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Electricity is not a noun

Gretchen Bakke

O body swayed to music, O brightening glance,
How can we know the dancer from the dance?

W. B. Yeats[1]

Not a thing, stolen

It begins with a theft. 'Early in the process of Soviet electrification,' writes Arkady Markin, a Soviet himself and chronicler of this era, 'two men were arraigned for stealing energy. Though they freely admitted to tapping somebody else's electric mains, they were acquitted on the following pretext: "The nature of electricity is unknown," said the judge. "When talking of electric current people take the word 'current' conventionally. A theft, however, implies that some definite object must be stolen, such as storage batteries, or wires." In response, the defense attorney crowed, having just won his case: "The courts cannot establish the fact of theft! Indeed," he continued, "can a smell, or air, or sound be stolen?"' (Markin 1961, 7).

The same story, again differently

In 2016, a power systems engineer in California repeated to me an explanation he had given his wife for the difficulty in assuring 100 per cent renewable power on any large-scale electricity system (a difficulty not acknowledged by those electricity retailers, who promise to sell such purity to customers for a small additional surcharge). 'Stand in the middle of a field,' said this engineer to his wife. 'At the other end of the field are a number of men, each equipped with an identical bass drum. This one we'll call coal; this one – nuclear; this one – natural gas; that one – wind, a last – solar. Imagine, one man, coal, begins to beat his coal drum, *bang bang bang*; add the natural-gas drum, *bang bang bang*, the nuclear, and the others, all the others, until the air is resonant with the same beat at the same rhythm.' 'Now,' he said, 'try to only listen to the one called wind.' It is as impossible to hear a single drum amid the cacophony as to separate out and use a single-sourced electron stream on a contemporary electric grid. Grids are made stable – culturally, fiscally, physically – by means of a mix of diverse energy sources feeding them (and, though this is not part of his story, also by a mix of diverse draws upon them; one listener is not enough, for when she sleeps, who will listen in her stead?).

As this single story intimates, understanding electricity presents a number of serious conceptual problems. It is, simply put, very difficult to think. Weirdly, it is easier to make, work with and design for electricity than it is to know it. We had dynamos aplenty for producing an electric current thirty years before anyone could figure out what to use it for and half a century before the intimate structures of the atom were divined. Even today, one can go to school and learn the physics, the math, the formulas, the drawing of circuits, but even then a gap persists, between laymen and experts, between a wife and a husband, between the legislator and system regulated, between the consumer and the producer.

The Soviet judge does right by this misunderstanding, by letting the gap rest, deeming it unbridgeable and thus beyond his capacity to enforce the law upon it. Capitalists, more eager in their pursuit of mastery, have also struggled mightily with electricity's intractabilities – How does one count what is indivisible? How does one store instantaneity? How might one enslave the lethal? How does one extract profit from a force? We are now 140 years into the era of domesticated electricity, and none of these questions have been resolved in a satisfactory way. Convention coupled with monopoly merged with the staid manageability of 'stock resources' (things that when we use them, we use them up) has worked well enough, but the mass integration of renewable sources of power is ripping convention apart. How electricity is understood and misunderstood, thus, matters a great deal to how future systems that make it and manage it are imagined, designed and built out.

Thinking with things, for better or worse

In 1963, Claude Lévi-Strauss wrote, in a small volume (not about electricity) that 'natural species are chosen [as "totems"] not because they are "good to eat" but because they are "good to think"' (Lévi-Strauss 1963, 89). It was a seemingly simple turn of phrase initially designed to refute functionalist approaches to 'primitive' social and religious practices that claimed the opposite: that animals became symbolically important because they *were* good to eat.[2]

However, by the 1950s, as Lévi-Strauss was framing his dismissal of the 'good to eat' school of social analysis, it was becoming clear: first that certain animals held great symbolic import to certain peoples despite being irritating and not particularly tasty (most notably the mosquito); and second that symbolic categorizations had more to do with the relational matrices that certain animals functioned within than with their literal qualities. Lévi-Strauss's interest was not in literal social function. Rather, he suspected that relations between animals were, for humans, primarily tools for thinking about *other* systems of relations. Their function was symbolic and culturally particular. So, for example, a suckling pig, or mosquito, or tortoise each stood within a system of natural relations with other species of animals, and these become etched, by dint of familiarity, into the minds of the people who live in intimate proximity with them.

Though Lévi-Strauss's proposition relating to categories of mind that become modally inflected categories of culture has had a long and fruitful afterlife within anthropology,[3] what has been most remarkable is the staying power of the phrase 'good to think with'. It might well be true that animals are good to think with but only about half as good to think with as the notion that 'things' of various sorts are good to think with. Thus do we have: women are good to think with; autochthony is good to think with; satyrs are good to think with; science is good to think with; Bourdieu is good to think with; glaciers are good to think with; genes are good to think with; disabled people are good to think with; the body is good to think with; and so is pantomime, and the apocalypse, and birds, and zombies, and community and so on and so on, pretty much ad infinitum. [These examples are taken from the first two pages of hits on a Google search for 'good to think with'].

What unites all these things good to think with is that they are all *things* – material objects in the world – or they can be treated, linguistically, as things. Thus, as the phrase itself has multiplied, what has become most clear is that more than any of the particular instances in which it has been used, the notion that 'things are good to think with' has itself proven very good to think with. And if, at the beginning, in Lévi-Strauss's baptismal use of the phrase, he was not arguing so much that animals were better to think with than, say, varieties of nut but rather that it was their 'being good to think with' rather than their 'being good to eat' that made them important to human society, this nuance has largely been lost with time. If animals are 'good to think with', and I agree that they are, it is now implied by the phrase that they are *better* to think with than with some other sort of thing. The examples above, thus, imply that women are better to think with than men; glaciers are better to think with than puddles of water; the undead are better to think with than the dead; and so on. Though this comparative is never made specific, it is always implied by both the structure of the phrase and the arguments that follow from it.

But what of the other things – things infelicitous to thought? And, I think it's worth also asking, what sorts of thought are they infelicitous to? We do have a partial list of things that are particularly difficult to think with, thanks to our Soviet defence attorney: smell, air, sound and electricity, all things which failed, in the early 1900s, to achieve a certain decided materiality. The atom had not yet been proven. Air and smell could not yet be thought of as particulate, sound's impact had not yet been thoroughly thinged into a 'wave', and no-one had any idea what electricity was; materiality, even metaphoric materiality, did not stick well to these non-things – non-things, not nothings. For if 'we know that a theft has occurred', what we do not know is what has been stolen. The fact that we can call that-which-was-stolen by a name, *electricity*, doesn't seem to help in the least. The name, in this case, is insufficient to 'thingize', or legally materialize, a non-thing.

It turns out that to transform things that are bad to think with into things that are good to think with, we need not so much *materiality* as *measure*. A whiff of roses on the wind. A 10-volt battery. A cubit foot of air. A pulse of sound. We need containers for unwieldy, infelicitous, bad-to-think-with things. Linguistically, this tends to mean that we need the genitive case, which is charged with both possession 'a whiff OF roses' and the partitive 'SOME tea'. The genitive allows a noun to modify another noun: 'a pound of flesh'. But who are we, who need the genitive case? Benjamin Lee Whorf, a fire inspector and amateur linguist from New England, gave us a name: *Standard Average Europeans*, or, the people for whom the genitive case appears to be not only good for thought, but essential to it.

Of containers and turns of phrase

In Lévi-Strauss's initial offering, social context was an explicit part of the story. All humans, he ventured (in a later work), hang their logical systems on scaffolding made from existing, locally salient fields of relationship (Lévi-Strauss 1966). But though the fact of the scaffolding may be universal, its shape is not. What I venture here is that one aspect of Lévi-Strauss's own scaffolding which also held, more or less constant for the French-speaking, English-speaking, German-speaking and Russian-speaking anthropologists who would follow in his footsteps, was precisely a proclivity to think with things rather than with non-things. The more material these things, and the more divisible, the better they were for thinking with. One might even suspect that the drive to understand immaterial and poorly divisible things *as* material and divisible – the search, for example, for the particulate nature of smell or the atomic nature of electricity – is part of what makes cultures akin to Lévi-Strauss's own so odd.

This argument is not, in fact, my own. In the 1920s, a generation before Lévi-Strauss began troubling over the relevance of tasty animals to human thought, Whorf posited that speakers of Standard Average European have a very well-developed bias for thinking with things. His argument was that this also serves as a sort of mental blindness. They are very poor at thinking otherwise and thus tend to either misunderstand non-things or do what is syntactically necessary to make things of them.

Whorf had a vested as well as an intellectual interest in sorting out culturally specific tendencies to misconstrue physical phenomena. As a part of his day job as a fire inspector, Whorf amassed hundreds of reports about the circumstances surrounding fires and explosions, many of which were the direct result of human error or, more precisely, human categorical misunderstanding. He wrote:

> In due course it became evident that not only a physical situation *qua* physics, but the meaning of that situation to people, was sometimes a factor, through the behavior of people, in the start of a fire. … Thus, around a storage of what are called 'gasoline drums,' behavior will tend to a certain type, that is, great care will be exercised; while around a storage of what are called 'empty gasoline drums,' it will tend to be different – careless, with little repression of smoking or tossing cigarette stubs about. (Whorf 1956, 135)

Whorf's New Englanders who accidentally caused fires by acting incautiously around things like limestone, or water, or lead, or 'empty gasoline drums' did so, according to Whorf, because they did not expect limestone or water or lead or 'empty' anything to burn. The place of linguistic categorization and the behaviour that followed from it in incendiary situations led Whorf the socio-linguist to an examination of categories of thought and the relationships to the material world that they begat. 'Limestone', 'water' and 'lead', like 'space', 'time', 'milk', 'sand', 'money', 'coal', 'butter', 'rain', 'meat', 'electricity' and 'gasoline', are all mass nouns in Standard Average European (a category of Whorf's own making that refers more or less to all Indo-European languages). The critical uniting characteristic of these languages for Whorf was their reliance on 'large subsumations of experience by language' (Whorf 1956, 138). In English, mass nouns are marked by the lack of a plural form, there are no milks, only cups *of* milk (or cartons of milk, or udders of milk; here you can see the genitive creeping in). This lack of a grammatical plural insinuates a 'homogenous continua without boundaries' (Whorf 1956, 140). Milk without limit; space without bounds. Electricity, however, is harder to containerize than is milk. In fact, resisting containment is one of the most definite qualities of electricity, not only (or even especially) linguistically; it can't be physically stored either.

The 'storage' we do have (and here I am switching from problems of language to problems of physics) is not of electricity exactly, but of electrically driven mechanical processes that can be reversed to *re*generate an electric current. The most common of these is pumped storage. When there is too much water in the reservoir of a hydroelectric dam, some of the electricity that that dam makes is used to pump excess water uphill, to a second reservoir, where it sits until additional power is needed; then this water is allowed to flow, with gravity, downhill again, passing through a set of turbines at the bottom which generate a 'new' electric current. Batteries, which look a lot like little electricity boxes, or fuel cells, which look like big electricity boxes, are not ever full of electricity. There is no electricity in there. Rather they are filled with layers of chemicals that produce an electric current under certain conditions. Flywheels, which store kinetic energy for about sixty seconds, are literally everywhere on contemporary electric grids. These are wound by an electric current and they then reproduce an electric current as they unwind. It's not the *same* electricity; the first is spent in the winding, and the second is made in the unwinding. In every case, it isn't electricity that is stored but electricity that is used to create a mechanical or chemical capacity to produce electricity later.

So while there are lots of ways to imagine and speak about different sorts of containers for milk, just as there are main ways to actually contain milk, there is arguably no way to use the genitive – noun-modifying noun means – to talk about electricity. Something leaks over from the physical problems of storing electricity into linguistic means for talking about it. Technically, we can say, 'a kilowatt hour of electricity', but we don't. We say simply, a kilowatt-hour, or a volt or a charge. The unit of measure stands alone. Nor do we use the partitive form of the genitive case and say 'some electricity', as in 'hey man, I need some electricity to charge my phone'. No, we simply charge the battery; the 'charge' is equal to the capacity of the battery to hold it. In the case of electricity, the container utterly trumps its contents. This is in part because there are no contents; there is no electricity in a battery, just as there is no electricity in the reservoir behind a hydroelectric dam. This nowhereness (which might also be thought of as 'immediacy' or newness) causes electricity, as an abiding physical substance, to fade further from conceptual grasp.

A case in point

If anything *is* a box for electricity, it's the electric grid itself. The grid, as mechanism for making, transiting and using electricity, is too vast and rangy to look like a box, and it seems to be comprised of too many objects to count as an object itself, and it fails the test of portability that a 'box' hints at, but at least it is *full* of electricity.[4] This, then, is where things grow strange, and terminology begins to feel like a trip through the funhouse mirror. Despite the fact that the grid has come to stand in metaphorically – as a network – for infrastructural imaginings as a general category of thought, because electricity is so unlike the other things in our world, the grid hardly works like other infrastructures.

According to anthropologist Brian Larkin, an infrastructure is an 'architecture of circulation', built to 'facilitate the flow of goods, people, or ideas and allow for their exchange' (Larkin 2013, 328). In this way, well-designed, well-kept roads allow cars to flow efficiently through the densest of cities and across the least hospitable of natural terrains. Well-made pipelines move oil with liquid efficiency from the wilds of extraction to the refinery. Train lines bring coal to power plants. Libraries circulate books. The whole story of infrastructure would seem to be of a thing that doesn't move, in order that other things might speed summarily along.

At first glance, the electric grid does seem to work like this too, except for the fact that there are no 'other things'. Roads have cars, libraries have books, pipelines have oil – two terms, two nouns put into relationship to each other with an infrastructural logic of facilitation. Convention, not grammar, holds one still and moves the other. One can, thus, interact with a car or with a road, with a car not on a road and with a road devoid of cars. One can interact with a pipeline and, in tapping it, also interact with the crude pouring out of it into a bucket.[5] One can take a book from a library and never give it back. As with a 'box of rocks', with infrastructure, there are two separate and separable things in play, the infrastructure which doesn't move and the 'goods, people or ideas' it was designed to set into fluid motion. With an electric grid, however, there is nothing to separate out. It isn't a thing of wires (*qua* conduits) transiting electricity in a magical golden stream from power plant to lightbulb. The two are, rather, one and the same: the wires, the electromagnetic force; same, same.

Imagine a carefully placed row of dominoes; tip the first with your index finger, watch them fall. The force that fells each in turn is not separate, nor separable, from the dominoes. Without the tipping of one into the next, there is no falling line; and without the dominoes correctly placed, there is no push to be measured. The dominoes and the act of falling/pushing-the-next are the same. This is similar to how an electron stream works. A generator rips electrons from atoms; those electrons bump into the next nearest atom. In nestling up to that atom, they push some of its electrons away; these bump along to the next atom and do the same, and with the next the same, and the same, and the same all the way around the great loop of the grid. Electricity is this bumping along, this displacement of electrons by other electrons. Some substances, metals most especially, make this process of displacement easier, and these are what we tend to build conductors (wires) out of. Take away the conductive material, and the electricity isn't there.[6]

The first trouble, then, is realizing that electricity is coexistent with and inseparable from its infrastructure. Whatever form a grid takes, whatever its scale, whatever future technologies we dream up for it, however full of electricity it is, it will never be a 'container' for that electricity. This is no more possible than dreaming up a fancy box into which gravity might be poured and stored. Despite this, if history is any guide, there will be a solid tendency to figure electrical systems and components *as if* they were objects, as if they too were the sorts of infrastructures that might push the genitive into the world, materializing it and giving it form, just as cartons of milk make the genitive a real, tactile and memorable part of everyday life;[7] just as pipelines and parking lots grind grammar into landscape, disrupting migrating reindeer and peregrinating persons respectively. This mode of building electrical systems that feel like the genitive (what difference really, between a pipeline and a power cable, between a tub of yogurt and a battery?) attempts to materialize an accord between a system of things and electromagnetism – which follows none of the same rules nor any of the same physical laws. One result is, as one might expect, that misunderstandings and weird preferences proliferate and are built out, legislated or funded. To my mind, this is part of the grid's charm; it holds social desires, many of which are grounded in the wrong logic, in its form. These desires produce iterative breakdowns, as common-sensical wants for electricity systems and the functioning of these systems fail consistently to align. The grid is a misunderstanding machine; a machine that 'works in practice, but not in theory' (Alexandra von Meier, Personal Conversation, 2010).

Being in time

What is electricity then, if not a noun? If not a verb? If not thing, and yet in possession of an abiding material substance, with its own physical rules and its own infrastructural logics? If not a Deleuzian becoming? If not precisely a tool, with its killing capacity? If it is a being at all, it is a being in time. Electricity is now. The trouble then, is not just thinking in time, or thinking without a sense of that-which-purdures, can be stored, manipulated or stolen, but in designing an electricity system that takes these difficult-to-think-with features of electricity as the centre point of innovation. It happened once before, in the 1890s. When Samuel Insull, an early utility man in Chicago, learned to see the clock, he understood electricity in time and from this built up the grid as a monopoly enterprise, a big thing into which all the customers within a given geography were folded, not because of economies of scale but because of economies of temporal ordering. His customers mattered because of *when* they used power, not because of how much of they used. This model, once devised, became the standard operating procedure in every country attempting universal electrification.

Understanding the importance of the temporal grounds for electricity networks requires a quick dip back into physics and twentieth-century solutions to the intractability of electric power. Because electricity doesn't properly exist in space, a business aiming to make money of it must take one of two routes: it must sell *not* electricity but grids, or bits of grids (things), or it must manage temporal rather than spatial orders.[8] This has been true from the start.[9] Even Thomas Edison, who was quite savvy in turning the electric grid and its various components (lightbulbs, electric sockets, dynamos, wires, etc.) into marketable products, faded into ignominy in the mid-1890s precisely because he misunderstood the nature of electricity *as a product*. As he built the necessary infrastructure to make electricity a viable competitor on the home and office lighting market, what he saw was not its instantaneousness but a (mistaken) materiality akin to that of gas – a substance governed by the laws of fluid dynamics rather than those of electromagnetism. Historian Maury Klein explains that

> [Edison's] error [was] in using the gas industry as a model. Gas could be stored, which made it possible to produce on an orderly rational basis like other manufactured products. It could maintain reserves to meet peak requirements and level out demand over a twenty-four hour period. Not so electricity. It had

> to be produced, sold, delivered, and used all at once, which meant that the plant supplying it needed the capacity to deliver the total maximum load demanded by customers at any given moment. (2010, 403)

In other words, the immediacy of electricity – that it could be no more stored in Edison's days than our own – meant that all the conventions of production and delivery well-known to markets, businessmen and capitalists in the late 1800s did not apply to the electricity business, and even Edison, who was both wily and brutally intelligent, didn't grasp this in productizing his force. As a result, despite popular perception, Edison's grid did *not* become the norm in North America; rather, the electricity system in use today is a mix of the alternating current grid developed by Nikola Tesla and brought to market by George Westinghouse in the late 1880s and a business model developed by Samuel Insull in Chicago in early 1900s.[10] Without Insull, who was unique in his understanding of the exigencies of electricity as a lethal, un-storable, intensely immediate, non-liquid non-thing and who structured a business around these constraints, the United States would have had elite light (the system Edison's grid was best suited to) in the form of private plants for wealthy customers, and industrial power for building and moving things, for much longer than it did.[11]

Insull's gift was the capacity to see time. His was not an immediate wisdom but developed over the course of decades of wrangling with the weird economics of an industry with an unstockpileable product. When, in 1892, Insull (a Brit by birth, and for years Thomas Edison's personal secretary) took over the management of Chicago Edison, it had much in common with electric companies sprouting up in urban America; it had, in Chicago's case, a single DC power plant (which could transmit power for about a mile) located in Loop, the densest part of the city.[12] This plant produced power at a single voltage – about 110 volts, or enough to run then state-of-the-art lighting – which was sold to businesses with large numbers of white-collar workers.

What this meant, practically speaking, was that Chicago Edison's 5,000 or so customers (in 1892) only used, and paid for, all the power the plant could make during the early evenings. When dusk settled over the city, every front-office clerk and every corner-office executive alike found themselves in need of artificial illumination. The demand for electricity then dropped off precipitously as offices closed up for the night and the last of the city's workers stepped aboard L trains bound for the suburbs, where they read by gaslight and ate food cooked with a gas flame. At night, in the Loop, when no one was at work; in the mornings; and for most of the day (most especially during the summer), Chicago Edison's sole power plant, fully capable of supplying its 3,200 kilowatts all the time, sat idle or was massively underutilized. As Insull once famously said: 'If your entire plant is only in use 5.5 percent of the time, it is only a question of when you will be in the hands of a receiver'. He needed a way to sell power the rest of the day, or his company would founder.

The problem was that the business strategy used by all the Edison franchises at that point to stay afloat was to sell, install and provide maintenance for private plants – tiny, privately owned grids. They had opted for the route of selling a thing, in this case, electric grids. While this was a wise tactic for maintaining solvency over the short term, over the long term, the multiplication of private plants further diminished the customer base for central-station power. When Insull first arrived in Chicago, the Loop was home to eighteen central-station electricity providers (including the Edison franchise he was to manage), plus another five hundred private plants (2010, 401).

These private plants, however, were in a critical way as limited as Insull's grid. Chicago's manufactories, for example, produced and used power during the day, turning their generators off at night; private plants in apartment buildings and luxury residences usually sprang into use in the evenings just as the bulb system in the business district was being shut down; streetlights – often municipally owned – only burned at night; and streetcars ran most intensively at dawn and dusk. Everybody was using their fairly expensive, almost identical infrastructure only part of the time because it was as cheap to produce their own power as it was to buy it from any centralized source.

What Insull wanted and strove to build was an infrastructure that would be the inverse of what he was saddled with. Instead of many little generating stations, with many owners, running intermittently, he wanted one that he owned and which ran all the time. In order to do this, he needed to acquire 'load' for each time period during the day.[13] He needed streetcar companies to buy from him at dusk and dawn, residential customers for the late evenings and early nights, municipal street lights for night-time, businesses for the late afternoons and early evenings and, most important of all, industry for midday. He wanted to make a lot more power, make it round the clock and to sell it all – every last watt.[14]

While it is easiest to see Insull as a narrow-minded monopolist (his empire would collapse in 1929, with Insull himself fleeing the country to escape corruption charges), I want to recuperate him here as something else. Insull built a monopoly out of electricity by securing control over the sole provision of a good in a particular territory; in this way, his activities were little different from those of the classic monopolies of his time: US Steel or Standard Oil. What set him apart was that he understood that, in order to do this *with electricity*, he would need to control a market that was primarily temporal in character. The hours of the day were the tranches of adversity. He did not see people or use or even land; he saw the need to engineer a constant consumption across a diurnal cycle. He needed a monopoly in order to capture twenty-four hours' worth of load.

This structure of monopolization of a temporally diverse customer base worked well in the United States until the early 1970s, when for technical and cultural reasons, the price of electricity began to rise and consumption to drop. Less than a decade later, in 1978, a piece of legislation called the National Energy Act made a tiny crack in the monopoly system that has, with time, computerization and further legislation, resulted in the dismantling of the utilities' control over the production of power. They have come apart. And as they shatter into bits (one can see it in every private wind farm and every home solar system), the structure Insull built up, which found profit in the control of consumption *in time*, has also been slowly dismantled without a wise replacement. Instead we've started to treat electrcity as a thing again, until today in the United States, it is treated in much the same way as gas, or coal or a box of bananas – able to enter market relationships designed for the sort of supply and demand comfortable from other commodity relations. The current moment is in this way utterly retrograde, with the genitive recolonizing discussions about electricity and renewably powered futures. The primary form this desire takes is the battery. As a thing, a battery would seem to catch a hold of electricity, objectivizing it and making it 'good to think with'.

Unwieldy

In the autumn of 2016, I had lunch with a small team of men in the unspectacular business of building high-voltage direct current power lines (HVDC). They are an upstart, a private company with ten employees who have decided to work around the utilities; they look for the cracks and seams in the existing power delivery system and aim to build these out. Right now, one big seam is the United States–Canada border and a giant resource that hovers just out of sight to most Americans above that line, the massive hydroelectric dams at James Bay in Northern Quebec. The goal of this company is relatively simple; they'd like to balance wind power with hydroelectric power wherever it is possible in order to create HVDC pipelines of renewable energy, one line at a time. Since electricity, with care, can be made to travel long distances with relatively little loss, 'near at hand' can be several thousand miles away, making the problem with Canadian hydro not the nine hundred miles that separate it from the wind farms of upstate New York, but the hardened politics of an international border.

The political–economic machinations of building a high-voltage power line are literally beyond my imagination. Hundreds of thousands of dollars slip like water from a leaky pipe into local economies; every wire requires substations, happy townsfolk and environmental and governmental stamps of approval as it runs through states, across borders, under bodies of water. Each takes years to negotiate and build, and all the capital is upfront. Investors have to sign on to things that a single town can slow or cause to grind to a halt. There are a lot of meetings at the beginning of every wire – years' worth of meetings. This lunch is one of them.

In a pause, between discussions of the desired wire, we are talking about cultural differences in R&D (research and development): Canada is very heavy on the D to the frustration of many of its scientists. The Massachusetts Institute of Technology (MIT), to no one's surprise, is exhibiting an extraordinary bias for the R. The CEO of this wire company launches into a story: the day before, he'd been at MIT talking to students about the future of grid technology, or rather they had mostly been talking to him – about batteries. Bigger, smaller, flow, anode-free, new chemistry here (cheaper), new chemistry there (longer-lasting), new chemistry everywhere. The promise, the research, the excitement was battery-promise, battery-research, battery-excitement. He shakes his head; so many bright minds all on one path. It's not that it's the wrong path so much as that its popularity exhibits the sort of bias that Whorf would have found unsurprising. These young researchers are trying to find a way to thingize electricity, in fact, and at a scale worth appreciating. They are trying to make it into something that *can be* stolen, or bought, or shipped, or traded or thought. Every way in which electricity defies easy categorization is soothed by batteries; they are exceptionally good to think with.

The line-builders, the men at the table, are trying to do something else. Hence the shaking of heads at the single-(battery)mindedness of the brightest, best-funded of youthful researchers. Building a line that allows for a marriage of wind power, which is variably produced, with hydroelectric power, which is not, involves thinking with electricity rather than trying to objectify it as means of getting it to behave like other things that are easy to think with. Premising grid reform on better battery technology, or (as Bill Gates dreams) on 'liquid solar', involves first converting it, in mind and, in fact, into a thing – an object, a liquid even – so that it might be managed within regimes of thought and structures of business comfortable for object-oriented institutions. This inevitably cuts much of electricity's native potential out from the new systems we are designing to utilize it. The history of electricity is littered with this precise battle between working with electricity's obduracy or pretending it is something it is not, and then working with pretence.

It's not that Insull has been forgotten; it's that given that grid reform is happening everywhere that has privatized generation and proclaimed high renewable-energy goals, there are two main routes into thinking grid reform. One privileges the box – a mode of conceptualizing electricity that relies strongly on the desire for electricity as a noun, a thing to be commanded and controlled and a hoped-for route of invention that will make electricity an orderable substance that it has never been. The other aims to build a stable, reliable infrastructure that takes the instantaneity of electricity as the starting point. This route does not attempt to hold power and make it work our way, but rather to let it go, to take electricity seriously in its own right. What this lunchtime conversation reveals is that both will likely be components of a twenty-first-century grid that relies on renewables like wind and solar. One, however, the one that makes electricity function like a noun, is generating a lot more excitement and attracting a lot more capital, making it all too easy to overlook that the conceptually more difficult route is both more innovative and holds more promise for a system's reform that feels like a good fit for the future.

It is not, then, simply that things are good to think with (à la Lévi-Strauss), but that we SAE folks prefer using things in order to think, to the degree that we make things out of non-things all the time. Indeed, according to Whorf, this is one of the primary things that we do with language, and then we forget that we have done it, treating these linguistic constructs as inalienable objects in the world with noun-like capacities to hold logical descriptors to them: a puddle of water, a gust of wind, a summer day, a 10-volt battery.

Be all of this as it may, there remains the problem that even if we think electricity *as if* it is a thing – a delimited material object in the world – it doesn't care. It continues to behave in most un-thing-like of ways. It is as immodestly indifferent to our metaphorizing modes of thought as it is to our laws or profit seeking. If however, we set aside the battery and its ilk for a minute, other solutions are forced to the fore. Or, as a young engineer in that same line company said (several weeks later) as he waved his hand dismissively in the direction of the future: 'Maybe in 25 years *they* will solve that storage problem.' His meaning was that that would be awesome, fantastic, game changing, but for now, as for the past 130 years (or the entire history of domesticated electricity), we'd best work with what we've got. Rather than premising systems design or business models on something that doesn't exist but feels good to the mind, it would be better to work with on the exigencies on the table. First among these is finding a way to get stock resources (coal, natural gas, oil, uranium) out of our electricity system without allowing that system, and the markets that make it, to tumble into ruin.

Notes

1 W. B. Yeats. 1961. 'Among School Children' from *The Poems of W. B. Yeats: A New Edition*, edited by Richard J. Finneran. Copyright 1933 by Macmillan Publishing Company, renewed © 1961 by Georgie Yeats. Reprinted with the permission of A. P. Watt, Ltd. on behalf of Michael Yeats. Source: *The Collected Poems of W. B. Yeats* (1989): 215.

2 See Lévi-Strauss (1963). See also the 'Totems – The Structural Study of Totemism' at http://science.jrank.org/pages/11480/Totems-Structural-Study-Totemism.html (accessed October 2014).

3 See, most notably, Mary Douglas' work on animals that stand between categories and by virtue of this fact alone become *not* good to eat, or 'unclean' (Douglas 1966) – for example, shrimp, which live in the sea but fail to have scales and fins and thus are not really fish; or pigs, which chew their cud (like cows) and yet have cloven hooves (like deer). How things fail to fit, and how these failures are made to matter symbolically, are worthy of consideration, as they reveal a great deal about the structures and values of a given culture. Douglas' point, which has become, increasingly, anthropology's point, broadened Lévi-Strauss's initial contribution. Animals are still good to think with, but this adheres as much to the ways in which relational matrices *fail* to be totalizing as it does to the actual systems of relationship these might describe (as between sorts of fish, for example, or between sorts ruminants).

4 There are teeny-tiny grids in use by the US military that involve flexible solar panels that roll out on a marching soldier's shoulders and, for example, wires that connect these to all the batteries that the solder carries. It still doesn't have the 'feel' of storage because power is being made by this system by means of an external fuel source (the sun).

5 See Woody (2016).

6 The exception, of course, is wild power, lightning, which proves that under extreme enough circumstances, almost anything can function as a conductor, but this is situation is not 'infrastructural'; it is what the infrastructure is designed to avoid.

7 Not just milk, but the tendency to manufacture containers (i.e. packaging) for many things that don't need it in order that the things themselves become 'contents' would

seem an additional interesting route of investigation into the ways in which grammatical biases and the made-world interact, with landfills full of the genitive for proof.

8 Rhythm is a management problem in all supply chains: getting the raw materials and labour force into place to make and move things to market at the right moment for consumption. *Making* electricity from fossil fuels is as subject to rhythmic disruptions, as is making any other product. Indeed, there are a surprising number of blackouts in the United States every year caused by jams on rail lines used to move coal to power plants. Once made, however, electricity is not subject to these sorts of interruptions or the machinations necessary to avoid them, the do-si-do of contemporary global commodity markets. From the user's point of view, electricity is binary, either there or gone; the light is on or it is off. This is an illusion based upon the instantaneousness of the link between production and use.

9 For a vastly expanded version of this argument, see Bakke (2016, 57–84).

10 All national grids, including the Soviet one, ran into the same issues solved in the United States by the combination of alternating current and a new sort of consolidation of markets around the clock, rather than over a certain geography. In many, but not all, cases, the Insull model was an important precursor to this understanding.

11 European grids developed differently (see Hughes 1983), but with time they too evolved into monopoly systems for large populations of temporally diverse customers. The difference is that as the monopoly system has been slowly dismantled in America since the late 1970s, in Europe it is has maintained; thus transitions towards renewables in the United States involve a lot more people trying to make a boxable product out of electricity, whereas in Europe, fewer people, at the tops of massive hierarchies are governing this process.

12 3,200-kilowatt DC power plant on West Adams Street, built in 1888.

13 Diversity here takes on a temporal twist; race, economic standing, gender – none of these matters for their its own sake to the governance of grids. They do matter, however, for their temporal qualities. If, for example, women are home during the day rather than integrated into the work force, they are able to alter the accounting necessary for both profit making and good grid governance.

14 It is worth noting that even this ideal cocktail of customers and times of day fails to provide significant night-time load. This remains a problem for our utilities today. Even taking into account public street lighting, electricity use drops off precipitously as people start to go to bed and only starts to creep upward again around 6 a.m. One of the reasons that electric cars have received such public praise is that they can be programmed to charge almost exclusively at night and thus provide that rarest of beasts – substantial midnight load. Insull, of course, gets no credit for the cars, but we can thank him for zealously promoting a rate structure that rewards night-time electricity use and for zealously promoting, including not only a rate structure that rewards night-time electricity use, but also home refrigerators and

hot-water heaters which, until the rise of the conservation movement in the 1970s, were phenomenally hungry appliances and even today remain – along with air-conditioning – the most electrically intensive items in a home (see Bakke 2016).

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