

Fluid technologies: The Bush Pump, the LifeStraw® and microworlds of humanitarian design

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Abstract

Over the past decade, many ingenious, small-scale gadgets have appeared in response to problems of disaster and extreme poverty. Focusing on the LifeStraw®, a water filtration device invented by the company Vestergaard Frandsen, I situate this wave of humanitarian design relative to Marianne de Laet and Annemarie Mol's classic article on the Zimbabwe Bush Pump. The LifeStraw shares the Bush Pump's principle of technical minimalism, as well as its ethical desire to improve the lives of communities. Unlike the pump, however, the straw defines itself through rather than against market logic, accepting the premise that one can 'do well while doing good'. Moreover, it does not share the assumed framework of de Laet and Mol's Zimbabwean socio-technical landscape: a postcolonial state happily en route to national self-definition. Nonetheless, it clearly embodies moral affect, if in the idiom of humanitarian concern rather than development. My aim is to open up three interrelated lines of inquiry for discussion. First, I consider aspects of a postcolonial condition at the micro-level of immediate needs, including assumptions about nation-state politics and markets. Second, I emphasize science and technology in the form of infrastructure, the material frontline of norms. Third, I return reflexively to love, and the complicated allure of engagement in academic work.

Keywords

humanitarian design, infrastructure, love, postcolonial development, water filtration

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At the turn of the millennium, Marianne de Laet and Annemarie Mol published a provocative article entitled, 'The Zimbabwe Bush Pump: Mechanics of a fluid technology'. In scrupulous detail and tongue-in-cheek style, it followed the movement of a model mechanism in order to highlight a non-heroic vision of design. It recast the unassuming pump of the title as an unlikely star, an object 'that doesn't impose itself but tries to serve, that is adaptable, flexible and responsive' – one that would, in their terms, be seductively fluid and thus easy to 'love' (De Laet and Mol, 2000: 225–226). Like the mechanism it describes, the piece itself proved triumphantly seductive. Even now, relatively little science studies scholarship addresses technology outside highly developed landscapes, particularly at the micro-level of modest miracles and mundane practice. For its part, postcolonial critique favors sweeping rhetoric and the vast geohistorical tableaux of a global North and South, rarely considering technical details at all. A humble, earnest artifact like the Bush Pump thus provided a particularly heart-warming contrast with grand narratives of innovation and development, just as its authors intended.

Fast-forwarding to the present, the article retains enduring – dare I say timeless? – charm. The socio-technical landscape around it, however, has proved far from an unchanging pastoral, even in the poorer reaches of the planet. Alongside the ever-expanding flotsam of commodities washed into villages by market flows, a new wave of well-intentioned devices from social entrepreneurs seeks to address problems of disaster and extreme poverty. Examples of these ingenious, small-scale projects fill volumes with titles such as *Design Revolution* or *Design Like You Give a Damn* (Architecture for Humanity, 2006; Pilloton, 2009). Like the Bush Pump, most are modest contraptions in technical terms and express similar claims to serve and adapt to shifting conditions, operating with minimal materials and an ecological ethos. Unlike it, however, many embrace market logic rather than defining themselves against it. Moreover, few share the assumed framework of de Laet and Mol's Zimbabwean socio-technical landscape: a postcolonial state happily en route to national self-definition. They are not, in other words, all so easy to love, at least for anti-colonial intellectuals. And yet they clearly embody, convey and manipulate moral affect. More precisely, they seek to do *good*, not simply expand power or reap profit. Often, we shall see, this sense of the good adopts an idiom of humanitarian concern as much as economic development. Uncomfortably close to charity and yet also untouchably close to life (Fassin, 2011), it proves hard to simply embrace or fully reject. Can one be against, say, clean drinking water? But this is getting ahead of the game.

By returning to de Laet and Mol's Bush Pump, I intend to recast their piece itself as a device, one that might help situate this expanding array of objects that engage the world in the name of improving human welfare. At the same time, I hope to probe the sensibilities that infuse it, that render a modest object fluid enough to claim academic affections. Outlining this brave new world beyond the Bush Pump, then, my aim is to open up three interrelated lines of inquiry for discussion. First, I wish to consider aspects of a 'postcolonial condition' at the micro-level of daily needs, including political assumptions about the nation state as a legitimate as well as normative form. Second, I want to emphasize science and technology in the form of infrastructure, the material frontline of norms that define 'modernity', particularly in their absence. Third, I desire to return reflexively to love, particularly the complicated allure of engagement in academic work. What aspects

of the Bush Pump's allure involve factors beyond an altered vision of action? Or in the more blunt language of affect: what entices and reassures, or conversely what disturbs and unsettles?

To follow the blueprint of my source I need a model object. Of those with which I have passing familiarity I will select the one that most clearly matches de Laet and Mol's with regard to function: a device for providing clean water known as the LifeStraw®. The Zimbabwe Bush Pump 'B' type and the LifeStraw® share a common commitment to water and its importance to community health. The two diverge considerably in form, however, as reflected even at the most nominal level. One is a pump, intended to extract groundwater; the other is a straw, a filtration device to be used on the surface. One invokes a country and an alphabetic series; the other points to raw existence combined with the legal protections of trademark. As the two names reveal, one emerges between simple modesty and institutional bureaucracies, the other between corporate ingenuity and innovative ethical markets. The LifeStraw, particularly the 'Family' version involved in an ambitious experiment described below, offers a potential other to the Bush Pump, a counterpoint as much as counterpart.

Before investigating this more recent innovation and the questions it raises, I will first review the original article, along with the artifact that inspired it.

Water for the nation

Why do de Laet and Mol love the Bush Pump so? In their article, the authors ascribe a number of admirable qualities to object of their affection. First and foremost, they applaud its 'advanced' simplicity and fluidity, which is built into the pump's very nature, and the 'modest' heroism of its designer's adaptive actions (De Laet and Mol, 2000: 225–226). Fluidity allows movement, they suggest, a lesson as relevant to science studies as Zimbabwean villages. Just as the boundaries of the device and its efficacy prove uncertain, so too does the mastery of its human companions. This account of innovation dispenses with domination, and even hierarchical command.

Beyond this central attribute of fluidity other aspects of the device merit their approval. Although innately mutable, the pump is also durable. It evolves out of an earlier model and remains open to refinement; at the same time, it is built to last. Even the bright blue color is a factor in its function, inviting use (De Laet and Mol, 2000: 228). Its hydraulic principles allow it to adapt to a range of wells and service up to 250 people. Its strokes are powerful and yet its steel and wood lasts longer than polyvinyl chloride (PVC) plastic. But that is not all! Once properly installed, the Bush Pump does not merely function as an instrument for water transfer, it also serves as a 'health promoting technology' (De Laet and Mol, 2000: 231). Studies suggest that its water proves strikingly *clean* in comparison to other pumps. And yet this cleanliness depends on the quality of its installation, on the concrete headworks that will protect its water from contamination. Installation remains the responsibility of the community members who will subsequently use the well; they find a site and drill a hole, in consultation with local water diviners. They also bear responsibility for maintenance and repair. Village participation is thus the key to a successful pump. But the pump's virtue does not stop at community participation, something that the authors recognize as '1980s wisdom' (De Laet and Mol, 2000: 234–235).

As it delivers clean water, it also helps 'build the nation'. Nations, the authors note, presume not just a sense of shared history, cultural imaginary and standard language, but also infrastructure. To unite Zimbabwe, its leaders must mediate the gap between citizens who enjoy the delights of indoor plumbing and those who trudge daily to distant water sources. The pump assists in this endeavor, and does so in a nationalist way, being thoroughly 'local' on a national scale. Unlike most water delivery devices, its design, parts and standards all derive from Zimbabwe (De Laet and Mol, 2000: 236).

As de Laet and Mol go on to discuss, all kinds of hazards can threaten this marvelous pump, and its success is no more certain than the limits of its form. Parts may break; users may not cooperate. The pump, however, proves remarkably forgiving and open to improvised repairs (De Laet and Mol, 2000: 241). Even the standards of water quality prove fluid in practice, as *E. coli* has different kinds of effects depending on how foreign it is to a body. Both wells and users are always in flux. The pump may help constitute a community, but it also depends on the functioning of one; without maintenance it will fail. Yet even here the policy around the object proves flexible. The horizon of 'community' may shrink to a subset of families or private ownership by an extended family itself (De Laet and Mol, 2000: 245–246). Such fragmenting of the local beneath the village level, however, may disrupt the state's national ambitions, as well as leading to the adoption of other devices. Success is not singular, or guaranteed at different levels. Even the outcome is fluid.

To top off the authors' admiration for the device, its very being raises questions about ownership. The modest human hero of their story, Dr. Morgan, is a migrant expert, after all, having crossed not just national boundaries but also from the field of microbiology into water sanitation. Although the Bush Pump may have become his life's work, he never filed a patent and asserts no ownership. It is not his property or really a commodity at all. Indeed, de Laet and Mol suggest that the very absence of such claims contribute to the pump's success. The pump remains a government thing, a part of the public domain. Abandoning ownership and control actually helps it spread through distributed action. In their modest hero's labors the authors even glimpse a 'feminist dream of an ideal man' (De Laet and Mol, 2000: 252): monitoring here is about service, not an exercise in authority. Simultaneously modern and non-modern – but always fluid – the Bush Pump proves easy to love.

One of the most interesting aspects of de Laet and Mol's piece is its combination of enthusiasm and nuance, a quality not always fully translated in its own mobility.¹ The authors weave their way between advocacy, neutral observation and criticism, suggesting drawbacks to each without proclaiming a new norm. Fluidity may not *always* prove a positive trait. Engagement holds hazards as well as opportunities. Rather than any certain epistemological standpoint they suggest a 'travel-bag normativity that can be taken along and fluidly adapted' (De Laet and Mol, 2000: 262). Even seduction itself, they caution, remains open to doubt.

On that note I wish to transport my model article's findings to another time and place, applying them to contemporary forms of design innovation. Although practiced in the name of the good, not all equally inspire love. At least I find aspects of their form troubling, and suspect that other academics, especially those whose anti-colonial conscience is seduced by the Bush Pump, will as well. Yet they also call into question normative

values of moral and political framing, the conceptual closets from which we routinely pack our travel bags. Seeing them newly at stake in these particular artifacts might then prove instructive as well as disturbing. By instructive here I mean returning assumptions to the realm of active questioning, and asking again why and whether they continue to seduce us.

In particular I wish to consider the play between tools, health and political space in the aftermath of empire. The Zimbabwe Bush Pump, after all, refers to a distinctly *national* artifact, part of a project to construct infrastructure in a postcolonial context. Through much of the text it floats in a relatively undefined map of Africa – the rural landscape beloved of development projects, a world of villages and traditions as well as thirsty households. But the moral geography of nation building is also in play, both as a modern political form and as an anti-colonial romance. I should make it clear that I am not seeking to criticize the authors on this point; de Laet and Mol are quite aware of tensions in this framing of space as they follow their object. Nor am I preparing to denounce the nation state as a postcolonial project. Rather, I simply wish to call it into question, particularly through the index of infrastructure. What do people expect nation states to do? What desires do they invoke? How do we respond to them if they do not deliver?

Dreams and magic bullets

Zimbabwe, we might recall, is a highly specific and charged place, the product of a dramatic revolution, Cold War contests and ongoing political struggle. Its human actors engaged all manner of elements to build a new nation, from geopolitical alliances to the AK-47 (Mavhunga, 2011). Moreover, the recent trajectory of Zimbabwe has proven fraught. Indeed, not a few of its citizens have crossed into neighboring countries, particularly South Africa, seeking a better future. For all the modest, fluid charm of the Bush Pump, it has dispensed no utopia alongside water. In political terms, it hardly appears, to put it bluntly, as a postcolonial magic bullet.

But then the Bush Pump – in de Laet and Mol's rendering at least – never claimed to move like a bullet. And any magic it acquired flowed from resolutely local sources, be they water diviners or collaborating community members. Or perhaps some enchantment also came from a further remove, from the inherited, projected and often-contested desire for a better world. Such desire has a long and multi-stranded history, extending well before the era and politics of decolonization. An older version of the pump, after all, already appeared in colonial Rhodesia in 1933, anticipating non-heroic appropriation and redesign (De Laet and Mol, 2000: 228). In this sense the device emerged *through* empire as much as against or after it.

Dreams of improvement also flow strongly through the present, and a surprising number of them congeal around artifacts, as exemplified in *Design Revolution* (Pilloton, 2009). Just as its subtitle promises, the book sets out to portray '100 Products That Are Changing People's Lives'. Flipping through the volume, one encounters a wide range of what the author describes as 'beautiful solutions to ugly problems'. From this perspective, beauty holds the key to power alongside knowledge, and part of the ethical calling of designers is to wield it responsibly in the cause of 'user-centered, humanitarian design' (Pilloton, 2009: 45–46). The work categorizes its featured objects by broad human

concerns: water, well-being, energy, education, mobility, food, play and enterprise. They range from low-tech solutions along the lines of the Bush Pump to far more elaborate devices, such as an automated Dutch bike dispenser (Pilloton, 2009: 190–191). Even the section on water runs the gamut, including, for example, both a do-it-yourself means to disinfect water with sunlight and an elaborate machine to generate a drinking supply entirely from air.

Design Revolution, for all its panache, is hardly unique; one can find similar assemblages in magazine or web form, not to mention wider circulation and disputes through the many capillaries of the internet.² The impulse to apply design critically to social problems goes back at least to 1970, although in another sense the entire tradition of ‘design’ embraces optimization by definition (Bürdek, 2005). What remains at stake is the precise terms of engagement with respect to political and ethical framing. Whereas Victor Papanek (1984) railed against industrial design’s harmful side, expressed in planned obsolescence and phony fads, he also conceived of radical renewal through a sense of social and ecological responsibility. In more recent years, two trends merit note. First, calls for social and ecological concern now echo through business settings. Not only has ‘Corporate Social Responsibility’ turned into an acronym (Rajak, 2011), but high tech centers of innovation like Silicon Valley have grown into focal points for a reinvigorated faith in market-based planning. In offering a breezy overview of the philosophy of ‘design thinking’, the designer Tim Brown (2009) moves from Apple Computer to Aravind Eye Hospital in Madurai, India, sliding easily between profit and nonprofit registers. For many actors, market and ethical logics now twist together rather than standing rigidly opposed.³ Second – in keeping with the title of the volume title I have chosen to feature – the term ‘design’ now appears to fill part of the aspirational vacuum left by idealist politics. Alongside human rights it has arguably emerged as something like a ‘last utopia’, a space for good will and progressive dreams following the decline of faith in modernist revolution (Moyn, 2010). Or, as Bruno Latour (2008: 2) has put it, the term has not only replaced revolution, but stands in opposition to it, substituting entanglement and care for emancipation and mastery.

These two trends associated with design do not stand in simple opposition (any more than capitalism and revolution), but they likewise do not neatly align in practice. Latour also notes that design has wriggled beyond most limits, and now floats freely. Adding ‘humanitarian’ as a modifier only adds to the complexity. That term has signaled a range of historical projects with charitable and philanthropic ambitions, if in recent years primarily designating actions focused on emergency relief rather than long-term development (Barnett, 2011; Bornstein and Redfield, 2011; Calhoun, 2008). The result appears as a claim to ethics in action, quite open-ended with regard to political and economic mobilization. Questions of standpoint (or perhaps ‘transit point’ in keeping with de Laet and Mol’s more fluid ontology) return, along with ones of inclusion, exclusion and accountability. Who speaks, and for what humanity? Who might benefit, and who might suffer? Or, to quote a provocation from within the exchanges of designers themselves: ‘Is humanitarian design the new imperialism?’ (Nussbaum, 2010; see also Design Observer, 2010; Johnson, 2011; Rule, 2008). Rather than attempting to answer such a question abstractly, I will follow the lead of the Bush Pump in thinking through a specific case. Let us now turn to pages 72 and 73 of *Design Revolution* (Pilloton, 2009) to meet the LifeStraw®.



Figure 1. LifeStraw® Personal.

Carbon for water

Like the Bush Pump, the LifeStraw® is a remarkable object. Moreover, the original device is elegantly simple: a thin, blue plastic tube with a fine mesh filter that neatly mediates between a consumer and a polluted drinking source. Whereas the Zimbabwean pump involves a gaggle of moving parts, the straw has none. In place of earnest energy, it offers the beauty of clever design, as defined with the clean lines of a modernist aesthetic. Its charm lies right on the surface: it looks as award winning as it is (Figure 1).⁴ Yet this seductive device is only part of the story, one element in an ongoing, complex coevolution of a company and a product line. To grasp the larger whole involves moving across several points of connection between the business end of international aid, health research and environmental concern. The journey reveals a shifting ecosystem of ethics and enterprise, one rather at odds with both the Bush Pump and postcolonial sensibilities.

First, however, let me expand the initial description. The LifeStraw entry in *Design Revolution* includes a large picture of a dark-skinned girl in a frilly dress, head bent to drink through this super straw from a large bowl of murky water. It is a striking image, variations of which appear alongside many accounts of the artifact. Yet as the accompanying text quickly points out, this is but one version of the straw, the 'personal' model. 'Following the success of, and media attention given to, the LifeStraw Personal ... the Danish company Vestergaard Frandsen released the LifeStraw Family system' (Pilloton, 2009: 72). This system, as the text proceeds to note, involves a bucket hung high on a wall and a connecting tube as well as a 'strawlike filtering tool' (Figure 2). A smaller photo that illustrates the Family device confirms that the ensemble is rather less simple or elegant than the individual version. In it a grown woman sitting next to a concrete wall holds the filtration end and smiles for the camera. The effect is more domestic than dramatic, reflecting a point of contrast between the two models. The elegant individual straw serves drinkers only one by one; it provides no water for collective use. The more cumbersome family straw offers a more transferable resource, if at the relatively modest rate of around 10 liters/hour. It does require regular cleaning (achieved by squeezing a built in bulb), and has a life expectancy of 18,000 liters. But in return, it produces remarkably *clean* water, removing not just



Figure 2. LifeStraw® Family 1.0.

turbidity but ‘99.9999 percent of all bacteria, 99.99 percent of all viruses and 99.9 percent of all parasites’. At some \$20 dollars a unit, the text assures us, this is a remarkable bargain for point-of-use hygiene.⁵

A point-of-use filter operates under a different logic from that of a groundwater pump. Rather than supply, it focuses on purification. Instead of worrying about contamination at the communal level of resource, it accepts its possibility up until the actual moment of consumption. Whereas the Bush Pump may be vulnerable at its headworks, depending on community involvement to assure purity, the LifeStraw shrinks the problem to the scale of the user, be it an individual or a household. The straw is also fluid in another sense of mobility, being fully portable in a way a borehole well is not. As such, it represents a different relational understanding of water sources, anticipating opportunistic use rather than attempting reliable stability. Bluntly put, its perspective is nomadic rather than agrarian. It thus gives additional anthropological pleasure to note that the straw indeed derives from nomadic innovation, along with a confluence of medical humanitarian and entrepreneurial ambition.

In 1982, the former US President Jimmy Carter founded the Carter Center in Atlanta, Georgia as a vessel to express ‘a fundamental commitment to human rights and the alleviation of human suffering’.⁶ Picking up on a theme from the World Health Assembly’s ‘Water Decade’ of the 1980s, the Center spearheaded a long campaign to eradicate

Guinea worm disease, a painful and debilitating parasitic condition once endemic in parts of Africa and Asia. By the year 2000, cases had dwindled enough to imagine a final effort that would place Guinea worm alongside smallpox as a vanquished threat to human health — all without vaccination. To this end, the campaigners distributed millions of simple filters known as the Guinea worm pipe. In the Carter Center's own origin story this pipe refined and standardized a nomadic variation on a household filter cloth, which involved holding a piece of nylon over the end of a reed to drink. By most accounts the filter proved a great success, at least in terms of its narrow, vertical mandate. Although other approaches to providing clean water (such as the Bush Pump) might have achieved a better drinking supply, general sanitation and overall health on a national scale, the Guinea worm pipe effectively blocked Guinea worm (Moran-Thomas, 2015). Among the main suppliers of this unusual device was an unusual company named Vestergaard Frandsen, which produced some 23 million units.⁷

Vestergaard-Frandsen began in Jutland, Denmark in 1957 to manufacture work uniforms. As a modest, family-owned textile business in northern Europe it found itself increasingly squeezed by global market forces. Whereas most such concerns simply went out of business, however, this one evolved. Within the family enterprise, an improvising father and a visionary young son with experience in Africa and a penchant for innovation recognized an emerging niche for humanitarian products. By the 1990s, the enterprise had shifted to creating goods for aid agencies, first recycling a pile of surplus wool from Swedish civil defense stockpiles into Red Cross blankets. It subsequently moved on to manufacture tsetse-fly traps, mosquito nets and tents impregnated with insecticide, as well as mesh filters for Guinea worm. To be closer to a nexus of international aid organizations, the company relocated its headquarters from western Denmark to western Switzerland, and actively recruited staff with health-related expertise. By 2005, it was selling two million mosquito nets, with sales of \$40 million. Nonetheless, its visionary leader expressed worry in *Forbes* magazine about the sustainability of this market: 'There is malaria hype in 2005. What about 2006?' (Freedman, 2005). The company would need to keep innovating to survive, even if — especially if — its products proved successful.

Innovate it did. By the time I visited their headquarters in Lausanne five years later, Vestergaard Frandsen had some 200 staff with offices in ten countries and an innovation center actively working on product development. Its website described it as 'a Europe-based international company specializing in complex emergency response and disease control products' whose 'innovation in disease control textiles is fuelled by our humanitarian entrepreneurship to create a healthier planet'.⁸ Whereas large chemical companies might produce mosquito nets as a sideline in the name of corporate social responsibility, Vestergaard Frandsen saw 'disease control textiles' as its core business and focused on creating new uses for them, such as water filters. The LifeStraw had become a signature project. Generalizing the principles of the Guinea worm pipe (which a V-F employee described to me as 'LifeStraw 0.5'), it created a filter to screen out all manner of pollutants, rather than concentrating on one parasite.

The result was a highly portable tube that produced exceptionally clean water, without electricity or moving parts. It was a formally elegant design, readily adaptable to a variety of geographic conditions. Any properly modern nomad would want one. However,

the company encountered some problems when it came to marketing them. Having focused its efforts on 'humanitarian entrepreneurship' and the UN's Millennium Development Goals, Vestergaard Frandsen wanted to apply the device to the very real problem of providing clean drinking water. 'We make a lot of things that could be used in the developed world', a company representative told me, 'but we filter off anything that doesn't reach the bottom of the pyramid, or isn't long-lasting'. By this, she meant that Vestergaard Frandsen sought to position its products as development devices. Yet an individual pipe, however well suited to sipping from streams and water holes, did not neatly fit with group needs in a settled community. It worked well for some contexts and less well for others, stopping most natural biological pathogens but not dissolved chemicals or industrial waste. Furthermore, the device required considerable suction to operate, which proved a struggle for very small children. Rather than a panacea for developing countries, the original LifeStraw turned out to be 'a standalone cool gadget', in the frank assessment of one person with whom I talked, useful in emergencies or for the 'hyper camper set' but limited when it came to general public health. Despite initial reluctance to position this product as a traditional commodity, in 2012 the company finally made the LifeStraw available to those in developed world who wished to buy it.⁹

In the meantime, Vestergaard Frandsen devised LifeStraw Family. If less elegant than the individual model, it promised greater functionality in a household setting. With the Family version one could draw water from any source and then slowly filter the contents through its bright blue assemblage hanging on the wall. However contaminated the source, the result promised to be clean and healthy, even *cleaner* than the individual model, as improved filtration removed most viruses. The device was not perfect or maintenance free, however; it produced a trickle instead of a torrent and required regular cleaning as noted above. It also was not cheap, running \$20-30 per unit, with a life expectancy of roughly three years. To succeed in poor contexts, the device would require innovative financing.

In 2011, Vestergaard Frandsen launched an ambitious experiment known as 'Carbon for Water'. The company distributed a million units of the LifeStraw Family in rural western Kenya, investing directly in its own product to the tune of \$30 million dollars. Rather than seeking grants from governments or aid institutions, or simply selling the device to consumers, it banked on the emerging market in carbon trading and gave the device away free. In an effort to 'civilize' markets into confronting their own effects and failings relative to global warming, the logic of carbon trading had created a new measure of value: the offset credit (Callon, 2009; MacKenzie, 2009). If enough Kenyan households used a LifeStraw instead of boiling water to purify it, then the decline in wood burning would reduce local carbon production. If that reduction were properly monitored and audited then it could itself transform the straw's impact into a commodity, a standardized good to offset carbon production elsewhere. Purchasing such credits would serve to balance the ecological profile of companies involved in messier enterprises. In this way, the ethical concern reflected in terms like 'carbon footprint' presented a new business opportunity, one that might be leveraged for all sorts of activities. Here Vestergaard Frandsen seized on this capitalist experiment in environmental concern to further its own health venture. If new and somewhat magical, carbon markets fit the company's ethical profile, and it gambled at an impressively large scale. All available

staff participated, as well as some four thousand contracted community health workers roaring about by motorcycle. All received smart phones with special apps to coordinate the distribution and record the location of each filter with global positioning system (GPS) coordinates and photographs. The company established over 30 repair centers and planned regular monitoring at 6-month intervals to evaluate actual use. Carbon offset would be independently monitored and reported to produce a trustworthy product. The plan was to run this program for at least 10 years.

Vestergaard Frandsen chose western Kenya, due to its prior experience in the area. But it imagined this endeavor as a global one, with a frontier largely determined by prevalence of water boiling rather than regional or linguistic histories. After Kenya, Rwanda, Bangladesh and Indonesia lay on the horizon. Even in the early stages of contemplating expansion, however, the company began to encounter various forms of friction (Tsing, 2005). It realized that relative population height in Indonesia was an issue for any device dependent on gravity and designed to hang on the wall, as user testing indicated people there might need a stool. The moniker ‘family’ also proved more complex than initially recognized, particularly when operating in contexts with variable conceptions of households and histories of reproductive politics. Nevertheless, Vestergaard Frandsen continued undaunted, busily innovating and working on successor models.

The carbon experiment remained an uncertain gamble, but the company displayed considerable adaptability on this front as well. Already in 2012 a company representative told me that although initial results appeared positive, the market was proving volatile. She noted brightly, however, that there had been unexpected side benefits: the mass campaign with regular follow-up presented an opportunity to generate new and better statistics at a household level, something that intrigued international health organizations and the Kenyan state. Even if the experiment failed at its initial objective, it might produce other benefits; data and knowledge were emerging from practice (Rottenburg, 2009b). As carbon markets continued to slide, it grew increasingly unclear whether Vestergaard Frandsen would recoup its investment through the original plan (Wolfson, 2015). Without retreating from the venture, the company pivoted its public face to display an ever-expanding array of LifeStraw® products. By 2014, not only had a Family edition 2.0 joined the lineup, offering enhanced life expectancy and a storage container (Figure 3), but also a device known as LifeStraw® Community (Figure 4). Resembling a miniature lunar lander in plastic and capable of serving 50–100 people a day, it edged a step closer to the Bush Pump’s social scale. At the same time, Vestergaard Frandsen had enhanced its offerings for the ‘hyper-camper’ set, matching the original straw with LifeStraw® Go, a portable filter ‘integrated with a sports bottle’ (Figure 5). In a gesture to history, the updated company website displaying all these goods also included the Guinea Worm pipe in the larger family.¹⁰ Vestergaard Frandsen now offered three products on the open market: the original straw, the first family version and the new Go bottle. It also launched a new charity campaign called ‘Follow the Liters’, promising that ‘[f]or each LifeStraw you purchase, one school child in a developing community receives safe drinking water for an entire school year’.¹¹ The company planned to distribute the community straw to schools in the Western Province of Kenya, uploading the results into a public geographical information system (GIS) database. As of 2015, it reported having placed 1,646 units into 301 schools serving an estimated 157,975



Figure 3. LifeStraw® Family 2.0.

students.¹² If a retreat from carbon credits into a more familiar ‘causumer’ culture of the commercialized gift (Richey and Ponte, 2011), the move linked the two channels of the LifeStraw® product streams.

Carbon for Water enjoyed a good deal of positive media coverage, in sync with an inspired public relations campaign that included a blogging contest by Women Deliver (a maternal health advocacy organization) and a documentary film.¹³ It also generated controversy. A pointed, critical piece in the *Stanford Social Innovation Review* described it as ‘a loopy funding scheme paired with a lousy public health solution’ (Starr, 2011). Its author challenged the project on both conceptual and technical grounds, questioning the degree

to which rural Kenyan households actually boiled water, the likelihood that use of the filter would actually reduce waterborne disease, and the prospect for sustaining such an expensive experiment. The posting inspired lively commentary, including a response by the CEO of Vestergaard Frandsen. Alongside debates about boiling rates, ‘suppressed demand’, and ‘courtesy bias’ (dueling efforts to estimate what people might do under other conditions or when not being interviewed) the discussion displayed considerable ethical feeling. Charges of ‘charity hoaxes’ combined with calls for greater sustainability and measurable impact. One self-identified Kenyan denounced the project in broad anti-colonial terms, writing: ‘We don’t need you to “rescue” us while enormously helping yourself!’ A self-identified Kenyan provincial health officer countered with an extended defense, citing the value of the experiment’s massive scale, attesting to its popularity and stressing the importance of cooperation and the moral value of saving lives.¹⁴

Not surprisingly, given the context, many engaging in the debate were clearly aid professionals. Quite a few commentators cited other filters and water projects with which they had personal experience or a direct stake. Those who objected spoke in terms of technical shortcomings, favoring this or that alternative, and the overall tone emphasized pragmatism or an attachment to locality over an elaborated politics. Moreover, skepticism expressed about carbon financing did not extend to the market in general. Indeed, one of the primary charges against the LifeStraw involved its expense and consequent inability to fit the local economy in traditional terms. The article that launched the discussion began by quoting a more glowing account in the business magazine *Fast Company*: ‘Vestergaard Frandsen makes an ingenious water filter that is too expensive for the people who need it. They figured out how to give it away and still make money’.¹⁵ From this critical perspective, the problem with the LifeStraw was *not* that it might turn a profit, but rather that it did so in a potentially ephemeral way.



Figure 4. LifeStraw® Community.



Figure 5. LifeStraw® Go.

Markets, or the other fluidity

Here I should pause to underscore a point of discomforting distinction. Part of the appeal of the Bush Pump, after all, rests precisely on its economic disinterest. The design is not proprietary, patented or sporting a registered trademark. The object itself involves little marketing, aside from earnest technical reports and the odd academic article. By contrast the Carbon for Water project – whether or not it proves technically advisable or financially successful – involves heavy marketing, along with distributed production and a global market that mixes ethics with finance. Distant measures of ecological impact can now trade as carbon credits, rising in value if they also improve human health. The image disrupts conventional conceptions of both aid and independence alike. While a partial gift, it is hardly a selfless enterprise and remains dependent on environmentalist feeling in wealthy countries, something far from certain amid economic instability. From perspectives dedicated to nonprofit values or local autonomy, then, the LifeStraw is not so easy to love.

One easy response to Vestergaard Frandsen's scheme – and humanitarian design in general – would be to categorize it under the broad umbrella of 'neoliberal' governance, if not a slower, softer form of disaster capitalism (Johnson, 2011; Klein, 2007). Such a designation might not inspire love, but at least a scholar with leftist political instincts might find some pleasure in familiar denunciation (Ferguson, 2010). Certainly, the

LifeStraw functions as a commodity of sorts and its maker participates in a humanitarian niche market, selling products to international aid agencies. However, such an analytic move risks overlooking specificities involved and the manner in which this actor foregrounds moral and medical values, not simply those of market reason or the privatization of previously public goods. The LifeStraw, after all, shares the Bush Pump's focus on *clean* water and hygiene. It also does not substitute for existing services in any simple sense, but rather tries to fill a perceived gap of access to modern infrastructural norms.¹⁶ Its direct competitors are a mishmash of other microtechnologies – household filtration systems, jerry cans and boiling pots (in some disputed number!) – rather than an urban water main. The device itself may not be fluid in a design sense, but Vestergaard Frandsen's efforts to find a use for it appear impressively 'adaptable, flexible and responsive', to echo de Laet and Mol. And while the Carbon for Water project might impose, it tries to serve while doing so. This market form is suffused with ethical concern (Roy, 2012). And recalling our Marx we should not forget that whatever else markets may do, surely they exhibit mercurial flow. To quote a Vestergaard Frandsen representative who spoke to me in 2011:

We're trying to find innovative ways to mobilize funds versus taking a market as being given. Look at 'there's a need here' and then ask how do we get the money? Credit cards for malaria, the malaria bond, it's all a question of how to bring new money to the table. We think there are opportunities out there, and as a private organization we have an advantage of knowing fundraising. Using carbon again, for example, not waiting for donors. It's the kind of company we are.

Indeed, the term 'neoliberalism' glosses over the complexities of recent efforts to extend the reach of business to the 'bottom of the pyramid' (Cross and Street, 2009; Prahalad, 2005). As Julia Elyachar (2012) notes, the logic of this approach to 'development after development' reconfigures both corporate vision and its perception of those living in abject poverty. Rather than persisting as a timeless, needy mass, the poor become a future resource, recognized as potential producers and consumers, not only as suffering victims. Their preferences register, albeit in a circumscribed way. Moreover, products designed for this sector must adapt to an absence of support infrastructure. They must survive a perilous environment and cannot depend on a regular supply of electricity. To be successful, humanitarian goods must recognize their users, adjusting to the reality of their worlds even as they seek to change them. In this respect, they follow the Bush Pump. Although the LifeStraw may struggle to find a niche, Vestergaard Frandsen generally views its products as commodities in the sense of seeking user appreciation. With mosquito bed nets, it has conducted market research to determine preferences for size, color or type of material among target populations. This philosophy met with approval from a malaria adviser for the United Nations Foundation quoted in the *New York Times*: 'Vestergaard is just different from other companies we work with ... They think of the end user as a consumer rather than as a patient or a victim' (McNeil, 2009). In the lumbering world of aid agencies such a perspective pushed other conceptual boundaries, even while extending market reason. To invoke neoliberalism seriously here, one would need to consider the terms of its enactment more precisely. As Stephen Collier (2011) points out, this might involve less an erasure of all social welfare through blind market enthusiasm than

‘a new patterning of social welfare mechanisms with techniques of commercialization and calculative choice’ (p. 26).

In any event, the onetime star of development discourse, the postcolonial nation state, appears cast in a diminished supporting role. Portable water filtration takes on a key function of modern government, in this case the provision of water essential to health and hygiene (Goubert, 1989; Orlove and Caton, 2010; see Rottenburg, 2009a in context of development). The Carbon for Water project, however, deals with the state in a strikingly different way. Although enjoying cozy relations with the Kenyan government, Vestergaard Frandsen does not frame its endeavor as one of nation building. Rather, it engages the state as a ‘partner’, a common trope of global health, in which contractual equality can mask both asymmetrical power relations and an absence of fixed obligations (Geissler, 2013). Once in place, the LifeStraw requires only minimal support systems beyond its own particular assemblage. Eminently mobile and focused on survival needs, it also displays ambitions to function as a substitute micro-infrastructure, one divorced from any project of extending a grid of urban services. Vestergaard Frandsen imagines water in medical terms with a preventative accent, stressing purity and hygiene. The LifeStraw presents a solution at the level of individuals and families rather than national populations; even the communities anticipated by the largest straw assume existing institutions like schools. Carbon for Water deploys household straws, not a water system or even a village borehole well. In describing this approach to me, one company representative struck a pragmatic and realist tone:

Let’s be honest; we’re not getting a municipal water system in rural Kenya anytime in the near future. Our project focuses more on quality, not just delivery So we’re creating new products all the time. All have a longer-term or medium-term vision of how the world should be. But for the company we define long-lasting as three years. That’s not enough for development, but we tend to use the terms humanitarianism and development interchangeably ... We’re a company that says let’s do what we can.

The case of Vestergaard Frandsen suggests an alternative corporate model of liberal care for a population, one in which social concern might offer not simply a public relations gambit or marketing strategy, but the cornerstone of a business plan. Describing social conscience as an obligation rather than responsibility, the company website expresses faith that its work will ‘some day afford all humanity the basic human rights so many of us are currently without’. Fulfilling this dream, however, now apparently involves accepting a humanitarian sense of realist limits and design rather than faith in revolution or political forms of social engineering.

Micro-worlds and states of desire

In a provocative article on neoliberalism, Jim Ferguson (2010) asks the important, ever-troubling political question of ‘what do we want?’ (p. 167) He points out that critical reflections on the contemporary moment routinely conclude by expressing indignation. They rightly denounce injustice and inequality, and righteously assign blame. They rarely, however, offer much in the way of a positive alternative vision, particularly at a

level of technical detail or material artifacts. The Bush Pump as presented by de Laet and Mol stands in happy exception to this trend. It offers a heroic, if open-ended, story. It promises love. Once beyond its bright blue centerpiece the political vision recedes; the state appears primarily through collective action and running water. Still, it reflects a potentially happy polity, flush with self-determination and independent pride. One can glimpse a measure of postcolonial romance with each cheerful swish of the pump.

By comparison, humanitarian design exhibits little faith in the nation state form. In place of the classic infrastructure of large technical systems smoothly humming in the background of daily norms associated with cities, states and landscapes that casually claim the future (Hughes, 1987; Star, 1999; Suchman, 2011), this phenomenon focuses on micro-worlds in poor contexts, albeit ones with global connections. Its advocates emphasize adaptability, the importance of tests and real-world feedback. They stress accountability, audit and impact, and pay at least lip service to community participation. Conspicuously absent is a middle level of abstraction between situated actors and far-flung networks. Nation states provide a familiar classificatory backdrop and define the legal regime, but rarely enter the dramatic narrative as the receptacles of hopes and dreams. Few seem to expect much of them in the quest for altered habits, improved lives and new material norms. In and of themselves, they no longer define the future.

To the extent that infrastructure embodies a material sense of modernity – understood as a privileged attitude of expectation rather than an epochal condition – its politics would appear significant (Edwards, 2003; Larkin, 2013). Its morality would also appear complex, involving multiple forms of worth and a compound sense of humanity (Latour and Venn, 2002; Thévenot, 2002). Even in places where large technical systems define a normal landscape, the humming grid of services rests on varied and often tortured histories, a technopolitics of empire and markets as much as any nation state (Hecht, 2011; see also Hecht, 1998, 2012). A primary ambition of postcolonial approaches has been to provincialize the experience of metropolitan centers enough to recall this crucial point (Anderson, 2002). When imagining an alternative to 20th century imperial hegemony, however, the concept of the nation state arises like a phoenix from these empirical ashes, purified of the blood and oil of its origins to define a norm of service delivery. In many places it does so precisely through a register of inadequacy, of its failure to ensure a proper material condition for modern experience: reliable electricity, running water, a functioning sewer. Why is there no functioning water system? Why do the roads remain poor? Does anyone remove the trash? My point is simply that ‘states’ and ‘governments’ (along with ‘communities’) are as much objects of desire and disappointment as conventions of political order. Moreover, that desire often fastens onto material systems, and civilizational markers like sanitation (Robins, 2014).

To perceive a place like rural – or even urban – Kenya as lacking in infrastructure overlooks a wide array of existing objects and relations, and complex, often ingenious efforts to extract livelihood from a modest set of elements in a ‘half-built’ environment (Simone, 2004). Nonetheless, such a perception also recognizes the precarity of such existence, as well as the political stakes of a desire for a better life in settings where the future appears more global than local (Johnson, 2011; Piot, 2010). This is the terrain where devices like the LifeStraw inherit the mantle of the Bush Pump, if not the same degree of hopeful enthusiasm—for the LifeStraw has inspired negative as well as positive

passions, partly arising through comparison with what a 'proper' water system should be.¹⁷ What is the status of micro-infrastructure relative to infrastructure and its utopian visions? Does the wave of humanitarian goods represent a new horizon of possibility? Or a surplus of innovation masking a degraded future?¹⁸

There is much to sift through, then, with regard to humanitarian design. A first task, to which this essay has devoted itself, would be suggesting what might distinguish these efforts from earlier attempts at technical intervention. On initial inspection, three features stand out. First, unlike major development projects focusing on large-scale endeavors such as dams, housing projects or even clinics, innovations like the LifeStraw operate with minimalist materials and an ecological ethos (whether or not fully realized in practice). Second, unlike previous forms of alternative technologies, they incorporate extensive monitoring and evaluation into their plans. Third, while claiming humanitarian values of improving health and saving lives, they profess little faith in states or traditional forms of aid, focusing instead on microscale market opportunities, community will and the miracle of innovation (Redfield, 2012).

This last feature merits further amplification, particularly the current appeal of small, incremental approaches to social change. Keeping in mind that scale is ever a relational concept (Marston et al., 2005), I should first note that the products of humanitarian design are no less global than earlier universalizing projects of 20th century development. they likewise involve far-flung networks of connection and flows, complex links between people, ideas, materials, and forms of labor, if in less concentrated or obvious ways. Nonetheless, their horizon remains emphatically 'micro' in its articulation, intentionally small when it comes to a spatial and temporal scope of action. The devices in question engage on a personal level and respond to immediate needs. By short-circuiting the gap between distant problems and technical imagination, they bring those problems within reach of individual initiative, framing a response as a potential, achievable 'fix'.¹⁹ The focused tangibility of devices like the LifeStraw, I suggest, appeals to a primary ethical imperative motivating actors in transnational domains like global health—the modest but urgent desire 'to make a difference' in an often intractable world (Good and Good, 2012). Humanitarian design offers a direct and material conduit for expressing care.

What then to make of these new forms? A half century on from the height of decolonization, what should we say about the 'postcolonial condition'? Particularly, what should we say at the level of clean drinking water? In the continuing absence of a functioning municipal water system, and in the presence of plastic bottles and shifting demography and patterns of consumption, the LifeStraw lays claim to a certain rationale. When politics, economics and ethics all increasingly appear to revolve around 'life itself' (Rose, 2007; Sunder Rajan, 2006), it becomes a growing challenge to articulate alternatives at several levels and on several fronts. An emphasis on micro-gadgets side-steps larger political questions, risking technological fetishism (Scott-Smith, 2013). The enthusiasm for do-good capitalism also threatens 'grassroots privatization' of basic services, even in the absence of any state guarantee (Johnson, 2011: 460). As Richard Rottenburg (2009b) points out, however, when describing humanitarian ventures in the Global South as 'therapeutic domination' (p. 437) one should be careful not to overemphasize the singularity or stability of this regime. Humans and nonhumans rarely prove

fully obedient in practice. Moreover, a degree of reflexive adjustment appears the hallmark of contemporary interventionism, as exemplified by the design tradition of prototyping. Rather than a great leap forward from planning to action, projects now entail back and forth steps. Efforts at critique likewise grow entangled in complicating details, as well as the awkward (but popularly stabilized) fact that utopian alternatives struggle to find traction. Rather than a sharp, happy contrast between fading empire and impending liberation, here the force of the future appears uncertain. Indeed, if anything, a pulse of innovation courses through the market, not just in its endless stream of generic commodities, but also targeted, designed, well-intentioned goods – gadget capitalism with a human face.

As a consequence, it grows harder to tell a postcolonial love story with technology. The political language of revolution fits awkwardly alongside humanitarian design, yet lingers in the background as an old, defining romance. Design operates in quite different terms, drawing things together rather than exploding them apart. However suffused with world changing rhetoric as well as innovative practice, it cannot fulfill dreams of abrupt transformation (Latour, 2008; Rule, 2008). This is all the more true with humanitarian strains that focus on the immediate question – immediate and thereby anti-utopian – of survival beyond infrastructure. It should come as no surprise then, if the field of affect around this form of design stretches into a complex of contradictory reactions, mixing passion with ambivalence, hope with doubt or even despair.²⁰

If we allow de Laet and Mol's invocation of love to open the door to a wider array of academic affect, however, ambivalence and doubt merit further consideration. The LifeStraw appears in a complex world, with many actors beyond states: nongovernmental organizations and corporations, activists and tourists, and merchants peddling everything from weapons to soda. It is a world where much of the 'technology transfer' from global North to South involves not intentional design but discarded objects, repurposed for a second life in a poorer environment. In recounting the story of one such artifact, a German ambulance that becomes a Ghanaian minibus, Uli Beisel and Tillmann Schneider (2012) emphasize the 'ambivalent achievement' (p. 643) of this transformation, which creates a newly functional but risky form of mass transport by packing passengers into an increasingly unstable vehicle. Referring directly to de Laet and Mol's Bush Pump, the authors suggest that technological fluidity can hold danger as well as opportunity. Instead of love they foreground the warier sentiment of ambivalence. Ambivalence and doubt seem well suited for humanitarian design. Objects like the LifeStraw are not castoff waste, but the result of a conscious effort to expand the scope of innovation to include 'the other 90%' (Smith, 2007). This effort for inclusion, however, may often fail to fully recognize the everyday innovation of inherited traditions, or to fully incorporate users as co-designers (Mavhunga, 2014). Humanitarian design also leverages market logic rather than seeking alternatives, accepting profit motives even as it emphasizes the well-being of others. For admirers of the purer Bush Pump, this is hardly an ideal match.

Ambivalence is rarely a satisfying feeling. It can, however, serve as a prompt for continued inquiry. So too can concern and care, even in a muddled, imperfect world.²¹ Writing about an 'ethos of care' relative to the study of science and technology, Maria

Puig de la Bellacasa (2011), channels modes of feminist thinking to expand Latour's (2004) reconsideration of critique into a new proposition for thought:

The notion of 'matters of care' aims to add something to matters of fact/concern with the intention of not only respecting them, but of engaging with their becoming. In that sense, this notion of 'matters of care' stands for a version of 'critical' STS that goes further than assembling existing concerns, yet resists the pitfalls identified by Latour: ready-made explanations, obsessions with power, and the imposition of moral or epistemological norms. (Puig de la Bellacasa 2011: 100)

Stressing that care is unstable, uncertain, active and highly contingent, Puig de la Bellacasa suggests we concentrate on fostering more caring relationships, asking 'how to care' anew in each situation. In these terms the LifeStraw has a long way to go. Lagging behind the more relational Bush Pump, it envisions users in ready-made forms: individuals, households, preassembled communities. It forgets the shortcomings of set scripts and that human aggregates require active work to remain viable (Akrich, 1992). Yet reversing the flow of questioning raises similar points about frames of potential critique. Studies of water use in such different sites as a tranquil US college campus and the urban sprawl of greater Mumbai remind us that the practice of community exceeds the categories of its analysis. People can exert collective claims while disowning public installations (Kaplan, 2011), and can exercise pressure even within incremental and differentiated citizenship (Anand, 2011). These are not ideal social forms but the product of fluid experience. The one advantage of uncertainty, doubt and ambivalence is an imperative to pause and consider them.

My ambition here has been the modest one of raising questions rather than advocating any certain answer. I will therefore close by reiterating a minor line from my model text. The authors of the 'Zimbabwe Bush Pump' include a useful admonition among their footnotes: 'Not every interpellation, however, should be taken as a reason for praise. In good Althusserian fashion, one may doubt whatever one is seduced by' (De Laet and Mol, 2000: 262). One might add reactions of troubled ambivalence or repulsion to that of seduction. With the postcolonial nation state, as with the LifeStraw, a measure of doubt may prove as vital as love.

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Notes

1. Beyond science studies, the piece has also served as a point of inspiration in design circles; see, for example, Van der Velden (2008) and http://ioe.academia.edu/JoshuaUnderwood/Papers/111493/Fluid_technology_design_for_development; <http://dddxyz.org/fluid-or-frozen-zimbabwe-bush-pump-and-the-playpump/>; <http://dddxyz.org/opinion-piece-identifying-the-individual-in-participatory-design/> (all accessed 7 November 2015).
2. As well as volumes like *Architecture for Humanity* (2006), Antonelli (2005) and Smith (2007), see organizations like the Institute without Boundaries, Project H Design, Catapult Design etc. (<http://www.institutewithoutboundaries.ca>, <http://www.projecthdesign.org/>, <http://catapultdesign.org/>). For more background on design relative to anthropology, see Clarke (2011); Suchman (2011) offers a clear-eyed assessment of the significance of location in transformation, while Turner (2006) traces the genealogy connecting cyber-entrepreneurialism with its countercultural antecedents, including the *Whole Earth Catalog*. Cross (2013) details the history of one remarkable design effort to produce a low cost solar light.
3. Barbrook and Cameron's (1995) sweeping critique of the 'Californian ideology' behind Silicon Valley visions of the future delineates and excoriates the politics of this trend toward market acceptance. From a different angle, Rees (2014) considers the logic of the Gates Foundation's conception of humanity and stateless planning in global health, while Escobar (n.d.) seeks to recuperate an alternative conception of design.
4. See the site <http://lifestraw.com/products/lifestraw/> (accessed 7 November 2015).
5. Pilloton (2009: 72–73). The Personal LifeStraw filters down to 0.2 microns, eliminating most parasites and bacteria (such as giardia, *E. coli* and cholera). The Family version contains both an 80 micron prefilter for large particles and an 0.02 micron membrane cartridge, catching most viruses as well. Neither device, however, eliminates heavy metals or desalinates water.
6. <http://www.cartercenter.org/about/index.html> (accessed 7 November 2015). For an insightful and critical analysis of this foray into a heroic mode of disease specific global health, see Moran-Thomas (2015).
7. See <http://www.cdc.gov/parasites/guineaworm/prevent.html>; http://www.emory.edu/EMORY_REPORT/erarchive/2001/October/erOct.22/10_22_01cartercenter.html; <http://www.cartercenter.org/news/documents/doc130.html>; <http://www.vestergaard.com/lifestraw-guinea-worm> (all accessed 7 November 2015).
8. The quoted self-description dates from the website in 2011; for the current, fluidly expanded update, see <http://www.vestergaard.com/about-us> (accessed 7 November 2015).
9. In an inversion of the earnest postcolonial utopianism of the Bush Pump, the device found unexpected fans among those concerned about zombies and dystopian apocalypse. See, for example, <http://www.zombiesurvivalshop.ca/tag/zombie-survival-camp/> (accessed 7 November 2015).
10. <http://www.vestergaard.com/our-products/lifestraw> (accessed 7 November 2015). By late 2015, the company had added another two products to the commercial lineup: LifeStraw Steel Personal Water Filter (a more rugged version of the original straw with a replaceable carbon capsule) and LifeStraw Mission (a portable campsite version of the family model available in 5 and 12 liter sizes) (See <http://lifestraw.com/products/lifestraw-steel/> and <http://lifestraw.com/products/lifestraw-mission/>). It also offered LifeStraw Carbon Credits directly

- to consumers; for \$12.95 one received a certificate attesting to the offset of one ton of CO₂ emissions and the provision of safe water to a Kenyan family for a year (<http://lifestraw.com/products/lifestraw-carbon-credits/>) (all sites accessed 7 November 2015).
11. <http://lifestraw.com/follow-the-liters/> (accessed 7 November 2015).
 12. <http://kenya.followtheliters.com/Default.aspx> (accessed 6 July 2015). See also Wolfson (2015).
 13. <http://carbonforwaterfilm.com> (accessed 7 November 2015).
 14. The discussion can be found at http://www.ssireview.org/blog/entry/thirty_million_dollars_a_little_bit_of_carbon_and_a_lot_of_hot_air (accessed 7 November 2015). See also http://www.ssireview.org/blog/entry/another_look_at_carbon_for_water_in_western_kenya (accessed 7 November 2015).
 15. <http://www.fastcoexist.com/1677938/fighting-water-borne-disease-in-africa-and-making-millions-in-the-process> (accessed 7 November 2015).
 16. For comparison see Von Schnitzler (2013) on water meters and Steven Robins (2014) on toilets in South Africa. See also the virtual collection of the journal *Cultural Anthropology* on the theme of 'water' as curated by Ashley Carse (http://www.culanth.org/curated_collections/10-water).
 17. See, for example, the critical perspective of Nathalie Rothschild (2009), who objects to any suggestion it represents a 'solution', asking whether it is 'the most degrading gadget ever invented'.
 18. See Edgerton (2007) on the limits of innovation.
 19. Here, I am adopting language from a blog series in the *New York Times*, for example, <http://opinionator.blogs.nytimes.com/2014/08/21/innovation-within-reach/> (accessed 7 Nov. 2015).
 20. For other accounts of intersections between politics and complex ends of desire, see Ferguson (2006) and Gould (2012). Lauren Berlant (2011) suggests the term 'cruel optimism' to describe a condition when 'something you desire is actually an obstacle to your flourishing' (p. 1). With regard to the LifeStraw one might read this line in more than one direction. For a more hopeful vision of the possibilities of a relational, ontologically expansive form of design see Escobar (n.d.).
 21. 'Care' is a notoriously complex concept in medical anthropology. For recent efforts to grapple with its ambivalent complications, particularly in depersonalized, normative and institutionalized forms, see Stevenson (2014), Ticktin (2011) and the October 2015 special issue of this journal on the politics of care in technoscience.

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