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# To fail at scale!

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# To Fail at Scale!
## Minimalism and Maximalism in Humanitarian Entrepreneurship

**Abstract:** Humanitarian entrepreneurs seek to do well and do good by developing goods and services that directly address the world's most intractable problems. In this article we explore the expectations built into two of their products: a point-of-care diagnostic device and a solar-powered lantern. We show how these objects materialise both a minimalist ethic of care and a maximalist commitment to universal access for health and energy. Such maximalist commitments, we propose, are fundamentally utopian. The developers of these humanitarian goods do not envision their objects as stop-gap solutions or 'band-aids' for entrenched systemic failures but rather as the building blocks for new kinds of universal infrastructures that are delivered through the market. We trace the work involved in scaling-up the humanitarian effects of these devices through processes of design, manufacturing and distribution. For humanitarian entrepreneurs, we argue, to fail at delivering expectations is to fail at scale.

**Keywords:** entrepreneurship, failure, humanitarianism, technology, utopia

## Utopian Beginnings

In the early 2000s, Bill Rodriguez, an infectious disease clinician from Harvard University, joined the Clinton Foundation as Chief Medical Officer, a role in which he was responsible for managing HIV treatment projects in multiple African countries. Following the hard-won fight by advocacy groups and campaigners for antiretroviral treatments (ARVs) to be made affordable to patients in poor countries, HIV treatment was becoming more widely available in African clinics. But Rodriguez told us he found the efficacy of the treatment programmes was hampered by the lack of diagnostic capacity: 'Every day I was getting emails from all over the world saying, "We can't take care of patients because we don't have diagnostics."' A major challenge related to the ability to detect whether the disease had progressed to a point where ARV treatment would be beneficial. At the time, this involved testing for 'CD4 cells', which required expensive and difficult-to-maintain equipment that public laboratories could rarely afford. What was needed, Rodriguez surmised, was an affordable, smaller, faster, more portable 'CD4 counting device' that could work in under-resourced clinical settings.

Daktari, the small start-up company he co-founded to make such a tool, was intended to encapsulate the virtues of global health innovation and demonstrate that for-profit product development could be an effective route for getting life-saving medical tools to markets in the Global South. With a strapline of 'Anywhere. Care.', Daktari's mission was to develop 'products that address the most pressing challenges in global health' (ASLM 2014).The point of such products was that, as portable commodities, they could get to places that a cumbersome and expensive public laboratory infrastructure could not.

Elsewhere in the late 1990s, a young Australian engineering graduate named Stewart Craine was working to improve the cost-effectiveness of rural electrification in Nepal as part of a growing international effort to tackle global energy poverty. He told us, 'The rate of rural electrification was not exceeding the rate of population growth. They were both around two percent. So it was like, "how do we disrupt that problem?"' In Nepal, he encountered a new technology: highly efficient white light-emitting diodes, which dramatically reduced the costs of electric lighting in ways that made off-grid energy more affordable for low-income rural households. What was needed, he and colleagues argued, were 'special humanitarian–entrepreneurial relationships' with manufacturers that could drive the costs down further (Robertson et al 2002: 6).

In the early 2000s, Craine joined an Australian energy consultancy that had been contracted to design a rural electrification strategy for Papua New Guinea. What was needed here, they proposed, were companies that would manufacture and sell small standalone off-grid lighting devices that would drive demand for larger off-grid systems. But they couldn't find any Australian companies that were interested. He explained to us, 'I couldn't find an organisation where we could actually build a power company for the poor. So we made one.' When the contract ended, he and a colleague founded a for-profit social enterprise, Barefoot Power, that aimed to increase access to energy by mass producing and marketing small-scale solar-powered lanterns.

## Minimalism and Maximalism: Scale in Humanitarian Design

At the turn of the century, companies like Daktari and Barefoot Power exemplified a new spirit of social entrepreneurship (Giridharadas 2019; Szeman 2015). At the heart of this new approach was the claim that it was possible to 'do well and do good' by developing goods and services that directly address the world's most intractable problems (Cross and Street 2009; Elyachar 2012). The range of such goods has proliferated and anthropologists have turned their attention to everything from biodegradable poo-bags and portable purification systems intended to eradicate water-borne and diarrhoeal diseases (Redfield 2012, 2016); nutritionally enhanced or fortified foods intended to eradicate malnourishment (Scott-Smith 2013; Street 2015); miniaturised diagnostic devices intended to replace

the need for large-scale laboratory infrastructures (Beisel et al 2016; Engel and Krumeich 2020; Street 2018); and solar-powered systems designed to provide electrical energy for people living off the grid (Cross 2013, 2019). As highly targeted expressions of concern, such goods are characterised by their combination of ethical and economic ambition; they seek to simultaneously save life and generate profit (Collier et al 2017).

Such goods, Peter Redfield has earlier argued, are resolutely non-utopian and yet deeply humanitarian. They operate in the shadow of state failure, and doubts about the capacity of states to ever fully realise the utopian visions of large-scale public infrastructure projects and social welfare programmes that characterised twentieth-century models of development (2012:157). At the same time, they are premised on the expectation that people should be able to live, even under 'extreme conditions of crisis, neglect and poverty'. To this end, they promise only 'minimalist forms of care' focused on bare survival rather than radical social improvement (2012:180).

We share with Peter Redfield a keen sense of the 'minimalist biopolitics' inscribed in small, mobile technologies that are designed to target a basic level of need. Like other humanitarian goods, a portable test for CD4 cells targets a population suffering from a single disease, seeks only to secure biological survival and presents a solution to one diagnostic gap in one disease programme rather than offering a more comprehensive solution to strengthening national health infrastructures. Similarly, a solar-powered lighting device targets only people burning kerosene for domestic illumination, seeks only to replace one lighting technology with another and presents a technical fix to one specific characteristic of energy poverty rather than any systematic solution to the extension of modern energy services.

At the same time, we have increasingly come to see that humanitarian goods are also defined by a maximalist biopolitics. By this we mean that humanitarian goods are also defined by their claims to universal utility; by a capacity to scale up in ways that have the same impact or achieve the same goals across diverse geographies and populations. Maximalist biopolitics are not tethered to the nation-state, and its populations of concern are defined by the global markets found 'at the bottom of the pyramid' (Prahalad 2006). Across a diverse range of technologies, from a point-of-care test to a solar-powered lantern, we find a common premise: the idea that sustaining life at the level of the population can *only* be achieved by scaling up the mass-manufacturing and distribution of products. This maximalist commitment is as much a part of the biopolitics of humanitarian goods, we argue, as their minimalism. Like the minimalist biopolitics built into these humanitarian goods, commitments to scale are also a form of design, rooted in the cultural history of twentieth-century industrial and product design (Escobar 2018: 32–35). Indeed it is this multifaceted aspect – the scale achieved when universal effects are built into miniaturised devices – that allows both humanitarian entrepreneurs and their goods to be so compelling or char-

ismatic (Ames 2019), capable of speaking simultaneously to different audiences and expressing different values.

Such maximalist aspirations, we propose, are fundamentally utopian. They may not be a fully elaborated revolutionary, radical or progressive programme for the restructuring of society but, as Fredric Jameson and Peter Frase ( Jameson 2005; Frase 2013) remind us, this is not the only way in which they might be considered utopian (see Redfield, this issue). Instead, both of the humanitarian goods we describe in this article are driven by what Jameson and Frase highlight as a utopian impulse that simply points in the direction of future programmes. The developers of these humanitarian goods do not envision their objects only as stop-gap solutions or 'band-aids' for entrenched systemic failures (Redfield 2018). They envisage their technologies as the building blocks for new kinds of universal infrastructures, accompanied by social and economic reforms – even if they do not spell out what precisely these might be (see also Neumark, this issue).

To the extent that they share a roadmap for utopia, these ambitions depend on markets as mechanisms for realising scale. The technologies developed by Daktari and Barefoot Power were never only intended to solve the technical problem at hand; they were also configured as 'market devices' (Muniesa et al 2007) that, by opening up new opportunities for humanitarian enterprise, would also catalyse markets for health diagnostics and energy systems that would be more far-reaching *and* more inclusive than any previous era's utopian vision for large-scale, national public infrastructures. After all, neither the laboratory systems nor the national electricity grids established by colonial and post-colonial development projects were ever universal in a geographic or demographic sense. Laboratories were always considered to be too expensive, complicated and specialised to extend to the community level, and until recently even the most aspirational standards set by the WHO took for granted that community health workers would need to treat patients without access to diagnostic testing (Street 2018). Meanwhile, large-scale, national projects of electrification either excluded large swathes of territory that were deemed inefficient and economically unviable to reach or prioritised the needs of urban populations and strategic industries (Cross 2020).

In the face of the failure of such large-scale public infrastructure projects for health and energy, humanitarian entrepreneurs envision the market as the most effective and sustainable solution to readdressing inequities in access to basic services. These technologies are not imagined as piece-meal solutions for individual consumption but the starting point for a radical restructuring of basic service provision premised on the biopolitical imaginary of technology as infrastructure. The futures designed into these products may, in part, reflect what Göran Therborn has called a 'curious utopia of resignation' (2007:97): that is, resigned to the conditions, values, institutions and assumptions of contemporary capitalism as the only viable political and economic system for organising the world. We are

not convinced, however, that 'resignation' fully captures the attitudes of human-itarian entrepreneurs to the products that they develop or their maximalist aspi-rations for them.

Through biographies of the Daktari CD4 device and the Barefoot Power solar lantern, we add to the portfolio of humanitarian goods that has attracted inter-est from anthropologists. Rather than interrogate their minimalism, however, we focus on what it means to scale up; that is, what is involved in building max-imalist aspirations into minimalist technologies. Critiques of the humanitarian good as a 'magic bullet' emphasise their failure to substitute for the comprehen-sive public services provided through large-scale public infrastructure, and their dependence on other large-scale infrastructures, like transportation or sanitation (Collier et al 2017; Cueto 2013). Redfield points out that if we were to alter the scale of expectation then the small-scale, highly targeted ambitions of devices like the rapid diagnostic test or the solar lantern may appear highly effective, as 'per-mitting tangible, immediate action within a delimited space of encounter' (Red-field 2018). Yet our concern here is not the scale of anthropological critique but rather the role played by humanitarian goods in the 'scale-making project' (Tsing 2000, 2012, 2015) of humanitarian entrepreneurship. By tracing the ideologies of scale and scale-work (Tsing 2000, 2012, 2015; see also Nonini and Susser 2020; Neveling and Wergin 2009) inscribed in humanitarian goods, we present them in a different light: as utopian projects that fail on their own terms. Like other recent anthropological engagements with the concept of failure (Appadurai and Alexander 2020; Smith and Woodcraft 2020; Prince, this issue; Rao, this issue), we are primarily interested in how the actors involved understood, defined and experienced failure, rather than providing an external diagnosis of its occurrence.

In what follows we examine what is involved in trying to scale up the effects of mobile, minimalist devices by deploying them through markets to populations in need. As we show, scaling up these effects involves the work of designing mul-tiple expectations and capacities into a single technological product. And it also involves the establishing of manufacturing and distribution systems capable of turning a single prototype technology into a mass-produced good, and moving this around the world from points of assembly to points of use. While the design of miniature devices involves trade-offs and compromises, the latter work of making them move to the right places in the right quantities often proves most challenging. Viewed through the lens of humanitarian entrepreneurship, the primary failure here was that of generating a scalar contrast between the 'small' device and its 'large' effects. The mobile, mass-manufacturable and useable qual-ities of miniature devices is essential to their production of universal humanitar-ian effects. The scalar ambitions and failures of their utopian projects, we argue in our analysis, extend current critiques of the ethics of technology, humanitari-anism and entrepreneurship beyond a focus on the individual device, to consider the world of device*s* they are helping to build.

## Global Health Utopias: Daktari's CD4 Machine

Daktari, which means 'doctor' in Swahili, was established by Bill Rodriguez and his co-founder Aaron Oppenheim in 2007 with the goal of revolutionising the care pathways of HIV patients across the African continent through the development of an accurate, portable, easy-to-use, rapid and affordable CD4 cell counting test. Daktari was founded in Cambridge, part of the Boston Greater Area, and a city at the heart of the US's genomics-driven life sciences boom. Long touted by university leaders and politicians as the East Coast biotech answer to Silicon Valley, Boston boasts an unrivalled density of top engineering and life science departments, research hospitals and investment firms. Fuelled by government incentive schemes and aggressive university commercialisation policies, the Boston Greater Area has become the place to be for scientists looking for opportunities to translate their research 'from the bench to the clinic'. While Rodriguez was grappling with the problems of HIV treatment and diagnosis in African clinics, a host of innovative diagnostic technologies were simultaneously under development in Boston's university laboratories, being tested in its hospitals and spun out into start-ups in search of venture capital and commercial success.

Looking for solutions to the problem of CD4 testing in African clinics, Rodriguez's immediate response was therefore to ask why Boston's biotech sector had not come up with a solution to this problem. He found that very few biotech start-ups focused on diagnostics for global health applications because of the challenge of raising venture capital for products intended for use in poor countries. Rodriguez thought that investors' concerns about the absence of a market in such places were misplaced. He had witnessed the clinical need and demand for those devices first hand. But, more importantly, through his links with the Clinton Foundation, he knew that philanthropy-led increases in global health funding, the development of public–private partnerships like the Foundation for Innovative New Diagnostics (FIND), and new pooled funding mechanisms like the Global Fund were generating donor-driven demand for life-saving technologies, including drugs, vaccines and diagnostics, that could overcome the limited reach of existing health infrastructures and provide calculable results in improving 'access' to basic health services for the poor. With his extensive personal connections to global health organisations, Rodriguez realised that he was uniquely positioned to allay the concerns of investors and demonstrate that donor funding to sustain a market for point-of-care diagnostic devices was out there.

From the beginning, Rodriguez thought of Daktari as establishing a model for success in the sector of humanitarian diagnostic innovation. As for most biotech start-ups, the plan was to attract initial investment from venture capitalists, develop the device, do some field trials, build up orders from both private providers and larger global health organisations, scale up manufacturing, and then get acquired by a larger biotech firm with the capacity to manufacture and distribute the product globally. As Rodriguez recalled in an interview with us, he

hoped to 'demonstrate how to start up a company and get it started, then sell it off'. His goal, then, was not only to develop a diagnostic test to support HIV treatment decisions, but to show that it was possible to develop and successfully commercialise a diagnostic tool for global health applications. In the language of entrepreneurship, he hoped to 'disrupt' a biotech sector focused on American insurance markets and demonstrate that the growth in donor funding initiated by the HIV epidemic in Africa offered new opportunities for product development for global health.

Massachusetts General Hospital technology transfer office put Rodriguez in touch with a chemical engineer at Boston University, Mehmet Toner, whose team had invented two promising technologies. The first was a microfluidic-based immunoassay to capture CD4 cells. CD4 cells are smaller and contain more antigen than other white blood cells. Using microfluidics, the team was able to 'find a sweet spot of flow conditions' where the smaller, 'stickier' CD4 cells stick to the antibody but other white blood cells do not. The 'beauty' of the technique, as Toner described it, being that the microfluidics made the process 'labour free'. Second, the lab had developed a miniature chip that used an electrochemical sensing technique to detect and count the cells captured by the immunoassay, eliminating the need for the complex optics involved in standard laboratory-based techniques. Rodriguez and Toner thought that, together, these two inventions had potential for the development of a more portable, affordable and rapid CD4 testing technology. As Toner explained it, 'basically, you take a fingerprick of blood, push it through the chip, do some processing, but all automated with different solutions, and it spits out the number of CD4 posted T-cells'.

The science was sound, but at this point Daktari had no hardware or user interface, and the hand-made devices they were using in the lab were made with makeshift materials that could not be scaled-up for manufacture. Knowing he needed to turn this technology into a product, Rodriguez brought in Aaron Oppenheimer, a software engineer from a large multinational consumer electronics company. The challenge Oppenheimer faced was to transform a technology that could work in a Boston lab into a product that could work in a rural African clinic.

If the device was going to perform consistently in under-resourced settings, to work 'anywhere', then it needed to be robust, reliable and manufacturable. But bringing all these different requirements together entailed trade-offs. To be mass manufacturable required affordable materials and a manufacturing process that could generate reliable results at volume, and that meant plastic. It took a year for Oppenheimer and his team just to figure out how to remake the electronic chip at the heart of the diagnostic technology from plastic and how to coat the CD4 antibody onto the plastic surface of the microfluidic cartridge. It was only then that they found out that no one had ever achieved antibody thermal stability at 35°C when attached to a plastic surface. The team wasn't willing to compromise on thermal stability, since to do so would be to compromise on the universal

qualities of the technology, so the team's microfluids and cell biology specialist, Marta Fernandez, spent a further two years to find a solution to the problem.

All the while that Daktari's designers and scientists were working on the transformation of bespoke laboratory technology into a portable, manufacturable product that could be used 'anywhere', Rodriguez ploughed through boardrooms, pitching the product and firm to investors. The pitch was that African markets with no FDA requirements could provide test markets at low-volume manufacturing in early years, with the firm eventually moving towards higher volume manufacturing and higher margins in high-end markets in the USA. This pitch, combined with Rodriguez's global health connections, played well, and Daktari did extremely well in its first investment rounds, closing deals with a combination of angel investment funds and small venture capital groups, and eventually bringing in a large biotech firm, Merck & Co., as a strategic investor. This enabled Daktari to run some initial field trials in East Africa which showed promising results. With those data, they were able to land a deal with UNITAID, which provided close to US$3 million for Daktari to work with CHAI, UNICEF and MSF on large pilot studies in seven countries and subsidised initial purchases. The plan was for the subsidised product to seed the market and help them raise the next round of investment for fully automated large-volume manufacturing.

By this point, Daktari had developed a device that counted CD4 cells in a drop of blood in under 10 minutes, had thermostability at 35°C, was battery-powered and fitted in a backpack. The team loved their device. As far as they were concerned, it did everything that they wanted it to, and their trials in East Africa had shown that many of the people who would be using it liked it too. This was a device that, Rodriguez and his colleagues believed, was truly capable of getting highly accurate, life-saving CD4 testing to places that laboratories were unable to reach.

Daktari's story also played well in the mainstream and tech media. 'Firms aiming to make money while doing good' ran the headline for one BBC News story about Daktari in early 2013, 'not only does the Daktari device play to the smaller, faster, cheaper ethos of the tech world, it addresses last mile challenges in HIV/AIDS healthcare' (Weintraub 2013). 'Daktari Diagnostics takes on Africa's healthcare challenges one diagnostic at a time', read another technology policy blog headline (Summerton & Churchill 2018). Such stories inevitably ran alongside a photo of the Daktari device, a small, white cassette player-shaped box with a chunky handle. Sometimes, magazines would use one of Daktari's own promotional shots, of a community health worker walking down a grassy path surrounded by tropical vegetation, swinging the Daktari device in one hand.

It was also at this point, however, that the team hit a snag. The WHO had been reviewing evidence from HIV clinics in the United States that showed viral load rather than CD4 cells was a superior indicator of when to initiate treatment, and in late 2014, just as Daktari was closing the deal with UNITAID, it declared its intention to change treatment guidelines. For Daktari, the announcement immediately took the bottom out of their donor-driven market. With standard

treatment guidelines now premised on viral load testing, their CD4 device would no longer be eligible for procurement by UN agencies or their affiliates. Within weeks of the announcement, UNITAID had clawed back its grant and investors were beginning to wobble. Unable to raise the next rounds of investment needed for their new manufacturing line, the company began to fold.

Reflecting on the reasons for that failure, some team members expressed their frustration with the WHO. At the time, viral load testing equipment was even more out of reach for African HIV clinics than CD4 testing, and the organisation had, some Daktari employees believed, put ideals before realism. The failure of the WHO to take the state of the commercial diagnostics sector into consideration in their decision-making felt like a betrayal. As one of the team members who worked on the trials in East Africa put it to us:

> Sure, maybe their guidelines were reflecting better clinical practice, but knowing how far they were from feasibility and putting them out there without any concern for the impact on the sector of diagnostics? It is hard to think about. It makes me reflect on what the WHO's role should be, should it have realistic or lofty goals?

In a more generous interpretation, Rodriguez wondered whether the team had, perhaps, taken too long trying to perfect their device. Unwilling to compromise on the universal qualities of the product, they had instead compromised on time. If they had sacrificed thermal stability, for example, then might they have got the product to market earlier, demonstrating its value for saving lives, and giving them a stronger voice in the WHO lobby, or buying them time to pivot to viral load testing? For Rodriguez, while they built a device that could theoretically work 'anywhere' and that the team and the biotech media loved for this very reason, they had failed to remember that it couldn't work 'anywhere' if it didn't get there first. Getting there, first and foremost, depended on keeping their investors on board – investors who cared little for the device's humanitarian credentials or even its truly universal aspirations. Making some compromises on the material features of universality in the short term might ultimately, Rodriguez ruminated, have allowed them to achieve their goal of reaching poor populations in the long term.

In what ways and against what expectations did Daktari fail? It built a device that could be used anywhere, but that ultimately went nowhere. While the design of the device itself might be deemed an achievement – and for many years a Daktari instrument sat on display in the Science Museum in Boston as an example of the city's capacity for ingenious innovation – this was not what really mattered to Rodriguez and his team. What mattered was that the manufacturing lines had been disassembled and a long list of pre-orders had never been fulfilled. They had succeeded in designing life-saving technology into a miniaturised device, but the crucial next step of moving a 'small' device to a 'big' global market did not eventuate: they had failed at scale.

## Global Energy Utopias: Barefoot Power's Firefly

In 2006, Stewart Craine bought a one-way ticket to Hong Kong. His plan was to travel to Shenzhen in mainland China, find the components for an affordable solar-powered lamp and build a supply chain to manufacture it. He explained to us, 'our model was to try and build the electricity grid backwards. By which I mean, instead of starting with centralised power, poles and wires, house wiring and then putting a lamp in last, we wanted to start with the lamp.' For Craine, this single device was only the beginning. 'So you can see it being a seed, being the start of something much, much bigger . . . Even something as simple as a small lantern or some plug and play wiring is vital, poverty alleviating infrastructure. If we can actually, really start building some serious infrastructure and getting serious finance involved, then . . . that is what we need to do.'

Craine had a budget for about six months, spoke no Cantonese or Mandarin, and knew that building a new solar lighting product from scratch would be prohibitively expensive. Manufacturing an entirely new model would require considerable investment, particularly the machine parts for plastic injection moulding. Instead, the company's strategy was to find an existing lighting product and convert it.

Craine knew one person in China. Working in Nepal five years earlier, he had used a World Bank procurement database to search for lighting technologies. The database had listed a small number of factories in China that the World Bank had certified as meeting their minimum quality standards, and had thus been approved to supply lighting products. One of the factories was run by an Australian-Chinese man who Craine had contacted to source a compact fluorescent lamp. They had stayed in touch and when Craine arrived in Shenzhen they agreed to meet. The two established an informal business partnership and Craine was given a desk in the corner of a warehouse to develop his ideas.

For several months, Craine wandered around the area, visiting factories and ordering sample lamps and torches in different shapes and sizes (or, in the language of design, with a variety of 'form factors'). He bought 40–50 different samples, using the warehouse as a postal address, and ordered solar lighting samples from other Chinese manufacturers. The arrangement allowed him to cut out the costs of travelling between Chinese factories and Australia, as well as of international freight for product samples. From the warehouse, he disassembled the samples before inspecting their components and testing their quality. He was looking for a solar-powered lighting device that didn't disperse light widely. One day, he came across a product that seemed perfect for his needs; it was sitting on a shop shelf just down the road from the hotel he was staying in.

The desk lamp had not been designed to be solar powered. Instead, it was charged directly from the mains and came with a retractable AC plug in its base. It was produced by a Chinese company, Tygear, which turned out to have a factory close to Craine's hotel. They produced lamps in dozens of shapes and sizes –

from rocket ships to cats to Santa Clauses – but the simple desk lamp was one of their most popular. At the time, the model was sold across China and was commonly used as a study lamp by university students living in shared dormitory accommodation.

Craine began to make minor modifications to the lamp and power supply, inserting new circuitry into the old casing and retrofitting the case. The original case was built around AC power rather than DC power, which is required by solar panels, and had two flat pins coming out of a gap in the bottom. Craine commissioned a custom piece of plastic to fill the gap, then drilled a hole in the case's side and ripped out the existing circuitry, after which he installed a DC plug inside. Then, he sourced small 1–1.5W solar panels from another company. He put the little desk lamp together with the panel, and *voilà*: he had one of the world's first solar LED desk lamps.

The final design was an old lamp with a new power source. 'We basically ripped it off', he said bluntly during an interview over Skype, and emailed a document with a photograph of one of their earliest prototypes. 'Look at Figure 21', he said, 'you can see one of our oldest models. It's actually a classic because it's still got the Mickey Mouse sticker on top and the love heart.'

For Craine and his partners, the little device seemed to present the solution to a whole range of problems and issues. 'It's rare when something that complex can be displayed or made an example of in something as small and simple as a solar LED lamp . . . But it is one of those that's just so easy to fall in love with.' They called their device the Firefly.

Barefoot Power's first order, for 2,000 products, was intended for sale in Papua New Guinea, where Craine had once worked. In the 2000s, however, the Pacific was not a key focus for European and North American social impact investors, and so they shifted their focus to East Africa. The fallout from an early experience with a Dutch investment company and their failed attempt to expand into a Tanzanian market led them to try a different strategy. They took inspiration from companies such as the US-owned fast food chain Kentucky Fried Chicken, which was making in-roads in China by selling franchises.

Untroubled by medical regulators, Barefoot Power's move to distribution was easier than Daktari's. Craine's co-founder moved to Uganda with a budget of around AUS$10,000 for the first year, with the aim of setting up franchising partners who would sell Barefoot Products. In Uganda, they found that they could reduce the payback time on their products from six months to three months, and began training their own network of entrepreneurs to sell their products, providing each trainee with a bag, shirt, cap, invoice book and marketing guide. They branded their strategy 'Business in a Bag'. Craine called it the company's 'catwalk model', something that raised the eyebrows of investors and brought them attention: 'The thing that everybody looks at and falls in love with.' The Business in a Bag model won Barefoot Power considerable traction. Today it appears in books, papers and reports on 'bottom of the pyramid' business models in East

Africa as an exemplar of the kind of 'micro-franchising' that helped the company win grant funding from international development organisations (MacLean and Brass 2015; Heuër 2017; Sireau 2017; Gudic et al 2020).

Craine was based in China for four years, where he managed the company's supply chain and its sales network. Barefoot Power's distribution strategy involved selling through multiple channels: NGOs, hardware shops, solar shops, microfinance organisations, governments and telecoms companies. No one channel made up more than 30% of the company's revenue, but they were all repeat customers. Half the company's revenue came from shipping to around 30 different countries worldwide, and the company also had subsidiaries in Uganda and Kenya, which earned about US$1 million each, making up the other 50% of revenue.

By 2011, the company had attracted US$5 million in debt and equity investment and had become the first Australian company listed in the CleanTech100, an annual list of the world's top 100 clean tech companies. In March that year, Craine was profiled in the *Sydney Morning Herald* as 'Mr Cool', an all-Australian social entrepreneur who had developed 'a great Australian innovation' (Wilson 2011: np). The company was, the paper reported, on the verge of reaching its five-year goal of reaching a million people. Media interviews like this are promotional gold dust for social enterprises, and Craine maximised the opportunity to talk up the company's ambition. 'Now we're ready to target 10 million people and build a solid, profitable company by 2015, ensuring our investors get healthy returns and possibly create the coolest company on the planet', the paper reported him as saying.

As they worked out how to realise this goal, Barefoot Power's five-member board decided that it was time for a change in management. The company's revenues had grown at a rate of around 200% per year for two years in a row, from $500,000 to $5 million. To break even, however, they needed to get to about $8 million. Different visions for how to achieve this saw Craine replaced as chief executive. Barefoot Power saw the path to success as lying in a CEO with a focus on the financial bottom line rather than a primarily ethical vision. Craine had maintained that the company's solar lighting products should be seen as a means to an end: rural electrification. Fellow board members differed, however. They increasingly saw sales of solar-powered lamps and lighting systems as an end in themselves, and the company soon expanded its share of growing markets for solar-powered consumer durables across Sub-Saharan Africa and South Asia.

In 2011, Craine and his co-founder resigned as executives. As founders, they remained as board members and retained minority shares in the company. The company's new chief executive had spent much of the past decade managing East Asian supply chains for the consumer electronics company, Philips. Under their new management, the company changed strategy to focus on sales to larger companies, like the energy giant Total, and tie ups with microfinance organisations in Kenya and India. In the short term, the strategy appeared successful. In 2012,

they had raised a further $5.8 million in Series B funding from three social invest-ment funds (the DOB Foundation, Ennovent and the Insitor Partners). But over the next five years, the company remained dependent on investment funds rather than sales. Increased competition from North American and European human-itarian entrepreneurs saw the company's market share and revenues decline by between 30% and 40%. In 2018, a number of essential contracts were delayed, the company ran out of cash to pay their employees and it went into voluntary liquidation.

The event left hundreds of thousands of dollars of stock stranded in a bonded warehouse in Rwanda and the board members facing a lengthy legal process with their creditors. Reflecting in an interview with us on the collapse of the company he had founded, Craine chose to see it as a failure of management – a failure of business acumen and operational logistics – rather than a failure in the tech-no-utopian promise of humanitarian markets. The problem, as he saw it, was that the company's prospects had been hampered by a lack of rather than an excess of humanitarian entrepreneurship. He was scathing about the capacity of people with little experience of the lived realities of energy poverty to understand the challenges involved. 'To get more poverty alleviating infrastructure out there, we need investors with a set of testicles long enough to do something more inventive than just flogging shit for cash from Total gas stations or something like that, for $5 a pop.' For Craine, the company's business model had become entirely sepa-rate from its foundational social mission. As he saw it, the failure to scale the mar-ket for their products in ways that reached communities living in extreme energy poverty meant that what had started as a humanitarian enterprise was now little more than just another consumer electronics company.

## Failure at Scale

Projects that seek to expand markets for technological solutions that they hope will achieve the same effects everywhere are striving for universality. As Anna Tsing puts it, scalability is the ability to expand without changing – to 'expand without rethinking basic elements' (2000: 347). Both the founders of Daktari and Barefoot Power sought to build universal qualities into the technology itself: to make them portable, robust and cheaply manufacturable. The makers of the Dak-tari diagnostic device and the Barefoot Power lantern loved their products for their universal qualities and their deceptive simplicity. It was also often a single device that featured in photography to accompany media coverage of the firms, or made its way into the museum display. But the technological artefact is only one element of the humanitarian entrepreneurial vision.

The makers of these products never imagined them as single objects, existing on their own. Rather, they imagined thousands, possibly millions, of their prod-ucts, making their way to every village without an electricity grid or laboratory

network. What really mattered was not that universal qualities were built into their material design, but that they were actualised in the manufacture and distribution of the product to the global poor. It was only through this achievement of scale that they could both maximise their effects at the level of the population and stimulate a market for more such goods, whether that be additional diagnostic devices or larger mini-grids of solar electrification, and help to build a new comprehensive and universal infrastructure.

Rodriguez's aspirations for Daktari were not only that the firm would meet the need for a specific diagnostic test, but also that by demonstrating that such needs could indeed be met through for-profit enterprise Daktari would inspire the development of a whole suite of point-of-care diagnostic tests for global health markets. Similarly, Craine saw the relatively modest solar lantern as driving demand for other off-grid appliances, from televisions and refrigerators, to agricultural and forestry equipment, and larger mini-grid systems capable of serving an entire community's energy needs. In both cases, one single portable device was imagined as the first step on the road to a future in which access to diagnostics and electricity was universal. In this utopia, the abundance of testing devices or community-based micro-grids would deliver comprehensive diagnostic and energy services to places that public laboratory infrastructures or national grids had never reached.

As a single object, any one humanitarian good appears as a miniaturised stand-alone technology and as a poor substitute for the large-scale, more comprehensive public infrastructures of health and energy they have replaced in a biopolitical imaginary. To see them as a humanitarian entrepreneur, however, is to imagine them at scale: as hundreds of thousands of devices, used by hundreds of thousands of people. For founders and designers like those in this article, one object was the starting point for a future in which the infrastructures for living are constituted by a multitude of individual technologies.

What mattered to Rodriguez and Craine was not only the technological object but the systems required to mass manufacture and distribute them as widely as possible: to scale them up. These ambitions to scale took material form. They were often legal commitments enshrined in the documents that start-up companies sign with investors. Projections, forecasts and business prospects – what we might dub 'the scale clauses' – that are presented to investors within the text of a Preferred Stock Investment Agreement or Stock Purchase Agreement become the 'material facts' on which the terms and conditions of their binding relationship is premised and on which investors calculate their returns. Ambitions for scale were also enshrined in the large capital outlays that were required for bespoke manufacturing equipment and the distribution agreements needed with multiple partners in multiple countries.

It was here, in the world of the boardroom, rather than with the technology itself, that these projects were seen, by their makers, to have failed. Daktari made the mistake of focusing on perfecting the universal qualities of the technology at

the expense of meeting the timescales of investors. Barefoot Power had far fewer challenges in creating a technology that could travel anywhere but their requirement to demonstrate rapid growth for investors meant they prioritised sales at urban and roadside markets to middle income consumers rather than the harder-to-reach rural poor. For these two humanitarian entrepreneurs, their ventures failed because they failed at scaling in particular ways.

Aligning the multiple agendas of scientists, investors, regulators, policy-makers and global health or energy donors in the pursuit of a universal product and persuading them that saving lives in poor countries is a viable commercial enterprise is, as our two case studies show, hugely challenging. For investors, in particular, the economic bottom line of the business is often the priority, with the humanitarian impact of end products viewed as an add-on. To provide an effective social critique of these ventures requires that we not only examine the hopes and aspirations built into the artefact itself, but also the network of actors, legal instruments, manufacturing lines and distribution systems that need to be built around them in order for those aspirations to be achieved. In a sense, what matters to humanitarian entrepreneurs is not the product itself, but where many millions of those products end up.

For the founders of Barefoot Power and Daktari, failure was not an end-point (Miyazaki and Riles 2005) but a provocation to try again to achieve success (see also Prince, Rao, this issue). Bill Rodriguez went on to work for the Foundation for Innovative New Diagnostics before moving to a social impact investment group, and continues to provide mentorship for Boston-based diagnostic entrepreneurs seeking to develop testing devices for the global poor. Stewart Craine set up an angel investment company that raised money to provide start-up capital and finance to small-scale social enterprises in the Pacific region. Like development workers (Ferguson 1994) or Soviet administrators (Ssorin-Chaikov 2016), humanitarian entrepreneurs are inclined to explain away failure as specific rather than systemic; they focus on the technical details that explain why things went wrong in this instance while maintaining a commitment to the possibility of achieving success in the future. In this sense the larger project of humanitarian entrepreneurship always remains incomplete (Ssorin-Chaikov 2016).

For the anthropologist, these attempts to both dissect and explain away failure also reveal the criteria for success. Neither of the humanitarian entrepreneurs we feature here appeared to lose huge amounts of sleep over the financial losses of their investors. They both also stood by the products themselves, as exemplary humanitarian technologies. Where they saw themselves as having failed was rather in their business acumen, in their ability to see all the moving parts and players and their ability to align them all in the pursuit of a humanitarian goal.

Perhaps the most sustained and influential public critique of the world of humanitarian entrepreneurship to date has come from journalist and commentator Anand Giridharadas (2019). Humanitarian initiatives like those we have described here, Giridharadas argues, are neither democratic nor collective.

Instead, they represent the efforts of corporate, socio-economic and educational elites to establish themselves as the solutions to the world's problems in ways that deflect attention from the ways that their own authority and power are entrenched. At the heart of their efforts, he argues, is the repeated commitment to the market's vocabulary, as well as its values and assumptions of growth, as engines of social change. It is an era, as he puts it, in which 'so-called thought leaders' tell you to do whatever you do 'at scale' (Giridharadas 2019: 17). 'So when people seek to make a difference, it is less about what they want to take down and challenge, and more about the ventures that they want to start up.' Giridharadas' critique presents any appeal to 'do good by doing well' as a superficial and ideological gesture that, knowingly or not, disguises entrenched self-interest. For Giridharadas, the work of critique is itself a utopian project, one that resists resignation and refuses capitalist realism. 'When we see through the myths', he concludes, 'the path to genuine change will come into view' (2019: 12).

We share a commitment to tracing the ways that humanitarian entrepreneurship reproduce relationships of power, not least, here, the continuing influence of investment capital and boardroom politics. In common with other anthropologists, and like Giridharadas, we are also wary of the claims made for social or humanitarian entrepreneurship. In the contexts we have described here, our wariness is two-fold. First, it arises from a mistrust of those market models that facilitate the extension of private interests into the public domain. Second, it arises from critiques of the 'magic bullet': technological solutions that depoliticise health inequalities and provide inadequate stop-gaps in the place of large-scale public infrastructures (Biehl and Petryna 2013; Cueto 2013; Packard 2016; Collier et al 2017; Scott-Smith 2018).

But we would also argue, as anthropologists, that the rise of humanitarian entrepreneurship as a social and economic phenomenon requires us to better understand the aspirations that people invest in the goods that they design and mass-produce, and to better understand how they work to achieve those aspirations. In this spirit, our concern in this article has not been to reveal that technology fails to live up to our expectations or that humanitarian commodities hide disguised interests. Rather, we have sought to take humanitarian entrepreneurs' attempts to do well by doing good seriously, to follow their projects of scale-making through their attempts to create and align multiple interests around a humanitarian technology, and to understand the failure of humanitarian commodities to fulfil these aspirations for scale on their own terms.

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## References

Ames, M. G. 2019. *The charisma machine: the life, death, and legacy of One Laptop per Child*. Boston, MA: MIT Press.

ASLM 2014. 'ASLM2014 Partner Spotlight: Daktari Diagnostics Develops Quality Products Geared Toward Remote Settings' (https://aslm.org/news-article/aslm2014-spon sors-spotlight-daktari/) Accessed on 12 April 2022.

Appadurai, A. and N. Alexander 2020. *Failure*. Medford, MA: Polity Press.

Beisel, U., R. Umlauf, E. Hutchinson and C. I. R. Chandler 2016. 'The complexities of simple technologies: re-imagining the role of rapid diagnostic tests in malaria control efforts', *Malaria Journal* 15: 1–9.

Biehl, J. and A. Petryna (eds.) 2013. *When people come first: critical studies in global health*. Princeton, NJ: Princeton University Press.

Collier, S., J. Cross, P. Redfield and A. Street 2017. 'Little development devices/humanitarian goods', *Limn* 9.

Cross, J. 2013. 'The 100th object: solar lighting technology and humanitarian goods', *Journal of Material Culture* 18: 367–387.

Cross, J. 2019. 'The solar good: energy ethics in poor markets', *Journal of the Royal Anthropological Institute* 25: 47–66.

Cross, J. 2020. No current: electricity and disconnection in rural India, in S. Abram, B. Ross Winthereik and T. Yarrow (eds.), *Electrifying anthropology: exploring electrical practices and infrastructures*, 64–81. Routledge.

Cross, J. and A. Street 2009. 'Anthropology at the bottom of the pyramid', *Anthropology Today* 25: 4–9.

Cueto, M. 2013. 1. A return to the magic bullet?, in J. Biehl and A. Petryna (eds.), *When people come first*, 30–53. Princeton, NJ: Princeton University Press.

Engel, N. and A. Krumeich 2020. 'Valuing simplicity: developing a good point of care diagnostic', *Frontiers in Sociology* 5: 1–11.

Elyachar, J. 2012. 'Next practices: knowledge, infrastructure, and public goods at the bottom of the pyramid', *Public Culture* 24: 109–129.

Escobar, A. 2018. *Designs for the pluriverse: radical interdependence, autonomy, and the making of worlds*. Durham, NC: Duke University Press.

Ferguson, J. 1994. *The anti-politics machine: 'development', depoliticization, and bureaucratic power in Lesotho*. Minneapolis, MN: University of Minnesota Press.

Frase, P. 2013. 'Curious utopias', *Jacobin* 14 May.

Giridharadas, A. 2019. *Winners take all: the elite charade of changing the world*. London: Vintage.

Gudic, M., T. K. Tan and P. M. Flynn (eds.) 2020. *Beyond the bottom line: integrating sustainability into business and management practice*. London: Routledge.

Heuër, A. 2017. 'Women-to-women entrepreneurial energy networks: a pathway to green energy uptake at the base of pyramid', *Sustainable Energy Technologies and Assessments* 22: 116–123.

Jameson, F. 2005. *Archaeologies of the future: the desire called utopia and other science fictions*. London: Verso.

MacLean, L. M. and J. N. Brass 2015. 'Foreign aid, NGOs and the private sector: new forms of hybridity in renewable energy provision in Kenya and Uganda', *Africa Today* 62: 57–82.

Miyazaki, H. and A. Riles 2007. Failure as an endpoint, in A. Ong and S. J. Collier (eds.), *Global assemblages: technology, politics, and ethics as anthropological problems*, 320–331. Oxford: Blackwell.

Muniesa, F., Y. Millo and M. Callon 2007. 'An introduction to market devices', *The Sociological Review* 55: 1–12.

Neveling, P. and C. Wergin 2009. 'Projects of scale-making: new perspectives for the anthropology of tourism', *Etnográfica. Revista do Centro em Rede de Investigação em Antropologia* 13: 315–342.

Nonini, D. and I. Susser 2020. *The tumultuous politics of scale*. New York: Routledge.

Packard, R. M. 2016. *A history of global health: interventions into the lives of other peoples*. Baltimore, MD: Johns Hopkins University Press.

Prahalad, C. K. 2006. *The fortune at the bottom of the pyramid*. Philadelphia, PA: Wharton School Publishing.

Redfield, P. 2012. 'Bioexpectations: life technologies as humanitarian goods', *Public Culture* 24: 157–184.

Redfield, P. 2016. 'Fluid technologies: the Bush Pump, the LifeStraw® and microworlds of humanitarian design', *Social Studies of Science* 46: 159–183.

Redfield, P. 2018. 'On Band-Aids and magic bullets', *Limn* 9.

Robertson, K., S. Craine, D. Irvine-Halliday and R. Stone 2002. 'Solid state lighting for human development', *Light Up the World – Update (2001–2002)* (https://tinyurl.com/y3saxbw4) Accessed March 2022.

Scott-Smith, T. 2013. 'The fetishism of humanitarian objects and the management of malnutrition in emergencies', *Third World Quarterly* 34: 913–928.

Scott-Smith, T. 2018. 'Sticky technologies: Plumpy'nut®, emergency feeding and the viscosity of humanitarian design', *Social Studies of Science* 48: 3–24.

Sireau, N. (ed.) 2017. *Microfranchising: how social entrepreneurs are building a new road to development*. London: Routledge.

Smith, C. and S. Woodcraft 2020. 'Introduction: Tower block "failures"? High-rise anthropology', *Focaal* 86: 1–10.

Ssorin-Chaikov, N. 2016. 'Soviet debris: failure and the poetics of unfinished construction in northern Siberia', *Social Research* 83: 689–721.

Street, A. 2015. 'Food as pharma: marketing nutraceuticals to India's rural poor', *Critical Public Health* 25: 361–372.

Street, A. 2018. 'The testing revolution: investigating diagnostic devices in global health', *Somatosphere Diagnostic Stories* 9.

Summerton, A. Churchill, N. 2018. 'Innovate4Health: Daktari Takes on Africa's Healthcare Challenges One Diagnostic at a Time', Centre for Intellectual Property x Inovation Policy March 6 (https://cip2.gmu.edu/2018/03/06/innovate4health-daktari-diagnostics-takes-on-africas-healthcare-challenges-one-diagnostic-device-at-a-time/) Accessed 12 April 2022.

Szeman, I. 2015. 'Entrepreneurship as the new common sense', *South Atlantic Quarterly* 114: 471–490.

Therborn, G. 2007. 'After dialectics', *New Left Review* 43: 63–114.

Tsing, A. 2000. 'The global situation', *Cultural Anthropology* 15: 327–360.

Tsing, A. L. 2012. 'On nonscalability: the living world is not amenable to precision-nested scales', *Common Knowledge* 18: 505–524.

Tsing, A. L. 2015. *The mushroom at the end of the world*. Princeton, NJ: Princeton University Press.

Wilson, D. 2011. 'Mr Cool: solar wizard lights up the world', *Sydney Morning Herald* 8 March (http://www.smh.com.au/business/small-business/mr-cool-solar-wizard-lights-up-the-world-20110308-1blyt.html) Accessed 11 December 2020.

Weintraub, K. 2013. 'Small firms which want to profit from doing good', BBC 6 May (https://www.bbc.co.uk/news/business-21351648) Accessed 12 April 2022.

## Échouer à l'échelle ! minimalisme et maximalisme dans l'entrepreneuriat humanitaire

Les entrepreneurs humanitaires cherchent à faire bien et à faire du bien en développant des biens et des services qui s'attaquent directement aux problèmes les plus insolubles du monde. Dans cet article, nous explorons les attentes intégrées dans deux de leurs produits : un dispositif de diagnostic au point de service et une lanterne à énergie solaire. Nous montrons comment ces objets matérialisent à la fois une éthique minimaliste des soins et un engagement maximaliste en faveur de l'accès universel à la santé et à l'énergie. Nous proposons que de tels engagements maximalistes sont fondamentalement utopiques. Les concepteurs de ces biens humanitaires n'envisagent pas leurs objets comme des solutions provisoires ou des « pansements » pour des défaillances systémiques bien ancrées, mais plutôt comme les éléments constitutifs de nouveaux types d'infrastructures universelles fournies par le marché. Nous retraçons le travail nécessaire pour augmenter les effets humanitaires de ces dispositifs à travers des processus de design, de fabrication et de distribution. Pour les entrepreneurs humanitaires, nous soutenons qu'échouer à répondre aux attentes est un échec à grande échelle.

**Mots clés :** échec, entrepreneuriat, humanitarisme, technologie, utopie.