency (Desimone and Popoff 1997) - with one difference. The corporations that espouse Carey-like ideas are global institutions dedicated to free trade rather than the local development that Carey preferred.

This similarity between Carey and the modern 'green' corporate vision is not entirely surprising. After all, Carey was, to the best of my knowledge, the first person to suggest that the corporate form offered the best possible prospects to realise the potential of human cooperation.

At a time when the populace was distrustful of corporations, Carey 'paint[ed] developing institutions, such as banks and limited liability corporations, as morally innocent and fully constructive examples of trust' (Conklin 1980, p. 276). In those years, investors had to prove that prospective corporations served the interest of the state before they could win a corporate charter (Horwitz 1977). Carey would have none of that. He extended his full-hearted support for association to the institution of the limited liability corporation. The right to association was all but absolute. He declared:

Every man has a *right* to associate himself with his neighbours and to trade with others on such terms as they may mutually deem most likely to be advantageous The tendency to association increases every day, and will continue to do so, and with it there will be an increasing tendency to permitting men to trade together in a manner as they deem most advantageous. With every increase in the habit of association, there will be a tendency to increase in the productiveness of labor. (Carey 1838, pp. 117, 119)

Carey dismissed Adam Smith's notion that corporations were under the control of self-serving people who were not interested in the welfare of investors. Instead, he asserted that the corporate form allowed for economies of scale in management (*ibid.*, p. 120-1).

Despite his support for association in virtually every aspect of economic and social life, Carey did not favour all kinds of associations. He was fervently against unions, since unions suggest a disharmonious relationship between labour and capital. In this spirit, Carey warned the Cordwainers of Philadelphia, who were organising and striking for higher wages at the time, that a rise in wages would destroy the shoe business and harm all.

Carey also opposed all charitable schemes to help labour. He was even against laws to make owners of business responsible for unpaid wages (Green 1951, p. 123). Still, Carey stubbornly insisted that the interests of labour were at one with the interests of capital.

What Carey Missed

How did Carey fail to see the contradictory nature of market economies? With respect to environmental economics, Carey's oversight was two-fold. First, Carey assumed that profit-maximising commerce would necessarily lead to optimal technological outcomes. He gave no indication that he was aware of the problem of externalities - except for soil depletion. But then England, not market forces, was the cause of soil depletion. While Carey's market utopianism might seem foolish, many conventional economists still fail to recognise this problem, even after a century and a half of experience.

Carey's second blind spot was far more telling with regard to his credentials as an environmental economist. Carey never acknowledged the essential role of fossil fuel in driving the capitalist economy. This gap is especially interesting because Carey himself held coal lands in Schuylkill and Luzerne counties, stock in Shickshinny Coal and Iron Company, and stock in Mammoth Vein Coal Company (Morrison 1986, p. 57). In addition, the steel producers, who were especially dependent on the coal reserves of Pennsylvania, were his close political allies.

So, while Carey was sensitive to the mining of the soil, he was oblivious to the mining of fossil fuels. As a result, he looked away from the seemingly paradoxical coexistence of increasing returns in manufacturing and decreasing returns in agriculture - a distinction that puzzled many economists before and after Carey.

In fact, in his zeal to attack British political economy, Carey rejected the idea that manufacturing could experience increasing returns to scale, while agriculture would be unable to avoid diminishing returns to scale. Instead, he proposed that returns to scale would be constant in manufacturing and rising in

agriculture - at least in a regime of commerce: 'A steam engine produces nothing [but] it diminishes the labor required for converting wool into cloth, or grain into flour The more an engine can be made to yield the worse it will become. The more the earth can be made to yield the better it will become' (Carey 1848, p. 129).

In conclusion, Carey's vision of sustainability was unsustainable, since he gave no thought to one of the most obvious unsustainable activities known to mankind - the reliance on fossil fuels. From another perspective, however, this defect in Carey's vision was probably a positive influence, for it allowed him to conceive of the possibility of a sustainable economy.

Making Sense of Carey

In his environmental work, Carey recognised the need to go beyond focusing on individual transactions. Instead, we must take account of what Marx called 'the metabolic interaction between man and nature' (Marx 1977, p. 290). In Carey's ideal organisation of such a society, nothing is wasted. Everything is recycled.

Carey's vision of the future was a capitalist vision, but one in which the distance between capitalist and worker was held to a minimum - probably like the free labour ideology of the time, which held that young people would begin as workers and then, as they matured, graduate up to the level of employer (Foner 1970).

In summarising Carey's theory, Marx left out what was probably Carey's greatest contribution - his theory of value, which could help to lay the groundwork of a sustainable society (Marx 1857-1858, p. 886). Of course, Carey himself did not recognise the full implication of his own theory for fossil fuels.

According to his dynamic theory of value, the cost of oil would not merely be the cost of extracting it from the ground, but the cost of replacing it. In addition, Carey's value theory suggests that new technologies, which are not yet mature, such as solar, with an enormous potential for increasing returns to scale, should be costed at their replacement cost - which is lower than their current cost, offering an inducement to move from petrochemical to solar.

On the Limits of Capitalist Agriculture

Marx had long been interested in problems of natural resources. In fact, problems concerning agriculture and the appropriation of natural resources first seem to have drawn his attention to social questions (Marx 1970, pp. 19-20; Engels to Richard Fischer, 15 April 1895, in Marx and Engels 1973, xxxix, pp. 466-7).

Sometime between 1861 and 1863, while writing the notebooks that became *Theories of Surplus Value*, Marx changed his analysis of the social nature of scarcity. Earlier entries in the notebook proposed that agriculture naturally progresses faster than industry. Suddenly, he became extremely pessimistic about the long-run prospects for capitalist agriculture: 'It is in the nature of capitalist production that it develops industry more rapidly than agriculture. This is not due to the nature of the land, but to the fact that, in order to be exploited really in accordance with its nature, land requires different social relations' (Marx 1963-1971, pp. 300-1).

Later, he added:

Capitalist production has not yet succeeded and never will succeed in mastering these [organic] processes in the same way as it has mastered

purely mechanical or inorganic chemical processes. Raw materials such as skins, etc., and other animal products become dearer partly because the insipid law of rent increases the value of these products as civilizations advance. As far as coal and metal (wood) are concerned, they become more difficult as mines are exhausted. (Marx 1963-1971, Part 3, p. 368)

Some years later, Marx made the sweeping observation that:

The moral history ... concerning agriculture ... is that the capitalist system works against a rational agriculture, or that a rational agriculture is incompatible with the capitalist system (although the latter promotes technical improvements in agriculture), and needs either the hand of the small farmer living by his own labour or the control of associated producers. (Marx 1967, iii, p. 121)

Marx did not come to this conclusion casually. He had taken copious notes on the problems of soil exhaustion from Liebig, Johnston and other agronomists (see Marx 1974, p. 754n; see also Marx 1967, iii, p. 617). In his opinion, 'the new agricultural chemistry in Germany, especially Liebig and Schonbein ... [is] more important than all the economists put together' (Marx to Engels, 13 February 1866; in Marx and Engels 1942, pp. 204-5). In a fascinating letter to Danielson, written late in his life, Marx continued to display a keen interest in the analysis of soil fertility (Marx to Danielson, 19 February 1881, in Marx and Engels 1942, p. 384).

Marx's agricultural research eventually led him to the verdict that capitalist agriculture 'leaves deserts behind it' (Marx to Engels, 25 March 1868, in Marx and Engels 1942, p. 237). His section on 'Modern Industry and Agriculture' in the first volume of *Capital* reads like some of the most insightful literature from the modern environmental movement:

Capitalist production collects the population together in great centres, and causes the urban population to achieve an ever-growing preponderance. This has two results. On the one hand it concentrates the historical motive power of society; on the other hand, it disturbs the metabolic interaction between man and the earth, i.e. it prevents the return to the soil of its constituent elements by man in the form of food and clothing; hence it hinders the operation of the eternal conditions for the lasting fertility of the soil. (Marx 1977, pp. 636-8; see also Marx 1967, 3, p. 301)

Marx even went so far as to speculate that the destruction of the land by the mindless profit-seeking bourgeoisie represented 'another hidden socialist tendency' (Marx to Engels, 25 March 1868, in Marx and Engels 1942, p. 237). Sooner or later, he predicted, capital will discover that nationalisation of the land would be the only course capable of assuring an adequate supply of agricultural produce (see Marx 1872, pp. 288-90). Quite a performance for a nineteenth-century writer who is supposed to have dogmatically insisted on the unimportance of nature!

Marx distinguished between what he referred to as 'social' and 'natural' productivity (Marx 1967, 3, p. 766). He understood that technical change would allow agricultural output to expand, but he was convinced that this increase might not be rapid enough to compensate for long-run natural resource exhaustion (*ibid.*, p. 766; see also Perelman 1975). Until capitalism came to be replaced by socialism, he believed, it would continue to be plagued more and more by rising raw materials costs.

The social importance of primary materials, however, is conditioned by the development of the mode of production, but even so:

[When] in the course of development, a larger output is demanded than that which can be supplied with the help of natural powers, i.e. ... this additional output must be created without the help of this natural power, then a new additional element enters into capital. A relatively larger investment in capital is thus required in order to secure the same outputs. (Marx 1967, iii, p. 745; see also Marx 1977, p. 751)

That is, an increasing proportion of social labour must be applied to the production of primary materials, despite the enormous advances in capitalist agricultural technology. This rising labour requirement is caused, in part, by improved technology that diminishes the portion of social labour used in the production of machinery (Marx 1967, iii, p. 109) and, in part, by the expanding labour requirements of the raw materials sector itself.

Instability and Raw Materials Production

During periods of rapid growth, the demand for raw materials will not easily be matched by a proportionate increase in production (see Marx 1963-1971, Part 2, p. 533; Marx 1977, p. 579).

The cotton industry, which loomed so large in Marx's analysis, bore out Marx's conviction that raw materials production would have difficulty keeping pace with demand. For example, in the brief period between 1830 and 1837, as the cotton industry grew, demand had outstripped agricultural production. Cotton prices doubled, only to fall again once growth slackened (Temin 1969, p. 92).

During the Civil War in the US, when Marx was working on both *Capital* and the notebooks that became *Theories of Surplus Value*, cotton again became scarce. This pattern moved Marx to observe:

It is in the nature of things that vegetable and animal substances whose growth and production are subject to certain organic laws and bound up with definite natural time periods, cannot be augmented in the same degree as ... other fixed capital... , whose reproduction can, provided the natural conditions do not change, be rapidly accomplished in an industrialised country. It is therefore quite possible, and under a developed system of capitalist production even inevitable, that the production and increase of the portion of constant capital consisting of fixed capital, machinery, etc. [measured in physical terms, M.P.], should considerably outstrip the portion consisting of organic raw materials so that demand for the latter rises more rapidly than supply.

The greater the development of capitalist production ... , so much more frequent the relative underproduction of vegetable and animal raw materials, and so much more pronounced the previously described rise of their prices and the attendant reaction. And so much more frequent are the convulsions, caused as they are by the violent price fluctuations of one of the main elements in the process of reproduction. (Marx 1967, 3, pp. 118-19)

Marx was certain that raw materials were the most important component of constant capital, at least on a flow basis (Marx 1967, iii, p. 106). Even though the value of raw materials might be less than the value of the stock of fixed capital, a

rise in raw material prices can make itself felt as a decline in the profit rate, with serious consequences for accumulation:

If the price of raw materials rises, it may be impossible to make it good fully out of the price of commodities after wages are deducted. Violent price fluctuations, therefore, cause interruptions, great collisions, even catastrophes, in the process of reproduction. It is especially agricultural produce proper, i.e., raw materials taken from organic nature, which - leaving aside the credit system for the present - is subject to such fluctuations in values in consequence of changing yield, etc. (Marx 1967, iii, p. 117)

By this stage in his development, Marx had abandoned the notion that capitalism could master nature. Instead, environmental limits presented a barrier which capitalism seemed unlikely to overcome. Marx went further. He rejected the notion that these barriers were natural. To a large extent, they were the product of the capitalist mode of production.

Scarcity and Social Relations

Increasing natural resource costs are frequently cited as proof of the operation of the law of diminishing returns, but Marx interpreted the same phenomenon rather differently; he saw it as evidence of a barrier, posed by capitalist social relations, which prevents society from taking full advantage of its natural-resource base. For example, Marx insisted that the booms and busts, which are endemic to capitalism, are incompatible with a rational agricultural system:

An actual improvement of raw materials satisfying not only the desired quantity, but also the quality desired, such as cotton from India of American quality, would require a prolonged, regularly growing and steady demand (regardless of the economic conditions under which the Indian producer labours in his country). As it is, the sphere of production is, by fits, first suddenly enlarged, and then violently curtailed. All this, and this spirit of capitalist production in general, may be very well studied in the cotton shortage of 1861-65, further characterised as it was by the fact that a raw material, one of the principal elements of reproduction, was for a time unavailable.

The closer we approach our own time in the history of production, the more regularly do we find, especially in the essential lines of industry, the ever-recurring alternation between relative appreciation and the subsequent resulting depreciation of raw materials obtained from organic nature. (Marx 1967, 3, p. 121)

More importantly, capitalist social relations impede the creation of a rational economic system in general. Although great strides have been taken in agricultural science, Marx's interpretation still seems to be the correct one, especially when we recall his special use of the term 'mastering' (see Perelman 1977).

Marx's general position was that, although land can be improved and, more generally, human potential is unlimited (Marx 1963-1971, Part 2, pp. 144-5, 595), the social relations of capital stood in the way of agricultural progress. He gave a specific example of the relationship between the social relations of production and agricultural progress, citing Frederick L. Olmsted's observations of cotton production in the Southern US:

I am here shown tools that no man in his senses, with us, would allow a labourer for whom he is paying wages, to be encumbered with; and the excessive weight and clumsiness of which, I would judge, would make work at least ten per cent greater than with those ordinarily used with us. And I am assured that, with the careless and clumsy treatment they must always get with slaves, anything lighter or less rude could not be furnished them with good economy, and that such tools as we constantly give our labourers and find our profit in giving them, would not last a day in a Virginia cornfield - much lighter and more free from stones though it be than ours. So, too, when I ask why mules are so universally substituted for horses on the farm, the first reason given, and confessedly the most conclusive one, is that horses are always soon foundered or crippled by them, while mules will bear cudgelling, or lose a meal or two now and then, and not be materially injured, and they do not take cold or get sick, if neglected or overworked. (Olmsted 1856, pp. 46-7; cited in Marx 1977, p. 304n)

Scarcity shows up, therefore, not simply because of natural shortages, but because of the inability of capitalism to utilise nature effectively. This failure of the capitalist system is particularly true with respect to the biological processes involved in agriculture.

The Civil War and the Cotton Famine

What may have caused Marx to change his mind so abruptly about the potential of capitalist agriculture around 1862? At the time, the price of cotton had reached its highest point since the Napoleonic Wars (Farnie 1979, p. 162). The actual extent of the Cotton Famine is a matter of dispute. Farnie notes that the outbreak of the Civil War in the US followed a period of severe overproduction on the part of the British textile industry. Thus he identifies the crisis with overproduction, rather than shortages brought on by the war, although British cotton manufacturers blamed their problems on disruption in cotton supplies (Farnie 1979, pp. 138ff).

Because the British expected a very short war, initially speculation that new cotton supplies would be forthcoming kept cotton prices relatively low, until 21 July 1861, when the Confederacy won its first military victory at Bull Run (*ibid.* p. 141). Thereafter, speculation exacerbated the shortages (*ibid.*; and Brady 1963). Cotton was held in the British ports in anticipation of a run-up in future cotton prices.

Eventually, as cotton stocks became depleted, the price of cotton soared. During a three-week period in August-September 1862, cotton prices rose by 50 per cent (Farnie 1979, p. 145). According to this chronology, the Cotton Famine made itself felt only after the crisis had begun.

Engels's correspondence casts some doubt on Farnie's thesis. His letters show a qualitative difference between his attitude before and after the Civil War disrupted supplies. Before that time, he wrote numerous letters to Marx about the sorry state of the cotton industry (for example, Engels to Marx; 9, 11 and 17 December 1857 and 7 October 1858, in Marx and Engels 1983, pp. 220-3 and 343-5).

Engels suggested that the Civil War affected the availability of cotton in two stages. Initially, the South, fearing a blockade, unloaded as much of their cotton as possible, rather than to keep some stocks as hedges (Engels to Marx, January 26, 1860, in Marx and Engels 1985, p. 7). Thus, the Civil War was initially

responsible for a surplus rather than a shortage of cotton. Once the conviction spread that the war would persist, the depletion of the stocks contributed to the eventual run-up in cotton prices.

Engels's personal circumstances also seemed to contradict Farnie's thesis. Although he took the earlier crisis seriously, he was still able to maintain his standard of living at first. Rather than be discouraged, he suggested to Marx, 'The present crisis provides an opportunity for a detailed study of how overproduction is generated by expansion of credit and *overtrading*' (Marx to Engels, 11 December 1857, in Marx and Engels 1983, p. 221).

With the onset of the Cotton Famine, Engels's mood altered. Although he was usually unperturbed by personal setbacks, by July 1862, his letters contained frequent complaints about the economic difficulties that the cotton scarcity caused him (Engels to Marx, July 3, 1862, early September 1862, 9 September and 16 October, in Marx and Engels 1985, pp. 382, 413, 414. and 418 respectively). He no longer rejoiced about the coming crisis. Instead, his letters referred to personal hardships that the Cotton Famine caused. Of course, a sample of one single producer does not constitute a convincing proof of the state of the industry.

Marx himself reported on the annual meeting of the Manchester Chamber of Commerce in early 1862, in which Henry Ashworth enunciated the Farnie thesis (Marx 1862a). Despite the diligence with which Marx followed British business developments, Ashworth's idea seemed to be new to Marx. Consequently, until that point, Marx seemed to believe that the Civil War set off the Cotton Famine. Moreover, the materials that Marx included in the third volume of *Capital* do not support that idea that the crisis was a crisis of overproduction.

Cotton and Scarcity

Regardless of the extent to which the disruption of the cotton industry was due to overproduction or the Cotton Famine, the consequences were clear enough. Marx noted: 'As the result of the American Civil War and the accompanying cotton famine, the majority of cotton workers in Lancashire were, as is well known, thrown out of work' (Marx 1977, p. 720). The prolonged bout of unemployment endured by the British textile workers during the Cotton Famine caused them great hardships (Marx 1861b, p. 56; 1862c, p. 241; 1862b, p. 247). Engels wrote to Marx, on November 5, 1862, that according to their friend Dr. Gumpert, the crisis was taking a significant toll on the workers' health (Marx and Engels 1973; 30, p. 295). Henderson confirms Engels's observations (Henderson 1973, chapter 5; but see Farnie 1979, p. 157). Matters became so bad that even *The Times* of London fulminated against the heartlessness of the Cotton Lords (see Marx 1862b, p. 247). A few years later British industry turned to India for cotton, restricting rice culture, causing the infamous famine of 1866, 'which cost the lives of a million people in the district of Orissa alone' (Marx 1967, 2, p. 141).

The importance of cotton for Marx's political environment was enormous. According to Riazanov, the First International resulted from the crisis, precipitated by the curtailment of cotton exports from the US during the Civil War (Riazanov 1973, pp. 140-1; see also Hobsbawm 1968, p. 51).

The state of the cotton industry was not without personal significance for Marx and Engels. The year 1862, when Marx's analysis of capitalist agriculture was about to change, was a time of 'disheartening material suffering' for Marx (Rubel and Manale 1975, p. 174), to a great extent due to the Cotton Famine.

Engels, who depended upon the firm of Erman and Engels for the bulk of his earnings, was unable to supply Marx with much money. Early in the year, the depressed conditions in the cotton trade forced Engels's factory to work at only one-half capacity.

Prior to the Cotton Famine, Engels had maintained two separate residences: one for receiving his bourgeois friends, and one for himself and Mary Burns. With the onset of the crisis, he had to save on rent by living with Mary Burns full-time (Engels to Marx, 28 February 1862, in Marx and Engels 1973, xxx, p. 215).

Later in 1862, Engels significantly informed Marx that the Marxian theory of rent was too abstract to contemplate at the moment; he was too involved in the cotton crisis (Engels to Marx, 9 September 1862, in Marx and Engels 1973, xxx, p. 284).

Engels's tightened circumstances had disastrous consequences for Marx's finances. Moreover, Marx's tenuous relationship with the *New York Tribune* was finally severed in that year. In August of 1862, Marx wished that he knew how to start a business (Marx to Engels, 20 August 1862, in Marx and Engels 1973, xxx, p. 280). He continued, paraphrasing Faust, 'Grey, dear friend, is all theory, and only business is green' (*ibid.*). Before the end of the year, he informed Kugelmann that he had tried to obtain a job with a railway office, but his handwriting was inadequate (Marx to Kugelmann, 28 December 1862, in Marx and Engels 1973, xxx, p. 640). By the beginning of the next year, Marx's family lacked coal to warm the house and enough clothing to go outdoors (Marx to Engels, 24 January 1863, in Marx and Engels 1973, xxx, pp. 314-16).

Marx and Scarcity

In the midst of the cotton crisis in the middle of 1862, Marx's thinking took a decidedly different turn. Previously, he had not paid much attention to the theory of rent or to environmental concerns. Suddenly Marx began his intensive researches into the theory of rent (see Marx to Engels, 2 August 1862, in Marx and Engels 1975, pp. 120-3). In addition, about the same time Marx reversed his previously optimistic prognosis for capitalist agriculture.

Before that time, Marx had merely assumed that, once socialism replaced capitalism, all the problems of natural resources would come to an end, ushering in a period of abundance. The disruption of cotton supplies brought home the realisation that natural resources were crucial in modern industry. As he studied agriculture more deeply, he realised that the management of nature is a very complicated affair. While capitalism was inherently incapable of maintaining natural resources, socialist management would still be challenging. Moreover, Marx remained relatively cryptic about resources for fear of lending credibility to the Malthusians and the followers of Lassalle.

Significantly, in his description of constant capital, 'raw material, auxiliary materials, machinery, etc.', raw materials were given first place (*ibid.*, p. 120). At this time, Marx first associated crises and raw materials shortages. He observed:

A crisis can arise ... through changes in the value of the elements of productive capital, particularly of raw materials, for example when there is a decrease in the quantity of cotton harvested. Its value will thus rise More must be expended on raw materials, less remains for labour (Marx 1963-1971, Part 2, p. 515; see also pp. 517, 533).

This idea comes only a few pages after a very optimistic assessment of the prospects for the evolution of capitalist agriculture cited above, suggesting a rather dramatic change in his thinking (*ibid.*, pp. 109-15). After 1862, Marx gave raw materials far more prominence in his work. From that time on, when addressing the increasing difficulties in producing enough raw material for industrial production, more often than not he brought up the example of cotton.

The dramatic effect of the Cotton Famine revealed the great disparity between the production of raw materials and the corresponding development of industry. Although great advances in industrial productivity were obvious to everybody, no significant improvements in cotton production had occurred since the cotton gin. Consequently, raw material production was unable to accelerate fast enough to match the rapid expansion of demand.

The short-run supply elasticity of agricultural produce makes trade in such items particularly vulnerable to speculative pressures, leading to 'sudden expansion soon followed by collapse' (Marx 1967, ii, p. 316). In addition, to the extent that agricultural production does grow, it does so by increasing the cultivated area rather than productivity. He wrote that the cotton supply increased only because of an 'expansion of production in one place and in another importation from remote and previously less resorted to, or entirely ignored, production areas' (Marx 1967, iii, p. 119).

For Marx, the example of cotton clearly illustrated the manner in which a particular mode of production may inhibit technical progress (see, for example, Marx 1977, pp. 303-4; Genovese 1967, especially chapter 2). By the time *Capital* was written, Marx insisted that raw materials, especially cotton, made up 'the most important element in all branches' other than wages (Marx 1967, iii, p. 117; see also *ibid.* p. 106).

Of course, Marx showed awareness of the importance of agriculture's role as an industrial supplier before the Civil War. He had noted the fact that the production process depends upon the continued flow of raw products and raw materials (Marx 1974, p. 728). Indeed, in the *Grundrisse*, he had chided Ricardo for failing to recognise the importance of the industrial demand for agricultural production (Marx 1974, p. 640), but Marx had not followed up that insight until the terrible costs inflicted by the Cotton Famine.

Although Marx explicitly devoted only one section of the third volume of *Capital* to the cotton scarcity (Marx 1967, iii, chapter vi, section 3), the subject was very important to him. Recall his observation that the 'spirit of capitalist production in general ... may be very well studied in the cotton shortage of 1861-65' (Marx 1967, 3, p. 121). He had earlier referred to 'that all-important branch of industry, cotton' (Marx and Engels 1850a, p. 282; see also 1850b, p. 498) and to the period in which he wrote as 'the *cotton age*' (Marx and Engels 1850b, p. 501; cf. Hobsbawm 1968). Elsewhere, he referred to the Irish potato and slave-produced cotton as the 'two pivots' of the British economy (Marx 1861a, p. 64). He also described the cotton industry as the 'dominant branch of Great Britain's industry' (Marx 1861b, p. 79). Not only were cotton fabrics the major product of English capitalism of Marx's time, but the cotton industry took the lead in introducing the giant factories that characterised modern technology for Marx.

References to cotton thus reinforce Marx's general observations about the limits to capitalist agriculture, whereby industrial demand outstripped raw material supply. One might object that cotton was produced by slaves, rather than by wage labour. Despite the similarities between the plantation owner and the capitalist (see

Mintz 1977; Engerman and Fogel 1974, pp. 73; Perelman 1983, chapter 5), the social relations of capitalism are distinctly different from slavery. In this sense, the example of cotton might be interpreted as diverting attention from the relationship between the capitalist mode of production and scarcity. For Marx, no such problem existed. Slave production and capitalist production were a part of a larger unity based on a world division of labour (see Marx 1977, pp. 579-80; see also Perelman 1983, chapter 5). White and black labour both participated in 'a two-fold slavery' (Marx 1861a, p. 20). In a letter to Annenkov, dated 28 December 1846, he wrote: 'Direct slavery is the pivot of our industrialism today. Without slavery no cotton; without cotton no modern industry.... Slavery is therefore an economic category of the highest importance' (Marx to Annenkov, 28 December 1846, in Marx and Engels 1975, p. 35). A few years later, he found a similar thought in an extract, which he copied from *The Economist* of 21 September 1850: 'That the prosperity of Manchester depends on the slave trade in Texas, Alabama and Louisiana, is as curious as it is alarming' (p. 1049; cited in Marx 1849-1851, p. 232). In the wake of the Cotton Famine, Marx began to recognise the connection between the structure of market incentives and the fate of the environment. Of course, he had always understood the importance of nature, but before that time he had not integrated his observations about natural resource utilisation into the core of his analysis.

In *Capital*, Marx noted that capitalists, with their fear of making long-term investments, avoid sinking money in long-term improvements in forestry (Marx 1967, ii, p. 235; Marx 1977, pp. 892-3), soil conservation (Marx 1967, iii, p. 617; Marx 1977, p. 376), and other durable investment projects. Furthermore, capitalists' single-minded pursuit of profit blinds them to the totality of natural processes. As Engels warned: 'Let us not, however, flatter ourselves overmuch on account of our human victories over nature. For each such victory nature takes its revenge on us' (Engels 1876, pp. 74-5). For Marx, the overestimate of capital's ability to control natural forces was particularly valid for agricultural production. In *Capital*, Marx explained that the rate of surplus value was unaffected by the increasing difficulty in producing foodstuffs during the period 1799 to 1815 only because real wages fell, while labour was forced to work longer hours at a more intense pace (Marx 1977, p. 666; Marx 1963-1971, Part 3, p. 408). Only Malthus, among all the classical economists, seems to have noticed this relationship (see Marx 1977, p. 666n). Elsewhere, Marx added cheap colonial imports and new technology to this list of causes offsetting the difficulty in producing food domestically (Marx 1963-1971, Part 2, p. 460).

Until the last years of his life, Marx continued to stress that an agricultural crisis threatened the "apparently" solid English society' (Marx to Danielson, 10 April 1879, in Marx and Engels 1975, p. 298).

Resource Scarcity and Capital

Marx expected that his critique of Malthusian rent theory would show 'how the price of raw materials influences the rate of profit' (Marx to Engels, 30 April 1868, in Marx and Engels 1942, p. 242). Contrast this evaluation with his earlier expectations that his study of Malthus's rent theory would somehow prove that enormous strides in the production of raw materials would diminish the relative importance of rent (Letter of 14 August 1851, in Marx and Engels 1973, 27, p. 314).

Even before the Cotton Famine, Marx had noted the increasing relative importance of the industrial consumption of agricultural produce (Marx 1974, pp. 771ff). Chapter 6 of volume 3 of *Capital* largely concerned the effect of raw material price fluctuations on the value of capital. More significantly, in the *Theories of Surplus Value*, he had even associated this movement with the rising importance of constant capital, relative to variable capital (Marx 1963-1971, Part 1, pp. 219, 195). Nonetheless, these early incidental remarks were not followed up by subsequent analysis. Instead, Marx left them hanging.

Given the strategic importance of cotton at the time of the Cotton Famine, Marx's analysis of scarcity took on a greater urgency. Rising cotton prices began to represent an increase in the organic composition of capital. He had alluded to that possibility earlier (Marx 1963-1971, Part 1, p. 195). In the wake of the Cotton Famine, that possibility had become a reality.

Many of Marx's discussions of the rising organic composition of capital relied on the example of cotton (see, for example, Marx 1963-1971, Part 3, chapter 23, and pp. 217-21). In a section entitled, 'On the Influence a Change in the Value of Constant Capital Exerts on Surplus-Value, Profit and Wages', he concluded: 'This analysis shows the importance of the cheapness or dearness of raw materials for the industry which works them up (not to speak of the *relative* cheapening of machinery)' (Marx 1963-1973, Part 3, p. 221). In a footnote to this citation, he suggested the nature of his mental association between the discussion of the analysis of cotton prices and the analysis of the organic, value, and technical compositions of capital: 'By relative cheapening of machinery, I mean that the absolute value of the amount of machinery employed increases, but that it does not increase in the same proportion as the mass and efficiency of machinery' (*ibid.*). Given the frequency with which he associated the rising organic composition of capital with cotton, an interesting question comes to mind: might not Marx's theory of the rising organic composition of capital be an obscure, but convenient method of introducing into his analysis an important phenomenon usually considered to be Malthusian?

The 'organic' in the expression, 'organic composition of capital', suggests a biological dimension. In fact, the earliest use of that term occurred in the *Theories of Surplus Value*. In January 1863, in the midst of the Cotton Famine, Marx used this term in an outline of his later treatment of the falling rate of profit (Marx 1963-1971, Part 1, pp. 415-16). There he wrote:

1. Different organic compositions of capitals, partly conditioned by the differences between variable and constant capital in so far as this arises from the stage of production - the absolute quantitative relations between machinery and raw materials on the one hand, and the quantity of labour which sets them in motion. These differences relate to the labour process.
2. Differences in the relative value of the parts of different capitals which do not arise from their organic composition. These arise from the difference of value particularly of the raw materials, even assuming that the raw materials absorb an equal quantity of labour in two different spheres. (*ibid.*)

Notice several points about this discussion. Firstly, raw materials and machinery are lumped together. Secondly, the reference to the 'relative value of the parts ... which do not rise from their organic composition' suggests that Marx had in mind two different causes for the value of raw materials to change. On the one hand,

value changes because of the changing labour requirements. On the other hand, relative values can fluctuate because of other forces. Coming on the heels of the enormous upheavals stemming from speculation in the cotton market, Marx may well have been thinking about the price instability of raw materials.

References to the changing values of raw materials recur in Marx's later work. He placed a similar thought in a section entitled 'Observations on the Influence of the Change in the Value of the Means of Subsistence and of Raw Material (Hence also the Value of Machinery) on the Organic Composition of Capital' (Marx 1963-1971, Part 2, pp. 275ff). In the next section, he returned to the subject of the organic composition of capital to explain how it affected the pricing of agricultural produce.

In a later section, dealing with the subject of 'Compound Interest: Fall in the Rate of Profit Based on This', Marx referred to the: 'organic ratio between constant and variable capital. In other words, the increase in the capital in relation to labour is here identical with the increase of constant capital as compared with variable capital and, in general, with the amount of living labour employed' (*ibid.*; Part. 3, p. 311). The context of this mention of the 'organic ratio' is especially revealing. Marx began the section by addressing the possibility that technical change might so effectively cheapen the cost of living that the rate of profit might rise. Marx responded: 'The value of labour-power does not fall in the same degree as the productivity of labour or of capital increases' (*ibid.*, p. 300).

Why not? Marx responded with the previously cited assertion: 'It is in the nature of capitalist production that it develops industry more rapidly than agriculture' (*ibid.*, pp. 300-1). This disparity between agriculture and industry was reflected in the turnover rates of their respective capital stocks. Concerning this matter, Marx wrote:

[T]he period necessary to get the product ready for the market ... is based on the existing material conditions of production specific to the various investments of capital. In agriculture they assume more of the character of the natural conditions of production, in manufacture and the greater part of the mining industry they vary with the social development of the process of production itself. (Marx 1967, 2, p. 316)

Recall that the turnover rate of capital is an important determinant of the rate of profit.

Marx, in his published works, continued to associate the organic composition of capital with the production of raw materials, especially cotton. He first mentioned the organic composition of capital (*sans* organic) immediately before writing: 'As to raw materials, there can be no doubt that the rapid advance of cotton spinning not only promoted as if in a hot house the growing of cotton in the United States, and with it the African slave-trade, but also made slave-breeding the chief business of the so-called border slave states' (Marx 1977, p. 571). Marx first introduced the complete term, 'organic composition of capital', to the public in chapter 25 of the first volume of *Capital*, the same chapter in which he contrasted his law of the demand for labour with Malthus's theory of population. The first sentence reads: 'In this chapter we shall consider the influence of the growth of capital on the fate of the working class' (Marx 1977, p. 762).

Two paragraphs later, he defined the organic composition of capital. Immediately thereafter, he stated: 'If we assume that ... the composition of capital remains constant, then the demand for labour ... [will] clearly increase in the same proportion and at the same rate as capital' (*ibid.*, p. 763). Next Marx turned to a

critique of classical political economy, ‘Adam Smith, Ricardo, etc.’ (*ibid.*, p. 764). Malthus was conspicuously absent. The central idea of this discussion was that the poor were necessary to maintain the rich. In other words, populationism was not a sufficient explanation of poverty.

A few pages later, in a section entitled ‘The Progressive Production of a Relative Surplus Population or Industrial Reserve Army’, Marx alluded to Malthus less obliquely. He had been pressing his theory that the increase in constant capital reduces the demand for variable capital: ‘The working population therefore produces both the accumulation of capital and the means by which it is itself made relatively superfluous This is a law of population peculiar to the capitalist mode of production’ (*ibid.*, p. 784). Marx then continued with the previously cited idea: ‘An abstract law of population exists only for plants and animals and even then only in the absence of any historical intervention by man’ (*ibid.*, p. 784; emphasis added). Malthus is mentioned only twice in this chapter. On one occasion Marx wrote that ‘Even Malthus recognizes that a surplus population is a necessity of modern industry’ (*ibid.*, p. 787). On the other occasion, the reference to Malthus is contained in a long footnote that began: ‘If the reader thinks at this point of Malthus ..., I would remind him that this work in its first form is nothing more than a schoolboyish plagiarism’ (*ibid.*, p. 766).

On the Importance of Scarcity

For Marx, the spectre of Malthusianism had to be exorcised at all costs. Yet scarcity was still an important consideration. In an effort to answer Malthus once and for all, Marx fell into the practice of using his category of constant capital. Had he merely demonstrated the Keynesian lesson that the market failures create unemployment and poverty, he would have been more successful. Had he shown that the combination of recurrent crises and scarcities can cause so much hardship for the working class; that the uprooting of traditional societies faster than they could be incorporated into the labour market ensures poverty for a large portion of the working class; and that capital requires poverty and unemployment to maintain a tractable labour supply, his contribution would have been unquestioned.

Instead, unwilling to concede any ground whatsoever to Malthus, Marx refused to admit the concept of scarcity directly in chapter 5 of *Capital*. He even neglected in this chapter to address the widespread hardship brought on by the Cotton Famine, except for dating specific events. His analysis of technological unemployment was excessively mechanical, almost undialectical. Because this chapter, in spite of its undeniable importance, was flawed, it detracted from the rest of his work. Perhaps sensing its shortcomings, Marx abruptly turned to his section on Primitive Accumulation, containing his analysis of the evolution of capitalist agriculture.

Scarcity, for Marx, was an important category, with substantial theoretical and political implications. Consequently, he treated it (overly) cautiously, so much so that he suppressed it altogether in his most direct analysis of Malthus, in his chapter on ‘The General Law of Capitalist Accumulation’.

Of course, one might well respond that the Cotton Famine was an occurrence unique to the period of the US Civil War. One cannot raise scarcity to a major theoretical status on the basis of Marx’s references to an individual event of more than a century ago.

Keep in mind that Marx did not explicitly assert the importance of cotton. Just the opposite! Cotton, or even resource scarcity, typically appears in his work as an example of a more general principle, one that is apparently unrelated to natural resource scarcity. Thus, the significance of Marx's discussion of the Cotton Famine is that he did not emphasise its importance. Instead, he underplayed it.

Marx, apparently, did not feel free to assert directly that shortages of raw materials were responsible for crises. To take that position would play into the hands of the Malthusians. Rather than risk getting bogged down in debates that he hoped to avoid, he used very abstract categories that seemed to have little to do with natural resource scarcity, even when addressing the momentous impact of the Cotton Famine.

For Marx, raw material shortages reflected the inability of capital to master the environment. He was confident that under socialism such problems could be overcome, but the specifics of that victory could not be given in detail. Otherwise, he would have to begin a series of endless debates about the minutiae of the appropriate form of socialist organisation. That sort of activity could only divert energies from more important tasks. The 'hidden socialist tendency' would have to remain hidden within the formulae of the rising organic composition of capital.

The inability of capital to obtain a sufficient supply of raw materials can explain the rising organic composition of capital, just as easily as the increasing reliance on heavy machinery. Judging by Marx's examples, expansion in the organic composition of capital was, to a very great extent, the result of lagging productivity in cotton.

If this hypothesis is correct, it solves the riddle of the relative lack of sophistication in Marx's rather formalistic two-sector theory of the tendency of the rate of profit to fall. This anomaly is especially obvious when comparing his theory of the falling rate of profit with the mathematical virtuosity, which he displayed in his two-sector models of the second volume of *Capital*.

For Marx, the law of the falling rate of profit was 'in every respect the most important law of modern political economy, and the most essential for understanding the most difficult relations' (Marx 1974, p. 748). His search for a mare's nest was compelling enough, but the alternative approach involving scarcity, suggested here, also raised grave political risks. Not surprisingly, he opted to continue his quest for an automatic law of the falling rate of profit.

Marx's section on the falling rate of profit contained numerous uncharacteristic slips, which suggest that Marx's own doubts about this part of his theory persisted, despite his strong commitment to discover a law that necessitated a fall in the rate of profit (Siegel 1978, chapter 11). In addition, Engels's scepticism about this part of Marx's theory led him to edit this section to minimise its deterministic aspects (*ibid.*). Moreover, Engels himself, even though he was the chief interpreter of Marxist theory for twelve years after Marx's death, never wrote anything about the falling rate of profit (see Howard and King 1989, chapter 1).

Scarcity, I believe, plays a much more significant role in Marx's theory than has been previously suspected. Judging from the frequency with which Marx associated difficulties in producing raw materials, a rising organic composition of capital, and a decline in the rate of profit, provide a further clue to what Marx's intentions may have been. To have noted the importance of scarcity, even in a rich dialectical fashion, apparently meant less to Marx than the discovery of an important law of the falling rate of profit. Moreover, the issue of scarcity opened up serious political risks, not to mention that it could lend support to the enemies of

socialism. Consequently, scarcity was downplayed, while the supposed law of the falling rate of profit was emphasised.

If my hypothesis is correct, Marx's tactic impoverished Marxist theory. The rehabilitation of Marx's notion of scarcity opens Marxist theory up to a rich line of analysis that can help to put Marxist analysis at the forefront of the inevitable future debates about the political economy of natural resource utilisation.

To carry on with Marx's project is no mean task. It is made no easier by the methodological tools with which we have saddled ourselves. Terms such as scarcity, shortage, or depletion conjure up images of technical needs. They suggest that if only more oil or better methods for handling resources were available, then economic problems would disappear. This perspective leads in circles. Each new technique is followed by new problems and the need for still newer techniques.

Marx attempted to forge a new set of categories to analyse these 'Malthusian problems' to the betterment of human society (cf. Harvey 1974). In place of overpopulation, he referred to the reserve army of the unemployed. Instead of allowing us to become bogged down in an historical concept of resource scarcity, he tried to grasp the social content of each situation. Marx's distinction between 'historically developed' and 'naturally conditioned productive forces' illustrates the manner in which 'natural' and organisational phenomena are bound together (Marx 1977, p. 651). The frequency with which he used examples of natural resource scarcity, when explaining the organic composition of capital, suggests another methodological alternative to the concept of scarcity he may have had in mind. His work was never completed. It is left to us to carry on.

While we can be of some use in rounding out Marx's work on the social relations of natural resource scarcity, Marx can be of great use to us in learning how to interpret the contemporary problems of natural resource depletion and contamination which plague our society today. Living in an age in which cost benefit analyses coldly calculate 'appropriate' levels of destruction of our heritage of natural resources, Marx's analysis points the way toward acting so as to preserve our birthright and create a humane society.

Conclusion

Both Marx and Carey, with their emphasis on reproduction costs, have contemporary relevance. Both point the way to the construction of an economic theory appropriate for the goal of establishing an economy based in the principle of sustainability. Carey, more than Marx, emphasised the importance of keeping material flows in mind. Marx, in turn, devoted considerable attention to the influence of social relations in affecting the manner in which an economy is able to use resources efficiently.

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