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The electric giant Westinghouse unveiled the world's first "mechanical negro"—the term is from a southern newspaper—at a National Electric and Light Association convention held in San Francisco in 1930.[1] This African American robot, given the racist nickname Rastus by journalists, was built to be a showpiece at tech fairs to demonstrate how far science and industry had advanced in perfecting a "mechanical man" that might one day replace the human worker. News reports from the time indicate that Rastus did not disappoint in this respect—that he simulated human-like movements, that he spoke in "a rich Baritone voice" of current events when prompted to do so, and that he performed in his signature act a rendition of William Tell by standing quietly onstage, apple perched on his head, waiting for an electric beam to knock it off. According to one report, at the climax to that act, at the dart of an arrow, Rastus reacted by sitting down in "dismay" and bursting out in a "human and startled cry" that made him seem just a little more like the rest of us.[2]

From a purely technological perspective, this black robot was not all that remarkable. He stood up, he sat down, he swept the stage in front of him, and he uttered a few preprogrammed phrases to his audiences' delight. But that was about it. In comparison with other technologies of the day, his functions were limited to a few show tricks, making him of considerably less utility than the newest RCA radio or General Electric refrigerator.

But Rastus drew crowds, and he did so for reasons that were symbolic, or cultural, in nature. As one of the period's rare humanoid automatons, he occupied a unique niche in our carbon culture. His presence, like that of the ethnic robot Katrina Van Televox, which appeared in promotional literature dressed in a Dutch maid's costume, or the cigarette-smoking Elektro the Moto-Man, gave "a human face," as the technology critic Sarah Toton writes,[3] to the terms *mechanical servant* and *slave* and to their successor the *electric slave*, these

nineteenth- and early twentieth-century terms that denoted any labor-saving device that could convert energy into the functional equivalent of a laboring body. The cultural value of a robot like Rastus was, in other words, that he personified mechanical energy and thus helped bridge the ontological chasm that had opened up between a premodern world of working hooves, feet, and hands and the newly industrialized one that drew its labor power from these so-called mechanical slaves that lacked the humanity, the rambunctiousness, and the sentience of actual slaves or wage slaves. Even the term *robot*, Tobias Higbie reminds us, traces back to the concept of captive or "forced" labor, to the Czech word *robota*, explicitly tying a mechanical body like Rastus to the social relationships between power and labor.[4]

In this respect, Rastus was remarkable. His investor, Westinghouse, and his inventor, S. M. Kintner, had gone to great lengths to ensure that he not only looked persuasively human but that he represented a historically specific type of laboring body, in this case, an African American sharecropper. To achieve that effect, he was given a realistic physiognomy formed out of flesh-colored rubber rather than the more typical aluminum—with features of curly black hair, prominent lips, and rounded cheekbones—and he was dressed up to look like a fieldworker in denim overalls and heavy work boots, signifying the standard dress of the cotton plantation. With a kerchief around his neck, to wipe away imaginary sweat and to shield himself from an imagined hot southern sun, and a tin pail placed upside down on his head, in a peculiar indignity, this mechanical body not only looked like the descendent of an antebellum slave but also, as one contemporary put it, like a "dark-skinned minstrel."[5] Black, male, and working class, Rastus was, in other words, different from other robots, and that difference invites opportunity.

This essay reconstructs the emergence of the techno-fundamentalist fantasy of energy and technology as servant to humanity from its development in the mid-nineteenth century in the writings of industry boosters, consumers, scientists, and the state to its current critique by climate activists.[6] It explains that the discourse of technological servitude, with its privileged tropes of *mechanical servants*, *electric slaves*, and more recently, *energy slaves*, performs ideological work on behalf of modernity's privileged classes by minimizing the persistence of sweated labor in the fossil economy; by directing attention away from the stratification of privilege and pain along racial, class, gender, and international lines in that economy; and by misrepresenting, in an increasingly concerning way, the ecological role that fossil fuels have played in modern society and its current climate crisis.[7] It contends that these omissions and repressions impede

Figure 1.
Rastus Robot, the mechanical slave (Westinghouse, 1930).

the development of a healthy climate politics that speaks across social and territorial borders.

The first step is to reconstruct the genealogy of the *mechanical slave* or *servant* (terms that were, in most cases, used interchangeably) so as to clarify the social and ideological context in which this terminology of technological servitude first took root.

The Genealogy of the Mechanical Servant and Electric Slave

It is no surprise that the mechanical slave, and its successor, the electric servant, first achieved widespread currency in the mid-nineteenth and early twentieth centuries, respectively, during the epochal rupture, or the "great divergence,"[8] that occurred in the world when coal and steam permitted industrializing societies to leapfrog the resource constraints and muscular limits of the earlier somatic economy. Out of that rupture came the now firmly entrenched fossil economy in which industrialized nations like the United States shifted their energy base and labor burden (in the aggregate) onto subterranean minerals and the technologies that could transmute those mineral fuels into the equivalent of a working body.

The social context of this paradigm shift is relatively straightforward. According to the technology critic Despina Kakoudaki, the application of coal-and-steam engines to labor in English and American paper and textile mills in the mid-nineteenth century meant that workers and managers alike started to see and feel in intimate ways and in everyday practice an intensifying "exchange in the energies" between fossil-fueled engines and workers' bodies. That exchange, which began in the textile industries, quickly expanded into other industries and then intensified when electric technologies were applied to the assembly line in early twentieth-century factories.[9]

Together these developments, or what we casually term *industrialization*, created the historical context for collapsing ontological distinctions of importance between living and mechanical bodies. For instance, the term *work*—this rich, dense, meaty, and sometimes suffering human signifier—came to be redefined in this period not as an exclusively human, or even animal, activity but as a generic thing, as the quantifiable product of the expenditure of energy (i.e., coal, food calories, petroleum) relative to the efficiency of a prime mover, living or mechanical, that could convert that energy into labor.[10] Work came to be seen as something abstract, as *the result of a force producing movement*, while the concept of energy was pinned down to its current scientific definition—*the capacity to do work*. This reconceptualization of the material world and the human experience through a thermodynamic lens redrew the lines between living bodies and inanimate forces as well as between food and rocks, and it put steam engines and servants, minerals and slaves, iron horses and panting horses into uncomfortably close quarters.[11]

To get clarity on these matters, we might step back in time—to 1827, and to an unsuspecting place, to a special hearing held by Britain's Privy Council focused on the manumission of slaves in what is now British Guiana. Here we can catch a glimpse of the emerging equivalence between carbon technologies and human labor as it first took shape. In that hearing, a planter from Berbice who owned over fourteen hundred slaves, Hugh Hyndman, was questioned by the council on the equivalence of human labor and steam power, that is, of literal bodies and mechanical ones. The question was direct: "Is it a fact that steam is now employed in Berbice in substitution of labour formerly executed by slaves?"[12]

Hyndman's answer was not surprising, and it reflected the degree to which mechanization had proceeded in agriculture. Steam power had not, he said, made many inroads into the sugar plantations. West Indian slaves still planted the crops, picked the sugar, carried the cane, boiled the cane, and delivered it to port. In fact, as far as he knew, coal and steam were being used only in grist

mills for breaking and grinding the cane, and this phase of the production process had previously not been done by humans but by "wind and cattle." Steam power might have "economized" slave labor in one part of the process, he said, but nowhere had it replaced human bodies.[13] Thus despite the proliferation of steam power in this period, there was, as yet, no functional equivalency on the sugar plantation between slaves and steam engines.

What is interesting in this early case, however, is that this discussion of steam power was introduced into a conversation over the "abstract value" of biological (in this case, slave) labor. England was at the time trying to determine what the proper monetary compensation should be for a slave owner under the proposed new emancipation laws. The steam engine appeared here as an example of how it was possible in theory for any given laboring body, following manumission, to be replaced by some other equivalent type of purchased labor power, whether another conscripted human body (but not that particular one) or some form of mechanical energy. The debate circled around the concept of abstract, standardized, and replaceable labor.

A defender of the old regime, this slaveholder insisted that enslaved labor was too variable to be flattened into one generic measure of productivity or monetary value. Hyndman argued in a perverse logic of self-interest that slaves were individuals and thus not alike in their capacity to be productive. Some, he said, were "more valuable for physical strength" in the fields; some brought unique technical skills; and others, he said, were valuable to the slaveholder because of "their moral character . . . and influence on the rest." By his calculation, only about one-third of the slaves on a plantation were actually what he called "effective and able" laborers, that is, adults able to perform physically demanding work day in and day out. The rest were, he thought, too young, too old, too resistant, or too disabled to measure up to that standard. Moreover, some slaves, like boilers and machine tenders, were not easily replaceable because, unlike field hands, they were not depended on for their physical might and endurance but for their coveted technical skills, which had a multiplying effect. These considerations made it complicated to put a definitive monetary value on slaves in the abstract. "I do not think," he testified, "that I could possibly put a just value upon the loss the master would sustain" by losing any particular slave.[14] Hyndman was, in a sense, simply stating the facts of the time: there was not, except in wildly gross terms, any accurate way to gauge in standardized units what was coming to be called manpower.

What is revealing here, however, is that coal and steam popped up in this discussion of the abstract value of human labor. Although the trope of the mechanical slave was not in play in this case, the detour that the conversation

took was an important step in its formulation. The possibility that labor might not only be objectified (as it had been throughout history) but also abstracted and reducible to a standard measure whether derived from a machine or a living body—and thus removed from the sweat and sentience of people—was evident, in other words.

Hyndman's logic was not unique. It was part of the larger revolution in our understanding of human labor provoked by industrialization. By the 1820s that revolution had, in fact, also produced the curious concept of manpower, a generic analogue of steam power and horsepower. To quote one contemporary, "the human body, as a whole is a self-moving, self-supplying, steam-engine, not of a horse-power, but of a man or woman-power."[15] Although no one had yet surmised a scientific gauge for tabulating what exactly constituted a manpower unit, that development—a key step in the formulation of later debates over these energy slaves—was not far off in this effort by a liberalizing state to equate human workers directly to carbon technologies.

For a second example, we might push forward fifty years to an urban industrial geography. By this point, and in this place, the trope of the mechanical slave had taken firm root. The commentary of a French journalist, Eugene-Melchoir de Vogue, attending the 1889 Paris Exposition shows just how far "the form of labor," as he put it, and the perception of that labor had changed.[16]

What most impressed Vogue at the Paris Exposition was the vast mechanical "organism" he saw operating throughout its exhibits. Gazing down from the balcony of the Palace of Machines, with his elbows on the balustrade, he imagined that he saw the "universal law of labor" revealing itself everywhere in the fair's complex of steam- and electric-powered machines. "This crowd of automatons," he said—these analogues of biological labor—seemed to him to be working tirelessly throughout the fair with none of the "fatigue . . . noticed in the arms of the [human] laborer." Their "mechanical arms," he wrote, "work the metals, weave the cloths, prepare the food, light the lamps; they sew, print, engrave, sculpture; they adapt themselves to all demands, the heaviest and the most delicate." Moreover, these carbon-powered laborers were the perfect servants. Their temperament was obedient and docile: they submitted to being "shackled," they "obeyed," and they went, he said, to "sleep" when ordered to do so. To Vogue, the lesson of the exposition seemed clear: "Man," he said, "now hides himself behind a great mechanical slave."[17]

Vogue's report on the Paris Exposition exemplifies how the language of organicism and mastery, which had historically been used to describe living labor, was coming to be applied to machinery in a way that discarded former ontological distinctions of importance. What was not exactly true, however,

was the conclusion that he drew from these developments: that mechanical slaves had *replaced* actual slaves and other manual laborers in the modern world—or, more precisely, that it was simply a matter of time, a technicality, that they had not yet done so. For Vogue and the industrial bourgeoisie at large, this trope of the mechanical slave performed ideological work, functioning as the centerpiece in a narrative of technological mastery and emancipation that came straight out of the Enlightenment and served class interest.

We can see how the trope of technological servitude operated in that narrative by following Vogue's observations of an African traveler standing next to a steam engine. Having chanced upon this Sudanese traveler in one of the fair's engine exhibits, Vogue imagined this man to have been emancipated by carbon technologies: "Occasionally," he said, "a Negro from Soudan is seen in this gallery examining a steam engine. He would get down upon his knees before it, if he knew how much he ought to bless this *mechanical slave* which has been substituted in his place." The language was insensitive, if strong. This "black flesh," which had been replaced by coal and steam, he wrote, augured a fully liberated world wherein the mechanical slave—this "deliverer of the human race from the most irksome forms of toil"—would replace manual labor at large. Mastery of nature—in this case, unlocking the labor potential in prehistoric carbon—was, in other words, the material basis of modern freedom and equality and the imagined mechanism for ending actual slavery.[18]

In such a context, the mechanical slave was a glib, even frightfully crude, metaphor that misrepresented the role that coal, steam, and electricity had played in the world. But it also had enough truth in it—after all, the form, intensity, and scope of mechanical labor had revolutionized society and frequently displaced labor—to retain a hold on the popular imagination and to serve as the linguistic linchpin in this "religion of technology" that was becoming so ingrained in bourgeois culture, state propaganda, and industry boosterism.[19]

The Social Unconscious of Technological Servitude

This discourse of technological servitude also reproduced a certain social bias, a class, racial, and gender positioning, that is instructive to reconstruct. On the one hand, contemporary references to mechanical servants and slaves in the nineteenth and twentieth centuries were typically cast in generic, or deracinated, terms to indicate the mechanical liberation of the nation, or the species, writ large. For example, state propaganda from agencies like the Rural Electrification Administration referred simply to having access to "the cheapest servant" one could buy and learning to relax, since these "kilowatt hours


Miss
Katrina Van Televox
Mechanical Wonder Maiden
The Westinghouse
$22,000
Robot Servant
Invites You to Her
Housework
Demonstration
At the
H. S. Auditorium
September 22
2:30 p. m.
KATRINA Talks . . . Runs Vacuum Cleaner . . . Makes Coffee and Toast . . . Turns lights on and off and does it all willingly at command from Mr. Kirkpatrick, the Westinghouse Expert who is accompanying her on her tour. The audience will also assist Mr. Kirpatrick in making Katrina work.

don't get tired."[20] Likewise, a consumer goods company like the Gainaday Company, which sold electric clothing wringers, marketed the notion that a person might be emancipated from work—that she might "gain-a-day" free from muscular labor—by bringing into the house what it termed a "dependable servant" and "inexpensive worker."[21] And the once-familiar trademark figure Reddy Kilowatt, a blue-collar cartoon character with arms, legs, and a head attached to a bolt of lightning, introduced by an Alabama electric company in 1926, was pitched simply as the nation's faithful "electric servant . . . who worked for pennies" so that the rest of us might be free.[22] Here the language of servitude was generic and evacuated of its history.

But the rhetoric of technological servitude, and its prevailing discourse of mastery, reproduced a decidedly classed, racialized, gendered, and sometimes regional positioning, with the repressed referent of the subaltern body and especially that of captive black labor not far below the surface. This is not surprising, because the privileges of the high-energy society were, and are, socially stratified along such lines. Racial inequality, for example, provides a barometer. In 1940 the vast majority of white Americans had electric lighting in the home (82.9 percent), whereas the majority of nonwhites was still fueling lamps by hand with kerosene or gasoline (55.2 percent). Additionally, nearly half of all white Americans had electric refrigerators, in contrast to the majority (90 percent) of the nation's minority population, which had no refrigeration or simply used ice blocks. And if a majority of white Americans had gas or electric stoves by that point (58.7 percent), nearly three-quarters of the minority population was still stoking stoves by hand using coal or wood (70.8 percent).[23] It is especially telling that even today African Americans have only 55 percent of the median equity in the automobile culture of their white counterparts, a much lower investment in the nation's marquee energy technology and its expansively subsidized infrastructure.[24] Of course, such stratification reaches even more extreme disparities outside the developed world, as 17 percent, or 1.2 billion people, living in sub-Saharan Africa, parts of Asia, and rural areas lack even rudimentary electricity.[25]

Figure 2.
Katrina van Televox, the Mechanical Wonder Maiden (Westinghouse, 1930), *Free Lance-Star*, September 30, 1930.

The uncomfortable racial, class, and gender unconscious of this discourse can be seen close to the surface in a 1924 article titled "Idle Slaves of the South." That article, written by a southern modernizer in the peak years of electrification in the United States, concerned the enormous hydroelectric potential of this underdeveloped region.[26] At a time when a racialized system of sharecrop-

ping was still in full swing in the region's cotton fields, Marion Jackson's article looked onto the untapped energy of the region's rivers and streams and saw not simply untamed mechanical power or generic mechanical slaves but quite specifically underemployed black bodies—"idle . . . Negroes," as Jackson put it. Here in the South's falling waters, he said, were "millions upon millions of slaves . . . offering to serve, waiting only the command of man," a veritable army of black bodies "equal in labor energy to more than 75,000,000 men [or] over five times the Negro population of the United States."[27] Given its historical context, the analogy struck close to home.

The historical thickness—and the racial positioning of the audience as white—gave this analogy of mechanical servitude its rhetorical and affective force. While there was nothing to prevent such metaphorical slaves from working on behalf of the African American community or any other minority community, the terminology of liberation, mastery, and service typically highlighted the uplift of white bodies and directed its appeal to white audiences. That rhetorical positioning, in other words, replicated the de facto material stratification of property and opportunity in the high-energy society.

Equally important was the gendered logic that provided an emotional tug to this discourse. Jackson spoke, for instance, of the indignity of America's rural women grinding out their days in strenuous physical tasks like chopping firewood and carrying water for cooking, heating, bathing, and cleaning. This type of backbreaking labor—symbolized by what he called "the gaunt farm woman lifting daily her ton and a half of dead weight"—did not align neatly to middle-class visions of white women's role in society, and it fueled the technologist's dream of liberating the nation through energy development.[28]

In this instance, the concern was specifically with white women and their families living in a prostrated South, which Jackson said had never recovered from the fall of slavery and which he thought might be resurrected on a new foundation of mechanical slaves. "Americans of the purest strain," he wrote, these beleaguered white bodies living amid "drudgery" and "darkness," might be returned to their rightful rank once these millions of metaphorical *Negroes* were put to the work that actual slaves once did.[29] Of course, that fantasy was a peculiar regional one, tied to a specific time and place, but it speaks to the fact that this broader discourse of technological servitude was never socially or racially neutral.

A second article from *Popular Mechanics*, "Thirteen Slaves for a Nickle," further delineates the racial, class, and gender circumference of this metaphor. Written in 1939 during the long fetch of the consumer's republic, this article

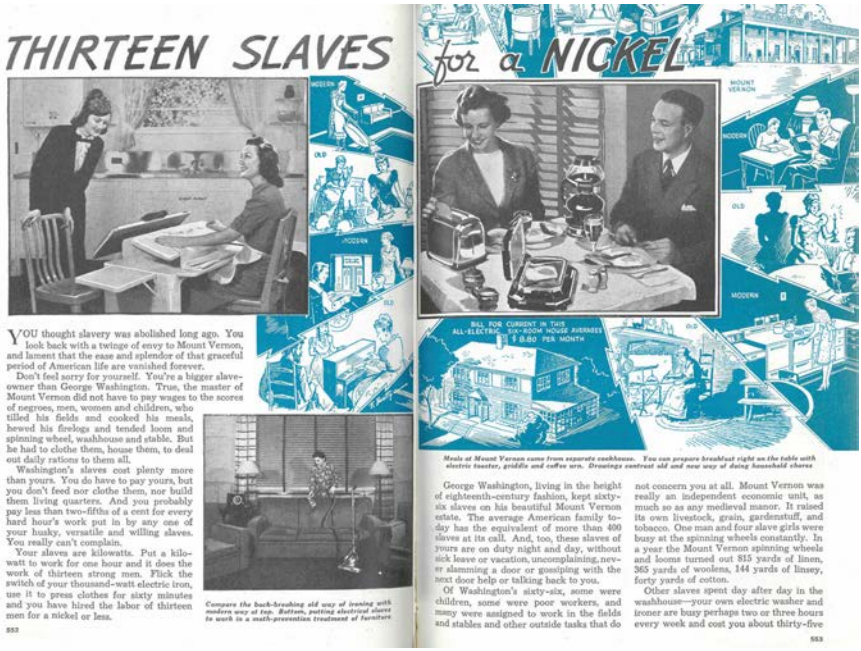

Figure 3.
"Thirteen Slaves for a Nickel," *Popular Mechanics*, 1939.

tied the joys of a midcentury high-energy lifestyle to an earlier history of racial and class privilege. Here the pleasures of the white middle class having work done for it by these electric washing machines, furnaces, dryers, stoves, and other mechanical devices—these modern "slaves"—were tied up in a racialized nostalgia for the plantation and for having actual servants and gendered black bodies at one's beck and call.[30]

"You look back," it started, "with a twinge of envy to Mount Vernon, and lament that the ease and splendor of that graceful period of American life are vanished forever." The article then turned the tables: "Don't feel sorry for yourself. You are a bigger slave owner than George Washington."[31]

The premise in this case was that Washington, living at the height of eighteenth-century fashion, had only 66 actual slaves (in reality, he had 123, plus dower slaves and rented slaves) working his Mount Vernon estate, whereas the modern middle-class consumer had several times that number of mechanical bodies at service in the home, as many as 400 potential "slaves" that when activated could work at a "muscular rate" that far outperformed that of real bodies. These included so-called "manservants" who kept the water hot and tended the furnace at night; "maidservants" who mixed, ground, and baked

one's food with only the touch of a button; and "kilowatt coolies" who worked for the "lowest wage" at whatever other mechanical tasks could be shifted onto electricity.

This framing of access to technological servants in class-inflected, gendered, and racially somatic terms was drawn out in several other ways. For instance, the article detailed the various muscular tasks, like churning butter, woodworking, and distilling wine, that slaves did on Washington's plantation and guessed at the number of man- and woman-hours devoted to each of those tasks. It then contrasted these literal slave hours with the work being done by mechanical energy in the average suburban home, tasks like pumping water, heating rooms, washing clothes, mowing grass, blending fruit, and lighting bedrooms—estimating that this mechanical work added up to as much as "156-servant hours a day." Moreover, it suggested that whereas the master of Mount Vernon had to bear the additional burden of housing, clothing, and feeding his "scores of negroes," modern consumers of electricity could own these "husky, versatile, and willing slaves" for less than a cent an hour without worrying that they might "complain," "slam the door," or "gossip" behind one's back.[32]

What is revealing in this rhetoric of mechanical servitude is that the imagery of the white middle-class body, and in particular the white female body (see fig. 3), being serviced by servants, coolies, and slaves was so explicit.[33] This rhetoric evoked an emotionally charged history of black men's bodies sweating in southern cotton fields, of Asian men's bodies toiling in western laundries and colonial plantations, and of black and immigrant women serving their white mistresses and masters in middle-class and upper-class homes. As such, it made transparent the otherwise tacit racial, class, and gendered substructure that gave to the trope of technological servitude much of its rhetorical force and that replicated in ideology the realities grounding the social stratification of the growing consumer's republic. In such a context, the advent of a "realistic mechanical negro" like Rastus seems culturally logical, if abhorrent, but it also speaks to the historic inequalities and blind spots that evolved in the nation's technological imaginary.

Quantifying Mechanical Servitude

How this discourse of mechanical servitude acquired a quantitative grounding is equally important, since its quantification has shaped how we understand the scale of the impact of carbon technologies on modern societies and the human experience. To gauge that scale, someone had to deduce what the abstract work output of a human body might be in kilowatt hours or some

common gauge that would allow us to equate the output of inanimate motors to that of the so-called human motor. That is, someone had to calculate what constituted a generic "manpower unit" along with the energy calories required to produce that unit.

Quantifying biological and mechanical labor, in this modern way, began as early as James Watts's efforts to determine the *horsepower* capacity of his steam engine in the 1780s, when he ran a set of calculations based on the ability of draft horses to perform comparable mill work. But it became a much larger business in the mid-nineteenth century when physicists, physiologists, and engineers in Europe and North America, who were grappling with the changes wrought by mechanization, reconceptualized the human body as an engine within a new physical paradigm that located energy (i.e., calories) and its conversion into work as the cornerstone of modern scientific thought. An entire industry of body studies developed in these years in the work of European engineers and physiologists like Etienne-Jules Marey and Hermann von Helmholtz that relied on time-motion studies, studies of respiratory rates during physical exertion, and studies of metabolism and fatigue to offer fairly precise calculations of the rates of energy efficiency, mechanical capacity, and physiological limits to organic bodies. This work in rethinking the body as a *human motor* capable of generating a standardized work output reached across the Atlantic and became popularized in the writings of industrial engineers like Frederick Winslow Taylor.[34]

We might take as representative the proceedings of the Franklin Institute, one of the nation's oldest scientific organizations, in Philadelphia. This group of engineers and academics gathered in 1873 to take stock of engineering terms concerning work and power and how they were being used and abused by various parties. In a treatise titled *Establishing Precision to the Meaning of Dynamical Terms*, the members of the institute proposed to nail down the definition of "manpower" to 50 foot-pounds per second of power, or the force needed to displace 50 pounds by one foot in one second—a figure they took directly from Arthur Jules Morin's earlier dynamometer experiments estimating the work output of various bodies in motion. They further proposed to lower Watt's estimate of a horsepower unit from 550 foot-pounds per second to 500 because it overestimated actual horsepower and because the lower figure would make its ratio to manpower a neater alignment of one to ten. The only additional rationale they offered for that latter ratio was that a man weighs about one-tenth that of a horse and that he eats about one-tenth the calories.[35]

This generic concept of manpower reproduced the assumption that work meant merely physical force rather than skill, precision, or intelligence and

thus proposed as its gauge the adult male body at brute tasks rather than some other measure. Such a redefinition of work, of course, elided the complex social realities of manual labor. Subsequently, however, one manpower unit, translated into wattage, came to be calculated simply at 75 watts of power, a consensus that, while always questioned, has remained intact today.

With such terminology in hand, geologists, economists, and engineers tossed around some ballpark figures of the nation's total mechanical servitude in the early twentieth century in an effort to quantify the material progress made in adopting carbon technologies. Those estimates derived chiefly from national inventories of mechanical horsepower capacity taken by the US Geological Survey, which tallied the nation's prime mover capacity in automobiles, steam-powered railways, electric stations and trolleys, manufacturing engines, carbon-powered ships, and farming and irrigation technologies. The estimate put forward by the director of that survey, George Otis Smith, was that Americans possessed, even as early as 1921, about a billion manpower units in mechanical labor, or what he described to be ten "energy servants" apiece "to do our bidding."[36] Other contemporaries, who tweaked his assumptions a bit, arrived at figures as high as three times that number—a total of "three billion hard-working slaves," or thirty mechanical slaves for every "man, woman, and child" in the United States.[37]

Of course, none of this was a perfect science. The disparities make that clear. The numbers changed depending on assumptions: Should mechanical equipment not in use, or periodically used, still be counted as a full horsepower? Was it sensible to assume a manpower unit could be sustained in the same way as that of a fossil-fueled tractor? How was energy used to generate power to be disaggregated from energy used for nonwork purposes like lighting, heating, or cooling? Still, this earlier work set the stage for later assessments of the role that fossil fuels and technology played in modern life.

Out of these efforts to quantify mechanical labor and assign to it a historic analogue came the term *energy slave*, a trope, or meme, that now circulates in environmental debates, albeit in a way different from its original instantiation. First used in 1940 by the popular intellectual Buckminster Fuller in a *Fortune* magazine graphic, this terminology of the energy slave shifted the metaphor's thrust from an emphasis on machines to an emphasis on the energy consumption that fueled those machines. If earlier geologists, engineers, and economists had based their estimates on actual inventories of existing mechanical capacity, Fuller had simply translated all our energy consumption, despite its end use, into theoretical manpower, or energy slaves. To derive his calculations, he estimated national and global energy consumption at large, then calculated how

much work potential was in that energy, and finally divided that number by the figure used to define a unit of manpower, 75 kilowatts. Bracketing the fact that as much as half of the world's use of energy went into heating rather than mechanical work, Fuller calculated that the world's two billion people now shared the globe with another "36,850,000,000 inanimate *energy slaves*" and that over half of those slaves, or "an army of 20,000,000,000," were housed in the United States alone. This, Fuller said, represented "man's answer to slavery," and it was driving the world's economy and populations radically upward.[38]

A final step in quantifying this concept of technological servitude was the stamp of approval given to it by the academy in the midcentury work of the anthropologist Leslie White. White's pathbreaking 1943 essay "Energy and the Evolution of Culture" provided this discourse with a recognized narrative format that, while always questioned, qualified, and critiqued, has persisted throughout environmental writing in the subfields of energy history and ecological anthropology.[39]

White argued in this and a series of related pieces that our species' historical progress could be measured, at bottom, as the product of the quantity of energy consumed by a society multiplied by that society's technological capacity to transform that energy into work. He argued, in a now-familiar story, that human history proceeded from low-energy strategies like hunting and gathering, where individuals had mostly "the energy of [their] own body under . . . control," through pastoralism and agriculture, which increased our control over solar energy through biological converters like domesticated animals and plants, to today's high-energy societies, where technologies for turning coal, oil, natural gas, and atomic power into work had revolutionized productivity, accelerated material wealth, and led to more complex forms of cultural development. That argument redefined the "cultures of mankind as a form or organization of energy" (relative to technology), and it reinterpreted all "behavior, whether of man, mule, plant, comet or molecule . . . as a manifestation of energy." "Energy is energy," White declared, "and from the point of view of technology it makes no difference whether the energy with which a bushel of wheat is ground comes from a free man, a slave, an ox, the flowing stream or a pile of coal." Here the human worker was shrunken to that of a prime mover, to "a groaning and sweating slave" capable of generating "75 watts of power," and human culture was reimagined as nothing more than the quantity of material goods that resulted from converting energy into economic productivity.[40]

The conclusion White proposed was as facile then as it is today. He concluded that "cultural development," or "C" could be measured by simply taking a society's energy consumption ("E") and multiplying that number by its technological capacity to convert that energy into work ("T").

To wit:

$C = E \times T$.[41]

Or to paraphrase that equation: fossil fuels multiplied by technology equals modern culture.

Such a bold conclusion was, of course, not tenable, but it demonstrates how the concept of energy as slave to humanity came to fit within a formulaic structure that embedded it in a master narrative of human evolution that assigned to technology, and humanity's mastery of nature's energies, an uninterrogated role. By such a gauge, the mechanical slave, the body of Rastus, or the "T" in the equation was assumed to outweigh all other nonmaterial factors in the progress of our species. That assumption, even if modified, has proved hard to dislodge.

The Energy Slave in Climate Discourse

To be sure, Rastus, and this discourse of technological servitude, has not gone away. Today's environmental activists have, in fact, resuscitated Rastus's body—now termed an *energy slave*, *virtual slave*, or *ghost slave*—to critique modernity and its addiction to fossil fuels. But they, and this includes my own writing, have done so in a way that carries forward some of the term's previous shortcomings and introduces new ones into the present politics of climate change.

The term *energy slave* popped up in its new environmental context in the mid-1960s and early 1970s coincident with the birth of the modern environmental movement and the oil crisis, both of which brought fossil fuels into national focus, but it then returned and intensified in the early twenty-first century in the current context of public debates over human-induced climate change. The term has since appeared with increasing frequency in popular media outlets like MSNBC, PBS, Wikipedia, and Grist.org, and it has shown up in academic writings on the environment, including such books as *Ecological Economics* (2005), *The Second Law of Economics* (2011), *Cultures of Energy* (2013), *Oil Culture* (2014), *Routes of Power* (2014), and in my own *Carbon Nation* (2014). The most influential use of the term derives from J. R. McNeill's landmark 2001 textbook, *Something New under the Sun*, a widely assigned environmental history of the twentieth-century world. In that text, McNeill argued that fossil fuels and their conversion into power, these *energy slaves*, so to speak, have played a singular role in propping up the material infrastructure of modern life and in defining the problematics of our present.

As McNeill puts it, the average global citizen has come to depend on twenty "energy slaves," or about "20 human equivalents working 24 hours a day, 365 days a year," to support the world economy and the material standards of living it makes possible. He tempered that claim by explaining that while the quantity of power unleashed by modernization was catalytic—"something new under the sun"—it was also cut through by differential access to that power, which reinforced old forms of inequality and produced new forms. The average American might command, he said, "upwards of 75 energy slaves," but the average Bangladeshi still depends on "less than one."[42] This rhetorical intervention brought a measure of self-consciousness to bear on our carbon dependencies, and subsequent environmental writers have found that rhetoric compelling.

Several premises are explicit or implicit in this logic, and each carries with it certain problems. For the technology and science critic Sara Pritchard, the discourse is not entirely "innocent" on ethical, historical, and political grounds.[43]

The first premise is a familiar one. It is that fossil fuels are equivalent to slaves, that when converted into work, they perform the same type of physical labor that slaves and other exploited bodies once did. This logic, seen in McNeill's writing and in the sociologist William Catton's earlier book *Overshoot* (1980), has been rapidly duplicated across environmental discourse. We see it foregrounded, for instance, in the title to the award-winning journalist Andrew Nikiforuk's *The Energy of Slaves: Oil and the New Servitude* (2012), a book that builds on the premise that each barrel of petroleum is "the equivalent of 3.8 years of human labor" and that modern consumers in oil-rich North America are thus dependent on "89 virtual slaves," or for "a family of five . . . nearly 500 slaves," to support their standard of living.[44] That claim appears casually across environmental writing, and it is not inert. It can be taken to mean, as one critic has pointed out, that petroleum and coal not only serve as the functional equivalent of laboring bodies but have caused slavery to be "a less desirable solution to global labor demands."[45] In other words, this premise can imply causality, whether intentionally or unintentionally, by suggesting that energy slaves had something to do with the displacement of actual slavery, and even sweated labor, itself. But, as the historian Klas Rönnbäck shows, the historical relationship between fossil fuels and slavery does not lend itself to so easy a conclusion.[46]

The second premise is that consumers living in North America and Europe represent a new type of master class that derives its social power from these "energy slaves." This premise is evident, for instance, in recent remarks made by the anthropologists Thomas Love and Michael Degani in *Cultures of Energy*, where they explain that even at the high price of $100 a barrel for oil (which

translates into 450 weeks of human work), Americans have come to rely on some "very cheap slave[s] indeed." This easy access to mechanical energy, they say, inclines those of us who hold that power to adopt the same "demigod sense of self" and "unwarranted belief in our prowess" as that of the preindustrial slaveholder.[47] The strongest statement of this position comes again from Nikiforuk, who contends that the world is run by a "petroleum slaveocracy." He writes that Westerners are a privileged class that "hoards" its energy slaves and the fruits of their labor by gleefully burning up for its comfort as much as 23.6 barrels of oil a person annually without regard to the social and environmental costs of that practice, while the rising class of "new and leaner slave masters" in Asia accomplish their own mastery with only 2.4 barrels of oil a year, or, in his words, with about "9 coolies at their beck and call.[48]

The ethical implications of this comparison came to light in an article published in the journal *Climatic Change* in 2011. In "Past Connections and Present Similarities in Slave Ownership and Fossil Fuel Usage," the historian Jean-Francois Mouhot argued that it was politically useful (if not also a bit risky) to compare past slaveholding to the burning of fossil fuels on historical and moral grounds. We in the West behave "like slaveholders," he wrote. "We are as dependent on fossil fuels as slave societies were dependent on bonded labour. . . . [and] in differing ways, suffering resulting (directly) from slavery and (indirectly) from the excessive burning of fossil fuels are now morally comparable, even though they operate in a different way." Mouhot was, of course, trying to shake things up a bit; and his rationale for doing so was that the cost of burning fossil fuels in the West was having, and would have, such an adverse impact on the global poor—as a result of rising sea levels on tropical islands, extreme droughts in already arid regions, and unpredictable weather patterns in vulnerable coastal communities—that burning them with a conscious understanding of their costs had become morally, and historically, comparable to the previous exploitation of slave bodies.[49] Although most writers do not reach that same conclusion, their use of the analogy depends on a similar guilt by association.

The third, and final, premise is that premodern slavery was a type of energy system. This premise, which grounds the field of energy history, can be seen in, for example, Jean-Claude Debeir and his collaborators' increasingly influential *In the Servitude of Power* (1991). The authors of that text explain that the slave's ability, and more generally the human body's ability, to convert energy calories into labor makes those bodies functionally equivalent to watermills, windmills, and steam engines for the purposes of productivity. That logic places the practice of slavery under the category of energy management,

or "the social control of energy," and it makes slavery historically equivalent to later practices of hydroelectric development or power grid management. Thinking within this paradigm can take on uncomfortable implications. For example, it allows for the conclusion that previous cultures depended on "the slave *engine*" or that they operated on "the two-cycle *engine*, the energy of solar-fed crops and the energy of slaves" (emphasis mine);[50] and it can imply that slaveholders saw the world through the same instrumental rationality as the modern engineer. Nikiforuk claims, for instance, that slaveholders "calculated the calories burned by slaves" with the "economic coolness" of today's engineer, that they worried about energy losses (i.e., runaway slaves and stolen food) in the same ways that the accountant does, and that they were, like the efficiency specialist, hell-bent on recapturing lost energy by hunting down fugitive slaves and punishing idle ones. Historical difference gets flattened in this rhetoric when we hear, for instance, that the Middle Passage was "a leaking pipeline," a wasteful energy practice that saw as much as one-fourth of its potential energy lost to poor transportation practices.[51]

This language is meant to provoke, as the historian Christopher Jones observes, and it has a catalytic verve to it that the drone of climate change statistics does not.[52] But it carries forward some undesirable luggage that is both old and new, and it is to those concerns that we finally turn.

Technology, Nature, and the Ethics of Energy Consumption

The ghost of Rastus haunts the nation's somatic past, present, and immediate future. Although long since decommissioned, he stands in for the modern problematics of energy, technology, and labor. To conclude, we can draw three lessons from the body of Rastus as we assess how this discourse bears on today's public debates over fossil fuels and climate change.

First, the body of Rastus returns us to the increasing exploitation of human labor under the fossil economy.

The mechanical slave, this metaphor of disembodied labor, and the later deracinated vocabulary of the energy slave have a tendency to underplay the lives of humans and our historical continuity with the somatic economy. What is often missing in these metaphors is what is missing in the bourgeois imaginary at large—a nuanced understanding of the historical experience of actual bodies under the fossil fuel regime and the structural constraints that divide those bodies from each other through a persistent dialectic of middle-class privilege and subaltern suffering. While the language of the mechanical slave, and the energy slave, is powerful in its ability to evoke the *amount* of

disembodied labor we collectively rely on today, and it helps dramatize how *some* bodies have been emancipated by this development, one unintended consequence is that it blinds us to the persistence of the muscular economy that still dominates much of the globe, where bodies are used up in old ways and where class exploitation has only been intensified and economized through the application of carbon's power. The trouble with how the metaphor of mechanical slavery has been deployed is that it steers the mind away from the persistence of physical labor in the current fossil economy while stripping the terms *slavery*, *servitude*, and *exploitation* of their ability to connote socially specific types of suffering. To paraphrase the anthropologist Alf Hornon, fossil fuels did not *replace* human labor, they *displaced* it by rendering physical exploitation less visible to the privileged.[53]

That is to say: our language and our politics carry the social landscape in them, and the body of Rastus calls us back to that fact. It speaks, for instance, to the problematics of carbon and class. While not intentional, the trope of technological servitude has always been a class-based metaphor, the language of the bourgeoisie, directed at those who command that energy, and a trope that has not sought its audience among, or derived its perspective from, those who have found themselves in the path of carbon. Likewise, the body of Rastus as an African American body brings us back to the relationship of carbon and race. It reminds us that mechanical labor has worked along racially stratified lines—that the virtual slave did not end racial exploitation but introduced into the world new racially contoured geographies of pain where minorities across the United States and global South were too-often exempted from the privileges of carbon. And finally, Rastus's body reminds us that the fossil economy is gendered—that while labor has often been pictured as a male burden, women's labor has always been deeply woven into the warp and woof of history.

Rastus's body, artificial though it might be, brings us back, that is, to these socially differentiated bodies and their place in our history and our future. It reminds us that it is too easy to speak in abstractions—of averages and medians—when we leave behind actual bodies. To confront climate change will mean bringing these bodies back to the table to take inventory of their values, their pains, and their fantasies for a postcarbon future.

Second, the body of Rastus speaks to a collective failure to understand how nature has been administered under the terms of the fossil economy.

From the advent of the steam engine, the mechanical slave has implied the circumvention of nature—an escape from the old rules where labor meant bodies, where bodies meant food, and where food meant thinking carefully about soil, trees, and other limited natural resources. The energy slave allowed

some of us to forget the logics of what we call the organic economy and to imagine that technology had somehow detached us from the environment. The phantasmagoric spike in wealth that occurred in the industrial core in the wake of these carbon technologies gave many of us the privilege of being very imprecise in our thinking about natural resources, technology, and wealth.

This imprecision is, in fact, carried forward in the literature of the energy slave itself. The current method used to derive estimates is to take Department of Energy data of total energy consumption and divide that number by the work potential of an average adult male estimated at 75 kilowatts of power. What is lost in translation is how that energy is actually utilized, how it flows through our lives, and who owns and controls it.

One part of the problem is that this trope simply misrepresents the ecological role that carbon technologies have played in modern life. Fossil fuels do much more than perform physical work. They free up arable land by taking pressure off forests previously needed to provide fuel; they relieve soils from the former demands of biological labor; they provide the surplus heat needed to construct a world of congealed carbons, of concrete, steel, glass, titanium bikes, and metallic solar panels; they ground our food supply; and they provide the main material input for the production of synthetic fibers, rubbers, epoxies, plastics, laminates, and fertilizers now critical to modern culture.[54] Hard and soft coals, short and long chains of hydrocarbons, enter into our lives through different processes and for different purposes, and there are thus different reasons for mining anthracite in Pennsylvania and bituminous in Wyoming's Powder River Basin.

Energy, work, and technology might bear a close kinship to one another, but they are not perfect synonyms, and thus part of the political work that needs to be done requires reckoning with the multifaceted ways that fossil fuels structure how we sit, at seven billion people, relative to nature.

That reckoning is, however, also a political one. The potentially bigger problem, as Bertrand de Jouvenal once said, is that our command of nature's energies and our access to technology do not fall under our management in the way that these terms *servitude* and *slavery* imply.[55] These energy slaves, and the industrial processes of modern life they reproduce, are not really owned and commanded by individuals or families but accessed in a premapped infrastructure of highly centralized corporate power that determines how we gain access to them and how we do not. We know that nature's bounty is not collectively shared, but it is important to remind ourselves that those who hold and pull the chains of carbon occupy a privileged position in administering our relationship to nature whether we are middle class, working class, or poor.

What our relationship to nature is today, and what it will be in the future, requires, that is, a frank confrontation with the structures of economic power in the world that have for too long made these decisions without our input.

And third, that body calls us back to the erasure of historical memory in the politics of economic development and forecasting within the current mineral paradigm.

It reminds us that neither the past nor our current climate politics lend themselves to neat liberal, neoliberal, or progressive metanarratives evacuated of historical difference. The conceit of inventing a mechanical slave or servant to free humanity from the material world was always a premade parable rather than a tested hypothesis or historical fact—a fable that has for two centuries insisted that we might emancipate ourselves through reason, science, technology, and the mastery of nature. That enduring techno-fundamentalist fantasy has been well suited to free market capitalism, with its emphasis on technology, private property, and the liberating effects of human creativity, and it has proved equally adaptable to political ideologies on the left and right. But today the danger is that this language of servitude reinforces neoliberalism's retrograde climate politics by emphasizing mastery and by functioning as the metaphor and evidence that gives to its story of progress a dose of credibility while making its ideology legible.

Today's climate activists, of course, understand that the relationship to fossil fuels has never been suitable to a story of emancipation, that our carbon technologies have always evinced a Janus-faced history that doles out wealth and penury, pleasure and pain, comfort and risk in equal measure, but this rhetoric of energy slaves risks leaving us, in Pritchard's words, "dangling in abstraction" as our politics concern actual people.[56]

To unthink today's carbon culture means unthinking overly generalized language. It means digging deep into the modern soul to bracket its *reason* and *common sense*, these historically specific things we inherited from a unique, and unrepeatable, moment of great ecological generosity; and it means reckoning with the fact that we are an odd type of self-rationalizing *animal* with some hardwired genetic and cultural coding that coaxes us toward a smoke-gray horizon despite ourselves. If we are to rediscipline the modern soul for a post-carbon future, then those of us who profit from this energy regime will need to distance ourselves from abstracted metaphors of empowerment and from the common sense that the technologist's fantasy perpetuates. A sustainable future will mean rethinking the tropes of *nature as servant to humanity* and *humanity as master of nature* in order to bring our technologies back into line with the

type of environmental and humanistic framework that comports not only with our understanding of the appropriate use of energy but also with our sense of social justice. That is, today's political project will require reweighing and rewriting the history of the industrial age and the postindustrial hangover by confronting not only its successes but all those blocked desires, those broken bodies, and those social failures locked up in a history that we have until now collectively repressed and struggled to articulate.

CO2 levels have climbed upward of four hundred parts per million. We face the prospect of entering a hothouse not seen since the time of the megatooth shark. To be ready for that future, we will need not only new technologies and new social policies but also the right language and history.

Notes

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2. "Electric Flea Circus," 19.
3. On the anthropomorphizing of Westinghouse robots, see Sarah Toton, "From Mechanical Men to Cybernetic Skin Jobs: A History of Robots in American Popular Culture" (PhD diss., Emory University, 2014), 30–31, 54.
4. *OED Online*, s.v. "robot," n.2, www.oed.com.ezproxy.nu.edu/view/Entry/166641?rskey=NuwWd1&result=2; see also Tobias Higbie, "Why Do Robots Rebel? The Labor History of a Cultural Icon," *Labor: Studies in Working-Class History of the Americas* 10.1 (2013): 99–121.
5. Taylor, "Machines That Are Almost Human," 6; Toton, "From Mechanical Men to Cybernetic Skin Jobs," 69–74. See also Gregory Hampton, *Imagining Slaves and Robots in Literature, Film, and Popular Culture* (Lanham, MD: Lexington Books, 2015) for discursive parallels between antebellum representations of slavery and robotic narratives of servitude.
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7. This essay builds on the 2006 special issue of *American Quarterly*, which reclaimed technology as a major organizing topic of the field. It proposes, however, that technology studies can benefit from locating itself in the field of energy studies. See Carolyn de Pena, "'Slow and Low Progress,' or Why American Studies Should Do Technology," *American Quarterly* 58.3 (2006): 915–41.
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9. Despina Kakoudaki, *Anatomy of a Robot: Literature, Cinema, and the Cultural Work of Artificial People* (New Brunswick, NJ: Rutgers University Press, 2014), 161.

10. See Anson Rabinbach, *The Human Motor: Energy, Fatigue, and the Origins of Modernity* (Berkeley: University of California Press, 1992), 49–52.
11. Bob Johnson, *Carbon Nation: Fossil Fuels in the Making of American Culture* (Lawrence: University Press of Kansas, 2014), 42–46.
12. "Slaves: Berbice and Demerara: The Minutes of Evidence," House of Commons, April 18, 1828, in *Slave Trade, Two Volumes*, 25.
13. Ibid.
14. Ibid., 28.
15. *OED Online*, s.v. "manpower," www.oed.com.ezproxy.nu.edu/view/Entry/236229?rskey=MshFGA&result=1&isAdvanced=false.
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17. Ibid.
18. Ibid., 195–97; E. A. Wrigley writes that the economist Emile Levasseur also developed this analogy in the 1880s (*Continuity, Chance, Change: The Character of the Industrial Revolution in England* [Cambridge: Cambridge University Press, 1998], 76).
19. Quoted in Dinerstein, "Technology and Its Discontents," 569.
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29. Ibid.
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31. Ibid.
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33. According to Toton, the concept of the robot as servant was tied to a gendered logic of marketing domestic help to middle-class housewives ("From Mechanical Men to Cybernetic Skin Jobs," 39, 56–57).
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