Capital Goes to Work

Once the money is assembled in the right hands and in the right place at the right time, then it has to be put to work to mobilise the raw materials, the plant and equipment, the energy flows and the labour power to produce a commodity. Let's consider, then, the various elements that must be procured for production to occur.

Perpetual accumulation at a compound rate depends on the permanent availability of sufficient accessible reserves of labour power. What Marx calls 'an industrial reserve army' is therefore a necessary condition for the reproduction and expansion of capital. This reserve army needs to be accessible, socialised, disciplined and of the requisite qualities (i.e. flexible, docile, manipulable and skilled when necessary). If these conditions are not met, then capital faces a serious barrier to continuous accumulation.

The dispossession of the mass of the population from direct access to the means of production (land in particular) releases labour power as a commodity into the market place. Marx’s account of so-called 'primitive accumulation' may be overdramatised and oversimplified but its essential truth is undeniable. Somehow or other the mass of a population has been put in a position of having to work for capital in order to live. Primitive accumulation did not end with the rise of industrial capitalism in Britain in the late eighteenth century. In the last thirty years, for example, some 2 billion wage labourers have been added to the available global workforce, through the opening-up of China and the collapse of communism in central and eastern Europe. All around the world the integration of rural and hitherto independent peasant populations into the workforces has occurred.
Most dramatic of all has been the mobilisation of women, who now form the backbone of the global workforce. A massive pool of labour power for capitalist expansion is now available.

Labour markets are, however, geographically segmented. A daily commuting time of four hours comes close to defining an outer limit for workers to get to their jobs on a daily basis. How far away four hours gets you depends, of course, on the speed and cost of transportation, but the inevitable geographical segmentation of labour markets means that questions of labour supply boil down to a series of local problems embedded in regional and state strategies, mitigated by migratory movements (of both capital and labour). The state becomes involved, *inter alia*, when it comes to immigration and labour laws (minimum wages, hours of work and regulation of the conditions of labour), the provision of social infrastructures (such as education, training and health care) that affect the qualities of labour supply and policies designed to maintain the reserve army (social welfare provision).

Capitalists can manage and circumvent the potential limits of labour supply, even in local contexts, in a variety of ways. Some expansion can be had through population growth (and in some instances pro-natalist policies on the part of the state, such as subsidies to large families in France, have had a definite impact upon labour supply conditions to the advantage of capital). There is, in fact, a very general relation between compound population growth and compounding capital accumulation. The astonishing growth performance of capitalism in China after 1980 depended, for example, on the radical reduction of infant mortality in the Mao years that later resulted in a massive young labour force clamouring for employment.

In the absence of increasing productivity, accumulation leads to relatively full employment of local labour resources. Scarcity of labour means increasing wages. Either wages continue to rise in such a way as to not interfere with the increasing mass of accumulation (because more labourers are employed) or accumulation slows along with the demand for labour, thus pushing wages down. On occasion,
capitalists in effect go on strike, refusing to reinvest because higher wages are cutting into profitability. The hope is that the resultant unemployment will rediscipline labour to accept a lower wage rate.

While such instances of 'capital strike' can be identified (the 'Reagan recession' of 1980–82, when unemployment rose to more than 10 per cent, had some of this quality to it), there are other more advantageous ways for capital to address problems of labour scarcity. Labour-saving technologies and organisational innovations can throw people out of work and into the industrial reserve. The result is a 'floating' army of laid-off workers whose very existence puts a downward pressure on wages. Capital simultaneously manipulates both the supply of and demand for labour.

Labour, knowing this full well, often fights against the deployment of new technologies (as happened in the case of the so-called Luddite movement in the early nineteenth century). 'Productivity agreements' that accept new technologies in return for job security became important in union bargaining after 1945 or so in the advanced capitalist countries. An alternative capitalist strategy is to mobilise elements within the population that have not yet been proletarianised. The most obvious target would be peasant and rural populations (as has happened in China in recent years). In the advanced capitalist countries, where such populations have largely disappeared; there has been a major turn towards the mobilisation of women into the labour force, along with the proletarianisation of elements in the population that have managed to live outside of the wage labour economy. In the United States, the family farm and small shopkeepers have been major targets for proletarianisation since the 1930s. In many respects the mobilisation of these reserves is preferable to increasing unemployment by lay-offs and technological change, which can be politically problematic as well as economically costly if the state is held responsible for unemployment benefits.

Since labour scarcities are always localised, geographical mobility of either capital or labour (or both) becomes vital in regulating the dynamics of local labour markets. Even short distance movements
(such as the move of businesses from unionised central cities in the US to suburbs where there were abundant non-unionised latent reserves, particularly of women, from the 1950s onwards) can radically transform the balance of class power with respect to wage rates and conditions of labouring. Longer distance moves, as from the industrialised and unionised north-east and midwest of the United States to the south and west, or the long migration of surplus southern labour to northern cities from the 1920s onwards, also impinge upon the labour supply problem. In recent times global labour flows have become of added significance. While the foreign-born population of the US stood at around 5 per cent in 1970, it is over 12.5 per cent today. One negative consequence of such policies has been a rising tide of anti-immigrant fervour accompanied by surges of racism and ethnic discriminations within the working classes.

All along, capitalists have sought to control labour by putting individual workers in competition with each other for the jobs on offer. To the degree that the potential labour force is gendered, racialised, ethnicised, tribalised or divided by language, political and sexual orientation and religious beliefs, so these differences emerge as fundamental to the workings of the labour market. They become tools through which capitalists manage labour supplies in tandem with privileged sectors of the workforce who use racism and sexism to minimise competition. The history of primitive accumulation itself entailed the manufacture of claims of 'natural', and hence biologically based, superiorities that legitimised forms of hierarchical power and class domination in the face of religious or secular claims to equal status in the eyes of God or of the state (the US and French Revolutions). Throughout its history, capital has been in no way reluctant to exploit, if not promote, such fragmentations, even as workers themselves struggle to define collective means of action that all too often stop at the boundaries of ethnic, religious, racial or gender identities. Indeed, in the US in the 1950s and 1960s, labour organisations sought to curb competition in labour markets by imposing exclusions based on race and gender.
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The ability to preserve such distinctions is illustrated by the fact that even after nearly a half century of campaigning for the principle of 'equal pay for equal work', the wage gap between men and women has not disappeared even in the United States where the pressures have probably been strongest. Elsewhere, for example in east Asia, the gender disparities are far worse and it is there, of course, that the bulk of the newly proletarianised populations are made up of women. The wage distinctions between blacks and whites as well as between Hispanics and Asians in the United States have similarly persisted, if not, in some instances, grown over the years. Elsewhere, as in India, caste distinctions have remained a formidable barrier in labour markets in spite of constitutional provisions for equal treatment. And to the degree that all labour markets are local, and more so for the workers than for the capitalists, so social and political solidarities, if they are to mean anything at all, have in the first instance to be constructed on a local geographical basis before any national or international movement can become possible. While capitalists are also often divided along ethnic and other lines (though they are usually much more homogeneous than their labour forces), workers find it hard to exploit such differences systematically to their own advantage, though the history of popular anti-Semitism towards the financiers of Wall Street often played a lamentable role.

From the mid-1960s onwards, also, innovations in transport technology made it far easier to offshore production to low wage locations with weak labour organisation. In the last few decades, as noted earlier, massive relocations of manufacturing activity have radically transformed the way labour markets work, compared to the circumstances that typically prevailed before about 1970.

There are, however, many contradictory aspects internalised within labour supply politics, not least arising out of the dynamics of class organisation and class politics as practised individually and collectively by workers within their distinctive labour markets. The real wage rate is set by the costs of supplying those goods and services required to reproduce labour power at a given and acceptable standard.
of living. What is 'acceptable' or 'given' is a product of class struggle, of customary standards and social compacts (more often than not tacit, but sometimes explicit as to the right to decent health care and education) achieved usually within some territorialised social organisation. (Hence, again, the significance of the state as one key institutional framework for defining some sort of rough consensus as to how social life shall be regulated.) Since labour markets are invariably local, so these other questions of costs and standards of living vary geographically even within fairly short distances (New York City is not Buffalo and neither of these cities, of course, is anything like Mumbai). The institutional framework within which wage bargaining occurs also varies from statewide (as in Sweden and until recently, the United Kingdom) to always local (the United States). In the latter case the result has been 'living wage campaigns', each with its own definition of what constitutes a living wage, proliferating from one locality to another, as happened from the mid-1990s onwards at a time when the federal government was politically opposed to raising the national minimum wage. The militancy, degree of organisation and level of aspiration within localised labour movements plainly vary from place to place and time to time, such that the potential barriers to continuous capital accumulation can proliferate here and fade away there. The ultimate power of the workforce – to withdraw its labour and strike – is always there, but here too there is all too often an asymmetry of power, since those with money reserves (typically the capitalists) can outwait those with little (the workers and their unions) even as the long-term threat to capitalism of widespread labour unrest remains a reserve power of great significance. But within this sea of struggle there are usually enough calm spots where capital can have its way with relative ease and ensure that the supply of labour power is adequate for its purposes. I think it fair to say that since 1980, the combination of political repressions (including the collapse of communist regimes), technological changes, the heightened capacity for capital mobility and a massive wave of primitive accumulation in (and migration from) formerly
peripheral zones have effectively solved the labour provision problem for capital. While local constraints exist here and there, the availability of massive labour reserves (including those with high level education, increasingly from India and east Asia) throughout the world is undeniable and weighs heavily upon the scales of class struggle so as to advantage capital mightily.

It is under these circumstances that enlightened capitalist class interests (as opposed to those of individual capitalists in intense competition with each other, who often practise the politics of *après moi le déluge*) can rally around a political project to subsidise the supply of cheaper wage goods to keep the value of labour power down (as happened when the industrial interest in Britain sought to reduce tariffs on imported wheat in order to cheapen the supply of bread in the mid-nineteenth century and, as has happened in the US with the advent of the Wal-Mart phenomenon, of cheap retail goods from China). They can also support investing in improvements to the qualities of labour supply through health care, education and housing and ultimately, as did Henry Ford when he moved to establish a $5 dollar 8-hour day in the 1920s, propose higher wages and rationalised worker consumption as a means to ensure a stronger effective demand in the market place.

The role of state power in relation to such struggles is by no means fixed. To be sure, if labour is too well organised and too powerful in a particular location, then the capitalist class will seek to command the state apparatus to do its bidding, as happened, noted earlier, with Pinochet, Reagan, Thatcher, Kohl et al. But labour organising through political parties of the left can push in the opposite direction, as has happened in various places (such as Scandinavia) and at certain times (viz. the 'social democratic' consensus of the 1960s in much of Europe). But the use of state power to transcend the barrier of strong labour organisation has been very effective since the mid-1970s in many parts of the world. Another method is to facilitate, if not subsidise, the mobility of capital so it can move to where business conditions, including those of labour supply and weak
labour organisation (as, for example, in the anti-union so-called 'right to work' states of the US south), are most advantageous to capital. Inter-urban, inter-regional and international competition on the part of state apparatuses for capital investment here plays an important role. The state (local, regional or national) becomes responsible for guaranteeing the supply of labour power of adequate quantities and qualities (including skills, training and political docility) in relation to corporate labour demand. While, therefore, the state apparatus may shift to following the corporate rather than labour's agenda, there is still a vested interest in localities supporting high-quality educational opportunities (universities and community colleges) since this will help to attract the high-tech manufacturing which will contribute more to the tax base of the locality.

Some Marxists have built a distinctive theory of crisis formation on the basis of barriers to adequate labour supply. The so-called 'profit squeeze' theory of crisis hinges on the perpetually fraught problem of labour relations and class struggle, both in the labour process and in the labour market. When these relations pose a barrier to further capital accumulation then a crisis ensues, unless some way (or, more likely, mix of ways of the sort outlined above) can be found for capital to overcome or circumvent that barrier. Some analysts, such as Andrew Glyn (see his impressive account, written with others, in 'British Capitalism, Workers and the Profits Squeeze' (1972)) would interpret what happened in the late 1960s and early 1970s (particularly in Europe and North America) as an excellent example of a profit squeeze situation. Certainly, the management of labour resources and the politics of labour organisation and supply dominated the politics of the period. Working-class organisation throughout much of Europe and even in the United States was relatively strong and state apparatuses everywhere were either wary of the power of organised labour or, through political parties of the left, rendered partly subservient to the interests of organised labour. There is no question but that this constituted a serious barrier to continuous capital accumulation. How that barrier
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was circumvented by capital through the rise of neoliberalism during the 1970s and early 1980s defines in many respects the nature of the dilemmas we now face.

The survival of capitalism depends upon the perpetual overcoming or circumvention of this potential barrier to sustained accumulation. As I write at the end of 2009, there is very little sign of a profit squeeze. Labour reserves exist everywhere and there are few geographical barriers to capitalist access to them. The political attack upon working-class movements worldwide has reduced serious worker resistance to very modest levels almost everywhere. The crisis of 2008–9 cannot therefore be understood in profit squeeze terms. Wage repression because of superabundant labour supply and consequent lack of effective consumer demand is a much more serious problem.

The labour question never goes away, however. Labour unrest can well up as a serious problem, at any time and in any place. Contemporary evidence from China, for example, suggests a rising tide of unrest there as the worldwide economic downturn creating unwelcome and unaccustomed (in China) increases in unemployment (in early 2009 estimated to be close to 20 million unemployed) within a recently proletarianised population. The uneven geographical development of labour struggles is important to keep an eye on.

The capital–labour relation always plays a central role in the dynamics of capitalism and may lie at the root of crises. But these days the main problem lies in the fact that capital is too powerful and labour too weak, rather than the other way around.

When capitalists reinvest, they need to find extra means of production available in the market place. The inputs they require are of two sorts: intermediate products (already shaped by human labour) that can be used up in the production process (such as the energy and cloth needed to make a coat) and the machinery and fixed capital
equipment, including factory buildings and the physical infrastructures such as transport systems, canals and ports that support the activity of production. The category of means of production is evidently very broad and complicated. But if any of these means of production turn out to be unavailable, then this constitutes a barrier to further capital accumulation. The auto industry cannot expand without more steel inputs, plastic and electronic components and rubber tyres, nor, incidentally, will its expansion make sense unless there are highways to drive on. Technological innovations in one part of what we now call a ‘commodity’ or ‘supply chain’ flowing into production invariably render necessary innovations elsewhere. Rising productivity in the nineteenth-century cotton industry with the advent of the power loom, Marx points out, required innovations in cotton production (the cotton gin), transport and communications, chemical and industrial dyeing techniques, and the like.

The conversion of a part of yesterday’s profit into fresh capital depends, therefore, on the availability of an ever-increasing quantity of means of production, as well as an increasing quantity of wage goods to feed the extra workers to be employed. The problem is to organise the supply of material inputs so as to sustain the continuity of capital flow. Capital has, in other words, to produce the conditions for its own continued expansion in advance of that expansion! How does it do this in a smooth and trouble-free manner?

The answer is, as Marx quaintly put it, that ‘the course of true love never does run smooth.’ There are always shortages here and surpluses there and occasionally these shortages coalesce into formidable barriers to further expansion which disrupt the continuity of capital flow. But efficiently functioning markets with freely moving price signals reflecting demand and supply conditions have historically provided one pretty good means of coordination. They have facilitated increasingly complex social divisions of labour and increases in what is termed ‘the roundaboutness of production’ (signalling the number of independent production steps involved prior to arriving at the finished product). The increasing number
of components incorporated in the final product (cars which incorporate sophisticated electronic devices like GPS systems, for example) increases the complexity of supply flows. This necessitates the creation of more or less 'honest' and reliable market structures with proper price signals to ensure the continuity of capital circulation. This inner connection between the expansion of capital at a compound rate and the use of market signals to coordinate flows calls forth state regulation against, for example, monopolisation, cornering or manipulating markets, at the same time as it requires the reduction of any social barriers (tariffs, quotas or unnecessary delays) to commodity movement. The removal of frontier checks in the 1980s on truck traffic in Europe had a huge impact on smoothness of flows of inputs into many production processes. Conversely, geopolitical tensions between states can disrupt the free flow of vital inputs and act as a check upon capital accumulation. The disruptions of Russian oil and natural gas flows through the Ukraine because of political disputes in 2008 created serious problems for producers and consumers as far west as Germany and Austria.

But the market is not the only means for coordination. Increasingly, producers deal with suppliers directly and, with optimal scheduling and supply models, transmit orders for components directly back down their supply chain and take delivery on a 'just-in-time' principle that minimises the cost of idle inventories. In many industries (autos, electronics, etc.) these direct coordinations have come to supplant the open market. Producers signal in advance how much extra means of production they will need and supplier firms calculate their output accordingly. And in certain instances of market failure, the state can step in with its own models of input–output structures to plan either the totality or a key component in a supply chain that capital has difficulty organising (such as power or water supply and a whole panoply of physical infrastructures for production). While it is a commonly held belief, particularly in the United States, that state interventions lead to inefficiency, the history of Japan's or Singapore's industrialisation leads a long list of examples in which the state
planning, coordination, intervention and reorganisation of capital flows has been more effective than the anarchy of open market coordinations. If corporations themselves have successfully avoided the anarchy of open markets by efficient optimal scheduling arrangements with their suppliers, then why cannot society do likewise on an even broader terrain?

Leaving aside the ideological fight over state planning versus market, what this all means is that the continuity of capital flow in a world of increasingly complicated social divisions of labour rests upon the existence of adequate institutional arrangements that facilitate the continuity of that flow across space and time. Where those arrangements are defective or do not exist, capital will encounter serious barriers. While ways can be found for capital to operate successfully under, say, conditions of lawlessness, corruption and indeterminate property rights, this does not in general constitute an optimal environment in which capital can flourish. What to do about 'failed states' and how to ensure the creation of 'a good business climate' (including the suppression of corruption and lawlessness) have therefore become leading missions of international financial institutions such as the IMF and the World Bank, as well as a project of various arms of contemporary US and European imperialist practices in many parts of the world. The WTO agreements, for example, codify 'good behaviour' for the states that have signed up (and many states have no option except to sign if they wish to continue to trade with the US and Europe) in such a way as to favour the freedoms of corporations to do business without excessive state regulation or interference.

Unfortunately, such projects invariably attack forms of value production and valuation other than those given by the market and, if successful (which they often are not), dissolve forms of cultural meaning and social solidarities that play an important role in sustaining daily life, both materially and socially, outside of ordinary commodity production. Non-market and non-capitalist-based modes of living are, in short, considered a barrier to capital
accumulation and they therefore must be dissolved to make way for the 3 per cent compound growth rate that constitutes the capitalist juggernaut. The complicated history of how the absolute limit against capital accumulation in China under communist rule was dissolved after the reforms of 1978 into a series of barriers, each of which was gradually transcended or circumvented, is, of course, one of the most significant political and economic stories of our times.

But there are also, it turns out, some tensions and potential contradictions within the supply chains that can lead to what are called ‘crises of disproportionality’. At the end of volume 2 of Capital, Marx set up what he called ‘reproduction schemas’ to analyse the dynamic relations between two broad sectors of the economy, those producing ‘wage goods’ (to feed, sustain and reproduce the labourer, later broadened to include ‘luxury goods’ for the personal consumption of the capitalist class) and those producing means of production (for the capitalist to use in production). Marx then asked how capital could shift from one sector to another, given the tendency for capitalists to equalise the rate of profit across all sectors through competition. What Marx showed was that situations could easily arise in which capital reinvestment would flow in such a way as to create disproportionalities between the sectors and that these disproportionalities could spiral into crises. The problem arose because, in striving to maximise the rate of profit, individual capitalists tended towards a systematic misallocation of capital flow across the two sectors. Later investigations that built on Marx’s arguments, using far more sophisticated mathematical models, suggested that Marx was correct in his general reasoning. The twentieth-century Japanese economist Michio Morishima, for example, showed that, depending upon the dynamics of technological change and capital intensity in the two sectors, you would either get ‘explosive oscillations’ or ‘monotonic divergence’ around a balanced growth path in the economy. This insight confirmed the conclusions from earlier modelling (based indirectly on Marx’s pioneering work on the reproduction schemas) of economic growth by the economists Roy Harrod
and Evsey Domar, back in the 1930s and 1940s, that economic growth was always on a 'knife edge' of balanced growth that could all too easily fall off that narrow path and plunge headlong into major crises.

What they also showed was that crises are, in effect, not only inevitable but also necessary, since this is the only way in which balance can be restored and the internal contradictions of capital accumulation be at least temporarily resolved. Crises are, as it were, the irrational rationalisers of an always unstable capitalism. During a crisis, such as the one we are now in, it is always important to keep this fact in mind. We have always to ask: what is it that is being rationalised here and what directions are the rationalisations taking, since these are what will define not only our manner of exit from the crisis but the future character of capitalism? At times of crisis there are always options. Which one is chosen depends critically on the balance of class forces and the mental conceptions as to what might be possible. There was nothing inevitable about Roosevelt's New Deal any more than the Reagan-Thatcher counter-revolution of the early 1980s was inevitable. But the possibilities are not infinite either. It is the task of analysis to uncover what might now be possible and to place it firmly in relation to what is likely given the current state of class relations throughout the world.

At the base of the long supply chain that brings the means of production to the capitalist, there lurks a deeper problem of potential natural limits. Capitalism, like any other mode of production, relies upon the beneficence of nature. The depletion and degradation of the land and of so-called natural resources makes no more sense in the long run than the destruction of the collective powers of labour since both lie at the root of the production of all wealth. But individual capitalists, working in their own short-term interests and impelled by the coercive laws of competition, are perpetually tempted to take the position of après moi le déluge with respect to both the labourer
and the soil. Even without this, the track of perpetual accumulation puts enormous pressures on the supply of natural resources, while the inevitable increase in the quantity of waste products is bound to test the capacity of ecological systems to absorb them without turning toxic. Here, too, capitalism is likely to encounter limits and barriers which will become increasingly hard to circumvent.

Nowhere has the idea of limits to capital been more stridently and persistently asserted throughout capitalism's history than with respect to scarcities in nature. The famous Enlightenment economists Thomas Malthus and David Ricardo both held that diminishing returns in agriculture would eventually lead the profit rate to fall to zero, thus spelling the end of capitalism as we know it because all profit would be absorbed by rent on land and on the supply of natural resources. Malthus went still further, of course, insisting (in the first version of his population theory) that the conflict between population growth and natural limits was bound to produce (and already was producing) crises of famine, poverty, pestilence and war, no matter what policies were implemented.

While Marx was not averse to contemplating the end of capitalism, he fiercely disputed the views of Malthus and Ricardo. With respect to Ricardo, Marx objected that falling transport costs and the opening up of new lands of remarkable fertility, particularly in the Americas, gave the lie to the idea that falling profits (a tendency which Marx readily accepted) and crises had anything whatsoever to do with natural scarcities. When faced with a crisis, Marx ironically observed, Ricardo 'takes refuge in organic chemistry.' In the case of Malthus, Marx's central objection was that capitalism creates poverty by virtue of its class relations and its compelling need to maintain an impoverished labour surplus for future exploitation. But the attribution of low living standards to scarcities in nature (rather than to the oppressions of capital) has been periodically resurrected. Environmental explanations were rife during the crisis of the 1970s (Donella H. Meadows' influential book *Limits to Growth* was published in 1972 and the first 'earth day' was in 1970) and it is no surprise that in
the times of economic turmoil since 2006 a wide range of environmental issues, varying from peak oil and rising commodity prices (at least until autumn 2008) to global warming, have been invoked as underlying explanations for, or at least components of, our current economic difficulties.

There are all sorts of ways, it turns out, in which supposed limits in nature can be confronted, sometimes overcome and more often than not circumvented. The difficulty is that the category ‘nature’ is so broad and so complicated that it can encompass virtually everything that materially exists (including, of course, the so-called ‘second nature’ produced through human activities which we will consider separately below). It is, therefore, extremely difficult to come up with any comprehensive accounting of the role played by scarcities in nature (as opposed to scarcities arising from market manipulations) in crisis formation. The concept of natural resources are, for example, technical, social and cultural appraisals and so any apparent natural scarcity can in principle be mitigated, if not totally circumvented, by technological, social and cultural changes. But, it turns out, cultural forms are frequently just as fixed and problematic as anything else.

Sea sharks are being senselessly hunted close to extinction to satisfy the Chinese cultural predilection for shark’s fin soup, as are African elephants for their ivory tusks which, when ground to powder, are supposed to have aphrodisiacal powers (the advent of Viagra may save the African elephant yet!). Western cultural preferences for meat-based diets have enormous implications for energy use and for global warming, both directly (cattle produce vast clouds of methane gas) and indirectly (the energy inputs in cattle feed are exorbitant relative to the energy imparted by meat-eating to human populations). The ‘anglo’ cultural preference for a ‘home of one’s own’ on a plot of land has generated patterns of suburbanisation that are energy profligate as well as wasteful of land. In none of these instances would it be formally correct to blame capitalism per se for the development and persistence of these environmentally perverse cultural preferences, though it has to be said that an equally
perverse capitalism is perfectly suited to fulfil, trade upon and in some instances go to great lengths to promote such cultural preferences (such as suburbanisation and meat-eating), whenever and wherever a profit is to be had by so doing.

Furthermore, ‘nature’ is far too simple a term to capture the immense geographical diversity of life forms and the infinite complexity of intertwined ecosystems. In the broad scheme of things the disappearance of a wetlands here, a local species there and a particular habitat somewhere else may seem trivial as well as inevitable given the imperatives of human population growth, let alone the continuity of endless capital accumulation at a compound rate. But it is precisely the aggregation of such small-scale changes that can produce macro-ecological problems such as global deforestation, loss of habitat and biodiversity, desertification and oceanic pollution.

Construing the relation to nature as inherently dialectical indicates a range of possible transformations in human behaviours as well as a process of natural evolution, including the human production of nature itself, that renders this relation dynamic and perpetually open. While on the one hand such a formulation would appear to deny the possibility of any out-and-out or prolonged, let alone ‘final’, environmental crisis, it also carries within it the prospect for cascading unintended consequences with widespread disruptive effects for the continuity of daily life as we currently know it. Who would have thought that refrigeration, which has saved so many lives and made possible large-scale urbanisation through the preservation of food quality, would ultimately produce the ozone hole by way of the chlorofluoral carbons used for cooling; that DDT would get so dispersed through the food chain as to lead to the deaths of Antarctic penguins; or that asbestos and lead-based paints would have such dire health effects on human populations many decades after their first use? It has long been understood (ever since the ancient Greeks, at least) that the unintended environmental consequences of human activities can be extensive and that the mere ability since ancient
times to use fire or to unleash sheep and goats upon the landscape, to say nothing of the vast range of more contemporary effects of chemical wizardry on the toxicity of ecosystems, can result in such extensive forms of environmental modification to the point where nothing we now call nature is bereft of human influence.

But the compound rate of growth of capital accumulation inevitably suggests that the environmental modifications become both deeper and more extensive in their consequences over time. When the Manchester cotton factories started belching out smoke around 1780 or so, the peat moors on the Pennine hills shortly thereafter collapsed from acid deposition. But this is a far cry from the Ohio valley power stations destroying the ecology of New England forests and lakes and the British power stations doing the same to Scandinavia from the 1950s onwards.

What we call the natural world is not some passive entity but, as the philosopher Alfred North Whitehead once put it, 'a system in perpetual search of novelty'. To begin with, tectonic movements beneath the earth's surface generate instabilities that give us earthquakes, volcanic eruptions, tsunamis and other events, while instabilities in atmospheric and oceanic circulations give us hurricanes, tornadoes, snow storms, droughts and heat waves that have all manner of human consequences, albeit unevenly distributed both geographically and socially. Furthermore, trading upon and profiting from human disasters induced by natural events is far too frequent a feature of capitalism to be taken lightly.

While human action has successfully eliminated the bubonic plague and smallpox, it now has to confront entirely new pathogens and diseases such as HIV/AIDS, SARS, the West Nile virus, Ebola and avian flu, to say nothing of the potential for a new mutated influenza pandemic of the sort that killed millions back in 1918. Climates have long been subjected to a whole range of forces that uncomfortably mix together human-induced and non-human elements in such a way as to make it difficult to determine which is which, even when the very best scientific minds are collectively put to work to figure
out the global climatic consequences of human action. While the effects are indisputable, the full range of consequences is almost impossible to determine. Past changes, before human beings set to work to change the face of the earth, have sometimes been quite rapid – at least as measured in geological time (hundreds of years) – and quite unpredictable, with wide-ranging effects (such as waves of species extinction). Other things remaining equal, the indisputably humanly-induced effects are subject to the compound growth rate rule, which surely must give cause for serious concern and at the very minimum command serious investigation and precautionary international regulatory action (of the sort accomplished in the 1989 Montreal Protocol that curbed the use of CFCs). But even then, anyone who thinks they can predict climatic futures with even modest certainty is fooling themselves.

The historical geography of capitalism has, however, been marked by an incredible fluidity and flexibility with respect to the relation to nature coupled with wide-ranging unexpected consequences (both good and bad, from the perspective of human welfare). Hence, it would be false to argue that there are absolute limits in our metabolic relation to nature that cannot in principle be transcended or bypassed. But this does not mean that the barriers are not sometimes serious and that overcoming them can be achieved without going through some kind of general environmental crisis (as opposed to the collapse of the shark population, which could be construed as ‘merely’ regrettable were it not for the unknown but probably wide-ranging effect it will have upon the whole oceanic ecosystem).

A lot of capitalist politics, particularly these days, is about ensuring that the free gifts of nature are both available to capital on an easy basis and also sustained for future use. The tensions within capitalist politics over these sorts of issues can sometimes be acute. On the one hand, for example, the desire to maintain an expanding flow of cheap oil has been central to the geopolitical stance of the United States over the last fifty to sixty years, precisely because capital surplus absorption by suburbanisation after 1945 was conditional upon the
availability of cheap oil. Making sure that the world's oil supplies are open for exploitation has drawn the US into conflict in the Middle East and elsewhere and energy politics, just to take one example of a crucial relation to nature, has often emerged as a dominant issue within the state apparatus and in inter-state relations.

But on the other hand the politics of cheap oil have posed problems of excessive depletion, as well as global warming and a host of other air quality issues (ground level ozone, smog, particulate matter in the atmosphere, and the like) that pose increasing risks to human populations. High-energy-consuming urban sprawl has produced chronic land use degradation conducive to flooding, the siting of waterways and the production of urban 'heat islands'. These environmental impacts complement the depletion of the natural resources required to support an automobile industry which played such a pivotal role in capital surplus absorption from the 1930s onwards.

Some Marxists, led by the Californian economist Jim O'Connor, who founded the journal *Capitalism, Nature, Socialism*, refer to the barriers in nature as 'the second contradiction of capitalism' (the first being, of course, the capital–labour relation). In our own times it is certainly true that this 'second contradiction' is absorbing as much if not more political attention than the labour question and there is a wide-ranging field of concern, of political anxiety and endeavour, that focuses on the idea of a crisis in the relation to nature, as a sustainable source of raw materials, as mere land for further capitalist (urban and agricultural) development, as well as a sink for an increasing stream of toxic waste. But there is always a danger in overemphasising supposedly 'pure' natural limits at the expense of concentrating upon the capitalist dynamics that force environmental changes in the first place and on the social (particularly class) relations that drive those dynamics in certain environmentally perverse directions. The capitalist class, it goes without saying, is always delighted, on this point at least, to have its role displaced and masked by an environmental rhetoric that lets them off the hook as the progenitors of the problem. When oil prices spiked in the summer of 2008, it was
helpful to claim natural scarcity when the oil companies and specula-
tors were to blame.

In O'Connor's work, this second contradiction of capitalism
came to displace the first after the defeats of the labour and socialist
movements of the 1970s onwards. For him, the environmental
movement constitutes (or should constitute) the cutting edge of
anti-capitalist agitation and during the 1980s and 1990s it did indeed
sometimes seem as if the environmental movement was the only
anti-capitalist movement that had any life in it. I leave you to make
up your own mind on how far that sort of politics should be pursued.
But what is certain is that the barrier in the relation to nature is not
to be taken lightly and that the stresses are becoming, along with
everything else, more global.

There may be an imminent crisis in our relation to nature that
will require widespread adaptations (cultural and social as well as
technical) if this barrier is to be successfully circumvented, at least
for a time, within the framework of endless capital accumulation.
The fact that capitalism has, in the past, successfully navigated
around natural barriers, and that it has often done so profitably
since environmental technologies have long been big business and
can certainly become much bigger (as the Obama administration
proposes), does not mean that the nature question can never consti-
tute some ultimate limit. But in terms of the immediate crisis of our
time that began in 2006, the question of natural limits cannot, on
the surface at least, be accorded primacy of place, with the possible
exception of the role of so-called 'peak oil' and its impact on energy
prices. The issue of peak oil requires, therefore, some commentary.

As background it is worth noting that what began to appear as
the greatest of all potential natural limits to capitalist development
in eighteenth-century Britain was neatly transcended by the turn to
fossil fuels and the invention of the steam engine. Before that time
the land had to be used for both food and energy production (from
biomass) and it became increasingly clear that it could not be used
for both at a compound rate of growth given the transport capacities
of the time. After 1780 or so, energy could come from underground (in the form of coal reserves laid down in the Carboniferous period) and the land could be used for food production alone. A century or so later the immense energy reserves of the Cretaceous period could likewise be tapped in the form of oil and natural gas. I make this observation in order to point up the obvious stupidity of trying to respond to supposed contemporary oil shortages by resort to ethanol production, which takes energy production back on to the land (using for the most part more energy in its production than it actually makes) with immediate and serious impacts on food grain prices. The perversity of a policy that takes us right back into the energy versus food trap of eighteenth-century Britain is nothing short of shocking. How did this come about?

The idea of ‘peak oil’ goes back to 1956 when a geologist then working for Shell Oil, M. King Hubbert, predicted, on the basis of a formula linking rates of new discoveries and rates of exploitation, that oil production within the US would peak in the 1970s and then gradually contract. He lost his job at Shell but his predictions proved correct and since the 1970s the United States has daily become more and more dependent upon foreign oil as domestic sources have continued to decline. The US now imports close to $300-billion-worth of oil annually, which accounts for almost one third of a burgeoning foreign trade deficit that has to be covered by borrowing from the rest of the world at well over $2 billion per day. The recent turn to ethanol combined a drive to diminish the political and economic vulnerabilities of the US to this foreign dependency with a delicious subsidy to a powerful agribusiness lobby which dominates the very undemocratic US Senate (where small rural states command 60 per cent of the votes) and which has long been one of the most powerful lobbies in Washington (the high level of agricultural subsidies in the US have been one of the most contentious issues in WTO negotiations with the rest of the world). The subsequent utterly predictable rise in food grain prices was also good news for agribusiness even as New Yorkers suddenly found their bagels increasing in price by 50
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per cent. The consequent exacerbation of world hunger is no joke. As one critic of the Hubbard thesis noted, 'Filling a twenty-five gallon tank of an SUV with pure ethanol requires 450 pounds of corn, enough calories to feed one person for a year. On present trends (2008), the number of chronically hungry people could double by 2025 to 1.2 billion.'

This was all backed by increasing evidence (and plenty of rhetoric) that the 'peak oil' formula that Hubbert had applied to the US could usefully be applied to predict global oil supplies. Since global rates of discovery peaked, according to the data, in the mid-1980s, then it could widely be anticipated that oil production would itself peak no later than around 2010. Several oil-producing countries other than the US have roughly conformed to Hubbert's peak formula, including Kuwait, Venezuela, the United Kingdom, Norway and Mexico. While the situation elsewhere, particularly in Saudi Arabia (where there are rumours that peak production has already been achieved), the Middle East generally, Russia (where President Putin recently declared, though almost certainly for political rather than factual reasons, that peak oil has been passed) and Africa, is harder to monitor, the rise in oil prices from less than $20 a barrel in 2002 to $150 a barrel (and a doubling of gas prices at the pump for US consumers) by the summer of 2008 provided all the popular evidence needed to show that peak oil had arrived and was here to stay. Fortunately or unfortunately, depending on your view, oil prices suddenly plunged to less than $50 a barrel by the end of 2008, putting a big popular question mark over the relevance of the theory and opening the path towards central bank relaxation of fears over an oil-price rise led inflation and a consequent reduction of interest rates to close to zero in the United States at the end of 2008. Since oil at $50 a barrel is often cited as the break point above which ethanol becomes profitable, the vast investment in nearly doubling the number of ethanol plants in the US since 2006 may now be in jeopardy.

How and why the scarcity supposedly given by nature and represented so neatly by the formula of peak oil can be so volatile in the
market place requires some explanation. To get into this requires that we introduce another distributive category, which Marx characteristically also left aside 'until later': rent on land and natural resources. There are two kinds of rent that matter (I discount here a third category that Marx proposed called 'absolute rent' because, frankly, I do not think it works). The first category that does work is called 'differential rent' and it arises in the first instance because of the difference in fertility or yield on lands and mines relative to the least productive land, mine or oil well that needs to be brought into production in order to satisfy the demands of the market. Differential rent also can and often does have a locational component (land closer to the centre of a city is typically more valuable than land on the periphery and oil wells on land are easier to exploit than those in deep waters or in Arctic locations). In the case of oil, the costs of exploitation of the least productive and least accessible wells have to be covered and a standard rate of profit added at the average rate for capitalists to engage in production - it is this that sets the basic price of oil. All other producers earn excess profits since their production and accessibility costs are lower and their yield higher than on the most marginal field. To whom does this excess profit accrue? Given that property rights can be exercised over the land and the oil well, then the holder of these property rights (individuals or the state) can claim a royalty fee for releasing the land or the resource for others to use. The fee can be a straight money payment (rent) for the use of the resource; a portion of the profits gained by the company exploiting the resource; or a straight excess yield on oil sold directly in the world market by some entity (such as a state-owned oil company) that holds the property right to the resource that it itself exploits. In all of these cases, however, the property owner has a reserve price which they typically demand and extract before they release the resource to others to exploit. They can claim all or most of the differential rent if they are savvy enough and still have production proceed.

The very existence of this reserve price testifies to the monopoly rent that attaches to all forms of property rights claims under the
institutional arrangements that characterise capitalism. Any holder of a property right can withhold access to that property, and refuse to release it until a reserve price is reached. In competitive situations this reserve price is typically rather low because if there is abundant land available, producers have choices as to where they go and if you do not release your land to them (by sale, lease or rental agreement) at a reasonable price, then others will. In some instances this reserve price goes close to zero, though in that case there seems to be no point in property owners releasing the land anyway.

But at this point we have also to acknowledge that the fertility or productivity of the resource is not entirely due to nature but to the investments in technologies and improvements that raise the productivity of the original resource to new levels. Land fertility is as much made as given by nature. The owner of the property right to the land has a vested interest in the user improving its productivity. In the successful period of 'high farming' in nineteenth-century Britain, before the long agricultural depression that began in 1873, owners favoured long leases since this encouraged tenants to undertake long-term improvements (such as drainage, fertilisation and crop rotation techniques) that improved fertility rather than degraded it. In this case differential rent would accrue to the user during the time of the lease as a return on capital investment in long-term improvements. But how do we account for the extremely fertile land that was drained or reclaimed from the sea in the sixteenth century? While differential rent is a single category it rather beautifully encapsulates the problem of how hard it is eventually to distinguish what is given by nature and what arises as a result of human action, even as it highlights the strategic question that has to be faced by any owner of a resource: to mine an existing resource (no matter whether its productivity is due to nature or to human action) with ruthless efficiency until it is exhausted, or to husband or improve the resource for future and potentially long-term sustainable use.

In the case of oil wells, however, we are here dealing with a non-renewable resource, the reserve price on which is given by conditions
of relative scarcity. Differential rent on oil wells (no matter whether it arises from superior production technologies or natural conditions of, say, high pressure and large quantities underground) here shades into monopoly rent, as has so obviously been the case with OPEC's control over the release of oil into the world market at a rate which maintains or stabilises prices at a given level. OPEC's range of action is limited, of course, by the fact that not all states belong to the cartel. But, in spite of all the usual objections, both producers and users generally benefit from reasonable stability in market prices that can be achieved by OPEC's actions. So why, then, such volatility in oil prices?

This brings us to the crux of the problem, because the market for oil is driven as much by scarcities created by social, economic and political conditions as it is by so-called natural scarcities. Oil rents and oil futures are targets for speculative investment and belief in some impending scarcity (whether it be due to political instabilities, wars or peak oil) drives up prices dramatically, particularly under conditions where there is even a temporary shortfall in the supply to match some 'peak' in demand such as that which arose when in the mid-1990s both China and India entered into the oil market in ways that matched their strong spurts of economic growth. Oil rents and oil futures therefore get capitalised as a form of fictitious capital and claims also circulate in such a way that all operators in these markets hedge their bets, create all manner of derivatives and then seek to manipulate the market in ways that match their bets. As oil prices rise, of course, all sorts of marginal fields get exploited (or in some cases re-opened) simply because the definition of the margin fluctuates with singular volatility. Canada's Athabaska tar sands are expensive to exploit but become highly profitable when oil goes to $150 a barrel. But the problem is that it takes considerable time to bring new fields into production and so the response time to a surge in demand is slow unless there is existing capacity, such as that controlled by OPEC, which can more easily be brought into play. But here, too, the whole operation including that of refining is capital-intensive and very sensitive both to conditions in capital markets,
to profit margins and to what is happening in the oil futures market, which is one of the great markets for hedging and betting and so heavily influenced by the availability of surplus capital. When the world is awash with surplus liquidity, then why not put some of it into betting in the oil futures market? Particularly if someone tells you that peak oil is just around the corner!

What is clear from all this is that the relation to nature is a two-way street down which the vagaries and contingencies of naturally occurring evolutionary changes are matched by the vagaries and contingencies of the social, economic and political situations that define both the meaning of and the relation to nature. Barriers to accumulation are perpetually dissolving and re-forming around the issue of so-called natural scarcities and on occasion, as Marx might put it, these barriers can be transformed into absolute contradictions and crises.

Nature has been modified by human action over the ages. The environment is a category that has to include the fields that have been cleared, the swamps and wetlands that have been drained, the rivers that have been re-engineered and the estuaries that have been dredged, the forests that have been cut over and re-planted, the roads, canals, irrigation systems, railroads, ports and harbours, airstrips and terminals that have been built, the dams, power-supply generators and electric grid systems that have been constructed, the water and sewer systems, cables and communications networks, vast cities, sprawling suburbs, factories, schools, houses, hospitals, shopping malls and tourist destinations galore. These environments, furthermore, are inhabited by entirely new species (think of dogs, cats, cattle breeds and featherless chickens) that have either been engineered through selective breeding practices (supplemented now by direct genetic engineering practices that modify such crops as corn and tomatoes) or that have mutated or found new environmental niches
(think of the patterns of diseases, like avian flu, that mutate and first gain a footing in the newly constructed environments of factory featherless chicken production). There is little left on the surface of planet earth that can be imagined as a pure and pristine nature absent any human modification. On the other hand there is nothing unnatural about species, including ours, modifying their environments in ways that are conducive to their own reproduction. Ants do it, bees do it, and beavers do it most spectacularly. In the same way that there is nothing unnatural about an ant hill, so there is, surely, nothing particularly unnatural about New York City.

But all of this has taken human energy and ingenuity to construct. The built environment that constitutes a vast field of collective means of production and consumption absorbs huge amounts of capital in both its construction and its maintenance. Urbanisation is one way to absorb the capital surplus.

But projects of this sort cannot be mobilised without assembling massive financial power. And capital invested in such projects has to be prepared to wait for returns over the long haul. This means either state involvement or a financial system robust enough to assemble the capital and deploy it with the desired long-term effects and wait patiently for the returns. This has usually meant radical innovations in the state–finance nexus. Since the 1970s, financial innovations such as the securitisation of mortgage debt and the spreading of investment risks through the creation of derivative markets, all tacitly (and now, as we see, actually) backed by state power, have permitted a huge flow of excess liquidity into all facets of urbanisation and built environment construction worldwide.

In each instance innovation in the state–finance nexus has been a necessary condition for channelling surpluses into urbanisation and infrastructural projects (e.g. dams and highways). But again and again over the last thirty years, excessive investment in such projects has become a regular catalytic trigger for crisis formation. As has been pointed out earlier, several of the financial crises since 1970 have been triggered by overextension in property markets.
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The compounding rate of growth that lies at the heart of a capitalist mode of production cannot be achieved without the necessary physical infrastructural conditions first being put in place. An export-led economic boom in some country requires adequate prior transport and port facilities just as a factory cannot function without adequate (and sometimes copious) supplies of water and energy inputs and a transport and communications infrastructure that permits production to proceed without too many bottlenecks in the supply of inputs (including labour) and in the marketing of the product. Workers also have to live, shop, educate their kids and meet their leisure needs somewhere reasonably close by.

This vast infrastructure that constitutes the built environment is a necessary material precondition for capitalist production, circulation and accumulation to proceed. This infrastructure, furthermore, requires constant and adequate maintenance to keep it in good working order. An increasing portion of economic output has therefore to be put into maintaining these necessary infrastructures in an adequate condition. Maintenance failures (such as the breakdown of an electric grid, the failure of water supply or disruptions in transport and communications systems) are far from uncommon even in the most advanced capitalist economies (the United States has seen its share of infrastructural disasters such as collapsing bridges and malfunctioning power grids over the last few years). Further capital accumulation is, moreover, predicated upon building new infrastructures. The survival of capitalism, in short, depends upon the organisation and financing of material infrastructural investments appropriate to a compounding rate of growth.

Capital has to create a landscape adequate to its own requirements - a second nature built in its own image as it were - at one point in time, only to revolutionise that landscape at a later point in time in order to accommodate further accumulation at a compound rate.

But what incentives exist for capital to invest in these infrastructures? An adequate rate of monetary return is the obvious answer and this means that payment for the use of these infrastructures has
somehow to be extracted from those who benefit from them. While that is easy enough to imagine with respect to the houses, shops and factories that can be rented, leased or sold to users and also imaginable (though not necessarily desirable) for certain items of collective provision (such as highways, schools, universities, hospitals) that could be funded on a fee-for-service basis, there are still many aspects of the built environment that are held in common and for which it is very difficult to extract a direct payment. It is here that the state again has to enter into the picture and play a central role. To do this it needs to extract taxes. The theory of productive state expenditures pioneered in Second Empire Paris by the Saint-Simonian financiers and later generalised by Keynes suggests that the tax base should increase as private capital responds positively to possibilities generated by new infrastructural provisions. The result is a form of state-capital circulation in which state investments not only pay for themselves but also earn extra revenues to be put into more infrastructures.

Considerations of this sort require that we liberate the concept of production from its customary confinements. The usual image of production that prevails is of workers toiling away in a factory, perhaps on an assembly line making cars. But the workers who produce and maintain the highways, the water supply systems, the sewers and the houses and those who do the landscaping and the interior decorating are just as important. A multitude of firms and labourers are actively engaged in the (almost invariably debt-financed) production of urbanisation, or what is perhaps better more generically described as the production of new spaces, places and environments. The political struggles that arise in this arena typically exhibit rather distinctive qualities. While construction workers may wage a fierce war with contractors over wage rates, conditions of labour and safety, they are notorious for supporting both private and state-led development projects of no matter what sort. To the degree that such projects spark oppositions on environmental, political and social grounds, and to the degree that they invariably entail
dispossession of the land rights of often vulnerable populations, then working-class factions are just as likely to collide in opposition as to unite in anti-capitalist struggle.

The production of spaces and places has absorbed, over time, vast amounts of capital surplus. New landscapes and new geographies have been created within which capital circulates in ways that are frequently haunted by deep contradictions. If the vast amount of fixed capital embedded in the land (look down upon the land next time you fly just to get a sense of how vast this is) is to be realised, then it must be used and paid for by capitalist producers in the here and now. Abandoning all those assets, as happened to many older industrial cities in the huge wave of deindustrialisation of the 1980s, incurs losses (social as well as infrastructural) and can itself be a source of crises that affect not only those that hold the debt on many of these infrastructural investments but also the economy at large. It is here that Marx’s thesis that capitalism inevitably encounters barriers within its own nature (in this case, within the spaces, places and environments it has produced) becomes most visible.

The relations between capital and labour as well as those between capital and nature are mediated by the choice of technologies and organisational forms. Marx is, I think, at his very best in theorising the forces driving these choices and why it is that capitalists fetishise technologies (machinery in particular) and new organisational forms. Got a problem? There has to be a technological or organisational fix!

Machines cannot produce profits by themselves. But those capitalists with superior technologies and organisational forms typically gain a higher rate of profit than their competitors and eventually drive them out of business. As they do so, the cost of goods consumed by the workers typically declines because of rising productivity. Labour costs can then be reduced without lowering the standard of living.
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of labour, generating greater profit for all capitalists. If productivity gains are very strong, material living standards of the workers can increase even as wages decline. This happened in the US after the 1990s with the Wal-Mart system of retailing based on cheap imports from China. Note that for Wal-Mart it was more organisational form than machinery that did the trick.

The upshot is a perpetual incentive for organisational and technological dynamism. 'Modern industry,' Marx notes in Capital, 'never views or treats of the existing form of a production process as the definitive one. Its technical basis is therefore revolutionary, whereas all earlier modes of production were essentially conservative.' This is a persistent motif in Marx's works. As he and Engels presciently noted in The Communist Manifesto, 'the bourgeoisie cannot exist without constantly revolutionising the instruments of production, and thereby the relations of production, and with them the whole relations of society ... Constant revolutionising of production, uninterrupted disturbance of all social conditions, everlasting uncertainty and agitation, distinguish the bourgeois epoch from all other ones.'

But why this revolutionary impulse in the heart of capitalism and why is capitalism so different from other modes of production? Human beings are clearly fascinated by the perpetual pursuit of novelty, but the social and cultural conditions under which such a fascination can become a central driving force in human evolution are very special. Most hitherto-existing social orders were inherently conservative. They sought to preserve the status quo, to protect a ruling class and repress human impulses towards innovation and new ideas. This was a persistent feature of the history of Chinese civilisation, for example. It ultimately proved to be the Achilles heel of actually existing communism. Bureaucratic and power-structure ossification became the problem.

For reasons that are much debated and which will probably never be finally settled, between the Catholic Church's inquisition and repression of Galileo in the early seventeenth century and Watt's invention of the steam engine in the late eighteenth century, there
occurred in Europe, and in Britain in particular, a radical reconfiguration of the social, political, cultural and legal conditions that turned innovation and new ideas into an open sesame for the creation of wealth and power. A ruling class continued to rule, but not necessarily through the same personae or their biological descendants.

The kind of society that emerged was grounded in private property rights, juridical individualism, some version of free markets and free trade. The state increasingly saw its role as the management of this economy as a way to augment its wealth and power. None of this worked perfectly according to the rubrics of John Locke and Adam Smith, and one only has to read Charles Dickens's *Bleak House*, with its interminable legal struggles in Chancery, to recognise that British society was and still is constituted as a perpetual power struggle between the old and the new social orders. But in Britain and its erstwhile colony the United States the coercive laws of competition that flowed from these new institutional arrangements were allowed broadly to do their work unhindered by class and status repressions.

The primary mechanism that liberates innovation from repression and regulatory control is, therefore, competition. This typically produces a perpetual stream of innovations in technologies and organisational forms simply because those capitalists with more efficient, effective and productive labour processes gain higher profits than the rest. The quest for greater efficiency actually encompasses all aspects of the circulation of capital, from the procuring of labour supplies and means of production (hence the supply-chain structure of just-in-time delivery from subcontractors to the modern corporation) through to efficient and low-cost marketing strategies (the Wal-Mart syndrome). Capitalist entities, from individual entrepreneurs to vast corporations, are therefore forced to pay close attention to organisational and technological forms and are always on the lookout for those innovations that yield them excess profit, at least for a time. The trouble is that the excess profit that accrues to them is ephemeral because competitors can catch up with and even leap over their technological and organisational advantage.
Fierce, and what capitalists sometimes call ‘ruinous’ competition tends, therefore, to produce leap-frogging innovations that more often than not lead capitalists to fetishise technological and organisational innovation as the answer to all their prayers (including the disciplining of labour in both the market and the labour process). This fetishism is fed upon to the degree that innovation itself becomes a business that seeks to form its own market by persuading each and every one of us that we cannot survive without having the latest gadget and gismo at our command. The fear of the destructive and the potentially ruinous impacts of new technologies sometimes provokes attempts to control or even suppress threatening innovations. In recent times, monopolising or buying up patents or systematically destroying certain innovative paths (like electric cars) through monopoly control has not been unheard of, but as we are currently seeing in the case of the Detroit auto industry, in the long run this sort of response does not work.

But it is not only competition between capitalists that matters. There are other decision-making entities that play a decisive role in fostering innovation, the most important of which is the state apparatus. A putative inter-state system was consolidated in Europe through the Treaty of Westphalia in 1648. Sovereign entities formed whose territorial integrity was supposed to be respected or protected by main force if necessary. From this point onwards many states became involved in the pursuit of superior military technologies, organisational forms and transport and communications systems. State-sponsored, though nominally autonomous ‘learned societies’ – for example, the Académie Française and the British Royal Society – started to sponsor research initiatives, such as the celebrated search for a chronometer that would work on the high seas and thereby facilitate navigation (the aristocratic orders that still held power refused, however, to recognise the achievement of a mere artisan, John Harrison, who actually solved the problem in 1772). What later on came to be called a ‘military-industrial complex’ emerged in shadowy form early on in the history of capitalist state development.
(the 'Ponts et Chaussées' organisation, founded in 1747, became legendary in France for its scientific and technological expertise on infrastructural and military construction problems). But it was only during and after the Second World War that this aspect of innovative behaviour became paramount as Cold War arms races, space races and all the rest of it involved the state directly in research and development activity along with capitalist firms in different sectors of the economy (everything from nuclear energy to satellite imaging and public health). War periods or periods of political tension (such as the Cold War, and more recently, the so-called 'War on Terror') have thus played a crucial role in directing paths of innovation. In much the same way that the state–finance nexus came to play a key role in capitalist development, so a state–corporate nexus also emerges around questions of research and development in sectors of the economy considered to be of strategic (and not solely military) importance to the state. Surveillance becomes big business.

To the degree that R&D underpins comparative advantage in global economic competition, so a wide range of departments within the governmental apparatus (dealing with health, food and agriculture, transport and communications and energy, as well as the more traditional military arms and surveillance), backed by a huge semi-public research university system, have come to play a vital role in technological and organisational innovation in association with industry in the leading capitalist powers. In Japan it was the state that bureaucratically welded together corporate activities around an organisational and technological research programme that brought Japan into competitive pre-eminence through industrialisation (a model that was subsequently followed in South Korea, Taiwan, Brazil, Singapore and now plays a crucial role in China).

As all these forces come together, so the pace of technological and organisational change typically accelerates to produce a rapid succession of new frontiers in product innovation and development as well as in methods of production. Such waves of innovation can become destructive and ruinous even for capital itself, in part
because yesterday's technologies and organisational forms have to be discarded before they have been amortised (like the computer I am working on) and because perpetual reorganisations in labour processes are disruptive to continuity of flow and destabilising for social relations. The devaluation of prior investments (machinery, plant and equipment, built environments, communications links) before their value has been recovered, for example, becomes a serious problem. Likewise, rapid shifts in labour quality requirements (e.g. the sudden need for new skills such as computer literacy) that outpace existing labour force capacities generate stresses in the labour market. Social and educational infrastructures find it hard to adapt quickly enough and the perpetual need for 'retraining' several times in a worker's lifetime puts stresses on public resources as well as private energies. The production of chronic job insecurity through deskilling and reskilling is backed by technologically induced unemployment (about 60 per cent of job losses in the US in recent years are attributable to technological changes while only 30 per cent are due to the widely blamed offshoring of jobs to Mexico, China and elsewhere).

Spiralling crises of disproportionality can also arise out of the uneven development of technological capacities across different sectors, producing, for example, imbalances in the output of wage goods versus means of production. Dramatic shifts in spatio-temporal relations consequent upon innovations in transport and communications can revolutionise the global landscape of production and consumption (as we have already argued in the case of deindustrialisation) and produce 'switching crises' (sudden switches in flows of capital investment from one 'hot spot' to another) within a volatile system of uneven geographical development. Sudden accelerations and general speed-ups in capital circulation (such as the computer trading in financial markets that are often blamed for the recent difficulties on Wall Street) can be chaotic and disruptive as well as advantageous and highly profitable for those whose mathematical models work best (at least for a time).
The history of technological and organisational change within capitalism has been nothing short of remarkable. But it is, evidently, a double-edged sword that can be as disruptive and destructive as it can be progressive and creative. Marx himself felt that he had identified a critical means to explain the falling profitability that both Malthus and Ricardo had hypothesised. It was best explained, he argued, by the overall impact of labour-saving innovations on profit rates. Displacing labour, the source of making all new wealth, from production was bound to be counterproductive for profitability in the long run. The trend towards falling profits (which Ricardo had identified) and the crises to which it inevitably would give rise were internal to capitalism and not explicable at all in terms of natural limits. But it is hard to make Marx's theory of the falling rate of profit work when innovation is as much capital or means of production saving (through, for example, more efficient energy use) as it is labour saving. Marx himself actually listed a variety of counteracting influences to a falling rate of profit, including rising rates of exploitation of labour, falling costs of means of production (capital-saving innovations), foreign trade that lowered resource costs, a massive increase in the industrial reserve army of labour that blunts the stimulus for the employment of new technologies, along with the constant devaluation of capital, the absorption of surplus capital in the production of physical infrastructures, as well as, finally, monopolisation and the opening up of new labour-intensive lines of production. This list is so long that it renders the neat explanation for a solid 'law' of falling profits as a mechanical response to labour-saving technological innovation more than a little moot.

The very last item on Marx's list of counteracting influences deserves further elaboration because the capital surplus absorption problem would long ago have sounded the death knell of capitalism, had it not been for the opening up of new product lines. Since Marx's day the elaboration of new product lines and product niches has been a life-saver for capitalist development at the same time as it has transformed daily life, even down to the modest income
levels of so-called developing countries (witness the rapid proliferation of transistor radios and cell phones throughout the world in a few decades). The household technologies now commanded by the professional bourgeoisie and the upper and middle classes of the advanced capitalist countries (which now include, in addition to Europe and North America, much of east and south-east Asia) are simply astonishing. Product innovation and development, like everything else, has in itself become big business applicable not only to the improvement of existing products (like automobiles) but also wholly new sectors of industry (such as computers and electronics and their huge fields of application in government, pharmaceuticals, health care, corporate organisation, entertainment, and the like, as well as in household goods). Much of this depends, of course, on the tastes of consumers and their level of effective demand (matters to be considered shortly). But the astonishing penchant for creating wholly new product lines and the acceleration that has occurred in new product development since the 1950s or so has placed the development of consumerism and a rising effective demand at the centre of the sustainability of contemporary capitalism in ways that Marx, for one, would have found hard to recognise.

The implication, however, is that any weakening in the coercive laws of competition, through, for example, patent laws and monopolisation, the increasing centralisation of capital or too heavily bureaucratised state intervention, will have an impact upon the pace and form of technological revolutions. In the United States, the research universities, which are hard to regulate and bring under centralised control even as they become more corporatised and increasingly reliant on state and corporate funds, play a crucial role in maintaining a technological comparative edge versus the rest of the world. The university's peculiarly loose form of organisation guards against the tendency towards ossification (and tacit corruption) in the overlap between state and corporate bureaucracies. Significantly and belatedly, the Europeans, the Japanese and the Chinese now recognise the significance of this sort of state-university R&D sector
to find new venues for capital surplus absorption. Where, then, will our next innovation-led speculative bubble come from? My current bet is biomedical and genetic engineering (this is where the big philanthropic organisations funded by those like Bill Gates and George Soros that have partially replaced the state in research financing are concentrating their activities), along with so-called 'green' technologies (which, I suspect, are more limited than generally imagined).

Consider, secondly, the revolutionary implications of technological and organisational changes for society in general. It has long been true that the drive to create new wealth and power through new product and organisational innovation has permitted a ruling class to continue to rule but not necessarily through the same personae or their biological descendants. Think of Andrew Carnegie, Jay Gould, the Vanderbilts, Andrew Mellon and the other 'robber barons' of post-Civil War America and the vast wealth they built from almost nothing on the basis of the railroads; think of Henry Ford, John D. Rockefeller (of Standard Oil) and all the others whose rising class power rested on the automobile; then think of Bill Gates, Paul Allen, Jack Welch, Michael Bloomberg and others who took over the reins after 1980 on the basis of the new electronic and communication technologies, along with the financial tycoons like George Soros, Sandy Weill, Robert Rubin, Bruce Wasserstein, Charles Sanford and all the rest of the Wall Street gang.

Plainly, the 'uninterrupted disturbance of all social conditions' and 'everlasting uncertainty and agitation', as Marx and Engels put it, applies as much to the composition of the capitalist class as it does to anything else. The capitalist class undergoes revolution after revolution, and not always peaceably so. Those who once held power often search to undermine the 'arrivistes' and 'nouveau riche' by entangling them in networks of exclusion and of culture that are hard to break when not actually manipulating their downfall (as the old-fashioned Rothschilds did to the 'arriviste' Péreire brothers and their new credit institutions in 1868 in Paris). The radical reconstitution of class relations through financialisation has yet to run its course.
But there is yet another dimension to the transformations of social relations consequent on new technologies and organisational forms. Marx held it to be a virtue of the technologies developed under capitalist modernity that they rendered transparent and understandable industrial processes that had long been opaque and mysterious. The science and technologies of pasteurisation, of steel-making, of steam power and of industrial materials and construction were all open for everyone to understand rather than locked into the minds and customary practices of artisans. But we have now come full circle, it seems. So many contemporary technologies (everything from nuclear power to materials science to electronics) are so complicated that we are increasingly subjected to a 'rule of experts'. We have all sat in the doctor's or dentist's office and had some blurry picture called an X-ray expertly interpreted as good or bad news; most of us would not know how to begin to construct an adequate interpretation. Diagnosing what is wrong with a computer system is no easy task (and dealing with hackers, viruses and identity robbers is even harder). Most of us rely on a user-friendly system that requires an expert (who often appears to speak in tongues even to those who are reasonably knowledgeable) to fix when it goes wrong. Much rests on trust in expert knowledge. Those who have that knowledge acquire a certain monopoly power, which can all too easily be abused (technofascism I have heard it called).

Any breakdown in trust can become catastrophic. Recent events in financial services are illustrative of exactly this problem. In the mid-1980s computers were both rare and primitive on Wall Street. Markets were still relatively simple, transparent and tightly regulated. Traders based their activities on some mix of information (insider if you did not get caught and prosecuted, as then indeed happened) and intuition. Twenty years later wholly new over-the-counter and hence unregulated and often undocumented markets in options and derivatives dominated trading ($600 trillion in business in 2008 relative to the total output of goods and services in the world economy of around $55 trillion!). One of the purposes
of this innovation wave was to avoid regulation and to create new arenas in which the capital surpluses could be profitably deployed in 'free' (that is, unregulated) markets without constraint. Innovations were ad hoc and private, corresponding more to the activities of the 'bricoleur' than of the systematiser. This was the way to avoid the regulator and free the market. The traders were by the mid-1990s often highly trained mathematicians and physicists (many arriving with doctorates in those fields straight from MIT) who delighted in the complex modelling of financial markets along lines pioneered back in 1972 when Fischer Black, Myron Scholes and Robert Merton (who later became infamous for their role in the Long-term Capital Management crash and bail-out in 1998) wrote out a mathematical formula for which they earned a Nobel Prize in Economics on how to value an option. The trading identified and exploited inefficiencies in markets and spread risks but, given its entirely new patterns, this permitted manipulations galore that were extremely difficult to regulate or even to spot because they were buried in the intricate 'black box' mathematics of computerised over-the-counter trading programs.

So much for Marx's hope that the new technologies and organisational forms would render matters more readily understandable and transparent! Profits earned by many individual traders soared and bonuses went stratospheric. But so too did losses. By 2002, the writing should have clearly been on the wall. A young Singapore-based trader named Nicholas Leeson brought down the venerable bank of Baring, and companies like Enron, WorldCom, Global Crossing and Adelphia would bite the dust, as would Long-term Capital Management and the government of Orange County, California, all of them as a result of trading in these new unregulated markets (derivatives and options) and hiding their trades in all manner of shady accounting devices and mathematically sophisticated valuation systems.

Technological and financial innovations of this sort have played a role in putting us all at risk under a rule of experts that has nothing to do with guarding the public interest but everything to do with using
the monopoly power given by that expertise to earn huge bonuses for gung-ho traders who aspire to be billionaires in ten years' time and thereby secure instant membership in the capitalist ruling class.

The more general point is to recognise technological and organisational innovation as a double-edged sword. It destabilises as it also opens up new paths of development for capital surplus absorption. Invariably, then, innovation waves in technological and organisational forms are associated with crises of 'creative destruction' in which one bundle of dominant forms is displaced by another. While Marx's account of how processes of technological and organisational change inevitably produce a tendency for the profit rate to fall may be unduly simplistic, his essential insight that such changes have a key role in destabilising everything and thereby producing crises of one sort or another is indubitably correct.

The application of human labour to reworking raw materials (either given in nature or already partially modified by human action) to make a new commodity takes us into the heart of the labour process where, under the control of the capitalist, old value is preserved and new value (including the surplus) is created. This is where profit is produced. Work is fundamental to all forms of human life because elements in nature have to be converted into items of utility to human beings. But under the social relations that dominate within capitalism, work takes on a very particular form in which labour, production technologies and organisational forms are brought together under the control of the capitalist for a predetermined time of contract for purposes of profitable commodity production.

The human relations involved within the labour process are always complex affairs, no matter how rigid the disciplinary apparatus, how automated the technology and how repressive the conditions of labour appear to be. It was one of Marx's most signal achievements to recognise that it is in fact the labourer - the person who actually
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does the work – that holds the real power within the labour process, even if it appears that the capitalist has all the legal rights and holds most of the political and institutional cards (through command over the state in particular). In the labour process, however, the capitalist is ultimately dependent upon the labourer. The worker produces capital in the form of commodities and so reproduces the capitalist. If the labourer refuses to work, downs tools, works to rule, or throws sand into the machine, then the capitalist is helpless. While the capitalist may organise the labour process, it is the worker who is the creative agent. Refusal to cooperate, as Marxists such as Mario Tronti who adopt the so-called 'autonomista' perspective have emphasised, is a crucial point of potential blockage where the labourer has the power to impose limits.

When we think of class struggle, too often our imagination gravitates to the figure of the worker struggling against the exploitations of capital. But in the labour process (as is indeed the case elsewhere) the direction of struggle is really the other way round. It is capital that has to struggle mightily to render labour subservient at that very moment where labour is potentially all-powerful. This it does both directly through the tactics of organisation of social relations on the shop floor, in the fields, offices and institutions and throughout the transport and communications networks. If capital is to be produced, then these social relations must be shaped in collaborative and cooperative ways. This can sometimes be achieved by brute force, coercion and technical modes of regulation but more often than not it involves forms of social organisation that entail trust, loyalty and subtle forms of interdependency that acknowledge the potential powers of labour while shaping it to capital's purpose. It is here that capital so frequently concedes to the labour movement certain powers, to say nothing of material advantages, provided of course that capital continues to be produced and reproduced.

To be sure, there are plenty of accounts of labour processes where labourers work under the whip of violent overseers, subject to all manner of verbal abuse and psychological and physical violence.
And one of the most persistent threads in the history of technological innovation has been the desire to disempower the labourer as much as possible and to locate powers of movement and of decision within the machine, or at least 'upstairs' in some remote control room. But the labour process is always a perpetual battleground which is both particular to the site of production and performed behind closed doors upon which are inscribed, as Marx observed, the capitalist creed: 'No Admittance Except on Business!' What happens behind those closed doors we do not generally know even as those that work within know full well and engage in forms of struggle and of compromise that have enormous implications in aggregate for the dynamics of how capitalism works (and indeed, if it continues to work and produce profitably at all).

Bourgeois constitutionality may perform beautifully in market affairs but it has an extremely hard time in extending its reach into production. Nevertheless, the power of labour over the years has yielded concessions over matters such as employment conditions, workplace safety, regulation of social relations (anti-harassment and equal treatment legislation), skill definitions, and the like. Legalised forms of labour organising may empower shop floor organisers (shop stewards in Britain) who can directly intervene in labour processes and regulate social relations within the workplace, while relating to broader class movements (such as national trade unions and left political parties). But workplace organising is not always easy and, even when it is achieved, it often regulates the labour process as much to the advantage of capital as it does for the benefit of labour. And as has again and again been revealed in recent years by scandals (ironically driven by anti-immigrant fervour) of employment of undocumented labour in the United States, the violations of labour laws are widespread in part because the capacity of government to enforce has been systematically gutted by a state increasingly ruled by corporate interests. The legal status of regulation of labour processes varies intensely from one place to another, however, such that the uneven geographical presence of unionisation movements and
regulatory regimes over labour processes is very marked throughout the capitalist world.

The range of capitalist tactics in the labour process needs to be appreciated. It is here, in particular, that capitalists use the power of social differences to their own utmost advantage. Issues of gender often become paramount on the shop floor, as do issues of ethnicity, religion, race and even sexual preference. In the sweatshops of the so-called developing world it is women who bear the brunt of capitalist exploitation and whose talents and capacities are utilised to the extreme under conditions often akin to patriarchal domination. This is so because, in a desperate bid to exert and sustain control over the labour process, the capitalist has to mobilise any social relation of difference, any distinction within the social division of labour, any special cultural preference or habit, both to prevent the inevitable commonality of position in the workplace being consolidated into a movement of social solidarity and to sustain a fragmented and divided workforce. The culture of the workplace, in short, becomes a crucial feature and it is there that broader cultural values - such as patriarchy, respect for authority, social relations of dominance and subservience - are all imported to play their part in the actual practices of production. Go into any workplace - like a hospital or a restaurant - and note the gender, race and ethnicity of those doing the different tasks and it becomes evident how power relations within the collective labour process are distributed among different social groups. The recalcitrance of such social relations to change has as much to do with the tactics of capital as it does with inherent conservatism of social relations and the desire to preserve minor privileges (including even access to low-paid jobs) on the part of different groups.

We are now fortunate to have available to us innumerable ethnographic studies, primarily by anthropologists and sociologists of labour processes, conducted in a wide range of situations and in radically different cultural contexts. Leaving aside the vested interest such researchers have in elaborating upon cultures of difference
and of specificity, the aggregate picture that emerges is indeed one of seemingly infinite varieties of social relations and cultural mores, albeit within an overall framing of constraints.

The constraint is, however, simply stated, even as the ideological and practical attempts to obscure its form multiply. Whatever else happens in the labour process, the potentiality for a revolutionary blockage of the sort the autonomists emphasise is always threatening. It must at all costs be averted by capital, because both capital and the capitalist must be perpetually reproduced by workers through the activity of labouring. The details of how this is done are infinite in their variety and certainly worthy of close investigation. Social struggles on the shop floor and in the fields, factories, offices, shops and spaces of construction, as well as over the production of spaces, places and built environments, define a potential blockage point to capital accumulation that is perpetually present and which perpetually needs to be circumvented if capitalism is to survive.