

Marx as a Food Theorist

 monthlyreview.org/2016/12/01/marx-as-a-food-theorist/

by John Bellamy Foster Topics: Ecology , Health , Inequality , Marxist Ecology Places: Global
Hunger is hunger; but the hunger that is satisfied by cooked meat eaten with a knife and fork differs from hunger that devours raw meat with the help of hands, nails and teeth.

—Karl Marx¹

Food has become a core contradiction of contemporary capitalism. Discussions of the economics and sociology of food and food regimes seem to be everywhere today, with some of the most important contributions made by Marxian theorists.² Amid plentiful food production, hunger remains a chronic problem, and food security is now a pressing concern for many of the world's people.

Yet despite the severity of these problems and their integral relation to the capitalist commodity system, it is generally believed that Karl Marx himself contributed little to our understanding of food, beyond a few general comments on subsistence and hunger. In their 1992 introduction to *The Sociology of Food*, Stephen Mennell, Anne Murcott, and Anneke H. van Otterloo declared that “food as such is only of passing interest to Marx,” quipping that the only mention of “‘Diet’ in an index of Marx’s writings” referred “to a political assembly.”³

To be sure, the capitalist food regime at the time of the Industrial Revolution was far less developed than our own, and hence had only just begun to be theorized, by Marx or others. Nevertheless, Marx was such a keen observer of the political economy of capitalism and the metabolism of nature and society that lack of an analysis of food would represent a surprising and significant gap in his work. I will show that Marx in fact developed a detailed and sophisticated critique of the industrial food system in Britain in the mid-nineteenth century, in the period that historians have called “the Second Agricultural Revolution.”⁴ Not only did he study the production, distribution, and consumption of food; he was the first to conceive of these as constituting a problem of changing food “regimes”—an idea that has since become central to discussions of the capitalist food system.

As will become clear, food for Marx was far more than a “passing interest”: in his work one finds analyses of the development of agriculture in different modes of production; climate and food cultivation; the chemistry of the soil; industrial agriculture; livestock conditions; new technologies in food production and preparation; toxic additives in food products; food security; and much more. Moreover, these issues are not peripheral, but organically connected to Marx's larger critique of capitalism.

Since Marx's analysis of food production and food regimes was not developed in a single text but integrated into this larger critique, which remained unfinished, and in some cases unpublished, it is understandable that many commentators have missed this aspect of his work altogether. Yet these issues were far from marginal to Marx, as he based his materialist conception of history on the notion of humans as corporeal beings, who needed, as “the first premise of human existence,” to produce their means of subsistence, beginning with food, water, shelter, clothing, and extending to all of the other means of life.⁵ “All labor,” he wrote in *Capital*, “is originally first directed towards the appropriation and production of food.”⁶

In outlining Marx's analysis of the commodification of food in capitalist society, I will proceed from food consumption to food production and food regimes, and finally to fundamental problems of the soil and the social metabolism of human beings and nature. The object here is to overturn the prevailing view, which focuses simply on questions of the cheapness of food and the irrational forms of food consumption prevalent in contemporary society, and to replace this with a deeper perspective that locates the contemporary food regime in the underlying material conditions of capitalist production, understood as an alienated metabolism of nature and society.⁷

The Food Commodity

In his discussions of food consumption under capitalism, Marx is directly concerned less with consumption by the upper classes than with the nutritional intake of the great majority of the population, namely the working class, both urban and rural. Now, as in Marx's day, our knowledge of the diet of the Victorian working class relies primarily on official studies commissioned by John Simon, the Chief Medical Health Officer of the Privy Council, and the leading medical authority in England. Simon, whom Marx much admired, organized the first major investigations into British public health, and this research was the main source for Marx's epidemiological knowledge of the English working class in the 1860s.

In his 1983 book *Endangered Lives*, Anthony Wohl describes what Simon and his medical teams discovered about the working-class diet from these studies:

As in the country, so in the town, the staples were bread, potatoes, and tea.... If the rural poor ate birds then the urban poor ate pairings of tripe, slink (prematurely born calves), or broxy (diseased sheep).... Stocking weavers, shoe makers, needle women and silk weavers ate less than one pound of meat a week and less than eight ounces of fats. Bread formed the mainstay of their diet with a weekly consumption which varied from almost eight pounds a head in the case of the needlewomen to over twelve pounds per adult among the 2,000 or so agricultural labourers in Smith's survey. Large numbers of workmen were getting their carbohydrates and calories mainly in bread—over two pounds of it daily! Dr. Buchanan, another of John Simon's team at the Privy Council's medical department, sadly concluded that there were "multitudes of people...whose daily food consists at every meal of tea and bread, bread and tea"....

While the total calorific intake might have been generally adequate, the Victorian working-class diet was heavy in carbohydrates and fats, low in protein, and deficient in several vitamins, notably C and D. Nearly all the diets investigated reveal a serious lack of fresh green vegetables, a low protein intake, and very little fresh milk.... For approximately one-third of the entire population there would be a ten-year period or so when the children were too young to contribute significantly to the family income, during which the family would be underfed. This must be put within the context of Victorian life-long working hours, often arduous physical labour, and long walks to and from work. Modern nutritional studies show that adults walking a distance to work and engaged in strenuous activity may use 3,700 or more calories a day [compared to an intake of "only 2,099 calories *per capita* for the working-class family" at this time], and that the body uses up far more calories when recovering from sickness.⁸

It is in this context of a class-based Victorian system and its effects on the working class that Marx's discussions of food and nutrition should be viewed. In *Capital*, he reproduced tables compiled by Simon and his associates showing the inadequate nutritional intake of workers in the industrial towns, noting that employees of Lancashire factories barely received the minimum amount of carbohydrates, while unemployed workers received even less, and both employed and underemployed received less than the minimum quantity of protein. More than a quarter of the factory operatives surveyed consumed no milk in an average week. The weekly quantity of bread per worker varied from around eight pounds for needlewomen to eleven and a half pounds for shoemakers, amounting to an average of almost ten pounds of bread. The average meat intake per worker, in contrast, was just 13.6 ounces per week. Agricultural workers were likewise deprived of the minimum "carbonaceous food" (carbohydrates, high in energy) and "nitrogenous food" (protein rich). Of all agricultural workers in the United Kingdom, those in England were the worst fed.⁹

"The diet of a great part of the families of agricultural laborers," Marx wrote, "is below the minimum necessary to 'avert starvation diseases.'" Drawing on a study by one of Simon's researchers, Dr. Edward Smith, that surveyed the nutritional intake of convicts, Marx constructed a statistical table on the nutrition of various workers, and the results were startling: agricultural laborers received only 61 percent as much protein, 79 percent as much non-nitrogenous nutrients, and 70 percent as much mineral matter as convicts did, while laboring twice as much. Marx considered the findings so important that he devoted the first two pages of his 1864 "Inaugural Address of the International

Working Men's Association" to presenting some of these results.¹⁰

Frederick Engels was equally concerned with nutrition. In 1845 he had pointed in *The Condition of the Working Class in England* to the artificial food scarcity and inflated prices that contributed to the poor nutritional intake of urban workers, along with problems of contamination and spoilage. He treated scrofula as a disease arising from nutritional deficiencies—an observation that, as Howard Waitzkin explains in *The Second Sickness*, “antedated the discovery of bovine tuberculosis as the major cause of scrofula and pasteurization of milk as a preventive measure.” Likewise Engels discussed the skeletal deformities associated with rickets as a nutritional problem long before the medical discovery that it was due to deficiencies in vitamin D.¹¹

Marx went beyond looking simply at the quantity and type of food and nutrients workers consumed; he also dealt with questions of food degradation, additives, and toxins, all associated with the transformation of food into a commodity. In the nineteenth century such discussions fell under the heading of “adulteration,” which classically carried a wider meaning than it does today, referring not only to mixing something else into a food, but more pejoratively to the “corruption or debasement by spurious admixture.”¹² The questions of what goes into food and why—basic problems of contemporary food analysis—arose here. Engels had raised these issues in *The Condition of the Working Class in England*, where he argued that the frequent adulteration of food was a key problem in nutrition. He cited an article from the *Liverpool Mercury* which explained that sugar was often mixed with a chemical substance from soap; cocoa was adulterated with dirt and mutton fat; and pepper was “adulterated with dust from husks.”¹³

Marx's critique of adulteration in *Capital* transcended Engels's earlier work, however, reflecting the more detailed data and improved science of the 1860s, which made clear the degradation of commodified food being fed to workers and even to the middle class. Factory owners, food manufacturers, and shopkeepers took advantage of working-class customers by adulterating food products—not simply by watering them down, but by incorporating deceptive, dangerous, and even toxic ingredients into their production, and reducing their nutritive value, all to save costs and enhance their saleability. In researching this problem, Marx relied especially on the work of Arthur Hill Hassall, the pioneering Victorian scholar of food adulteration. Marx also drew on a report of H.S. Tremenheere, a Royal Commissioner charged with studying the conditions of journeymen bakers, as well as two parliamentary reports on food adulteration, published in 1862 and 1874, and the work of the French chemist Jean Baptiste Alphonse Chevallier.¹⁴

Hassall, a London physician, was the first to use a microscope effectively to detect food adulteration. He had already made a pioneering contribution in 1850 with *A Microscopic Examination of the Water Supplied by the Inhabitants of London and the Suburban Districts*, showing “for the first time,” in the words of Mary P. English, “the mass of organic refuse and living animalcules in the drinking water of the metropolis.” It was Hassall's technique that was to be employed by Dr. Edwin Lankester (the father of E. Ray Lankester, Charles Darwin and Thomas Henry Huxley's protégé and Marx's friend) in his investigations at the time of the 1854 smallpox outbreak in Soho—during which Lankester played a key role in the discovery of the waterborne source of the disease.¹⁵ Hassall himself was invited to deliver a report to Parliament on the 1854 cholera epidemic, resulting in his dramatic *Report on the Microscopical Examination of Different Waters (Principally Those Used in the Metropolis) During the Cholera Epidemic of 1854*, which included twenty-seven enlarged engravings of microscopic samples of the city's water supply.

Hassall soon turned to the study of food adulteration, and, with the encouragement of *Lancet* editor Thomas Wakley, published a series of articles on the topic. In 1851–1854, he made a microscopic analysis of 2,500 food and drink samples. Hassall was able to detect alum—toxic in large doses, used for whitening—in bread, iron and mercury in pepper, copper in bottled pickles and fruits, and iron oxide in potted meats, fish, and sauces. Inspired by Hassall, Lankester published a 103-page book entitled *A Guide to the Food Collection in the South Kensington Museum*. In it he presented the details of food adulteration, listing over eighty common substances used to adulterate various foods and drinks. Lankester's list included over forty mineral substances, such as lead carbonate (or white lead) and

carbonate of copper, used in tea; red lead (or lead chromate) used in cocoa; and chalk, used in sugar. Hassall's work, including his 1857 *Adulterations Discovered; Or, Plain Instructions for the Discovery of Frauds in Food and Medicine*, which was utilized by Marx, led to the various parliamentary inquiries into adulteration. [16](#)

Hassall defined adulteration as “the intentional addition to an article, for purposes of gain or deception, of any substance or substances the presence of which is not acknowledged in the name under which the article is sold.” He noted that such practices were often excused on the basis that customers wanted them, as in the use of “various pigments” to color food. The public was kept ignorant however, of the fact that these colors were “produced by some of the most poisonous substances known.” In estimating the “effects of adulteration on health,” Hassall emphasized “that some of the metallic poisons used are what are called *cumulative*”—that is, they accumulate in the body. Moreover, “the great cause which accounts for the larger part of the adulteration which prevails,” he wrote, “is the desire of increased profit.” [17](#)

Marx traced such food adulteration to class. He quoted Tremenheere to the effect that “the poor man, who lives on two pounds of bread a day, does not now get one-fourth part of nourishing matter, let alone the deleterious effects on his health.” The bread, particularly of the poor, was commonly “adulterated with alum, soap, pearl-ash [potassium carbonate], chalk, Derbyshire stone-dust and other similar...ingredients.” [18](#) As Marx noted, “the bread of the poor” was quite different from that of the rich. Produced in “holes” underground, as opposed to the “finest bakeries,” loaves bought by the poor were far more likely to be subjected to “the adulteration of the flour with alum and bone earth.” [19](#) Already by the early years of the Industrial Revolution, according to Marxian historian E. P. Thompson, bread production was characterized by three kinds of loaves: the finer white loaf for the wealthy, the intermediate “household’ loaf” for the middle class, and the brown loaf, full of waste, for the poor: “Dark bread was suspect as offering easy concealment for noxious additives.” All but the finest bread, available only to the rich, was adulterated, and even in high-end bakeries the quality of the bread and the conditions under which it was produced were suspect. [20](#) As Marx put it,

Englishmen, with their good command of the Bible, knew well enough that man, unless by elective grace a capitalist, or a landlord, or the holder of a sinecure, is destined to eat his bread in the sweat of his brow, but they did not know that he had to eat daily in his bread a certain quantity of human perspiration mixed with the discharge of abscesses, cobwebs, dead cockroaches and putrid German yeast, not to mention alum, sand and other agreeable mineral ingredients. [21](#)

Here Marx was suggesting, based on his knowledge of the work of Tremenheere and Hassall, that some of these artificial additives such as alum and potassium carbonate, might be toxic in cumulative amounts.

Of course, much of this dangerous adulteration—the contamination from people, cobwebs, cockroaches, and rodents—arose from the unsanitary conditions in which bread was produced, particularly for the poor. In his study “Bread Manufacture,” Marx stressed that the labor process compelled workers, in this case journeymen bakers, to begin work before midnight and complete their weekday shifts at 3 PM the next day, while on weekends they worked continuously from 10 P.M. on Thursday evening until Saturday evening without a break. The underground vaults where they worked were full of “pestilential vapors” and “noxious gases” that not only harmed the workers but entered the food. [22](#) The average lifespan of a working-class journeyman baker was just forty-two years.

The work of the French chemist Chevallier provided another source for Marx's writings on food adulteration. Chevallier had shown that for each of 600 items he studied there were, in Marx's words, “10, 20, 30 different methods of adulteration”—not only in food and drink, but also medicine. The most widely used medication of the time, opium, was adulterated with “poppy heads, wheat flour, gum, clay, sand, etc.” Some samples did not contain any trace of the drug at all. [23](#) The unhealthy and even poisonous contents of the Victorian working-class diet was thus a key concern of Marx's food analysis.

Wohl summed up the adulteration of food in Victorian England as follows:

Much of the food consumed by the working-class family was contaminated and positively detrimental to health.... The list of poisonous additives reads like the stock list of some mad and malevolent chemist: strychnine, cocculus indicus (both are hallucinogens) and copperas in rum and beer; sulphate of copper in pickles, bottled fruit, wine, and preserves; lead chromate in mustard and snuff; sulphate of iron in tea and beer; ferric ferrocyanide, lime sulphate and turmeric in chinese tea; copper carbonate, lead sulphate, bisulphate of mercury, and Venetian lead in sugar confectionary and chocolate; lead in wine and cider; all were extensively used and were accumulative in effect, resulting, over a long period, in chronic gastritis, and indeed, often fatal food poisoning. Red lead gave Gloucester cheese its “healthy” red hue, flour and arrowroot a rich thickness to cream, and tea leaves were “dried, dyed, recycled again and again.” As late as 1877 the Local Government Board found that approximately a quarter of the milk it examined contained excessive water, or chalk, and ten per cent of all the butter, over eight per cent of the bread, and over 50 per cent of all the gin had copper in them to heighten the colour.²⁴

Quoting Simon extensively, Marx argued that the dietary conditions of the working class were part of a larger dialectic of poverty, a symptom of the entrapment of the poor in capitalist society. As Simon wrote, “privation of food is very reluctantly borne...as a rule, great poorness of diet will only come when other privations have preceded it.”²⁵

Mennell, Murcott, and Otterloo’s dismissal of Marx on food notwithstanding, diet clearly played an underappreciated role in Marx’s analysis. Indeed, the issues that concerned Marx, including the nutrition of workers, and the profit-driven adulteration and contamination of food, still concern us today. Food security remains an urgent problem in the United States, affecting some 15.8 million households in 2016—around one in eight.²⁶ Only stringent federal regulations have kept the food supply relatively safe. But chemicals added to enhance color, flavor, or storage properties remain ubiquitous, and toxins in food, resulting from the introduction into the environment of some 80,000 new synthetic chemicals, not the product of evolution, are a major concern.²⁷ All of these problems are best understood in terms of the logic of capitalism, including its effects on food production and consumption, which Marx was already grappling with in the mid-nineteenth century.

Food Regime Change

Contemporary food-regime analysis as a formal subject of inquiry grew out of the Marxian and world-system traditions, particularly the work of Harriet Friedmann and Philip McMichael, in the late 1980s.²⁸ From the start, it centered on the notion of global food “regimes,” based on specific and unequal distributions of power and resources, in contradistinction to mainstream analyses that depicted the history of food systems as a process of linear, continuous development and expansion.²⁹ The concept of the food regime thus stood for the historical specificity of given arrangements of production, exchange, distribution, and consumption. Friedman and McMichael focus on two regimes: the first, which in their analysis began in the 1870s, depended on colonial tropical imports to Europe, and on imports of grain and livestock from the settler colonies—in other words, a global system dictated by the needs of the metropolitan countries. The second food regime, emerging after the Second World War with the rise of U.S. hegemony and a postcolonial, if still imperialist, world, was organized around the export of surplus food, mainly grain, from the United States, and by the Green Revolution, dominated by agribusiness. Also important in the development of this second global food regime were exports to the wealthy countries of tropical fruits, especially bananas, and later of orange juice concentrate (mainly from Brazil), coffee, cacao for chocolate, spices, and so on. Other scholars have since tried to define a third, current food regime, in which globalization and emerging economies play an increasing role. Marx’s theory of metabolic rift has been incorporated into some of these theories as a way of explaining disjunctures in food regimes.³⁰

The biggest weakness of food-regime analysis has been its approach to agriculture during the Industrial Revolution, including its response to Marx’s analysis. In 1996, Colin Duncan, a Canadian scholar with a background in Marxian theory, published *The Centrality of Agriculture*, in which he contended that mid-nineteenth-century agriculture in Britain remained in essence “preindustrial” (or at most “light-industrial”) and represented an “ecologically balanced age” in farming—rooted in the famous Norfolk four-course system of crop rotation.³¹ Duncan strongly rejected Marx’s critical analysis of British agriculture in this period, claiming that he had seen only its flaws, and failed to

recognize its pre-industrial, self-sufficient, and ecologically sound character. In advancing these ideas, Duncan rejected not only Marx, but also set aside the work of contemporary economic and agricultural historians who had reached conclusions that largely supported Marx's critical view.³²

Duncan began his book by contending that Marx was "alarmist" about the ecological effects of capitalism in his time. In particular, he argued that Marx's adoption of the German chemist Justus von Liebig's notion of the "robbing of the soil," was "quite untenable in general and indeed...probably nowhere less appropriate than in the case of England the ostensible case study for *Capital*." Duncan insisted that the English model of high farming in the mid-nineteenth century, based on new scientific methods of cropping, was the "most ecologically benign among all the highly productive farming systems the world has seen." Innovations in British high farming remained preindustrial or protoindustrial, in his view, since they relied very little on mechanization and artificial chemicals, instead focusing on the development of biological or ecological technique. Notably, Duncan sought to glorify English agriculture of this period while ignoring the rest of the British Isles, including a colonized Irish agriculture—as if these could be separated. Nor did he give any real attention to English livestock raising, or the provision of fertilizer and what he called the "crypto-industrial" aspects of oilcake manufacture. Duncan considered the mechanization of agricultural technology "negligible"—a view that hardly took into account the changing reality.³³

Such an obviously deficient analysis might well have been ignored by subsequent scholars. But Duncan's vision of the "ecologically benign" character of English agriculture, including his criticisms of Marx, have been enthusiastically and uncritically adopted by Marxian food-regime analysts and world-system theorists, such as Friedmann and McMichael. In her 2000 essay "What on Earth is the Modern World-System?" Friedmann argued, following Duncan, "that English High Farming demonstrates that under specific conditions...capitalist agriculture was ecologically sustainable." In terms of energy, she contended, English high farming "achieved the most productive and sustainable wheat farming ever known." (The source cited in support of this statement, however, was a study of agriculture in England in the 1820s, *prior* to the advent of high farming.) What destroyed English high farming, she argued, was not its internal ecological contradictions but its struggle to compete on the world market, especially with the advent of what was then known as the Great Depression in Europe, in the final quarter of the nineteenth century. This exposure to "alien ecosystems," i.e., competition from ecosystems outside England, along with the intrusion of world-market system, meant that "high farmers [were] prevented from continuing their ecologically benign mix of domestic species."³⁴

Duncan's criticisms of Marx on English high farming were likewise taken up by Minda Schneider and McMichael, who repeated the claim that it was the most ecologically sustainable form of high-productivity agriculture in history, and that its four-course rotation efficiently recycled nutrients. In the Norfolk rotation, wheat was grown in the first year, turnips in the second, barley—with clover and ryegrass undersown—in the third, and the clover and ryegrass grazed in the fourth. Turnips were fed to the cattle in the winter. The clover fixed nitrogen in the soil. Schneider and McMichael cited the existence of such a rotation as evidence of the ecological soundness of English high farming.

Marx's analysis of agriculture under capitalism, Schneider and McMichael argued, following Duncan and Friedman, was therefore flawed and distorted, even in relation to his own time. Marx, they said, mistook the problems of soil for universal conditions, and "failed to understand soil formation as a historical process"—though here they overlooked the fact that Marx was a close student of the geology of soil formation and referred throughout his works to soils as *historical* products, unlike most earlier classical political economists. Schneider and McMichael consequently dismissed the historical relevance of Marx's theory of metabolic rift, drawn from the work of Liebig, in which the soil was depleted of its nutrients as food and fiber were sent to the cities. As they put it: "The success and relative ecological sustainability of England...challenge Marx." They charged that he "neglected to include agriculture as a primary driver of the mechanisms of the metabolic rift." Rather, he made the error of focusing on the *industrialization* of agriculture as a disruptive force, turning a blind eye to the "centrality of agriculture" and its almost complete independence from industry in this period, as this was later propounded by Duncan.³⁵

It is worth digressing somewhat to note that the Norfolk four-year rotation, the basis for most of the foregoing claims

for the ecological superiority of English agriculture, did have some advantages, but still generated problems, and in any case was never universally applied, but was only one of multiple agricultural methods in use at the time. First, the benefits: (1) Only in two of the four years (in the cases of wheat and barley) did large quantities of products—and therefore nutrients—leave the farm. (2) The rotation facilitated pest control, including weeds, diseases, and insects. (3) Nitrogen fixation by legumes was what made the system sustainable; otherwise lower levels of available nitrogen would have decreased yields of the other crops. It is true, then, that a mixed animal-crop system can be more ecologically sound than a cropping system by itself.

But there were also drawbacks: (1) Nutrients were still being exported from farms in two of the four years, and they needed to be replaced. Of course, not that many nutrients per hectare were exported in animal products in such a system, because most passed right through the animal in the form of manure and urine, which, if captured and returned by farmers to the fields, could significantly limit this loss of nutrients. (2) The whole system was not motivated by sustainability, but by increasing production and capital accumulation. It thus gave way, especially after the abolition of the Corn Laws, before a high-farming system governed by the massive inputs of fertilizers. As economic historian Mark Overton has written, “the development of chemical fertilizers and other external inputs” undermined the system, creating an agriculture that “depended on energy-intensive inputs.”³⁶

Indeed, rather than identifying high farming of the mid-nineteenth century with the Norfolk rotation, which had already long been in use, it should be seen rather as an overlay of intensive energy imports on the crop rotation system, culminating in the decline of grain production itself. As agricultural historian E. L. Jones explained, the main innovation of high farming, or more accurately “high feeding,” was

intensity of operation, the feeding of purchased oilcake to the livestock on a lavish scale, to produce both meat and dung; the latter, with purchased agricultural fertilizers, in turn lavished on the arable land to promote high yields of grain, and fodder crops for the stock. The greater the scale of feeding farm-grown and bought-in fodder, and the heavier the applications of farm-produced and purchased fertilizer, the more the saleable produce and the more manure for the next round of cropping, that is, the higher the farming. This was the “expanding circle” that [John Joseph] Mechi [the most famous proponent of high farming] advocated.³⁷

The disappearance of anything like food self-sufficiency was in fact implicit in the increased emphasis on meat and dairy production over cereal production after 1846, leading to the growth of pasturage, particularly in Scotland and Ireland, and marking the decline of the more sustainable, mixed animal-crop system. Although the growth of pasturage and of an agriculture centered on meat production in some ways alleviated the soil nutrient problem, since a ruminant-based system of food production can recycle nutrients more efficiently, even this was only possible as a result of a shift to imports of wheat and other grains. In effect, a large part of the British metabolic rift was transferred abroad, to the main exporters of grain to Britain—Germany, Russia, and the United States—depleting their own soils and permitting the British to concentrate on sheep and cattle.³⁸

By the 1870s imports of guano and nitrates began to drop, while imports of bones, oilcakes, and seeds for domestic oilcake production continued to skyrocket. The decreased reliance on guano and nitrate imports reflected England’s shift during the so-called “golden age” away from domestic grain production. However, imports of bones continued to increase, primarily as inputs for the superphosphate industry, the first chemical fertilizer. Likewise, oilcakes and seeds for their production were increasingly imported as high-energy imports fed to cattle to spur growth and yield a richer manure.³⁹ At the same time, as part of the same logic, Britain was importing more and more of its wheat, to be consumed primarily by the working class.

The historical sequence is thus clear. Following the repeal of the Corn Laws in 1846, wheat imports soared, and by the end of the century the share of wheat in Britain produced domestically had fallen from 90 percent to less than 25 percent. Already in 1861–67, as Marx was at work on *Capital*, British wheat imports had risen to almost 40 percent of domestic consumption.⁴⁰ The writing was already on the wall for English agriculture, which would be done in by an unbalanced emphasis on livestock, a vastly expanded land area devoted to pasturage, and the massive infusion of grain, fertilizer, and energy inputs from abroad. With this history in mind, it becomes clear that the criticisms of

Marx by Duncan, Schneider, and McMichael, not only missed the larger context of Marx's analysis, but also ignored the wider body of research on the history of British agriculture. Although the notion of a "golden age" of English agriculture in the third quarter of the nineteenth century was common in the work of economic historians in the early twentieth century, subsequent scholarship overturned this idea well before Duncan wrote his book.

Far from ignoring the question of food regimes, Marx can be credited with introducing into political economy the concept of what he himself called the "new regime" of industrial-capitalist food production, connected to the repeal of the Corn Laws and the triumph of free trade after 1846. He associated this "new regime" with the conversion of "large tracts of arable land in Britain," driven by the "reorganization" of food production around developments in livestock breeding and management, and by crop rotation, coupled with related developments in the chemistry of manure-based fertilizers. In the mid-1850s, these trends were already apparent: close to 25 percent of wheat consumed in Britain was imported, 60 percent of it from Germany, Russia, and the United States.⁴¹ The 1830s and '40s had been characterized by a soil fertility crisis, due to the lack of fertilizers to replace the nutrients shipped as food and fiber to the cities and thus lost to the soil. Hence, in addition to new forms of stock management and breeding and the system of crop rotation, the "new regime" was characterized by intensified efforts to augment fertilizers, partly by chemical means, partly by imports of guano and other natural fertilizers. Guano imported from Peru was not only rich in phosphates, but also had as much as thirty times the nitrogen of most manures.⁴² The use of legumes as part of the rotation system helped provide at least some of the needed nitrogen for grains and turnips. On top of all this was the increased use of machinery in agriculture. Marx also emphasized that British agriculture, even within the British Isles, was an imperial system, particularly in English control of Irish agriculture; he noted that Irish "manure was also exported" to England, and Ireland gained little or nothing in return—an early form of unequal ecological exchange.⁴³ In Marx's view, the industrialization of agriculture led initially to a period of progress, but carried with it deep ecological and economic contradictions, threatening the future of British agriculture.

Marx did not of course deny the initial economic advances achieved under the new regime of high farming. As he wrote in *Capital*:

The repeal of the Corn Laws gave a marvelous impulse to English agriculture. Drainage on the most extensive scale, new methods of stall-feeding and the artificial cultivation of green crops, the introduction of mechanical manuring apparatus, new treatment of clay soils, increased use of mineral manures, employment of the steam-engine and all kinds of new machinery, more intensive cultivation in general, are all characteristic of this epoch.... The actual productive return of the soil rose rapidly. Greater outlay of capital per acre, and as a consequence more rapid concentration of farms, were essential conditions of the new method. At the same time the area under cultivation increased from 1846 to 1856.⁴⁴

Nevertheless, Marx was deeply concerned with the contradictions and dangers of the new regime of food production. Two central issues (beyond the more general problem of the metabolic rift) stood out in his critique. The first was the shift in British agriculture from cereal and grain production for human consumption to increased pasturage and forage crops to supply an agriculture increasingly geared toward meat and dairy. Cereal or grain production was clearly aimed at feeding the working population, which, as described above, lived largely on bread; meat production, and to some extent dairy, primarily fed the upper classes. Nor was there any doubt, even then, which use of land—grain or meat and dairy—was most efficient in the overall production of food for human consumption.

Second, Marx also worried about the abuse of animals under new methods of breeding for meat and fat content, introduced by Robert Bakewell and others. Sheep and cattle breeds were developed to be rounder and broader, carrying larger loads of flesh and fat relative to bone structure, to the point that animals could often barely support their own weight. The growth rate of animals bred for meat production accelerated, with sheep and cattle subject to butchering after two rather than five years. Calves were weaned earlier, in order to increase dairy industry production. English bullocks in the period were increasingly stall-fed and kept tightly confined. Cattle were fed a concoction of ingredients to speed up growth, including imported oilcakes, which produced a richer manure. Each

bullock was fed some ten pounds of oilcake a day, and slaughtered the moment it reached maturity.⁴⁵

Sheep still grazed on pastures in the high-farming-system, forming a major part of the Norfolk system of crop rotation, in which legumes and cover crops replaced fallow fields. Legumes partially enriched the soil by fixing nitrogen from the atmosphere (a process that was not yet understood when Marx was writing). This, however, encouraged the growth of pasturage over grain production. The population working the land was further replaced by sheep—part of the process of the enclosure of communal land that was by then well developed in England and expanding elsewhere in the British Isles.

Marx's analysis of this new regime focused especially on the French agriculturalist Léonce de Lavergne's 1854 study *The Rural Economy of England, Scotland, and Ireland*. Lavergne was a strong supporter of the meat-based, dairy-based English high-farming-model, with its Norfolk rotation, use of forage crops, and its enhanced and accelerated feeding, breeding, and butchering—all described in great detail in Lavergne's work, which Marx studied closely, along with Walter Good's 1866 *Political, Commercial, and Agricultural Fallacies*. Lavergne contended that Bakewell, in showing how to speed the growth of meat and fat in animals, had established himself as an innovator on the level of Richard Arkwright and James Watt. Agriculture had decisively changed in the British Isles, Lavergne wrote, "from a natural [process into] more and more a manufacturing process; each field will henceforth be a kind of machine...the steam-engine sends forth its columns of smoke over the green landscapes."⁴⁶

However, Marx rejected many of Lavergne's claims for the superiority of English high farming. Among these were Lavergne's assertions about soil nutrition and his emphasis on the advantages of meat and dairy-based food production. Marx noted the extreme deformities in animals, stall-feeding, earlier weaning of calves, and high levels of pasturage initiated by this new regime, in contrast to cereal and grain production for the general populace. While Lavergne argued that France should follow the English example and shift from grain to meat, Marx took the opposite view. He also emphasized the reliance of English agriculture on energy-intensive inputs from abroad, and stressed, based on the works of Good and Lavergne, that the English high-farming system shortened the turnover time for cattle, violating natural processes.⁴⁷

The treatment of animals under the new regime was another critical issue for Marx. "The cattle, usually of the short-horned Durham breed," Lavergne observed, "are there [in cattle houses] shut up loose in boxes, where they remain till ready for the shambles. The flooring under them is pierced with holes, to allow their evacuations to fall into a trench below." In 1851 the *Economist* trumpeted the superiority of "box-feeding" of bullocks, which confined them almost completely to stalls.⁴⁸ All of this struck Marx, as he wrote in an unpublished notebook, as "Disgusting!" Feeding in stables, he wrote, created a "system of cell prison" for the animals:

In these prisons animals are born and remain there until they are killed off. The question is whether or not this system connected to the breeding system that grows animals in an abnormal way by aborting bones in order to transform them to mere meat and a bulk of fat—whereas earlier (before 1848) animals remained active by staying under free air as much as possible—will ultimately result in serious deterioration of life force?⁴⁹

This question, as Marx posed it, was more ecological than economic, and capitalist agriculture, with its emphasis on commodity value and purely instrumentalist orientation, could offer no answer. Nor was there room in the dominant attitude toward food production for sympathy toward animals, which were treated as mere machines or raw materials for human use.⁵⁰

The new regime of industrial-capitalist agriculture, Marx suggested, led to further expropriation of land, since meat-based agriculture required fewer laborers than grain-based systems. This could be seen most dramatically in Ireland, where between 1855 and 1866, "1,032,694 Irishmen [were] displaced by about one million cattle, pigs, and sheep,"⁵¹ and Marx noted similar developments in Scotland.⁵² After the repeal of the Corn Laws, Ireland lost its grain monopoly within the English colonial tariff system, and hence grain was imported from outside the British Isles, while Irish fields lay waste. Marx dryly observed that Lavergne and his fellow bourgeois agronomists had suddenly discovered that Ireland, once thought fit only for growing grain, was in fact destined by providence for pastures.⁵³

Marx's ultimate concerns in all of this were the food and nutrients available to the working class under the new system of industrialized agriculture.

As we have seen, Marx recognized both that the new regime of high farming was initially characterized by significant growth, and that it contained deep internal contradictions that would lead to its eventual demise. These insights anticipated the subsequent analyses of economic historians of British agriculture, who more than a century later arrived at the same conclusions. Since the high-farming system's contradictions were first highlighted, in 1968, by F. M. Thompson in his essay "The Second Agricultural Revolution," historians have largely repudiated the notion of a "golden age" of agriculture in England in the third quarter of the nineteenth century. As E. J. T. Collins, coeditor of Part VII (1850–1914) of the multivolume *Agrarian History of England and Wales*, wrote in 1995:

By the early 1900s, Britain was importing over three quarter of its bread grain and nearly one half of its temperate foodstuffs, where a century before she had been almost self-sufficient.... In a number of important respects nineteenth century agriculture failed, not just in the Great Depression [the last quarter of the nineteenth century in Europe], but in the prior "Golden Age."... The High Farming period, 1850–73, is [conventionally] depicted as one of unprecedented technical progress....

Recent research [however] is now suggesting that agricultural growth rates were significantly higher in the second quarter of the century under the Corn Laws than in the third quarter, the Golden Age, suggesting that after an impressive start, the Second Agricultural Revolution and its new scientific husbandry quickly lost momentum. The trend is similar to that inferred from the national accounts, with one estimate suggesting an average annual growth rate of upwards of 1.5 percent between the 1830s and 1850s, falling to 0.5–0.7 percent over the following two decades, and another more recent one, a mere 0.2 per cent between 1856 and 1873, compared with 2.0 percent for the whole economy....

After a strong performance in the second quarter [of the century], wheat yields levelled off from the later 1850s, and declined slightly between 1868 and 1880.... Not just the arable sector but...the livestock sector appears to have underperformed. Indeed, the agricultural evidence suggests only a modest improvement in meat output, of at best one per cent per annum, and between the early 1850s and later 1860s only a fraction of that....

By this reading the "Second Agricultural Revolution" would appear to have run out of steam long before the onset of the Great Depression [beginning in 1873]. Agricultural growth rates between 1850 and 1875 averaged, according to Collins, 0.8 percent per annum at most.⁵⁴

Collins's explanation for the failure of English high farming was similar to Marx's: the inability rapidly to increase the productivity of the soil per hectare as required by the accumulation process, despite growing amounts of imported nutrients (a problem referred to as a "technological plateau").⁵⁵ The shift of food production from grains to sheep and cattle, which appeared to circumvent the metabolic rift, in fact only exported it elsewhere, to those countries now feeding Britain with imported grain. High-energy inputs could not keep the new meat- and-dairy-oriented economy from stagnating. Meanwhile, despite the Corn Law repeal, persistent high prices for grain plagued the economy in the mid-1850s, as Marx stressed. Collins writes that concerns about "food security in the third quarter of the century," were rampant. "Grain prices in the mid-1850s were higher than at any point since the 1810s and very little lower in the early and mid-1870s than in the 1840s.... The Golden Age, indeed, saw a resurgence of food riots. An unruly mob looted bakers' shops in Liverpool in February 1855, and disturbances broke out subsequently in London and Liverpool."⁵⁶ Hence, nothing could be further from the truth than the claim that British high farming represented a "golden age," a worldwide peak of self-sufficient, ecologically sustainable, high-productivity agriculture.

The Metabolic Rift and the New Regime of Food Production

At the root of food production for Marx was the question of the soil, and thus of soil chemistry, geology, agronomy, and other natural sciences. A given means of production, he argued, could be judged in part by the "means of

nourishment” it derived from the soil.⁵⁷ Capitalism, while promoting increased productivity in agriculture, also caused a metabolic rift by robbing the soil of its nutrients.⁵⁸

It is precisely here, however, that some on the left have faulted Marx’s analysis. Ecosocialist Daniel Tanuro has criticized Marx for being “very ironical” regarding Lavergne’s declaration that, in the latter’s words, all the “principal elements” needed for the growth of forage plants could be obtained by them “from the atmosphere,” suggesting that Marx, despite his close attention to soil chemistry, had made an error here—a fault that Tanuro oddly attributed to Marx having privileged Liebig’s science over traditional knowledge.⁵⁹

Here it is important to take a close look at the facts. In Lavergne’s view, only cereal crops exhausted the soil, while forage crops that fed livestock were self-renewing.⁶⁰ Yet we now know that for almost all plants it is only carbon (via CO₂) that is derived from the atmosphere. This means that the other sixteen essential chemical elements have to be derived from the soil—except in the case of legumes, such as clover, alfalfa, peas, and beans, which can obtain *one* of the nutrients that they need, nitrogen, by the symbiotic bacteria living in their root nodules, thereby drawing nitrogen gas (N₂) from the atmosphere and converting it to a form that plants can use. But legumes too are dependent on the soil for the other fifteen essential nutrients, and like all plants—as Marx following Liebig argued—they rob the soil of its nutrients.⁶¹

Given these basic conditions of soil chemistry, a strictly grass/legume system organized around ruminants could circumvent this by exporting fewer nutrients per unit of land. But that means that grains would need to be imported, because the system would no longer be self-sufficient in the production of food, and particularly the grains that fed the nineteenth-century working class. Moreover, the actual attempts constantly to *expand* production in the high-farming-period within a livestock-based system, required energy-intensive fertilizer inputs. When agriculture became a capitalist enterprise it needed to try to increase output and value added continuously just as in any other sector. Capitalism, as Marx emphasized, is the opposite of an ecologically self-sufficient system.

Criticisms of Marx’s metabolic rift analysis by other left food-regime theorists were more wide-ranging and less precise, with no more basis in reality. Duncan wrote that “Marx thought guano was applied to English fields because their fertility had been exhausted. There is no evidence for this view. There is ample evidence, however, that English farmers were enthusiastic about getting more out of their land”—and for this reason alone they desired guano.⁶²

But the fact is that the soil *had* been exhausted from its natural state. Normally during the first years following conversion of forest to agriculture, sufficient nutrients are available from nutrients stored in the soil for high crop yields. “It is only about twenty years,” Marx noted in *The Poverty of Philosophy* in 1847, “since vast plots in the eastern counties of England were cleared; they had been left uncultivated from the lack of proper comprehension of the relation between the humus and the composition of the sub-soil.” Thus, farmers were often “enthusiastic” simply to return the fertility of soils to something close to its original level. Further, Duncan’s point here ignores that Marx was writing about a system governed by capital accumulation, in which the failure to expand engenders crises. Farmers not only desired, but were required by the sanctions of the market, to extract more from the soil in each successive cycle of production, on pain of economic failure. This meant that a metabolic rift, caused by the intensive robbing of soil of nutrients and a boom-and-bust cycle, was built into industrial-capitalist agriculture.⁶³ The system’s underlying logic was to draw more and more energy inputs from outside the economy. This was well captured by the Doncaster Agricultural Assembly, which declared in 1828 that “one ton of German bone dust saves the importation of ten tons of German corn.”⁶⁴

The reality is that England imported 88,540 tons of guano in 1847–50, and 209,460 tons in 1868–71, showing a huge growth in intensity of the application of this natural fertilizer, far exceeding the growth rate of agriculture. The same could be said for bones and oilseed cakes, imports of which increased by similar proportions. This was a necessity driven by the intensive extraction of nutrients from the soil. It is for this reason that Good was to declare in 1866: “We have scoured the globe for raw bones” and guano.⁶⁵

In this context, it is difficult to know what to make of Schneider and McMichael’s claim, against Marx, that “English

high farming was a sophisticated form of self-renewing agriculture.”⁶⁶ It was, as we have seen, and as Marx indicated, a system that required massive net energy inputs in the form of fertilizers and material inputs from abroad that increased far more rapidly than did productivity in agriculture. It also required, even in the heyday of high farming, the massive and rapidly increasing import of wheat, the main staple of the populace. English agriculture itself in the “golden age” was geared more and more to meat production.

For Marx, the new regime of food production was *industrial*, in the sense that it relied heavily on the application of science to agriculture (in this case geology, chemistry, and physiology), heavy use of energy inputs, factory-like production, and a simplified, degraded division of both labor and nature.⁶⁷ Machinery, too, was increasingly applied, and while that machinery was initially powered by farm animals, not fossil fuels, the use of steam engines in agricultural production was beginning. Duncan’s claim that English high farming was “preindustrial” hence makes as little sense as it does to describe it as a self-sufficient and benign ecological system.⁶⁸

All of this points to the power of Marx’s theory of metabolic rift, which captures the reality of changing food regimes and ever shifting ecological crises. As Michael Carolan argues in *The Sociology of Food and Agriculture*, the key to theorizing “the ecological footprint of food systems” is Marx’s “metabolic rift thesis.” Disconnecting people from the land,” he continues,

caused major disruptions in the soil nutrient cycle in the form of too few nutrients in the countryside and far too much in the cities, often in the form of sewage.... And the “solution” to this problem—was it to repair the rift by bringing agricultural practices in line with ecological limits? No; the solution was to exacerbate the rift through artificial fertilizers. This solution may have relieved certain tensions in the short term but it failed to deal with the root of the rift—namely, producing food in ways that ignore ecological limits.⁶⁹

Marx’s analysis of the new regime of food production in mid-nineteenth century industrial Britain therefore takes us in a full dialectical circle. An examination of the conditions involved in the consumption of food nutrients leads to the question of the whole regime of industrial-capitalist food production, and from there to the issue of the soil and capitalism’s alienated social metabolism. In Marx’s own words: “Capitalist production...only develops the techniques and the degree of combination of the social process of production by simultaneously undermining the original sources of all wealth—the soil and the worker.”⁷⁰

Notes

1. ↪Karl Marx, *Grundrisse* (London: Penguin, 1973), 92.
2. ↪See, for example, Fred Magdoff, John Bellamy Foster, and Frederick Buttel, eds., *Hungry for Profit* (New York: Monthly Review Press, 2000); Fred Magdoff and Brian Tokar, eds., *Agriculture and Food in Crisis* (New York: Monthly Review Press, 2010); Michael Carolan, *The Sociology of Food and Agriculture* (New York: Routledge, 2012). On food regime theory, see Philip McMichael, “A Food Regime Genealogy,” *Journal of Peasant Studies* 36, no. 1 (2009): 139–69; Robert Albritton, *Let Them Eat Junk* (London: Pluto Press, 2009).
3. ↪Stephen Mennell, Anne Murcott, and Anneke H. van Otterloo, eds., *The Sociology of Food* (Thousand Oaks, CA: Sage, 1992), 1–2. See also William Alex McIntosh, *Sociologies of Food and Nutrition* (New York: Plenum, 1996), 1; Jane Dixon, *The Changing Chicken* (Sydney: University of South Wales Press, 2002), 14.
4. ↪F. M. Thompson, “The Second Agricultural Revolution,” *Economic History Review*, n.s. 21, no. 1 (April 1968): 62–77. Thompson dates the First Agricultural Revolution to the late seventeenth century, the high point of which was to be the Norfolk four-course crop rotation, and sees the Second Agricultural Revolution as occurring mainly in the mid-nineteenth. See also B. A. Holderness, “The Origins of High Farming,” in Holderness and Michael Turner, eds., *Land, Labour and Agriculture, 1700–1920* (London: Hambledon, 1991), 149–64.
5. ↪Karl Marx and Frederick Engels, *Collected Works*, vol. 5 (New York: International Publishers, 1975), 41–42; Joseph Fracchia, “Beyond the Human Nature Debate: Human Corporeal Organisation as the ‘First Fact’ of

- Historical Materialism,"*Historical Materialism* 13, no. 1 (2005): 33–61.
6. ↪ Karl Marx, *Capital*, vol. 3 (London: Penguin, 1981), 770.
 7. ↪ In his 1848 speech "On the Question of Free Trade," Marx mocked those free traders and political economists who wanted to reduce the whole complex food question simply to the need for "cheap food." Karl Marx, *The Poverty of Philosophy* (New York: International Publishers, 1963), 206–07.
 8. ↪ Anthony S. Wohl, *Endangered Lives* (Cambridge, MA: Harvard University Press, 1983), 50–52.
 9. ↪ Karl Marx, *Capital*, vol. 1 (London: Penguin, 1976), 809–11.
 10. ↪ Marx, *Capital*, vol. 1, 834–35; *On the First International* (New York: McGraw-Hill, 1973), 5–7.
 11. ↪ Howard Waitzkin, *The Second Sickness* (New York: Free Press, 1983), 67; Marx and Engels, *Collected Works*, vol. 5, 399–400.
 12. ↪ Oxford English Dictionary, compact ed. (Oxford: Oxford University Press, 1971), vol. 1, 33.
 13. ↪ Marx and Engels, *Collected Works*, vol. 4, 370.
 14. ↪ It is significant that Marx followed the issue of food adulteration so closely that he continued to update these sections through the final French edition of *Capital* in 1875, as can be seen by his reference to the 1874 parliamentary report on food adulteration. Marx, *Capital*, vol. 1, 750; Marx and Engels, *Collected Works*, vol. 19, 253.
 15. ↪ Mary P. English, *Victorian Values* (Bristol, UK: Biopress, 1990), 65, 102, 121; Wohl, *Endangered Lives*, 52–54.
 16. ↪ Arthur Hill Hassall, *Adulterations Detected; Or, Plain Instructions for the Discovery of Frauds in Food and Medicine* (London: Longman, Brown, Green, Longmans and Roberts, 1857), 20; *Report on the Microscopical Examination of Different Waters (Principally Those Used in the Metropolis) During the Cholera Epidemic of 1854*, Appendix VIII, "Report of the Committee for Scientific Inquiries in Relation to the Cholera-Epidemic of 1854" (London: Her Majesty's Stationery Office, 1855), 384–521; Edwin Lankester, *A Guide to the Food Collection in the South Kensington Museum* (London: Her Majesty's Stationery Office, 1860), 100–02; Royal Society of Chemistry, "[The Fight Against Food Adulteration](http://rsc.org)," <http://rsc.org>, accessed November 7, 2014.
 17. ↪ Hassall, *Adulterations Detected*, 1–8.
 18. ↪ Tremenheere quoted in Marx, *Capital*, vol. 1, 278.
 19. ↪ Marx and Engels, *Collected Works*, vol. 19, 254.
 20. ↪ E. P. Thompson, "The Moral Economy of the English Crowd in the Eighteenth Century," *Past and Present* 50 (1971): 80–81.
 21. ↪ Marx, *Capital*, vol. 1, 359–61.
 22. ↪ Marx and Engels, *Collected Works*, vol. 19, 252–55. Marx's research on historical bread consumption led him to examine why the Romans appeared to eat far more bread than the average inhabitant of France in his own time. He explained this as a result of the imperfections and adulterations that characterized modern milling and baking. Marx, *Grundrisse*, 834–35.
 23. ↪ Marx, *Capital*, vol. 1, 359, 750; Marx and Engels, *Collected Works*, vol. 19, 254.
 24. ↪ Wohl, *Endangered Lives*, 52–53.
 25. ↪ Simon quoted in Marx, *Capital*, vol. 1, 811; Simon, *Public Health Reports*, vol. 2, 96–97.
 26. ↪ World Hunger Education Service, "[Hunger in America: 2016 United States Hunger and Poverty Facts](http://worldhunger.org)," <http://worldhunger.org>, accessed October 22, 2016.
 27. ↪ Fred Magdoff and John Bellamy Foster, *What Every Environmentalist Needs to Know About Capitalism* (New York: Monthly Review Press, 2011), 23–24.

28. ↪ Harriet Friedmann, "International Regimes of Food and Agriculture Since 1870," in Teodor Shanin, ed., *Peasants and Peasant Societies* (Oxford: Blackwell, 1987), 258–76; Harriet Friedmann and Phillip McMichael, "Agriculture and the State System," *Sociologia Ruralis* 29, no. 2 (1989): 93–117.
29. ↪ McMichael, "A Food Regime Genealogy," 140.
30. ↪ Hugh Campbell, "Breaking New Ground in Food Regime Theory," *Agriculture and Human Values* 26 (2009): 309–19.
31. ↪ Colin A. M. Duncan, *The Centrality of Agriculture* (Montreal: McGill-Queens University Press, 1996), 51, 69–71. The view of English agriculture in the third quarter century of the nineteenth century constituting a "golden age" was quite common among economic historians in the 1960s. See, for example, E. J. Hobsbawm, *Industry and Empire* (London: Penguin, 1969), 106, 199. It was largely dispelled, however, by the 1980s.
32. ↪ See Thompson, "The Second Agricultural Revolution"; E. J. T. Collins, "Did Mid-Victorian Agriculture Fail?: Output, Productivity and Technological Change in Nineteenth Century Farming," *ReFRESH* 21 (1995): 5–8; "Rural and Agricultural Change," in Collins, ed., *The Agrarian History of England And Wales, Part VII (1850–1914)* (Cambridge, UK: Cambridge University Press, 2000), 72–78; E. J. Jones, "The Changing Basis of English Agricultural Prosperity, 1853–1873," *Agricultural History Review* 10 (1962): 1–19; B. A. Holderness, "The Origins of High Farming," in Holderness and Turner, eds., *Land, Labour and Agriculture, 1700–1920*, 151. In Holderness's words, "high farming remained high risk farming," and failed "in stiffening the backbone of British cereal production in the long term." Holderness, "The Origins of High Farming," 151.
33. ↪ Duncan, *The Centrality of Agriculture*, 9–10, 54, 64–69, 72, 90, 94. Duncan's book relied on the work of the Japanese Marxist Kozo Uno, who claimed that England had developed not only the basis of a purely capitalist society, but also an agriculture uniquely suited to its needs as a self-regulating system. Kozo Uno, *Principles of Political Economy* (Atlantic Highlands, NJ: Humanities, 1980), 106–07.
34. ↪ Harriet Friedmann, "What on Earth Is the Modern World System?" *Journal of World-System Research* 11, no. 2 (2000): 489–91. In addition to Duncan, Friedman relies on the work of the British geographer T. P. Bayliss-Smith, who in the early 1980s studied the "pre-industrial" system of agriculture in Wiltshire, England in the 1820s, before the advent of high farming. However, since the issue in question is the state of agriculture in the third quarter of the nineteenth century, and not the first, Bayliss-Smith's analysis has no direct relevance. Guano imports, for example, did not begin until the 1840s, while bone imports totaled only 1,400 tons in 1821–24, as opposed to 68,340 tons in 1854–58. These developments were crucial, as F. M. Thompson contends, in breaking the earlier "closed-circuit system of agriculture." Indeed, the massive imports of natural fertilizers, far exceeding the growth of agricultural productivity, can be seen as a manifestation of growing ecological disruption of natural cycles—the primary concern of Marx's metabolic rift analysis. T. P. Bayliss-Smith, *The Ecology of Agricultural Systems* (Cambridge, UK: Cambridge University Press, 1982), 37–55; Thompson, "The Second Agricultural Revolution," 75; Brett Clark and John Bellamy Foster, "Guano: The Global Metabolic Rift and the Fertilizer Trade," in Alf Hornborg, Brett Clark, and Kenneth Hermele, eds., *Ecology and Power* (London: Routledge, 2012), 74–75.
35. ↪ Mindi Schneider and Philip McMichael, "Deepening, and Repairing, the Metabolic Rift," *Journal of Peasant Studies* 37, no. 3 (2010): 465, 469–74. The rigid separation of industry from agriculture is central to Duncan's whole work (captured by his phrase "the centrality of agriculture"). In this view, Marx was wrong to focus on the industrial disruption of agriculture; rather, agriculture in mid-nineteenth-century England should be viewed as largely independent of industry. This division allows Schneider and McMichael to argue, ostensibly following Friedmann, that English agriculture at the time was ecologically sustainable but "socially unsustainable"—a view most ecological Marxists would find absurd. See Schneider and McMichael, "Deepening, and Repairing, the Metabolic Rift," 474. Marx, in contrast, to such views argued as early as 1859 that, "Agriculture to an increasing extent becomes just a branch of industry and is completely dominated by capital." Karl Marx, *A Contribution to a Critique of Political Economy* (Moscow: Progress Publishers, 1970),

36. ↪ Mark Overton, “[Agricultural Revolution in England 1500–1850](#),” BBC, February 17, 2011.
37. ↪ Jones, “The Changing Basis of English Agricultural Prosperity,” 104; Collins, “Rural and Agricultural Change,” 93–95. Marx was aware of Mechi, since most of Walter Good’s 1866 *Political, Agricultural, and Commercial Fallacies*, which Marx read and cited, was critical of Mechi and his high-farming ideas. Walter Good, *Political, Economic, and Commercial Fallacies* (London: Edward Stanford, 1866).
38. ↪ Mette Erjnaes, Karl Gunnar Persson and Søren Rich, “Feeding the British,” *Economic History Review* 61, no. 1 (2008): 147.
39. ↪ Thompson, “The Second Agricultural Revolution,” 68–74; Erjnaes, Persson, and Rich, “Feeding the British,” 146.
40. ↪ Erjnaes, Persson, and Rich, “Feeding the British,” 146.
41. ↪ Karl Marx, *Dispatches for the New York Tribune* (London: Penguin, 2007), 169; Karl Marx and Frederick Engels, *Ireland and the Irish Question* (Moscow: Progress Publishers, 1971), 126, 133–34, 147–484. Marx wrote of the “new regime” of food production in English for the *New York Tribune* in 1855. He also discussed the new regime in relation to Ireland, arguing that the potato blight of 1845–46 had hastened the repeal of the Corn Laws, and hence the advent of the new “regime after 1846” in England, Scotland, and Ireland. It is clear that in connecting the abolition of the Corn Laws and excessive pasturage to the decrease in food production, namely the grain harvest, Marx was referring to the general shift in British agriculture towards an increasingly meat-based system of production, coupled with the overall industrialization of agriculture, which was soon to emerge as a major theme. This is verified by Marx’s letter to Ferdinand Lassalle, written a few days before the *Tribune* piece, in which he made similar observations linking the Corn Laws’ repeal to the decrease in cereal production, increased pasturage in Scotland and Ireland, and the rising imports of wheat. Marx and Engels, *Collected Works*, vol. 39, 511–14.
42. ↪ Karl Marx, *Theories of Surplus Value, Part 2* (Moscow: Progress Publishers, 1968), 159; *Capital*, vol. 1, 348; David R. Montgomery, *Dirt: The Erosion of Civilizations* (Berkeley: University of California Press, 2012), 184–85.
43. ↪ Marx, *On the First International*, 90; *Capital*, vol. 1, 860.
44. ↪ Marx, *Capital*, vol. 1, 831–33.
45. ↪ Léonce de Lavergne, *The Rural Economy of England, Scotland, and Ireland* (London: Blackwell, 1855), 13–25, 34–51, 184–87, 196; “High Farming in Norfolk,” *The Economist*, May 11, 1851, 511. Bakewell’s experiments in sheep breeding were also described by Charles Darwin, *The Origin of Species* (Cambridge, MA: Harvard University Press, 1964; facsimile of first edition), 36.
46. ↪ Lavergne, *The Rural Economy*, 19, 196.
47. ↪ Karl Marx, *Capital*, vol. 2 (London: Penguin, 1978), 313–15; Lavergne, *The Rural Economy*, 184–87.
48. ↪ “High Farming in Norfolk,” 511.
49. ↪ Karl Marx, Marx-Engels Archives, Sign. B. 106, 336; quoted in Kohei Saito, “Why Ecosocialism Needs Marx,” *Monthly Review* 68, no. 6 (November 2016): 62. See also Holderness, “The Origins of High Farming,” 160–61.
50. ↪ Today broiler chickens—“meat birds” or “broilers”—reach a market weight of five pounds in five weeks, in contrast to the ten weeks required to reach four-pound market weight forty years ago. This is only achieved, however, by using chickens specially bred for rapid weight gain and large breasts, crammed by the thousand into massive windowless sheds and fed a high-energy feed laced with antibiotics. The poultry “farmer” of our contemporary system has been converted into a laborer for large, vertically integrated “protein” corporations. See “Modern Meat Chicken Industry,” Penn State Extension, <http://extension.psu.edu>, accessed October 25, 2016. For a metabolic-rift analysis of contemporary livestock agribusiness, see Ryan Gunderson, “The

Metabolic Rift of Livestock Agribusiness,” *Organization and Environment* 24, no. 4 (2011): 404–22; Richard Lewontin, “The Maturing of Capitalist Agriculture: Farmer as Proletarian,” in Magdoff, Foster, and Buttel, eds., *Hungry for Profit*, 93–106.

51. ↪ Marx and Engels, *Ireland and the Irish Question*, 121–22. Marx argued that British colonial agriculture, whether in relation to Ireland or India, simply made matters worse. “The English...in the East Indies...only managed to spoil indigenous agriculture and to swell the number and intensity of famines.” Karl Marx, “Letter to Vera Zasulich,” third draft, in Teodor Shanin, ed., *Late Marx and the Russian Road* (New York: Monthly Review Press, 1983), 121.
52. ↪ Marx and Engels, *Collected Works*, vol. 39, 512; Marx, *Dispatches for the New York Tribune*, 113–19.
53. ↪ Marx, *Capital*, vol. 1, 870.
54. ↪ Collins, “Did Mid-Victorian Agriculture Fail?”; “Rural and Agricultural Change,” 72–78.
55. ↪ Collins, “Did Mid-Victorian Agriculture Fail?”
56. ↪ E. J. T. Collins, “Food Supplies and Food Policy,” in Collins, ed., *The Agrarian History of England and Wales*, 34; Marx, *Dispatches for the New York Tribune*, 166–69. Collins observes that “high-farming prosperity owed far more to high prices than to higher output or improvements in biotechnical efficiency.” Collins, “Rural and Agricultural Change,” 127.
57. ↪ Marx, *Capital*, vol. 1, 908; *Capital*, vol. 3, 904, 909.
58. ↪ See John Bellamy Foster, “Marx’s Theory of Metabolic Rift,” *American Journal of Sociology* 105, no. 2 (1999): 366–405.
59. ↪ Daniel Tanuro, “[A Plea for the Ecological Reconstruction of Marxism](#),” presentation at the Historical Materialism conference, London, November 10, 2012, <http://europe-solidaire.org>.
60. ↪ Lavergne, *The Rural Economy*, 51; Marx, *Capital*, vol. 3, 768–69.
61. ↪ The argument here relies on John Bellamy Foster and Paul Burkett, *Marx and the Earth* (Chicago: Haymarket, forthcoming in 2017), 27–30, where we received help from Fred Magdoff.
62. ↪ Duncan, *The Centrality of Agriculture*, 188. Oddly, Duncan in this passage describes high farming with the aid of guano as “superproductive,” despite all empirical evidence to the contrary. Ostensibly to bolster his criticisms of Marx, he also quotes historian F. M. Thompson as calling English farming in the early nineteenth century a “self-renewing” extractive industry. But Duncan overlooks the larger point Thompson was making in the very same sentence: that English farming in the so-called “golden age” (the third quarter of the nineteenth century) was organized on a “manufacturing” or industrial basis, and was not self-sufficient, but rather required massive infusions of bones, guano, and oilcake from abroad. This was, Thompson wrote, “the essence of the Second Agricultural Revolution”—as Marx had suggested more than a century earlier. See Thompson, “The Second Agricultural Revolution,” 64.
63. ↪ Justus von Liebig, *Letters on Modern Agriculture* (London: Walton and Maberly, 1859), 175–78, 183, 220; Marx, *The Poverty of Philosophy*, 162; John Bellamy Foster, *Marx’s Ecology* (New York: Monthly Review Press, 2000), 149–63. Marx described soil depletion as a slow process, especially when offset by the robbing of nutrients from other countries. He generally reserved the term soil “exhaustion” for extreme cases like those of the slavery-based South in the United States. See Marx, *Capital*, vol. 3, 756.
64. ↪ Doncaster Agricultural Association quoted in Thompson, “The Second Agricultural Revolution,” 69.
65. ↪ Thompson, “The Second Agricultural Revolution,” 73–74; Good, *Political, Agricultural, and Commercial Fallacies*, 368.
66. ↪ Schneider and McMichael, “Deepening, and Repairing, the Metabolic Rift,” 472.
67. ↪ See Nathan Rosenberg, *Perspectives on Technology* (Cambridge, UK: Cambridge University Press, 1976), 136; Marx, *Capital*, vol. 3, 894. On the intensity of inputs in high farming, see Holderness, “The Origins of High

Farming,” 150–51.

68. ↪ Duncan, *The Centrality of Agriculture*, 65, 69. Duncan argues that Marx was “misled” in his critique of English high farming by “bourgeois radicals.” Ibid., 72.
69. ↪ Carolan, *The Sociology of Food and Agriculture*, 249–50.
70. ↪ Marx, *Capital*, vol. 1, 638.