Carbon Democracy

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POLITICAL POWER IN THE AGE OF OIL

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To Adie and JJ

Contents

CHAPTER 1

Machines of Democracy

Understanding the question of oil and democracy starts with the question of democracy and coal. Modern mass politics was made possible by the development of ways of living that used energy on a new scale. The exploitation of coal provided a thermodynamic force whose supply in the nineteenth century began to increase exponentially. Democracy is sometimes described as a consequence of this change, emerging as the rapid growth of industrial life destroyed older forms of authority and power. The ability to make democratic political claims, however, was not just a by-product of the rise of coal. People forged successful political demands by acquiring a power of action from within the new energy system. They assembled themselves into a political machine using its processes of operation. This assembling of political power was later weakened by the transition from a collective life powered with coal to a social and technical world increasingly built upon oil.

BURIED SUNSHINE

Until 200 years ago, the energy needed to sustain human existence came almost entirely from renewable sources, which obtain their force from the sun. Solar energy was converted into grain and other crops to provide fuel for humans, into grasslands to raise animals for labour and further human fuel, into woodlands to provide firewood, and into the wind energy and water power used to drive transportation and machinery. For most of the world, the capture of solar radiation in replenishable forms continued to supply the main source of energy until perhaps the mid-twentieth century (thanks to the success of China and India in maintaining viable forms of rural life, only in 2008 did the world's urban population begin to outnumber those living in villages). From around 1800, however, these organic supplies were steadily replaced with highly concentrated stores of buried solar energy, the deposits of carbon laid down 150 to 350 million years ago, when peat bog forests and marine organisms decayed in a watery, oxygen-deficient environment that interrupted the normal process for returning carbon to the atmosphere as carbon dioxide. Instead the decomposed biomass was compressed into the relatively rare but extraordinarily potent accumulations of coal and oil.[1]

1 E. A. Wrigley, 'Two Kinds of Capitalism, Two Kinds of Growth', in *Poverty, Progress, and Population*, Cambridge, UK: CUP, 2004: 68–86. Coal replaced wood and other biomass materials

Humans had exploited coal since ancient times, but only on a limited scale. The limit was set by the energy required to produce the fuel – a limit that approaches again today, as oil companies attempt to exploit the world's most inaccessible reserves of oil. Mines tended to fill with ground water, which in deeper pits was pumped out using teams of animals. At a certain depth, keeping the workings dry consumed more energy than could be obtained from mining them. In Britain, where the shortage of timber increased the value of coal and a dense network of waterways was developed to lower the cost of its transportation, Newcomen's atmospheric-pressure steam engine overcame this limit. Introduced in 1712, the engine used coal from the mine to produce steam that drove a vacuum pump and enabled miners to extend the workings deep underground using less energy than the energy they produced.[2] The engine was inefficient, converting less than 1 per cent of the energy it burned into useful motion and consuming large amounts of the mined coal. Since waste coal was now abundant at the mines, however, there was little need to improve the pump's efficiency. Not until 1775 did Boulton and Watt introduce and patent a more efficient design with a separate condenser, which was adopted initially where coal was scarce, especially in iron smelting and in the copper and tin mines of Cornwall. The patent may have delayed further improvements, but its expiry in 1800 enabled Cornish mining engineers to develop more efficient high-pressure engines, allowing steam power to replace animal and water power more widely, both in manufacturing and transportation.[3]

The transition to an energy system based on the combination of coal and steam power required a third component – the iron used for building the pumps and other mining machinery. Previously dependent on the high process heat of charcoal, iron production had been limited by the considerable areas of woodland required to run even a small smelter. By the end of the eighteenth century iron smelters had mastered the difficult process of smelting with coke, with

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as the main source of the world's commercial energy as early as the 1880s, but until well into the twentieth century the bulk of this fossil energy was consumed by just a handful of countries. Bruce Podobnik, *Global Energy Shifts: Fostering Sustainability in a Turbulent Age*, Philadelphia: Temple University Press, 2006: 5.

2 Rolf Peter Sieferle, *The Subterranean Forest: Energy Systems and the Industrial Revolution*, Cambridge, UK: White Horse Press, 2001: 78–89; and 'Why Did Industrialization Start in Europe (and not in China)?' in Rolf Peter Sieferle and Helga Breuninger, eds, *Agriculture, Population and Economic Development in China and Europe*, Stuttgart: Breuninger-Stiftung, 2003. See also Smil, *Energy in Nature and Society*.

3 Alessandro Nuvolari and Bart Verspagen, 'Technical Choice, Innovation and British Steam Engineering, 1800–1850', *Economic History Review* 62, 2009: 685–710; Alessandro Nuvolari, Bart Verspagen and Nick von Tunzelmann, 'The Early Diffusion of the Steam Engine in Britain, 1700–1800: A Reappraisal', *Cliometrica*, 5 March 2011, 1–31; Alessandro Nuvolari, 'Collective Invention During the British Industrial Revolution: The Case of the Cornish Pumping Engine', *Cambridge Journal of Economics* 28, 2004: 347–63.

the aid of steam-driven bellows, allowing the production of iron to keep pace with the increased supply of coal. The Cornish high-pressure engines were then combined with iron and coal to build steam railways, whose initial function was the carrying of coal. The abundant supplies of energy could now be moved in bulk from the coal pit to the nearest waterway or industrial plant, facilitating the switch from water-driven to steam-powered manufacturing.

Freed from the limits of the muscular power of animals and the speed of regeneration of woodlands, the supply of energy began to grow at an exponential rather than a linear rate. Human societies had known previous episodes of exponential growth, where each year's increase is greater than the previous one, fuelled by a sudden technical advance or the rapid colonisation of new territories. However, the nineteenth-century increase was different. Technical breakthroughs and, as we will see, the control of large additional areas of the earth's surface were combined with the opening up of a third dimension: the subterranean stores of carbon. Whereas previous bursts of accelerating growth might have lasted a generation or two, the new ability to access and rapidly deplete the world's stores of fossil fuel allowed such exponential growth to continue for over 200 years, into the early twenty-first century.[4] The amount of energy produced was extraordinary. Britain's coal reserves, today virtually exhausted, produced a quantity of energy equivalent to the cumulative oil production of Saudi Arabia, allowing the motive power used in British industry to expand by about 50 per cent every decade, from an estimated 170,000 horsepower in 1800, almost all water-driven, to about 2.2 million horsepower in 1870 and 10.5 million in 1907. This growth in turn was dwarfed by later increases, including the use of fossil fuels to generate electrical power. The 10.5 million horsepower of 1870 included a capacity for generating electricity of 1.56 million horsepower. That sector alone grew to about 22 million horsepower (15,000 megawatts) by 1950, and about 100 million horsepower (70,000 megawatts) by 1977.[5]

The constantly accelerating supply of energy altered human relations in space and time in ways that were to enable new forms of mass politics. Since the solar radiation that powered pre-industrial life was a much weaker form of energy, converting it for human use required a sizeable terrain. The need for energy encouraged relatively dispersed forms of human settlement – along

4 Sieferle, 'Why Did Industrialization Start?': 17–18.

5 John W. Kanefsky, 'Motive Power in British Industry and the Accuracy of the 1870 Factory Return', *Economic History Review* 32: 3, August 1979: 374. After 1973 the rate of increase began to slow, reaching 85,000 MW by 2009 (statistics at www.decc.gov.uk). Ultimate cumulative British coal production, now slowed to a trickle from a handful of remaining mines, is projected to be about 29 Gt (billions of metric tons). David Rutledge, 'Estimating Long-Term World Coal Production with Logit and Probit Transforms', *International Journal of Coal Geology* 85: 1, 2011: 23–33. At a nominal energy value of 27 GJ per ton, this is equivalent to the cumulative oil production of Saudi Arabia from 1936 to 2008, estimated at 128 Gb (billions of barrels), with a nominal energy value of 6.1 GJ per barrel of oil (equivalent).

rivers, close to pastureland, and within reach of large reserves of land set aside as woods to provide fuel. The timescale of energy production was dependent on the rate of photosynthesis in crops, the lifespan of animals, and the time taken to replenish grazing lands and stands of timber.[6] In contrast, fossil fuels are forms of energy in which great quantities of space and time, as it were, have been compressed into a concentrated form. One way of envisioning this compression is to consider that a single litre of petrol used today needed about twenty-five metric tons of ancient marine life as precursor material, or that organic matter equivalent to all of the plant and animal life produced over the entire earth for four hundred years was required to produce the fossil fuels we burn today in a single year.[7] Coal and oil made available stores of energy equivalent to decades of organic growth and acres of biomass in compact, transportable solids and liquids.

This transformation released populations from dependence on the large areas of land previously required for primary energy production. Regions that had relied on timber to provide fuel for cooking, heating and industrial processes were now freed from the limits set by the size and proximity of woodlands. In Great Britain, substitution of wood by coal created a quantity of energy that would have required forests many times the size of existing wooded areas if energy had still depended on solar radiation. By the 1820s, coal freed, as it were, an area of woodland equivalent to the total surface area of the country. By the 1840s, coal was providing energy that in timber would have required forests covering twice the country's area, double that area by the 1860s, and double again by the 1890s. Thanks to this new social-energetic metabolism, a majority of the population could now be concentrated together without immediate access to agricultural land, in towns whose size was no longer limited by energy supply.[8]

DEMOCRACY AND COLONY

The change from the use of wood and other renewable energy sources to the use of coal underlies the 'great divergence' between the development of northern and central Europe after 1800 and the development of China, India, the Ottoman Empire and other regions that until then had enjoyed comparable

6 Wrigley, 'Two Kinds of Capitalism': 75.

7 Jeffrey S. Dukes, 'Burning Buried Sunshine: Human Consumption of Ancient Solar Energy', *Climatic Change* 61: 1–2, November 2003: 33–41 (figures from 1997); Helmut Haberl, 'The Global Socioeconomic Energetic Metabolism as a Sustainability Problem', *Energy* 31: 1, 2006: 87–99.

8 Sieferle, *Subterranean Forest*; Kenneth Pomeranz, *The Great Divergence: China, Europe, and the Making of the Modern World Economy*, Princeton: Princeton University Press, 2000; Haberl, 'Global Socioeconomic Energetic Metabolism'.

standards of living. Other parts of the world faced similar pressures to overcome shortages of land or develop new sources of energy, and China had large reserves of coal. But its coalfields faced different technical obstacles to their development and were not linked to the main centres of population by navigable waterways. These regions pursued other solutions, which did not happen to trigger the switch to an energy system capable of expanding exponentially.[9]

Although other world regions continued initially on different paths, the transition to a new energy regime was never an event confined only to Europe. From its beginnings, the switch in one part of the world to modes of life that consumed energy at a geometric rate of growth required changes in ways of living in many other places. Coal made available thermal and mechanical energy in unprecedented quantity and concentration, but this energy was of no benefit unless there were ways to put it to work. Its use in manufacturing required a large increase in the supply of industrial raw materials. Many of these, such as cotton, still depended on dispersed, organic (including human) energy for their production. So, at the same time as the opening of subterranean stores reduced the amount of land required to supply process energy, ever larger areas of surface territory were needed to produce the materials to which this increasing quantity of energy was applied. As growing human labour forces worked on the production of industrial goods, and no longer grew the food required to provide their own energy, further territory and populations outside the industrialising regions had to be organised to supply these workforces with energy, especially concentrated food energy in forms such as sugar.

We think of industrialisation (and the democracy that followed) as an urban phenomenon based on fossil fuels, but it depended on an agrarian – and colonial – transformation based on organic forms of energy. By freeing areas previously reserved as woodland for the supply of fuel, allowing more land for grazing and cultivation, the use of coal in northern Europe contributed to the creation of additional farmland. However, the development of fossil energy required a means of making much greater areas of land available for solar-based production, along with large amounts of human labour, in areas of the world beyond Europe.

The commodities Europe needed as industrial raw materials could not be obtained simply through relations of trade, for two reasons. First, agrarian populations typically preferred to use their land and labour to produce materials largely for their own needs, making only a small surplus available for export. Europe now required methods that would compel people to devote an exceptionally large proportion of solar-based production to supplying its

9 Pomeranz, *Great Divergence*; Wrigley, 'Two Kinds of Capitalism'; Terje Tvedt, 'Why England and Not China and India? Water Systems and the History of the Industrial Revolution', *Journal of Global History* 5: 1, 2010: 29–50.

fossil-fuel-driven needs. Second, when one world region developed a new process that gave it a technological advantage, other regions typically adopted the innovation as soon as possible.[10] The coal-based energy system was both more difficult to emulate and more dependent on not being imitated. It was difficult to emulate because large reserves of coal and iron ore were concentrated in few places, and the exponential increase in energy that coal supplied gave Europe very rapidly a considerable head start over other regions; and it depended on not being imitated because the large overseas regions that Europe now required for solar-energy-based products like cotton and sugar would turn their organic energy systems to their own needs if they were able to introduce fossil-fuel-based manufacturing of their own.

Unable to rely on relations of trade, Europe needed alternative ways of obtaining materials from overseas, using methods that prevented those farming the land from controlling what they grew and impeded local efforts to industrialise. In acquiring lands for sugar and cotton production in the New World, Europeans had relied on the total dispossession of the local population and the importing of slave or indentured workforces. In places where the agrarian population could not be removed en masse – India and Egypt were the main examples – Europeans and their local allies pioneered a method of localised dispossession known as private land ownership. This replaced older ways of claiming shares of agricultural revenue with a regime where one claimant, now designated the 'landowner', determined the crops to be grown and asserted exclusive control of the product. These colonial arrangements secured the extensive, solar-based production used to supply agricultural goods in quantities that allowed the development of intensive, coal-based mass production in the towns and cities of Europe.

The relationship between coal, industrialisation and colonisation provides a first set of connections between fossil fuels and democracy. Forms of representative central government had developed in parts of Europe and its settler colonies in the eighteenth and nineteenth centuries. The advocates of representative government had seen it not as a first step towards democracy but as an oligarchic alternative to it, in which the power of government was reserved to those whose ownership of property (the control of land, but also of women, servants and slaves) gave them power over the point of passage for the revenues on which government depended, and qualified them to be concerned with public matters. In most of these countries, property qualifications and registration procedures restricted the electorate to no more than 30 to 40 per cent of adult males, or less than one-fifth of the adult population. In many cases, moreover, the rise of a centralised fiscal-military state in which representation justified the exercise of power coincided with the weakening of other, dispersed forms of participation

10 Pomeranz, *Great Divergence*.

and self-government that were sometimes more accountable to their constituents, such as the elected corporate bodies in England that governed universities, towns, companies and societies.[11] By the 1870s, a wave of upheavals in Europe and the Near East – including the unification of Italy and of Germany, the creation of the Third Republic in France, constitutional settlements or liberal revolutions in countries from Spain and Greece to Serbia and Austria-Hungary, and liberal reforms in the Russian and Ottoman Empires – had created varieties of representative government. While continuing to exclude most people from a role in public life, these constitutional arrangements provided in many cases a legal order under which labour unions and popular political parties could emerge. Across the industrialising regions of northern and western Europe in particular, in protest against the exclusion of the majority from public life and against the great inequalities in well-being that industrialisation had brought, mass political movements and organised political parties began to emerge and to create a new form of politics.[12]

The period of transformation that followed, from the 1870s to the First World War, has been called both the age of democratisation and the age of empire.[13] The mobilisation of new, democratising political forces depended upon the concentration of population in cities and in manufacturing, associated with the forms of collective life made possible by organising the flow of unprecedented quantities of non-renewable stores of carbon. At the same time, utilising fossil fuels whose supply increased by as much as 50 per cent each decade required the rapidly expanding control of colonised territories. Those territories were connected to the same assembly of energy flows based on coal and steam power, but were connected in ways that could not easily be used to manufacture effective political claims. To understand why the rise of coal produced democracy at some sites and colonial domination at others, we must look more closely at the way the flow of fossil energy could be employed to organise successful collective demands.

CONTROLLING CARBON CHANNELS

When most energy was derived from widely dispersed renewable sources, a significant part of the population was involved in the work of generating and

11 Jacques Rancière, *Hatred of Democracy*, London and New York: Verso, 2009; Bernard Manin, 'The Metamorphoses of Representative Government', *Economy and Society* 23: 2, 1994: 133–71; and Mark Knights, *Representation and Misrepresentation in Later Stuart Britain: Partisanship and Political Culture*, Oxford: OUP, 2006. The changes in voting restrictions in the British case are explained in Neal Blewett, 'The Franchise in the United Kingdom 1885–1918', *Past and Present* 32, December 1965.

12 Geoff Eley, *Forging Democracy: The History of the Left in Europe 1850–2000*, Oxford: OUP, 2002, stresses the pan-European constitutional transformation of the 1860s as a basis for the subsequent role of the left in creating democracy.

13 Eric Hobsbawm, *The Age of Empire, 1875–1914*, New York: Vintage, 1989: 88.

transporting energy, in small amounts. With the large-scale use of fossil fuels, and especially following the advent of electricity in the 1880s, a large majority of people in industrialised countries became consumers of energy generated by others, and most work involved the handling or supervision of processes that were driven by energy from elsewhere. A much smaller part of the population now handled the production and distribution of energy, and they handled it in huge quantities.

The concentration of energy supplies in large amounts at specific sites led to the creation of an apparatus of energy supply with which the democratic politics of the late nineteenth and early twentieth centuries would be built. Large stores of high-quality coal were discovered and developed in relatively few areas: in central and northern England and south Wales, along the belt running from northern France through Belgium to the Ruhr Valley and Upper Silesia, and in the Appalachian coal belt in North America. Most of the world's industrial regions were assembled above or adjacent to these supplies of coal.[14] The creation of the new energy system, as we saw, resulted not just from the quantity of coal produced but from the mutually reinforcing interactions between coal, steam technology, and iron and steel. The introduction of iron rails, produced in blast furnaces fired by coal using steam-driven bellows, and of iron bridges, allowed the rapid development of railway lines. By the end of the nineteenth century, industrialised regions had built water and rail networks that moved concentrated carbon stores from the underground coalface to the surface, to railways, to ports, to cities and to sites of manufacturing and electrical power generation.

Great volumes of energy now flowed along narrow, purpose-built channels. Specialised bodies of workers were concentrated at the end-points and main junctions of these conduits, operating the cutting equipment, lifting machinery, switches, locomotives and other devices that allowed stores of energy to move along them. Their position and concentration gave them opportunities, at certain moments, to forge a new kind of political power.

The power derived not just from the organisations they formed, the ideas they began to share or the political alliances they built, but from the extraordinary quantities of carbon energy that could be used to assemble political agency, by employing the ability to slow, disrupt or cut off its supply.

Coal miners played a leading role in contesting work regimes and the private powers of employers in the labour activism and political mobilisation of the 1880s and onward. Between 1881 and 1905, coal miners in the United

14 Sidney Pollard, *Peaceful Conquest: The Industrialization of Europe, 1760–1970*, Oxford: OUP, 1981: 120–1. European capital also developed coal resources further afield, both in British colonies – Natal and the Transvaal, parts of Queensland and New South Wales, and West Bengal – and in the Donets Basin in Russia.

States went on strike at a rate of about three times the average for workers in all major industries, and at double the rate of the next-highest industry, tobacco manufacturing. Coal-mining strikes also lasted much longer than strikes in other industries.[15] With the same pattern found in Europe, waves of industrial action swept across the world's coal-mining regions in the later nineteenth and early twentieth centuries, and again after the First World War.[16]

The militancy of the miners can be attributed in part to the fact that moving carbon stores from the coal seam to the surface created unusually autonomous places and methods of work. The old argument that mining communities enjoyed a special isolation compared with other industrial workers, making their militancy 'a kind of colonial revolt against far-removed authority', misrepresents this autonomy.[17] In his classic study of 1925, *The Miner's Freedom*, Carter Goodrich had argued that autonomy was a product not of the geographical isolation of coal-mining regions from political authority but of 'the very geography of the working places inside a mine'.[18] In the traditional room-and-pillar method, a pair of miners worked a section of the coal seam, leaving pillars or walls of coal in place between their own chamber and adjacent chambers to support the roof. They usually made their own decisions about where to cut and how much rock to leave in place to prevent cave-ins. Before the widespread mechanisation of mining, 'the miner's freedom from supervision is at the opposite extreme from the carefully ordered and regimented work of the modern machine-feeder'.[19] The militancy that formed in these workplaces was typically an effort to defend

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15 The strike rates per 1,000 employees for coal mining and for all industries, respectively, were 134 and 72 (1881–86); 241 and 73.3 (1887–99); 215 and 66.4 (1894–1900); and 208 and 86.9 (1901–05). P. K. Edwards, *Strikes in the United States, 1881–1974*, New York: St Martin's Press, 1981: 106.

16 Podobnik, *Global Energy Shifts*.

17 Clark Kerr and Abraham Siegel, 'The Interindustry Propensity to Strike: An International Comparison', in Arthur Kornhauser, Robert Dubin and Arthur M. Ross, eds, *Industrial Conflict*, New York: McGraw-Hill, 1934: 192. More recent accounts stress the diversity of mining communities and the complexity of their political engagements with other groups, with mine owners and with state authorities. Roy A. Church, Quentin Outram and David N. Smith, 'The Militancy of British Miners, 1893–1986: Interdisciplinary Problems and Perspectives', *Journal of Interdisciplinary History* 22: 1, 1991: 49–66; Royden Harrison, ed., *Independent Collier: The Coal Miner as Archetypal Proletarian Reconsidered*, New York: St Martin's Press, 1978; Roger Fagge, *Power, Culture, and Conflict in the Coalfields: West Virginia and South Wales, 1900–1922*, Manchester: Manchester University Press, 1996; John H. M. Laslett, *Colliers Across the Sea: A Comparative Study of Class Formation in Scotland and the American Midwest, 1830–1924*, Champaign, IL: University of Illinois Press, 2000.

18 Carter Goodrich, *The Miner's Freedom: A Study of the Working Life in a Changing Industry*, Boston: Marshall Jones Co., 1925: 19.

19 Goodrich, *Miner's Freedom*: 14; Podobnik, *Global Energy Shifts*: 82–5. On the relative autonomy of coal miners and its loss under mechanisation, see also Keith Dix, *What's a Coal Miner to Do? The Mechanization of Coal Mining*, Pittsburgh: University of Pittsburgh Press, 1988; and Chris Tilly and Charles Tilly, *Work Under Capitalism*, Boulder, CO: Westview Press, 1998: 43–51.

this autonomy against the threats of mechanisation, or against the pressure to accept more dangerous work practices, longer working hours or lower rates of pay.

The rise of mass democracy is often attributed to the emergence of new forms of political consciousness. The autonomy enjoyed by coal miners lends itself to this kind of explanation. There is no need, however, to detour into questions of a shared culture or collective consciousness to understand the new forms of agency that miners helped assemble. The detour would be misleading, for it would imply that there was some shortage in earlier periods or other places of people demanding a less precarious life.[20]

What was missing was not consciousness, not a repertoire of demands, but an effective way of forcing the powerful to listen to those demands. The flow and concentration of energy made it possible to connect the demands of miners to those of others, and to give their arguments a technical force that could not easily be ignored. Strikes became effective, not because of mining's isolation, but on the contrary because of the flows of carbon that connected chambers beneath the ground to every factory, office, home or means of transportation that depended on steam or electric power.

Strikes were also common among coal workers outside Europe and North America. The workers of the Zonguldak coalfield on the Black Sea coast of Turkey organised repeated strike actions, and a strike in April 1882 by the coal heavers at Port Said, the world's largest coaling station, is recorded as the first collective action by an emergent Egyptian workers' movement. However, without the linkages that connected coal to large centres of industrial production within the country, these actions could not have paralysed local energy systems and gained the political force they enjoyed in northern Europe and the United States.[21]

SABOTAGE

The power of the miner-led strikes appeared unprecedented. In Germany, a wave of coal-mining strikes in 1889 shocked the new kaiser, Wilhelm II, into abandoning Bismarck's hard-line social policy and supporting a programme

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20 Staying just with England, E. P. Thompson's classic *The Making of the English Working Class*, New York: Pantheon Books, 1964, is evidence enough. On the precariousness of life, see Karl Polanyi, *The Great Transformation: The Political and Economic Origins of Our Time*, New York: Farrar & Rhinehart, 1944; and Judith Butler, *Precarious Life: The Powers of Mourning and Violence*, New York: Verso, 2004.

21 Donald Quataert, *Miners and the State in the Ottoman Empire: The Zonguldak Coalfield, 1822–1920*, New York: Berghahn Books, 2006; Joel Beinin and Zachary Lockman, *Workers on the Nile: Nationalism, Communism, Islam, and the Egyptian Working Class, 1882–1954*, Princeton: Princeton University Press, 1987: 23, 27–31.

of labour reforms.[22] The kaiser convened an international conference in March 1890 that called for international standards to govern labour in coal mining, together with limits on the employment of women and children. By a 'curious and significant coincidence', as the *New York Times* reported, on the same day that the conference opened in Berlin, 'by far the biggest strike in the history of organized labor' was launched by the coal miners of England and Wales. The number of men, women and children on strike reached 'the bewildering figure of 260,000'. With the great manufacturing enterprises of the north of England about to run out of coal, a correspondent reported 'the possibilities of a gigantic and ruinous labor conflict open before us'.[23]

The strike was not the only method of disrupting the flow of energy and the critical functions it supplied. In 1889, striking dockworkers in Glasgow were forced back to work after their employers hired groups of strike-breakers. The dockers decided to work as slowly and clumsily as the unskilled men brought in to replace them. After three days they won their demand for increased wages.[24] The newly formed National Union of Dock Labourers publicised the success of this method of disruption, and it was emulated in France and formally adopted there by railwaymen, miners and other workers as a means of fighting for the right to unionise and for improvements in working conditions. In 1909 Émile Pouget published the book that popularised the method's name, *Le Sabotage*.[25] Within a year the new word 'sabotage' had been adopted in English, initially to describe an industrial action by French railwaymen, but then to refer to the slow-down, the work-to-rule and other means of interrupting the normal functioning of a critical process.[26]

Foot-dragging and other forms of worker protest were nothing new. But the term 'sabotage' reflected the discovery that a relatively minor malfunction, mistiming or interruption, introduced at the right place and moment, could

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22 Kathleen Canning, *Languages of Labor and Gender: Female Factory Work in Germany, 1850–1914*, Ithaca, NY: Cornell University Press, 1996: 130–3; G. V. Rimlinger, 'Labour and the State on the Continent, 1800–1939', The Cambridge Economic History of Europe, vol. 8, *The Industrial Economies: The Development of Economic and Social Policies*, ed. Peter Mathias and Sidney Pollard, Cambridge, UK: CUP, 1989: 576–8.

23 'Labor's Cause in Europe: The Kaiser's Conference and the English Strike', *New York Times*, 16 March 1890: 1.

24 Geoff Brown, *Sabotage: A Study in Industrial Conflict*, Nottingham: Bertrand Russell Peace Foundation for Spokesman Books, 1977.

25 Émile Pouget, *Le Sabotage*, Paris: M. Rivière, 1911 [1909], English translation, *Sabotage*, transl. Arturo M. Giovannitti, Chicago: C. H. Kerr & Co., 1913.

26 The Oxford English Dictionary records the first use of the term in English, in 1910, in an article in the *Church Times* deploring 'the sabotage of the French railway strikers'. During the First World War the word was used in military operations to refer to the disabling or destruction of enemy resources, giving it the connotation of deliberate violence. But in 1921 Thorstein Veblen described its common meaning as 'any manœuvre of slowing-down, inefficiency, bungling, obstruction', or what the Industrial Workers of the World called 'conscientious withdrawal of efficiency'. Thorstein Veblen, *The Engineers and the Price System*, New York: B. W. Huebsch, 1921: 1.

now have widespread effects. 'With two pennies-worth of a certain substance, used in the right way', explained the leader of the French railwaymen's union in 1895, 'we can make a locomotive unable to work.'[27] A coal-fired steam locomotive could deliver three megawatts of power (about 4,000 horsepower), or thirty times the motive power of the first reciprocating steam engines of a century or so earlier.[28] The new effectiveness of sabotage derived from this vast concentration of kinetic energy in a mechanism that a single operator could disable.

By the turn of the twentieth century, the vulnerability of these mechanisms and the concentrated flows of energy on which they depended had given workers a greatly increased political power. Large coal strikes could trigger wider mobilisations, as happened with the violent strike that followed the 1906 Courrières colliery disaster in north-eastern France, which helped provoke a general strike that paralysed Paris.[29] The most common pattern, however, was for strikes to spread through the interconnected industries of coal mining, railways, docking and shipping.[30] In Britain, the miners, railwaymen and transport workers organised three great national strikes in 1911–12, formalising their relationship in the Triple Alliance created on the eve of the First World War.[31] The coordination of strikes, slow-downs and other forms of sabotage enabled the construction, at certain moments, of a new political instrument: the general strike. 'A new force has arisen in trades unionism', warned Winston Churchill, who as home secretary in Britain confronted this novel threat. 'Shipping, coal, railways, dockers etc. etc. are all uniting and breaking out at once. The general strike "policy" is a factor which must be dealt with.'[32]

A generation earlier, in 1873, Friedrich Engels had rejected the idea of using a general strike as a political instrument, likening it to ineffectual plans for the 'holy month' – a nationwide suspension of work that the Chartist movement had advocated in England in the 1840s. The idea reflected an anarchist belief in locally based, spontaneous rebellion, Engels argued, whereas in practice workers lacked the resources and organisation to make a general strike effective. Were they to acquire such resources and powers of organisation, he said, they

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27 Quoted in Pouget, *Le Sabotage*, available at raforum.apinc.org.

28 Smil, *Energy in Nature and Society*: 228–30.

29 In one of world's worst pit disasters, a gas explosion destroyed the Courrières mine on 10 March 1906, leaving 1,100 dead. Robert G. Neville, 'The Courrières Colliery Disaster, 1906', *Journal of Contemporary History* 13: 1, January 1978: 33–52.

30 Beverly J. Silver, *Forces of Labor: Workers' Movements and Globalization Since 1870*, Cambridge, UK: CUP, 2003: 98, shows that strikes were concentrated in these industries rather than in manufacturing.

31 John H. M. Laslett, 'State Policy Towards Labour and Labour Organizations, 1830–1939: Anglo-American Union Movements', *Cambridge Economic History of Europe*, vol. 8: 522.

32 Randolph S. Churchill, *Winston S. Churchill: Young Statesman 1901–1914*, London: Heinemann, 1967: 365.

would already be powerful enough to overthrow the state, so the general strike would be an unnecessary detour.[33]

Thirty years later the general strike still appeared to many on the European left as an anarchist tactic that should not take the place of organised political action. The Belgian general strike of 1902, led by the coal miners in an effort to win universal suffrage, reopened the debate about the tactics of social democracy in Europe – although even supporters like Rosa Luxemburg argued that the efficacy of the general strike in Belgium's case rested on the geographical concentration of the country's industry and could not be replicated in larger countries.[34] Three years later, she changed her mind. After witnessing the wave of strikes that paralysed Russia in the 1905 Revolution, she argued in *The Mass Strike* that workers could now organise a social revolution without a unified political movement, because isolated economic struggles were somehow connected into a single political force. This force, she wrote, 'flows now like a broad billow over the whole kingdom, and now divides into a gigantic network of narrow streams'.[35] Luxemburg's language tried to capture the dispersed yet interconnected power that workers had somehow acquired. But her fluvial metaphor missed the fact that it was not streams and tides that brought workers together into a novel political force but railways, rivers and canals and the concentrated stocks of energy they carried.

During the First World War, US and British coalfields and railways were placed under the direction of government administrators, and coal and rail workers were in some cases exempted from conscription and integrated into the war effort industrially. The number of strikes was reduced, but the critical role of these energy

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33 Friedrich Engels, 'The Bakunists at Work', in Karl Marx and Friedrich Engels, *Revolution in Spain*, London: Lawrence & Wishart, 1939, first published in *Der Volksstaat*, 31 October, and 2 and 5 November 1873; see also Adrian Shubert, *The Road to Revolution in Spain: The Coal Miners of Asturias 1860–1934*, Urbana: University of Illinois Press, 1987. The rejection of the general strike was part of Marx and Engels's battle with the anarchists, led by Bakunin – a fight that led to the breakup of the First International. The anarchists advocated locally based, widespread rebellion, epitomised by the general strike. Marx and Engels argued for the steady organisation of the working class in order to win the political reforms that would enable them to conquer the power of the state at the national level. In their view the role of trade unions, beyond gaining economic improvements within the workplace, was to promote the political education of the working class so that they would act increasingly in their own collective interests. See Paul Thomas, *Karl Marx and the Anarchists*, London: Routledge & Kegan Paul, 1980: 249–340.

34 Ernest Mahaim and Harald Westergaard, 'The General Strike in Belgium, April 1902', *Economic Journal* 12: 47, 1902; Janet L. Polasky, 'A Revolution for Socialist Reforms: The Belgian General Strike for Universal Suffrage', *Journal of Contemporary History* 27, 1992, 449–66; Carl E. Schorske, *German Social Democracy, 1905–1917: The Development of the Great Schism*, Cambridge, MA: Harvard University Press, 1983: 28–58.

35 Rosa Luxemburg, *The Mass Strike, the Political Party, and the Trade Unions*, (a translation of *Massenstreik, Partei und Gewerkschaften* 1906), Detroit: Marxist Educational Society, 1925: 44. Georges Sorel offered another contemporary reflection on the new power of the general strike in *Reflections on Violence*, transl. Thomas Ernest Hulme, New York: B. W. Huebsch, 1914 [1908].

networks became more visible. In Germany, compulsory works councils were set up in major industries, and in France the government banned strikes in industries related to the war and took a direct role in setting wages and working conditions.[36] The war's duration and destructiveness, to which the energy from coal contributed, undermined political orders everywhere, in many cases bringing the new populist forces to power. In central and eastern Europe these forces overthrew the old order; in western and northern Europe and the US they were accommodated within it. From the West Virginia coal strikes of 1919 to the German general strike of 1920 and the British general strike of 1926, the coordination of industrial action by mine workers, dockers and railwaymen reaffirmed their new power to shut down energy nodes. The dispersed energy systems of solar radiation had never allowed groups of workers to assemble a political capability of this sort.

The power of the general strike put large industrial employers on the defensive. In 1918, the Rockefeller Foundation in New York issued a report explaining the vulnerability:

> If the recent past has revealed the frightful consequences of industrial strife, do not present developments all over the world afford indications of possibilities infinitely worse? Syndicalism aims at the destruction by force of existing organization, and the transfer of industrial capital from present possessors to syndicates or revolutionary trades unions. This it seeks to accomplish by the 'general strike.' What might not happen, in America or in England, if upon a few days' or a few weeks' notice, the coal mines were suddenly to shut down, and the railways to stop running! . . . Here is power which, once exercised, would paralyze the . . . nation more effectively than any blockade in time of war.[37]

The Rockefeller family had commissioned the report following the Ludlow Massacre of 1914. The killing of striking coalminers by the Colorado National Guard – armed with machine guns and brought in to defeat the attempt by the United Mine Workers to unionise a Rockefeller-owned mine in the Great Coalfield War of 1913–14 – had caused a national political crisis that threatened the 'present possessors' of large industrial capital.[38] The Rockefellers hired

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36 David Corbin, *Life, Work, and Rebellion in the Coal Fields: The Southern West Virginia Miners, 1880–1922*, Champaign, IL: University of Illinois Press, 1981; Thomas E. Reifer, 'Labor, Race and Empire: Transport Workers and Transnational Empires of Trade, Production, and Finance', in Gilbert G. Gonzalez, Raul A. Fernandez, Vivian Price, David Smith, and Linda Trinh Võ, eds, *Labor Versus Empire: Race, Gender, and Migration*, London: Routledge, 2004: 17–36; Rimlinger, 'Labour and the State': 582, 587.

37 William Lyon Mackenzie King, *Industry and Humanity: A Study in The Principles Underlying Industrial Reconstruction*, Boston: Houghton Mifflin, 1918: 494–5.

38 Thomas G. Andrews, *Killing for Coal: America's Deadliest Labor War*, Cambridge, MA: Harvard University Press, 2008; Ron Chernow, *Titan: The Life of John D. Rockefeller, Sr.*, New York: Random House, 1998: 571–90.

William Lyon Mackenzie King, who had helped resolve more than forty coal, railway, shipping and other strikes as minister of labour in Canada, to devise a less violent method of defeating the mine workers. The Rockefeller Plan, widely copied in the interwar period, created company unions that allowed workers to negotiate over pay and working conditions while preventing them from joining independent unions.[39]

Large American firms portrayed the new company unions and other forms of worker representation as 'industrial democracy', and compared them to the 'self-government' that the United States championed in the Middle East and other regions in the same period.[40] The firms compared the difference between the old industrial relations and the new to 'the difference between a feudalistic state – the government of which, however enlightened, contains nothing of the consent of the governed – and a democracy', explaining that, 'if people have a voice in the making of the regulations which affect them, they are more able to understand and accept law'.[41]

Labour movements in the US and other countries fought against the paternalism of welfare industrialism, and later managed to have company-controlled unions made illegal; but industrialists continued to promote corporate benevolence and welfare as a method of weakening union power. They supported broader welfare measures where they promised to weaken organised labour. After working as an industrial relations consultant to Rockefeller and other firms, Mackenzie King returned to politics in Canada, where he served as prime minister for twenty-two years, opposed attempts to introduce New Deal–style protections for workers, and became the architect of the country's welfare state.[42] As workers in industrialised regions fought for a more egalitarian life, the democracy they began to achieve was always liable to slip from providing a means of making effective egalitarian claims to offering a means of regulating populations through the provision of their welfare.

Between the 1880s and the interwar decades, workers in the industrialised countries of Europe and North America used their new powers over energy flows to acquire or extend the right to vote and, more importantly, the right to form labour unions, to create political organisations, and to take collective action including strikes. In most cases, these changes enabled mass-based parties to win power for the first time. Workers also acquired the right to an eight-hour

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39 Jonathan Rees, *Representation and Rebellion: The Rockefeller Plan at the Colorado Fuel and Iron Company, 1914–1942*, Boulder, CO: University Press of Colorado, 2010.

40 A comparison I will explore further in Chapter 3, where I examine Britain's adoption of the policy of 'self-determination' as a mode of governing the oil regions of the Arab world.

41 Cited in Lizabeth Cohen, *Making a New Deal: Industrial Workers in Chicago, 1919–1939*, Cambridge, UK: CUP, 1990: 171–2.

42 'William Lyon Mackenzie King', *Dictionary of Canadian Biography Online*, at www.biographi.ca.

day and to social insurance programmes, including provisions against industrial accidents, sickness and unemployment, as well as to public pensions in retirement.[43] The emergent women's movements fought against the exclusion of women from public political life, sometimes with the support of socialist parties, and gradually forced the granting of voting rights to women. Large industrialists often came to support limited versions of these reforms, since improving workers' well-being would increase their stamina and discipline and reduce industrial protest, while welfare measures that strengthened domestic hierarchies could reinforce the maternal roles that women had begun to escape during wartime mobilisation.[44] Labour organisations sometimes opposed proposals for social insurance as partial measures that would undermine their efforts to achieve a more effective change in the ownership of wealth. Where more radical change was threatened, as in interwar Germany and Austria, industrialists supported the destruction of the parliamentary system.

Despite such limits and setbacks, working people in the industrialised West acquired a power that would have seemed impossible before the late nineteenth century. The rise of large industry had exposed populations to extraordinary forms of social insecurity, physical risk, overwork and destitution. But the concentration and movement of coal required to drive those industrial processes had created a vulnerability. Workers were gradually connected together not so much by the weak ties of a class culture, collective ideology or political organisation, but by the increasing and highly concentrated quantities of carbon energy they mined, loaded, carried, stoked and put to work. The coordinated acts of interrupting, slowing down or diverting its movement created a decisive political machinery, a new form of collective capability built out of coalmines, railways, power stations, and their operators. More than a mere social movement, this socio-technical agency was put to work for a series of democratic claims whose gradual implementation radically reduced the precariousness of life in industrial societies.

THE BATTLE FOR COAL

After the Second World War, the leading industrialised countries began to reorganise the relations between labour forces and energy flows. In the United States, the change began in response to a strike by oil workers. In September 1945, workers at a Standard Oil refinery in Michigan organised a strike that spread to Texas and California and became the first nation-wide oil strike, closing down

43 Despite the vast increase in the production of wealth in the nineteenth century, measures of human welfare even in industrialised countries did not begin to improve until the twentieth century. John Coatsworth, 'Welfare', *American Historical Review* 101: 1, 1996.

44 Susan Pedersen, 'The Failure of Feminism in the Making of the British Welfare State', *Radical History Review* 43, 1989: 86–110.

a majority of the country's refineries. *Time* described the oil workers' union as 'the world's . . . most recalcitrant labor union'. It was the oil companies, however, that rejected government arbitration. In response, the government used the War Powers Act to place the refineries under military control. Strikes spread to coal mining, electrical power, iron and steel, railroads, and automobile manufacture, producing the most concentrated period of industrial conflict in American history. To end the oil strike, the government forced the Standard Oil companies and other large refiners to concede the right of national unions to represent a collective workforce, while limiting their role to bargaining over remuneration and working conditions.[45] The settlement provided a new model of labour relations, which replaced the company unions pioneered by Rockefeller in coal mining and the oil industry, and was also adopted in automobile manufacturing and other large industries. The concession defeated more far-reaching postwar proposals for industrial democracy, in which workers would play a role in managing an enterprise and earn shares in its profits. Instead, government and industry promoted the new science of industrial management, which focused on methods of increasing 'productivity'. Improvements in pay and terms of employment would in future depend on workers' accepting speedups, closer supervision, the elimination of jobs, and increased physical exhaustion, rather than any more radical redistribution of shares of the nation's wealth.[46]

The American model of industrial relations was exported to postwar Europe, along with a decisive switch in sources of energy. In France, Germany and Britain, the 'battle for coal' of the late 1940s shaped postwar politics, as coal miners led campaigns not just for improved pay and working conditions but for more extensive changes to the way prosperity and well-being were distributed. Following the nationalisation of the French coal industry in 1944, the Communist-led union movement turned coal mining into a showcase of increased productivity, in exchange not only for improved wages but for a direct role in the management of industry. Three years later, however, after rapid inflation caused real wages to collapse, coal miners joined a series of strikes demanding that the government increase pay levels or extend food rations.[47] Rather

45 'The Last Traffic Jam', *Time*, 15 December 1947; Myron L. Hoch, 'The Oil Strike of 1945', *Southern Economic Journal* 15, 1948: 117–33.

46 Anthony Carew, *Labour Under the Marshall Plan: The Politics of Productivity and the Marketing of Management Science*, Detroit: Wayne State University Press, 1987; Victoria de Grazia, *Irresistible Empire: America's Advance through Twentieth-Century Europe*, Cambridge, MA: Harvard University Press, 2005: 336–75.

47 Darryl Holter, *The Battle For Coal: Miners and the Politics of Nationalization in France, 1940–1950*, DeKalb: Northern Illinois University Press, 1992; Adam Steinhouse, *Worker's Participation in Post-Liberation France*, Lanham: Lexington Books, 2001. Gabrielle Hecht, *The Radiance of France: Nuclear Power and National Identity after World War II*, Cambridge, MA: MIT Press, 1998, explores the subsequent battles among labour unions to shape a postwar political role for workers through their place in the production of a new form of energy – nuclear power.

than yield to these claims, France and other European governments turned to the United States. Keen to promote their new corporate management model abroad (and to have Washington subsidise their exports), American industrialists used a fear of the popularity of Communist parties in Western Europe to win support for postwar aid to Europe. 'The Communists are rendering us a great service', commented the future French prime minister Pierre Mendès-France. 'Because we have a "Communist danger" the Americans are making a tremendous effort to help us. We must keep up this indispensable Communist scare.'[48] The European Recovery Program (ERP), popularly known as the Marshall Plan, sought to engineer a political order in Europe built on a new relationship between organised labour and large industrial enterprises, similar to the order America was pioneering at home.

There were three elements to the American-funded reorganisation of the power of labour. First, the Marshall Plan promoted US-style industrial management. The Labour Division of the ERP became a laboratory for developing and testing the new American methods of managing manpower and machines. The doctrine of productivity justified increased supervision of labour, and paying wages that failed to keep pace with rising prices. 'The only answer to Britain's difficulties', the American ambassador to London reported to the secretary of state, George Marshall, 'is to work harder and, I fear, for less.' Studies showed, however, that most of the difference between American and European productivity could be explained not by Americans working harder but by America's abundant supplies of coal and oil, which allowed its industry to use between two and three times as much electrical power per worker.[49]

Second, the recovery programme as a whole was made conditional on the acceptance by European governments of plans for economic integration, which began with the integration of Western Europe's coal industry. The European Coal and Steel Community, established as a first step towards the political union of Europe, reduced competition in the coal industry and supported the mechanisation of production, with funds provided to alleviate the effects of the resulting pit closures and unemployment. The United States helped finance the programme, which reduced the ability of coal miners to carry out effective strikes by rapidly reducing their numbers and facilitating the supply of coal across national borders.

The third element was the most extensive. The US funded initiatives to convert Europe's energy system from one based largely on coal to one increasingly dependent on oil. An important goal of the conversion to oil was to permanently weaken the coal miners, whose ability to interrupt the flow of energy had given organised labour the power to demand the improvements to collective life that had democratised Europe.

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48 Alexander Werth, *France, 1940–1955*, New York: Henry Holt, 1956: 351.
49 Carew, *Labour Under the Marshall Plan*: 136.

The corporatised democracy of postwar Western Europe was to be built on this reorganisation of energy flows. ERP funds helped pay for building oil refineries and installing oil-fired industrial boilers, putting in place the infrastructure needed to convert from coal to oil.[50] The US encouraged the building of roads, gave ERP countries $432.5 million to purchase American vehicles, and subsidised Italian and French car manufactures. Western Europe had no significant oilfields, so the additional oil would come from the Middle East, in particular from the new fields in Saudi Arabia, where American companies and the US government were keen to increase production to provide funds to support the insecure oligarchy of Ibn Saud.

Scarce supplies of steel and construction equipment were shipped from the United States to the Persian Gulf, to build a pipeline from eastern Saudi Arabia to the Mediterranean, enabling a rapid increase in oil supplies to Europe. At the same time, Marshall Plan administrators devised a global pricing plan for oil. Oil was cheaper to produce in the Middle East and cheaper to transport from there to Europe, in comparison to the equivalent costs for US oil, the price of which was protected by government production quotas. Under the pricing plan, rather than allow Europe to benefit from cheaper oil, supplies from the Middle East were sold to Europe at the much higher price of imports from the US. The plan protected oil producers in America and the monopoly profits of the international oil companies, but would have made it difficult to switch Europe from coal, especially as the US companies supplying Middle Eastern oil would accept payment only in dollars. So ERP dollar funds were also used to pay for the European purchases of oil – an arrangement that secured the role of the dollar as the basis of the global financial system, built on the need to use dollars to acquire oil. Over 10 per cent of ERP funds were used to procure oil, representing the largest single use of Marshall Plan money. The ERP financed more than half the oil supplied to Marshall Plan countries by US companies during the period of the Plan (April 1948 to December 1951), making the oil companies among the largest beneficiaries of Marshall Plan aid.[51]

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50 Raymond G. Stokes, *Opting for Oil: The Political Economy of Technical Change in the West German Industry, 1945–1961*, Cambridge, UK: CUP, 1994: 96. The European Cooperation Administration (the agency responsible for administering the ERP) spent $24 million on increasing refinery construction; and dollars freed by ECA funds from other expenses, such as oil purchases, were switched to refinery construction, along with ECA counterpart funds. David S. Painter, 'The Marshall Plan and Oil', *Cold War History* 9: 2, May 2009: 168. Building oil refineries represented an important means of reducing the severe shortage of dollars among European countries, as the ECA director Paul Hoffman reported to Congress, because it enabled them to import crude oil rather than more expensive refined products. Although an ostensible aim of the ERP was to address the dollar shortage, US oil companies successfully fought to limit the use of ERP funds to construct oil refineries. US Congress, House of Representatives, Committee on Interstate and Foreign Commerce, Petroleum Study, Progress Report, 15 May 1950, 81st Congress, 2nd Session.

51 David Painter, 'Oil and the Marshall Plan', *Business History Review* 58: 3, 1984: 362; Painter, 'Oil and the Marshall Plan': 164–5; Nathan Citino, 'Defending the "Postwar Petroleum

Spurred by these American subsidies, oil increased its share of Western Europe's energy consumption from 10 per cent in 1948 to almost one-third by 1960. The diversion of steel to build pipelines and of Marshall Plan funds for this purpose was justified in part by the need to undermine the political power of Europe's coal miners.[52]

OIL IN THE AGE OF COAL

If coal played a critical role in forging democracy, what difference did it make to replace coal with oil? Like coal, oil sometimes enabled workers to assemble themselves into new social forces. Although the refinery strike of 1945–46 was the first nation-wide oil strike in the United States, in California, the country's leading oil-producing region for the first third of the twentieth century, petroleum workers had led the struggles during and after the First World War not only for better pay and conditions, but also for a broader social transformation. They fought for the public ownership of the oil industry as the basis of 'a true democracy' in which '*government* shall be so formed as to benefit the great mass of the common people . . . against the material interests of the remaining few'.[53] They failed to have the industry placed under public control, but they forged a new kind of community-based labour movement deeply involved in local and state politics, and better able than unions in other industries to survive the political repression that followed.[54]

The political strength that oil workers could acquire depended on the ways in which oil was used and the vulnerabilities its use created. Before the twentieth century, the main use for petroleum was to provide artificial lighting, in the form of kerosene (also known as paraffin) for oil lamps, and to supply lubricants for machinery. It was widely distributed, mostly in small amounts, and supplied in reusable metal cans to individual consumers. With the exception of Russia, no country in the nineteenth century converted oil into a significant source of mechanical power to drive industry and transportation. Unlike coal, therefore, oil was not concentrated into vital channels on

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Order": The US, Britain, and the 1954 Saudi-Onassis Tanker Deal', *Diplomacy & Statecraft* 11: 2, 2000: 137–160; Fred Block, *The Origins of International Economic Disorder: A Study of United States International Monetary Policy from World War II to the Present*, Berkeley: University of California Press, 1977.

52 James Forrestal, 'Diaries of James V. Forrestal, 1944–1949', vols 9–10, 6 January 1948, in 'James V. Forrestal Papers, 1941–1949', Princeton: Seeley G. Mudd Manuscript Library. See also ibid., vols 7–8, 2 May 1947; Painter, 'Oil and the Marshall Plan': 361–2.

53 *Kern County Union Labor Journal*, 10 November 1917 and 18 May 1918, cited in Nancy Quam-Wickham, 'Petroleocrats and Proletarians: Work, Class and Politics in the California Oil Industry 1917–1925', PhD dissertation, Department of History, University of California, Berkeley, 1994: 13–14.

54 Quam-Wickham, 'Petroleocrats and Proletarians'.

which other processes depended, and oil regions did not become industrial centres. The places where oil was produced were often remote from large markets, most of which were found in the regions that had industrialised using coal. Even there, lamp oil was increasingly a product for rural areas rather than towns and cities, which were illuminated with coal gas and, by the end of the nineteenth century, with electricity. The weakness of these linkages and the limited role of oil as a concentrated source of mechanical energy restricted the potential political force of those who produced the oil – except, as we will see, in Russia.

These weaknesses can be seen in the largest oil-producing region outside America and Russia before the First World War – the Austrian province of Galicia, part of modern Poland and Ukraine. The Galician oil wells extended eastwards from Cracow in a 300-mile arc towards the border of Romania. By the 1890s steam-powered percussion drills had replaced the hand-digging of wells, accessing deeper layers of oil-bearing rock and causing a surge in production in the following decade. The increased supply threatened the large firms that controlled the European kerosene market, the Standard Oil Company and its main European rival, Deutsche Bank in Germany. However, Galicia lacked a network of navigable waterways or railways for transporting its oil to Germany and other important markets, an isolation that the large companies could use to weaken both local Galician oil firms and the workforce. Starting in 1904, oil workers organised a series of strikes over conditions of work and collective rights, including the demand for an eight-hour day. The local firms were vulnerable to the strike and willing to negotiate, but the large foreign operators refused to deal with the strikers. When the workers responded by sabotaging the oilfields, disabling the pumps that moved oil to storage reservoirs and allowing it to flow into local streams, the Austrian government sent seven infantry battalions to protect the pumps and pipelines. By refusing to negotiate and prolonging the strike, the large firms were able both to defeat the workers and to put the smaller producers out of business. In fact, rumours circulated that Standard Oil had financed the 1904 strike with this dual aim.[55]

In the twentieth century, as the spread of electric lighting began to limit the growth in demand for kerosene in industrialised countries, oil companies were forced to look for new uses for their product. The solution was to convert the oil from a means of illumination into a source of mechanical power. At first it was used in boilers as a direct substitute for coal to drive reciprocating steam engines, in the form of fuel oil. The development of the internal combustion engine, which spread rapidly after 1900, gave oil a use for which it had

55 Alison Fleig Frank, *Oil Empire: Visions of Prosperity in Austrian Galicia*, Cambridge, MA: Harvard University Press, 2007: 140–72.

no readily available substitute, both in the lightweight gasoline engine and the more powerful diesel engine.[56]

In the Russian-controlled Caucasus, oil workers were already able to benefit from this development. The oilfields of Baku, in modern Azerbaijan, concentrated around the city and occupying an area of no more than 12 square miles, produced more than half the world's petroleum for a brief period at the start of the twentieth century. Linked by a rail line and pipeline to the Black Sea port of Batumi and by waterways and railways to the rest of Russia, the oil industry launched the protests that culminated in the Revolution of 1905. Labour unrest in the south Caucasus began in 1901–02 with strikes and demonstrations led by the pipeline, refinery and port workers of Batumi, culminating in a large strike by oil workers at the Rothschild plant in which 14 protesters were killed. The labour organisers, including the young Joseph Stalin, stayed in touch with allies in Baku.[57] The wider Revolution began with a strike of Baku oil workers in July 1903, which spread along the railway line to the marshalling yards and workshops at Tiflis (now Tbilisi), the midpoint of the Transcaucasus Railway, then to Batumi, and then 'like a brushfire across southern Russia'.[58] It was the country's first general strike, which, as we have seen, led Rosa Luxemburg to recognise the new power of workers connected, as she put it, by individual 'economic' grievances rather than 'political' organisation.[59] In December 1904 the Baku oil workers announced a second general strike, from which the 1905 Revolution was launched.

As the Revolution unfolded, local observers reported that 'labour troubles have been felt in Baku more severely, perhaps, then in any other part of Russia'.[60] Stalin later claimed that the advanced organising skills of the oil workers of Baku and the intensity of their conflict with the oil industrialists gave him an experience that qualified him as 'a journeyman for the revolution'.[61] In fact, however, the leaders of the striking oil workers broke with the local Bolsheviks

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56 The first oceangoing ship to be equipped with a diesel engine was an oil tanker, the *Vulcanus*, built for the Royal Dutch company and launched in December 1910. Frederik Carel Gerretson, *History of the Royal Dutch*, 4 vols, Leiden: E. J. Brill, 1953–57, vol. 4: 54–5.

57 Ronald Grigor Suny, *The Making of the Georgian Nation*, 2nd edn, Bloomington: Indiana University Press, 1994: 162–4; Robert Service, *Stalin: A Biography*, Cambridge, MA: Belknap Press of Harvard University Press, 2005: 48–50.

58 Robert W. Tolf, *The Russian Rockefellers: The Saga of the Nobel Family and the Russian Oil Industry*, Stanford, CA: Hoover Institution Press, Stanford University, 1976: 156.

59 Luxemburg, *Mass Strike*: 44.

60 Report from Mr Vice-Consul Urquhart, Baku, appended to Mr Consul Stevens, 'Report for the Year 1905 on the Trade and Commerce of Batoum and District', 26 March 1906: 13, in United Kingdom Parliamentary Papers, House of Commons, vol. cxxvii, Command Paper 2682, no. 3566 Annual Series, Diplomatic and Consular Reports, Russia, 1906.

61 Stalin's words, from a 1926 speech to railway workers, are cited in Ronald Grigor Suny, 'A Journeyman for the Revolution: Stalin and the Labour Movement in Baku, June 1907–May 1908', *Soviet Studies* 23: 3, 1972: 373.

and negotiated with the owners of the oil industry the first labour contract in Russian history, winning the right to a nine-hour day, sick pay, free fuel and elected factory representatives. Their political demands were for 'the convocation of a constituent assembly on the basis of universal, equal, direct, and secret suffrage' and 'freedom of speech, assembly, press, strikes, and unions'.[62]

The power of the oil workers reflected the fact that the Baku industry at the turn of the century was organised and connected in ways that more closely resembled the contemporary coal industries of northern Europe than oil production elsewhere or in later periods. More than a hundred enterprises produced oil in the space of a few square miles, creating a dense network of derricks, open storage pits and steam engines, crisscrossed with pipes carrying oil and supplying water, steam and natural gas, and with high-tension cables distributing electricity. A short distance away, on the Caspian coast, were over a hundred refineries, with their own large workforces, and from there the oil was carried by steamship and rail across the Russian Empire. The proximity of wells, workshops, pumps, power supplies and refineries created a concentrated labour force with the ability to disrupt supplies of energy across a broad region.[63]

A second way in which Baku production resembled that of the contemporary coal industry was that its oil was used primarily not for illumination, but to produce steam power. The heavy crude of Baku contained relatively low amounts of the more volatile hydrocarbons refined into kerosene, and yielded a higher proportion of residual oil more suitable for use in steam boilers. The Caucasus lacked the supplies of coal and timber found in Pennsylvania and other oil regions, a deficiency that encouraged the use of oil to produce combustion heat. Engineers in Baku had developed an atomising spray for burners that enabled the efficient use of oil to fuel steam engines in ships and railways. The Russian Caspian fleet converted from coal to oil in the 1870s, and Russian railways began to switch in the 1880s. By 1890, all Russian trains except those in the coal region of the Donets basin and in Siberia ran on fuel oil, and its use had spread to the metallurgical industry and to factories in the north. Over the following decade, oil accounted on average for an estimated 41 per cent of commercial primary energy consumption in Russia.[64] The oil strikes that

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62 Solomon M. Schwarz, *The Russian Revolution of 1905: The Workers' Movement and the Formation of Bolshevism and Menshevism*, transl. Gertrude Vakar, Chicago: University of Chicago Press, 1967, Appendix 6: 'The Baku Strike of December, 1904: Myth and Reality': 303; Beryl Williams, '1905: The View from the Provinces', in Jonathan Smele and Anthony Haywood, eds, *The Russian Revolution of 1905*, London: Routledge, 2005: 47–8.

63 Tolf, *Russian Rockefellers*: 145–7. My analysis in this and the following paragraph draws on Richard Ryan Weber, 'Power to the Petrol: How the Baku Oil Industry Made Labor Strikes and Mass Politics Possible in the Russian Empire (and beyond)', MA thesis, Program in Liberal Studies, Columbia University, May 2010.

64 Tolf, *Russian Rockefellers*: 70–1; N. L. Madureira, 'Oil in the Age of Steam', *Journal of Global History* 5: 1, 2010: 79.

launched the 1905 Revolution were able to paralyse transportation networks and industrial activity across the Empire, much as coal strikes could in north-western Europe.

Unlike north-western Europe, Russia was a multi-ethnic empire. Its ethnic divisions were reflected and employed in the organisation of the Baku oil industry – and in the defeat of the 1905 Revolution. Unskilled labour in the industry was carried out partly by local Azeris and partly by migrant workers from Iran, from both Persian- and Azeri-speaking communities. The skilled workforce was chiefly Russian and Armenian. The managers and local owners of oil businesses and other commercial enterprises were mostly Armenians, many of whom had prospered in the oil boom. A local British observer described Baku as 'commercially and ethnologically the Johannesburg of Russia', comparing it to the gold-mining boomtown of the Transvaal.[65] The South Africa war had recently consolidated a system of imperial self-government based on a racialised labour regime, developed in the mining industry, from which Britain would derive ideas for 'self-determination' in the oil-producing regions of the Arab world (see Chapter 2).

The Russian imperial government responded to the revolutionary strikes by unleashing the Black Hundreds, ultranationalist counter-revolutionary forces whose principal weapon was the pogrom – the organised use of mob violence against ethnic minorities. The first round of ethnic violence in Baku, in January 1905, was unsuccessful and 'gave renewed impetus to the labour movement'. The following September, however, the Black Hundreds stormed the city, set fire to the oilfields, and stirred up and armed the Muslim Azeris against the Christian Armenians. Thousands were killed, the oil industry was crippled and the workers' revolutionary demands were defeated.[66]

Despite the signs that oil might be turned into an instrument for building political freedoms, the patterns of labour mobilisation, transportation and energy use found in Baku at the turn of the twentieth century proved to be an exception. The use of ethnic divisions to organise oil production proved more common, and would later be employed throughout the Middle East.[67] The ability to weaken the labour force by dividing it into separate racial groups, with managers, skilled workers and unskilled workers housed and treated separately, reflected the different distribution of oil production across the world compared

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65 James Dodds Henry, Baku: *An Eventful History*, New York: Arno Press, 1977 [1905]: 12; Arthur Beeby-Thompson, *The Oil Fields of Russia*, London: Crosby Lockwood & Son, 1904: 125–6; Hassan Hakimian, 'Wage Labor and Migration: Persian Workers in Southern Russia, 1880–1914,' *International Journal of Middle East Studies* 17: 4, 1985: 443–62.

66 Report from Mr Vice-Consul Urquhart: 13; Tolf, *Russian Rockefellers*: 156–60; Henry, *Baku*, 149–218.

67 See Robert Vitalis, *America's Kingdom: Mythmaking on the Saudi Oil Frontier*, 2nd edn, London: Verso, 2009.

to coal, and its development after rather than before the rise of modern industry. Oil production often grew rapidly, in regions remote from large populations, to serve distant users in places already industrialised with coal – a fact that encouraged the producers to import workers from different places and then perpetuate the forms of ethnic division. This difference, however, was only one of several factors that made oil production increasingly unlike the production of coal. Oil was produced using distinctive methods, and transported over longer and often more flexible routes, for reasons connected in part to the different physical and chemical form of the carbon it contains. To understand further why the politics of oil differed from those of coal, we must turn to these factors.

OIL FLOWS

Since oil comes to the surface driven by underground pressure, either from water trapped beneath it or from gas trapped above, sometimes assisted by the action of pumps, its production required a smaller workforce than coal in relation to the quantity of energy produced.[68] Workers remained above ground, closer to the supervision of managers. As the carbon occurs in liquid form, the work of transporting energy could be done with less human labour. Pumping stations and pipelines could replace railways as means of transporting energy from the site of production to the places where it was used or shipped abroad. These methods of transport did not require teams of humans to accompany the fuel on its journey, to load and unload it at each junction, or to continuously operate engines, switches and signals. In fact, oil pipelines were invented as a means of reducing the ability of humans to interrupt the flow of energy. They were introduced in Pennsylvania in the 1860s to circumvent the wage demands of the teamsters who transported barrels of oil to the rail depot in horse-drawn wagons.[69] Baku borrowed the innovation in the following decade from the American oil drillers, for the same reason. Pipelines were vulnerable to sabotage. During the 1905 Revolution in Russia, for example, the British consul in Batumi reported that 'a considerable number of pipes have been holed by the revolutionaries and have thereby been rendered useless'. But they were more difficult to incapacitate than the railways that carried coal, and could be quickly patched up. The damage, the consul reported, 'will not take long to repair and the line will in all probability be at work shortly'.[70]

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68 As oil is extracted the pressure in the reservoir drops. Pumps may then be used to bring more oil to the surface, or to increase the reservoir pressure by driving water or gas into secondary wells.

69 Daniel Yergin, *The Prize: The Epic Quest for Oil, Money, and Power*, New York: Simon & Schuster, 1991: 33.

70 Mr Consul Stevens, 'Report for the Year 1905': 8.

In addition, diesel oil and petrol are lighter than coal and vaporise more easily, and their combustion leaves little residue compared with the burning of coal. For these reasons, as Lewis Mumford noted in 1934,

> they could be stowed away easily, in odds and ends of space where coal could not be placed or reached: being fed by gravity or pressure the engine had no need for a stoker. The effect of introducing liquid fuel and of mechanical stokers for coal, in electric steam plants, and on steamships, was to emancipate a race of galley slaves, the stokers.[71]

The fluidity and relative lightness of oil made it feasible to ship it in large quantities across oceans. In contrast, very little coal had historically crossed oceans.[72] In 1912, Britain exported one-third of its coal and was responsible for two-thirds of the world's seaborne exported coal; but almost 90 per cent of its exports went to the adjacent regions of Europe and the Mediterranean.[73] Over the course of the twentieth century, the proportion of coal exported internationally stabilised at about 15 per cent. By contrast, following the development of the oil tanker in the late nineteenth century, oil could be moved cheaply between continents. From the 1920s onwards, about 60 to 80 per cent of world oil production was exported. So much oil was moved across oceans that, by 1970, oil accounted for 60 per cent of seaborne cargo worldwide.[74]

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71 Lewis Mumford, *Technics and Civilization*, New York: Harcourt, Brace, 1934: 235.

72 The main exception was high-quality steam coal from South Wales, essential for the navy and fast liners, which was shipped to British overseas coaling stations (H. Stanley Jevons, *The British Coal Trade*, London: E. P. Dutton, 1915: 684). In fact, half the coal Britain shipped outside Europe in the decade 1903–13 went to just two places – Río de la Plata in South America and the Suez Canal (Rainer Fremdling, 'Anglo-German Rivalry in Coal Markets in France, the Netherlands and Germany, 1850–1913', *Journal of European Economic History* 25: 3, 1996: Table 2). Historically, long-distance coal shipments from Britain could be used as ballast or make-weight, and benefited from low rates for back-carriage (William Stanley Jevons, *The Coal Question*, London: Macmillan, 1865: 227).

73 H. S. Jevons, *British Coal Trade*: 676–84. The economic historian Charles Kindleberger, an architect of the Marshall Plan who had headed a section on military supplies in the Office of Strategic Services in 1942–44, recalled that, at the outbreak of the Second World War,

> coal was regarded as something that didn't move across big bodies of water. It was shipped to British coaling stations but you wouldn't expect international transoceanic trade as a regular thing. And yet when the war came along, and we needed to get coal to Europe we started to move coal out . . . They were loading it in clam shell buckets on to barges in Puget Sound to go to Europe, a landing in Texas, Portland, Maine, everywhere.

Richard D. McKinzie, 'Oral History Interview with Charles P. Kindleberger', Independence, MO: Harry S. Truman Library: 108–9, at www.trumanlibrary.org/oralhist/kindbrgr.htm.

74 In 2005, 86 per cent of world coal production was consumed within the country of production. International Energy Agency, 'Coal in World in 2005', at www.iea.org. For oil, see Podobnik, *Global Energy Shifts*: 79; for the 1970 figure (which refers to ton-miles of crude oil and oil products), see United Nations Commission on Trade and Development, *Review of Maritime Transport 2007*, Geneva: UNCTAD, 2007. In 1970 coal accounted for less than 5 per cent of seaborne trade.

Compared to carrying coal by rail, moving oil by sea eliminated the labour of coal heavers and stokers, and thus the power of organised workers to withdraw their labour from a critical point in the energy system. Transoceanic shipping operated beyond the territorial spaces governed by the labour regulations and other democratic rights won in the era of widespread coal and railway strikes. In fact shipping companies could escape the regulation of labour laws altogether – as well as the payment of taxes – by registering their vessels in Panama or under other 'flags of convenience', removing whatever limited powers of labour organising might have remained. (When oil production later moved offshore, in places like the Gulf of Mexico, the rigs were treated as vessels and also registered under flags of convenience, enabling even the production site to operate free of local taxes and labour laws.)

Unlike railways, ocean shipping was not constrained by the need to run on a network of purpose-built tracks of a certain capacity, layout and gauge. Oil tankers frequently left port without knowing their final destination. They would steam to a waypoint, then receive a destination determined by the level of demand in different regions. This flexibility carried risks: in March 1967 it was one of the causes of the world's first giant oil spill, the Torrey Canyon disaster off the coast of Cornwall, which helped trigger the emergence of the environmental movement, a later threat to the carbon-fuel industry.[75] But the flexibility further weakened the powers of local forces that tried to control sites of energy production. If a labour strike, for example, or the nationalisation of an industry affected one production site, oil tankers could be quickly rerouted to supply oil from alternative sites.

In other words, whereas the movement of coal tended to follow dendritic networks, with branches at each end but a single main channel, creating potential choke points at several junctures, oil flowed along networks that often had the properties of a grid, like an electricity network, where there is more than one possible path and the flow of energy can switch to avoid blockages or overcome breakdowns.

These changes in the way forms of fossil energy were extracted, transported and used made energy networks less vulnerable to the political claims of those

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75 The *Torrey Canyon*, an oil tanker owned by a Bermuda-based subsidiary of the Union Oil Company of California, registered in Liberia, chartered to BP, built in 1959 and rebuilt in 1966 in a Japanese shipyard to increase her size from 66,000 to 119,000 deadweight tons, ran aground off the coast of Cornwall, England, in March 1967. The tanker had set sail without knowing its final destination, and lacked detailed navigation charts for the coast of south-west England. The damage to the coastline and to wildlife was exacerbated by the lack of methods to handle large oil spills. The British government tried to set fire to the oil by having air defence forces bomb it with napalm, creating further damage and inadvertently revealing both their possession of the controversial weapon and the inaccuracy of the bombers (more than a quarter of the bombs missed their target). John Sheail, 'Torrey Canyon: The Political Dimension', *Journal of Contemporary History* 42: 3, 2007: 485–504; Cabinet Office, *The Torrey Canyon*, London: HMSO, 1967.

whose labour kept them running. Unlike the movement of coal, the flow of oil could not readily be assembled into a machine that enabled large numbers of people to exercise novel forms of political power.

PRODUCING SCARCITY

There was another set of ways in which the different properties of oil compared to coal affected its democratic potential. The fluidity of oil and its relative ease of distribution presented those who controlled oil resources and their distribution networks with a new problem. In both the coal and the oil industries, producers always sought to avoid competition. Competing with rival firms over prices or market share destroyed profits and threatened a company with ruin. In the case of coal, the high cost of transporting supplies across oceans ensured that producers faced competition only within their own region. They avoided competition either by forming cartels, as in France, Germany and the United States, or by creating organisations to regulate prices and production, such as the postwar European Coal and Steel Community. In Britain, producers were ruined by competition, and in 1946 were taken over by the state.

Oil companies faced a much larger difficulty in avoiding competition. With the advent of the bulk oil tanker in the 1890s, it was no longer enough to control production and distribution in only one region. Since oil could travel easily between continents, petroleum companies were always vulnerable to the arrival of cheaper oil from elsewhere. This vulnerability, seldom recognised in accounts of the oil industry, created another set of limits to the democratising potential of petroleum.

The solutions that oil companies developed to this problem might be called a method of sabotage. In the coal age, workers had discovered the power that could be built from the ability to interrupt, restrict or slow down the supply of energy. The challenge facing large oil companies was to do something similar: to introduce small delays, interruptions and controls that, by limiting the flow of energy, would enhance their control. Émile Pouget's pamphlet of 1909 on sabotage had concluded by suggesting that the capitalist class were perhaps the real saboteurs. A decade later, following the publication of an English translation of the pamphlet in Chicago, the American economist Thorstein Veblen developed this idea.[76] Large business corporations, Veblen wrote, depended for their profits on a form of sabotage. Their goal was not to maximise production, but to raise prices by restricting output to ensure a shortage. The 'pettifogging

76 Thorstein Veblen, *An Inquiry Into the Nature of Peace and the Terms of Its Perpetuation*, New York: Macmillan, 1917, rev. edn 1919: 167–74; *On the Nature and Uses of Sabotage*, New York: Oriole, 1919; and *The Industrial System and the Captains of Industry*, New York: Oriole, 1919. Veblen's argument has more recently been developed by Shimshon Bichler and Jonathan Nitzan, *The Global Political Economy of Israel*, London: Pluto Press, 2002.

tactics of Standard Oil', for example, demonstrated how profits far exceeding the earning capacity of invested assets flowed from the 'power of inhibition' exercised by large business.[77] This 'capitalisation of inefficiency' was especially profitable with a commodity such as oil, which was relatively cheap to produce but becoming so vital to industrialised society that great profits could be made if the supply was restricted. The goal of oil companies was to place themselves in control of the conduits, processing points and bottlenecks through which oil had to flow, to restrict the development of rival channels, beginning with oil wells themselves, and to use this command of obligatory passage points to convert the flow of oil into profits.

The two world wars of the twentieth century helped restrict the supply and movement of oil, but between the wars both domestic firms in the United States, where most world oil was then produced, and the handful of oil companies seeking to control international trade, needed a new set of mechanisms to limit the production and distribution of energy. The devices they developed included government quotas and price controls in the United States, cartel arrangements to govern the worldwide distribution and marketing of oil, consortium agreements to slow the development of new oil discoveries in the Middle East, and political agencies to manage the threat of those in the Middle East and elsewhere who opposed the oil companies' system of sabotage. These controls shaped the development of the transnational oil corporation, which emerged as the leading long-distance machinery for maintaining limits to the supply of oil. One could think of this development as the formation of what has been called a 'technological zone' – a set of coordinated but widely dispersed regulations, calculative arrangements, infrastructures and technical procedures that render certain objects or flows governable.[78]

The following chapters explore how this was done, beginning with the efforts in the early twentieth century to prevent and then constrain the production of oil in the Middle East, and the technical and political arrangements that made this possible. After the Second World War, as we will see, when significant quantities of oil began to flow from the Middle East (almost half a century after its discovery there), further devices were added to this machinery for the production of scarcity. While powers to limit the production of oil in the Middle East continued to develop, two further techniques emerged for transforming

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77 Thorstein Veblen, 'On the Nature of Capital', *Quarterly Journal of Economics* 23: 1, 1908: 104–36.

78 Andrew Barry, 'Technological Zones,' *European Journal of Social Theory* 9: 2, 2006: 239–53. Other raw materials presented similar problems of regulating global production to prevent competition. None of them, however, were as cheap to produce and transport as oil, or usable in such vast quantities, so they did not generate the same scale of need for techniques for the production of scarcity. On the constructing of political machines, see also Andrew Barry, *Political Machines: Governing a Technological Society*, London: Athlone Press, 2001.

carbon-energy abundance into a system of limited supplies. The first was the new apparatus of peacetime 'national security'.[79] The Second World War had given US oil companies the opportunity to reduce or shut down most of their production in the Middle East. In 1943, when Ibn Saud demanded funds to compensate for the loss of oil revenues, the oil companies persuaded Washington to extend Lend Lease loans to the Saudi Arabian monarch. These payments for *not* producing oil were presented as a necessity for America's national security. They marked the start of a postwar politics in which the collaboration of local governments in restricting the flow of oil, and US antagonism towards those who tried to increase its supply, was organised as though it were a system for 'protecting' a scarce resource against others.

The second method of preventing energy abundance involved the rapid construction of lifestyles in the United States organised around the consumption of extraordinary quantities of energy. In January 1948, James Forrestal, recently appointed as the country's first secretary of defense under the new National Security Act, discussed with Brewster Jennings, president of Socony-Vacuum (later renamed Mobil Oil, now ExxonMobil), how 'unless we had access to Middle East oil, American motorcar companies would have to design a four-cylinder motorcar sometime within the next five years'.[80] In the following years the US automobile companies helped out by replacing standard six-cylinder engines with the new V-8s as the dream of every middle-class family, doubling the average horsepower of American passenger car engines within less than a decade.[81] While Forrestal spoke, the Morris Motor Company in Britain was preparing to challenge the successful four-cylinder Volkswagen Beetle with the four-cylinder Morris Minor, Citroën to do the same with the two-cylinder

79 Critical accounts of US international oil policy tend to accept 'national security' as the concept with which to frame the history of oil, exposing its true meaning either in terms of the logic of capitalist expansion that confronts an inevitable scarcity of resources – as in Michael Klare, *Resource Wars: The New Landscape of Global Conflict*, New York: Henry Holt, 2001, and *Rising Powers, Shrinking Planet: The New Geopolitics of Energy*, New York: Metropolitan Books, 2008 – or in terms of the need for an imperial power to secure the conditions for capitalist expansion – as in Simon Bromley, *American Hegemony and World Oil*, University Park, PA: Pennsylvania State University Press, 1991, and 'The United States and the Control of World Oil', *Government and Opposition* 40: 2, 2005: 225–55. Explaining oil in terms of the logics of capitalist expansion leads such accounts to overlook the socio-technical work that must be done to turn the multiple struggles over oil into the singular narrative of the unfolding and stabilising of the logic of capital. On the ability of the US oil majors to frame their programme in terms of 'national security', and the reproduction of this perspective in scholarship, see Vitalis, *America's Kingdom*.

80 Forrestal, 'Diaries', vols 9–10. He made the same argument at a Cabinet meeting on 16 January 1948 (ibid., 2,026).

81 Tom McCarthy, *Auto Mania: Cars, Consumers, and the Environment*, New Haven: Yale University Press, 2007: 107–8. Paul Sabin's study of the California oil industry traces the building of the 'infrastructure of consumption' that produced the scarcity of oil (Paul Sabin, *Crude Politics: The California Oil Market, 1900–1940*, Berkeley: University of California Press, 2004). On the history of American attitudes towards energy, see David E. Nye, *Consuming Power: A Social History of American Energies*, Cambridge, MA: MIT Press, 1999.

2CV, and the German engine maker BMW with its first postwar passenger car, the one-cylinder Isetta 250. The European vehicles outsold and outlasted the badly engineered American cars, but the latter helped engineer something larger. They manufactured the carbon-heavy forms of middle-class American life that, combined with new political arrangements in the Middle East, would help the oil companies keep oil scarce enough to allow their profits to thrive.

The ability of organised workers to assemble a political machine out of the networks and nodal points of a coal-based energy system had shaped the kinds of mass politics that emerged, or threatened to emerge, in the first half of the twentieth century. The rise of oil reorganised fossil-fuel networks in ways that were to alter the mechanics of democracy. The possibilities for making democratic claims were altered in both the countries that depended on the production of petroleum and those that most depended on its use.

Much more could be said about the role of the major oil companies and car manufacturers in helping to produce and popularise ways of living based on very high levels of energy consumption. This is a question not of balancing the history of oil production and distribution with an analysis of its consumption, so much as understanding that production involved producing both energy and the forms of life that were increasingly dependent on that energy.