Fossil Capital: The Rise of Steam Power and the Roots of Global Warming – Book Review

***Fossil Capital: The Rise of Steam Power and the Roots of Global Warming*. Andreas Malm. Verso. 2016.**

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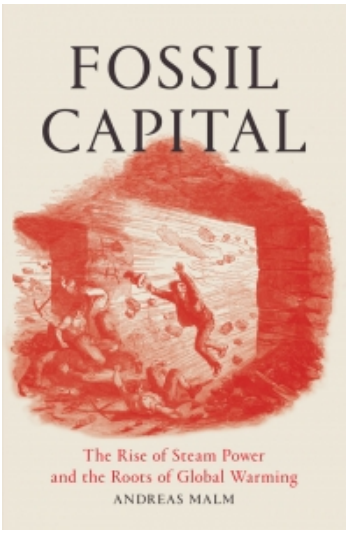

In this bold, original and provocative book, Andreas Malm offers a radical reinterpretation of the origins of the steam age as means to challenge conventional analyses of global warming. He aims to develop a Marxist account of climate change that emphasises the link between carbon-centric development and capitalist accumulation. He proffers the concept 'Capitalocene' to replace 'the Anthropocene' in a challenge to the idea that the build-up of carbon in the atmosphere is a long-term process reflecting a universal trait of the human species. The underlying claim is that capitalist social relations produced the steam age and global warming, and that they will prevent the emergence of the large-scale collective efforts essential to the successful application of renewable energy. Understanding the origins of the steam age, then, is crucial to understanding the way that socio-economic processes are welded to distinctive forms of energy use.

Fossil Capital: The Rise of Steam Power and the Roots of Global Warming is superbly written and is scholarly, measured and rigorous. Despite the novelty of its argument, the book has a refreshingly old-fashioned feel. This is narrative economic history of a type that seems increasingly rare in a discipline that has fetishised econometric techniques. Much of the argument rests on disinterring original scientific and engineering sources: Andrew Ure, Charles Baggage, Nassau Senior, William Jevons and others are resurrected to bolster an analysis that challenges the findings of cliometric techniques.

Malm surveys, synthesises, incorporates and critiques many influential recent contributions to British economic history (Wrigley, von Tunzleman, Crafts, etc), but challenges their assumptions, analysis and conclusions. The crux of the argument concerns a novel explanation of how steam replaced water as the 'prime mover' of the emerging machine age. Malm distinguishes between three forms of energy. *Flow* energy is uncaptured by photosynthesis and is accessible for collection and concentrated use by machinery, conditioned by landscape and weather and exemplified by wind and water. *Animate* power refers to sources of energy embodied in living creatures and conditioned by the imperatives of metabolism. *Stock* energy consists of the relics of solar energy from the distant past, residing outside the landscape, freely transported and stored, but requiring human labour to exploit. The story of the industrial revolution is the replacement of flow and animate power with stock energy. Malm is concerned to explain why this happened.

Early industrialisation relied on flow and animate energy, especially the watermill. Eighteenth and early nineteenth-century innovations, such as Arkwright's water frame and Crompton's mule, were attached to water mills mainly located in the deep valleys of the west of Scotland and north of England, most notably in Lancashire where it powered the rise of the cotton industry. The expansion of coal production during this period was mainly to provide heat for industry and the home rather than for steam.

Growing interest in the use of steam power for industry occurred following the waves of industrial militancy during the crisis of overproduction in the 1820s. Ure promoted mechanisation to liberate production from reliance on the worker. The self-acting mule was developed to be driven by steam power. As spinning was mechanised, weaving remained a scattered cottage industry powered by low-cost animate power – workers – who masters found hard to discipline. The invention of the steam-driven power loom allowed the creation of the 'combined factory': a new generation of mills that integrated the production process under one roof, thereby ending the role of the unruly cottage weavers. Steam power was therefore a critical manifestation of class power.

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The orthodoxy assumes the shift from water to coal reflected a growing scarcity of usable water and the falling cost of coal as fuel: that is, it was the outcome of 'market forces'. But Malm's evidence suggests there was neither a shortage of water nor was it more expensive than steam or less technologically advanced. Steam engines in this period required costly coal and were unreliable, being prone to disastrous breakdowns. Water was defeated in the battle with steam by two factors. First, the management of water power required cooperation between competing mill owners. A feasible system of reservoirs on the River Irwell that would guarantee dependable low-cost water supplies to Manchester was rejected by mill owners. Steam engines, although more expensive, could be operated independently. Second, steam freed mill owners from settlements in upper river valleys and allowed production to be concentrated in towns with large supplies of labour. Small remote settlements, such as Arkwright's Cromford, provided their own labour problems, requiring large investments by mill owners in expensive physical and social infrastructure, such as schools, chapels and housing.

The emergence of the fully integrated factory required large concentrations of workers, while towns attracted labourers because of the availability of unskilled jobs. In towns, generic infrastructure could be supplied speculatively. Housing workers was no longer the responsibility of the mill owner. Towns expressed 'spatial crystallisations of the wage relation' (148) and steam was adopted because of its 'mobility in space' (156). The rapid growth of Manchester, 'Cottonopolis', gave expression to these developments. For the first time in history, machine and energy source – the engine and the mine – were separated, allowing the concentration of factories in large towns. 'The flow was stationary and the stock on the move' (164). This generated working-class resistance, notably in the form of the 1842 General Strike, which saw attacks on mills and mines with the cry of 'Stop the Smoke'. Carbon emissions were linked to the entrenchment of capitalist social relations, hence 'fossil capital'.

With this evidence, Malm offers a reformulation of Marxist theory. The production of surplus value is still central to capital accumulation because labour power creates anthropogenic products, but the transformation of fossils fuels into carbon dioxide is intrinsically linked to capital accumulation. Malm extends Marx's notion of a distinction between the formal and real subsumption of labour to the realm of nature to emphasise the way it is subordinated to the production of surplus value. This is a version of Marxism in which an analysis of the production of space is foregrounded, with Henri Lefebvre, Michael Storper and others mobilised in the argument. It is a productionist account which is dismissive of the role of mass consumption as the cause of carbon emissions.

The book ends with an essay on China's contemporary rise to the status of top carbon emitter, reflecting globally mobile capital's search for cheap and disciplined labour power by means of the massive consumption of fossil energy: the latest twist in an old story. For Malm, the solution to global warming lies in a return to the flow, but history indicates the difficulties ahead. The rejected reservoirs on the River Irwell are testament to the difficulties of organising the collective management of the flow.

Fossil Capital is a brilliant book that reveals both the value and limits of Marxist insights. Its strength lies in its original account of the birth of the British steam age. But the categories of capital and labour seem too large to organise our understanding of the complexities of our current predicament or to guide our political responses to it. Malm acknowledges that twentieth-century efforts to plan on the scale necessary to manage the transition to renewable energy have failed, but he has no faith in market forces to achieve this objective. Nevertheless, this impressive book should be read by anybody interested in the history of fossil capital.

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