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BOOK REVIEW

Daggett, Cara New. The birth of energy: fossil fuels, thermodynamics, & the politics of work

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The Birth of Energy calls for a new theory of energy based on an examination of its origins as a scientific concept, and Daggett sees her study as a prelude to dealing with contemporary problems of energy, including climate change. It is a deeply epistemological book on political theory that draws extensively on history and philosophy of science, physical and biological science, the history and politics of imperialism, political theory, theories of social change, science & technology studies (STS), eco-feminism, environmental history, and nineteenth century European history, among others. Daggett's overarching conclusion is that humanity will not solve the conundrum of eliminating fossil fuels without a reconceptualization of energy.

The story begins as Daggett reviews the role of Scottish scientists and engineers during the nineteenth century in developing thermodynamics (energy science) as a theory of steam engines. Energy itself, as Daggett and many other physicists and historians have noted, is not a thing that can be captured and weighed. It is a calculated quantity, the existence of which is inferred by its effects, and, with this assertion, modern physical sciences and engineering created new, material objects and processes fundamental to modern societies.

Thermodynamics postulated two laws. The First Law maintained that energy could not be created or destroyed, but it could be transformed from one form to another. Engineers, for example, controlled the transformation of stored chemical energy, released as heat by burning coal, into work done by a steam engine. The Second Law stated that in every transformation, some energy was transformed into work, but some appeared as entropy—heat that could do no useful work. At the time and still today, entropic heat is often referred to as "waste heat," a loss that makes every transformation of energy into work "inefficient:" Less than 100% of the heat from a fuel appears as physical work.

Thermodynamic scientists and engineers, Daggett argues, created their conclusions in a social-historical context that powerfully affected the interpretation of the two laws in society. Specifically, she maintains that the context-generated metaphors, which guided and justified actions by scientists, engineers, political leaders, and industrialists to promote British industrialization and imperialism and reflected the moral sentiments of Scottish Presbyterianism, which recoiled at the prospect of "waste." Political and business leaders adopted goals of controlling and extracting from workers in imperial colonies and factories, all aimed at achieving greater efficiency and less waste.

Thermodynamic metaphors and models also, maintains Daggett, strongly influenced other emerging areas of knowledge, e.g., evolution, ecology, economics, the social theories of Max Weber and Herbert Spencer, and the scientific management theories of Frederick Taylor. Her discussion of the spread of metaphors into other areas of thought and politics is the heart of her mission. As she states,

> ". . . I am not arguing that thermodynamics is false, but rather that the energy—work connection cannot claim to be a reflection of the whole truth of energy, much less the cosmos. . . [T]hermodynamics does not simply describe a preexisting thing called energy, but rather *invents* energy as a unit of accounting (and work and waste), thereby offering new governance strategies that were particularly useful to Victorian industry." (p. 111, emphasis in original)

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For Daggett, modern political economies and states reflect the influence of scientific metaphors—especially based on thermodynamics, evolution, and ecology—in their focus on productivity, waste, and their mission to improve the lives of their citizens. Regrettably, she maintains, the emphasis on energy and productivity is so intense that it has distorted improvement of lives into the drive for perpetual economic growth, consumerism, and overconsumption. The results are pollution and climate change, problems familiar to readers of this journal.

For modern states and political economies to extract themselves from the downsides of intensive energy use, Daggett argues the need to reconceptualize energy and its corollary work. To do this, she turns to ecofeminist conceptions of work and to post-work and post-carbon movements.

For example, ecofeminism criticizes the dominance of waged labor in society, because women have been relegated to unpaid, reproductive work of maintaining homes, families, and children. The mantra, "work means paid jobs," pervades discussions of modern energy policy, but Daggett suggests breaking the links between energy and work with a universal basic income that everyone receives. Moreover, modern people, she argues, must remake leisure and enjoyment so that they do not involve energy-intensive consumption.

Without such reconceptualization of energy and work, Daggett concludes, humanity will not be able to break away from its current dependence on fossil fuels. She criticizes "ecomodernists" who want to substitute renewable energy for fossil fuel energy and extol the job-creating potentials of the transition. They leave unexamined, Daggett maintains, the current connections between energy, waged labor, capitalist economic systems, inequality of income, and ideas of leisure. Without new concepts, mitigation of climate change and other problems will not happen.

Daggett's thesis is provocative and interesting. Her strongest case centers on the role of thermodynamics in providing metaphors for other sciences, especially the social sciences. In addition, thermodynamic metaphors played a part in "legitimizing" the extraction of wealth and resources from empires and the working class.

Chapter 7 on education about and using energy is also interesting and significant. For example, the engineering schools of universities took on the role of educating engineers to design energy infrastructure and manage labor. Community colleges embraced education of technicians to operate infrastructure, under the supervision of engineers. Differentiations in wealth, class, and prestige accompanied the division of educational labor.

As with every book, however, readers will find things to argue about. Some of my complaints are at the quibble level. For example, she conflates two meanings of the word "work." One is the physicists' meaning that calculates quantities of energy by measuring mechanical work and heat. Another is the everyday use of "work" as physical or mental labor, a social concept. She also overly likes neologisms such as *geo-theology, energy as logic of dominance, energopolitics, alternative organic ethics*, and others. For this reader, these unfamiliar phrases caused extra work to decipher her intended meaning.

More importantly, however, were two ways in which she diverted attention from topics that, for me, are crucial to debates about energy. Her deep journey into epistemological issues and theories of social structure and change, legitimate as these matters are, slighted issues that are at least equally important in political debates about energy and formulating strategies of change.

First, Daggett's argument rests upon only one of two ways of studying energy. She chooses to emphasize energy-intensive consumption and the downsides of economic growth, including climate change. That framing is important, but it also misses the other way to examine energy: energy services needed to maintain human life.

Little doubt can attend, for example, the conclusion that urban people today rely on agricultural production in rural areas. Energy services enable a small number of farmers to raise enough wheat and rice to feed themselves and the increasingly overwhelming number of urban dwellers, and they employ large amounts of energy to run machinery that replaced human labor. Energy services power the farm machinery that plants and harvests the crops. Energy services synthesize and distribute fertilizer. Energy services power the trucks, trains, and ships that carry grains around the world. Energy services power the grinding and processing needed to make a loaf of bread or a bowl of rice. Moreover, if the human population continues increasing, these energy services, too, must grow if all babies are to survive. Yes, all these activities count as "growth," "consumption," and "pollution," but they also count as "survival" and "health."

Daggett's book directs our attention, legitimately, to the structural inequalities of societies and evil politics such as imperialism. She also recognizes that a severe problem attends any field of knowledge that postulates the need for perpetual economic growth. But, to ignore the energy services buttressing societies and human life is to ignore the political alarm that will attend any proposal for radical social change that purports to reduce energy from fossil fuels.

Second, Daggett diverts our attention to social structures but pays far less attention to the primary energy sources powering the world. She gives no reason to think that she would not favor the substitution of renewable energy for fossil fuels, but she clearly disparages the "ecomodernists" who focus on exactly that task: move away from dependence upon fossil fuels but replace the energy services lost with energy services from wind, solar, and hydropower. Daggett thinks such efforts are bound to fail, because they do not pay attention to the social and cultural transformations she maintains

must come first. She does not, however, explain why transition in energy sources cannot precede or be simultaneous with social change to avoid panic.

Daggett has written a useful book deserving of consideration. Her main argument that social transformation must precede energy transition away from fossil fuels was not convincing compared with her subsidiary arguments that the metaphors from thermodynamics and other sciences legitimized oppressive behaviors and politics. Could she persuade me that her main argument was right by including more attention to, e.g., vital energy services and primary energy sources? That is a good question, and I do not know the answer. More work along the lines Daggett has pioneered is needed.