Discussion paper

S|S|S

Social Studies of Science
2015, Vol. 45(5) 749–771

DOI: 10.1177/0306312715607413
sss.sagepub.com
SAGE

Counting, accounting, and accountability: Helen Verran's relational empiricism

Martha Kenney
Women and Gender Studies Department, San Francisco State University, San Francisco, CA, USA

Abstract

Helen Verran uses the term 'relational empiricism' to describe situated empirical inquiry that is attentive to the relations that constitute its objects of study, including the investigator's own practices. Relational empiricism draws on and reconfigures Science and Technology Studies' traditional concerns with reflexivity and relationality, casting empirical inquiry as an important and non-innocent world-making practice. Through a reading of Verran's postcolonial projects in Nigeria and Australia, this article develops a concept of empirical and political 'accountability' to complement her relational empiricism. In *Science and an African Logic*, Verran provides accounts of the relations that materialize her empirical objects. These accounts work to decompose her original objects, generating new objects that are more promising for the specific postcolonial contexts of her work. The process of decomposition is part of remaining accountable *for* her research methods and accountable *to* the worlds she is working in and writing about. This is a practice of narrating relations and learning to tell better technoscientific stories. What counts as better, however, is not given, but is always contextual and at stake. In this way, Verran acts not as participant-observer, but as participant-storyteller, telling stories to facilitate epistemic flourishing within and as part of a historically located community of practice. The understanding of accountability that emerges from this discussion is designed as a contribution, both practical and evocative, to the theoretical toolkit of Science and Technology Studies scholars who are interested in thinking concretely about how we can be more accountable to the worlds we study.

Keywords

accountability, feminist theory, Helen Verran, politics of method, postcolonial STS

Corresponding author:
Martha Kenney, Women and Gender Studies Department, San Francisco State University, 1600 Holloway Avenue, San Francisco, CA 94132, USA.
Email: mkenney@sfsu.edu

Introduction

To do Science and Technology Studies (STS) research is to participate in the collective activity of making and unmaking technoscientific worlds. Recently, the literature on care in technoscience, in particular, has emphasized how we strengthen and erode practices of care through mundane practices of research, teaching, and writing, sustaining some worlds and weakening others (Martin et al., 2015; Mol et al., 2010; Müller and Kenney, 2014; Puig de la Bellacasa, 2011). These new accounts – which fold in and refigure ongoing STS concerns about reflexivity and the politics of research methods – encourage us to ask how we can be more accountable for our participation in the technoscientific worlds we study and inhabit. Although 'to be accountable for our participation' might at first sound a bit bureaucratic, in this article I suggest that 'accountability' could be a useful name for the politics of knowing, caring for and building worlds in STS. Whereas the more common term 'reflexivity' foregrounds the self as the key player in enacting responsibility, accountability emphasizes the self *in relation* to a collective and draws attention to how value is calculated and enacted in everyday life. This sense of accountability I develop here draws on a feminist lineage (Barad, 2007; Haraway, 1991, 2008; Singleton, 2012; Suchman, 2002) that begins from the situated political questions: 'What counts, for whom, and how?' (Nelson, 2013).[1]

To consider what practices of accountability in STS might look like, I turn to the work of Helen Verran – a scholar who has struggled to remain accountable to the epistemic worlds inside which she works. In *Science and an African Logic* (2001), which details her work with Yoruba and English counting in Nigeria, and her journal articles about Yolngu and Euro-American knowledge practices in Australia, Verran (2007b) practices a relational empiricism[2] (p. 179), where the 'analyst [herself] is configured as an emergent part of the collective' (Verran, 2013: 5). Figuring herself as part of the collective, Verran found that she could not ignore how her own research practices contributed in small ways to reinforcing or resisting colonial legacies in places where the dominance of Western science has threatened other ways of making and knowing worlds. Throughout her work, she examines and adapts her methods to better participate in situated projects of 'imagin[ing] futures different from pasts' (Verran, 2001: 5) in Nigeria and Australia. Accountability is, for Verran, an accountability to postcolonial 'contexts-in-the-making' (Asdal and Moser, 2012), contexts made through collective action.

In what follows, I aim to thicken this feminist sense of accountability through a detailed reading of Helen Verran's scholarship. I show how Verran – through decades of thoughtful participation – attunes her modes of attention, analysis, and narration as she struggles to remain accountable for the colonial histories of her knowledge-making practices. I offer this analysis for STS scholars – both familiar and unfamiliar with Verran's work – who are interested in considering how questions of accountability can re-orient our knowledge-making practices and 'generate knowledge not only *about*, but also *for* the life worlds we study' (Müller and Kenney, 2014: 3). Carefully examining how Verran theorizes and practices her relational empiricism, I argue, can help us consider the politics of our research methods and connect us more thickly with our 'matters of care' (Puig de la Bellacasa, 2011).

Accounting for counting: *Science and an African Logic*

From 1979 to 1986, Helen Verran lived and worked in Ile-Ife, Nigeria. She taught science teachers at the Obafemi Awolowo University and supervised them in primary school classrooms as they taught lessons they had developed together. Although the official language of instruction was English, the school children were able to speak and count in both English and Yoruba. Counting in Yoruba is different than counting in English. For example, Yoruba numbers are not based on a system of base-10 graphics; instead, 'the Yoruba series of number names generates primarily around a base of twenty. Utilizing a secondary base of ten, and then a further subsidiary base of five, integers emerge' (Verran, 2001: 55). Verran found that this intricate system of numbers was active in Yoruba life, yet, by government mandate, it was not taught in the classroom. Less than two decades after Nigeria's independence from the British Empire, advocating for local knowledge traditions felt timely and important. As a result, Verran set out to argue for the importance of teaching Yoruba numbers alongside English numbers in primary school curricula.

Science and an African Logic (Verran, 2001), published 15 years after Verran left Nigeria, is the result of this original desire to do postcolonial politics with numbers. The structure of the book stages Verran's long and difficult writing process, presenting her insights not ex nihilo but as emerging tentatively from a careful ongoing engagement. It contains segments of an earlier manuscript called 'Numbers and Things', where Verran employed a cultural relativist argument in order to combat the colonial assumption that the Yoruba number system was a primitive version of the English number system. She argued that English and Yoruba number systems offer equally good ways of numerating – that the difference between number systems was not hierarchical, as in 19th century colonial accounts, but based on different cultural histories of quantifying.

Despite her confidence that her work was politically important in that it showed the epistemic value of Yoruba numbers, Verran was unable to finish the first manuscript, feeling it 'failed to deliver a useful critique' (p. 20). *Science and an African Logic* both incorporates and comes to terms with the failure of her first effort, in order to offer new possibilities for thinking of the lives of numbers in postcolonial times and places. We can see Verran working toward this explicitly in the sequence of its chapters. After introducing the challenges she faced writing *Science and an African Logic* and how she came to her current methodology, the book is divided into three sections. Each section consists of three chapters – the first is a chapter from her earlier manuscript, the second chapter decomposes the argument and objects of the first through a critique of her unstated assumptions, and the third chapter develops an alternative account that does not rely on the same assumptions (see Figure 1). Verran is clear that 'the sequence of chapters in each section does not constitute a redemption narrative'; rather, she 'struggles to keep the tensions' (p. 20).

These sequences of three chapters also explicitly stage Verran's accounting process, as she presents nuanced empirical and theoretical arguments about English and Yoruba counting. Although the arguments Verran makes could stand alone as a philosophical and anthropological contribution to the literature on numbers and mathematics, the recursive chapter structure emphasizes how Verran's distinctive *process* of theorizing constitutes

Chapter	Function in *Science and an African Logic*
1	Part 1: Introduction
2	Part 1: Introduction
3	Part 2: Original Chapter
4	Part 2: Decomposing Chapter
5	Part 2: Alternative Account
6	Part 3: Original Chapter
7	Part 3: Decomposing Chapter
8	Part 3: Alternative Account
9	Part 4: Original Chapter
10	Part 4: Decomposing Chapter
11	Part 4: Alternative Account

Figure 1. Chapter structure in *Science and an African Logic* (Verran, 2001).

the lifeblood of *Science and an African Logic* and, as I will show, becomes a distinguishing feature in her subsequent writing.

This recursive methodology resonates with Karen Barad's notion of accountability, which emphasizes the relationship between empirical objects and research practices. Barad (2007) suggests that a robust politics of knowledge might begin by providing accounts of the material-discursive apparatuses that generate research data (p. 224). Like an expanded version of the 'equipment list' section of a scientific paper, her suggestion is to track the material, historical, economic, social, political, and other relations that produce knowledge, including our own research practices. The purpose of this extended equipment list is not just to provide accurate representations of how knowledge is made but also to learn how to remain accountable for 'what matters and what is excluded from mattering' (p. 220) within research apparatuses. In other words, Barad's accountability demands that we consider the politics of our research practices, which includes a critical attention to what we help bring into the world. In *Science and an African Logic*, we can see Verran's accounting practice at work in the way she uses the middle chapters in each section to trace the significant relations that materialized the empirical objects of her original manuscript. As she makes her equipment list, her objects are decomposed and then recomposed, demonstrating accounting not just as critique but as a re-signification and re-materialization practice.

From wonder to disconcertment: Decomposing the Yoruba number system

In the first set of chapters (3, 4, and 5), Verran accounts for some of the relations that materialized the most prominent object in her original study, 'the Yoruba number system'. In Chapter 3, Verran describes the system: it is multi-base; it had been a strictly oral system until the 19th century; it is made up of words that generate numerals rather than

graphics that represent them; vowel harmony and elision are important for numeral generating; small numerals are expressed using standard words, but there are multiple possibilities for naming larger numerals; some of the possible names for large numerals are considered more elegant than others; there are several distinct sets of Yoruba numbers, two that are akin to English cardinal and ordinal numbers, and another that is used only for currency; there is no 'zero' in any of these sets of Yoruba numbers. Verran (2001) also provides a chart where she gives English numerals, their corresponding Yoruba names, and how each name is generated through addition, subtraction, and multiplication (p. 56).

Reified by a standard organizing technology (a chart) and a description of its inherent properties, the Yoruba number system can be compared with other objects in the same family, like our own base-10 English number system. Verran locates the differences between these systems in separate cultural histories: English speakers inherit a numbering tradition based on counting on fingers (base-10), while Yoruba speakers inherit a numbering tradition based on counting on fingers and toes (base-20, 10, and 5). Here, cultural relativism provides a causal story for the intuitive perception that the two systems are different.

Observing and describing these two objects originally entailed a particular way of perceiving difference, one guided by a pleasure in the discovery and careful study of strange and marvelous objects, a mode of attention we might call 'wonder'. Verran writes, 'I was quite enchanted by Yoruba numbers and turned my delight to painstaking work' (p. 52). This painstaking work manifested a marvelous object deserving of her readers' wonder too: 'How can we appreciate the complex architecture of this system?' (p. 56), she asks, teaching us to see and to admire the elegance of this exotic artifact.

In Chapter 4, the decomposing chapter, Verran explains how wonder did not merely draw her to her object; it actually contributed to the shape and character of the Yoruba number system in her original manuscript. Objects constituted by wonder and as 'wonders' travel in specific ways. By outlining the Yoruba number system in an academic article for non-Yoruba speakers to admire, it needed to be translated into base-10. This translation, Verran argues, 'can be understood as a form of standardizing, as finding a form to bring the Yoruba numeral system "home" to display its beauty and unusual features to my colleagues' (p. 74).

She builds this argument by drawing a troubling comparison between her own relativist project and Adolphus Mann's universalist project for the Royal Anthropological Institute of Great Britain and Ireland. In 1886, Mann describes the Yoruba number system as part of his 'objective scale of civilization' (p. 78), where he compared civilizations in order to scientifically explain the cultural superiority of white Europeans. Mann, too, was delighted with Yoruba numbers and turned his delight into painstaking work. Despite their different historical context and opposing political aims, Verran argues that they experienced, collected, and displayed their object in a similar way:

> [W]e have disentangled the Yoruba numeral system from its embedded and literally embodied way of contributing to the ongoing life of Yoruba trading and reentangled it in the pages of books and journals. By getting it onto pages and into books in reembodying it, we have literally objectified it; we have rendered it as an object – the Yoruba numeration system – whereas before our interventions there was not an object at all. (p. 75)

Verran adds a second historical comparison, which lends more concreteness to this concept of disentangling/reentangling. Drawing from the colonial history of her home country, Australia, she compares herself collecting the Yoruba number system to Captain Cook collecting 'spears, axes, carrying baskets, flutes, fans, and hats' (p. 74) from the Pacific islands for display in European museums. Although Cook, Mann, and Verran presented their objects as found, Verran comes to argue that it was the collecting process (including wonder as mode of attention) that defined the contours of the objects (number systems or carrying baskets).

I want to briefly pause here to suggest that although this analogy is rhetorically effective, it does not, I believe, speak to the underlying character of Verran's first manuscript, but works as a kind of 'speculative comparison' that motivates her to develop a different set of empirical practices, which effects a shift between scholarly writing as a representation of natural objects to scholarly writing as a form of participation. The Yoruba number system as an object was more suited to participating in academic lectures 'back home'; it was not a promising object for collectively addressing the epistemic challenges of everyday life in a bilingual community with a specific colonial history. In the decomposing chapter, Verran *accounts* for how the Yoruba number system had been constituted by her own wonder, together with the translation and standardization required to take her object home. Verran's accounting is not a rejection or disavowal of her painstaking work; rather, accounting for the object decomposes the object, allowing her to name and practice a different mode of attention. She calls this nascent mode of attention 'disconcertment'.

Science and an African Logic begins with a story of Verran sitting in the classroom of one of her students, Mr Ojo, as he showed the children how to measure the length of their bodies. Verran was expecting him to teach the lesson as they had planned: each child is given a length of string to represent his or her height, the string is then placed on the floor and its ends marked with chalk; finally, a meter stick is used to measure the space between the chalk marks. This is not the lesson Mr Ojo taught. Instead, he gave each child a string and a 10-cm long piece of cardboard with 1 cm divisions marked. He instructed the children to use the string to represent their heights, wind the string around the card, count the number of full times the string was wound around the card, multiply that number by 10, and add the remaining centimeters of string to the product. The children were delighted; Verran was 'scandalized' (p. 3). She experienced the new lesson as both exactly the same and completely different than the one they prepared; caught by the whiplash between difference and sameness, she laughed. Visceral laughter, as Verran tells it, was an embodied response to the difference between the two lessons: the difference between a length of string paired with chalk and a meter stick, and a length of string paired with a 10-cm long piece of cardboard; the difference between length as singular extension (stretch of string) and length as a plurality (bundle of strands).

Verran describes her new method as 'staying true to laughter', starting from the moment of puzzlement and confusion: the moment of disconcertment. Disconcertment names a way of paying attention to specific differences that are often forgotten or explained away:

> It is easy to ignore and pass by these moments – part of the problem is their fleeting subtlety – yet it is possible to become acutely sensitized to them. Interruptions, small and large, are what we, as theorists must learn to value and use. (p. 5)

Here, we are no longer being asked to appreciate the complex architecture of the Yoruba number system; we are invited to join Verran in laughter.

And, in this peal of collective laughter, the Yoruba and English number systems fade away; now there are just children, cards, string, little pieces of cardboard, moving about the classroom, succeeding or failing at doing length. Quantifying – in this case, measuring – is one of the products of all this activity (a messy classroom might be another). When learning how to measure, Verran (1999) argues, students are not learning how to correctly apply abstract entities (numbers) to nature, they are learning the rituals and routines necessary to enact quantification: 'Certainty of numbers is an outcome of the routines by which they are constituted in collective acting, not in their unique capacity to truly represent a foundation in a system of symbols' (p. 150).

We can characterize this movement from wonder to disconcertment as 'postcolonial' in two related ways. First, *Science and an African Logic* is based in a 'critical practice that addresses the significance of colonialism in the formation and practice of social theory' (Mitchell, 2002: 7). Comparing her methods to those of colonial science, Verran shifts her way of imagining and attending to the constitution of difference, which remakes her empirical objects. Wonder gave her essential numbers with inherent properties that could be collected and transported back home; disconcertment gives her numbering and children (objects and subjects) as outcomes of collective acting.

This process of decomposing and recomposing her empirical objects can be considered part of a thicker definition of the postcolonial offered by Verran (2001): 'the ambiguous struggling through and with colonial pasts in making different futures' (p. 38). Postcolonial projects, in this sense, involve learning to craft knowledge and collective practices that can contribute to the epistemic flourishing of historically subjugated people. For Verran, this is not simply about protecting or valuing indigenous knowledge, but about finding ways of respecting and working with differences in situated technoscientific practice. When colonial relations have largely defined what knowledge practices are considered legitimate, creating conditions for epistemic flourishing requires ongoing attention to what enables and forecloses the recognition of differences and the ability to stay with differences as they emerge in practice. The differences between Mr Ojo's lesson and the planned lesson are important to examine because Mr Ojo's lesson succeeded at teaching the children to measure their height, whereas other attempts to teach quantification 'by the book' were less successful (pp. 10–11). Teaching and learning creatively are important parts of crafting different futures. However, what counts as creative teaching or collective flourishing cannot be known in advance but is a matter of attentive participation; this is why Verran calls the struggle of postcolonial projects 'ambiguous'.

How does *Science and an African Logic* as an academic book contribute to this postcolonial project? Verran's first manuscript had a straightforward political aim; she conceived of it as a text that could both give an accurate account of Yoruba numbers and inform progressive policy decisions. The political project of *Science and an African Logic*

is less clear-cut. It is a difficult and at times awkward book (even for an STS audience) that will likely not be read by Yoruba math teachers or by policy makers. However, if we think of writing a book as one participatory practice among many others (e.g. teaching, discussing, counting), we do not need to locate its politics in its accessibility (nor locate all of Verran's political practices in her writing). In this book, Verran formulates concepts and narratives that re-orient her within her own research practices, helping her learn how she might contribute meaningfully to collective flourishing. At the same time, she offers her readers approaches for recognizing and respecting differences that could be useful within their own projects. Indeed, one key practice that Verran offers in her ambiguous struggling though and with colonial histories of empiricism in Nigeria and Australia is what I am calling here accountability.

Into the compost heap: Decomposing, composting, and composing

There is a danger, however, in using the word 'accountability' to describe what Verran is doing. It can quickly call to mind the audit regimes of contemporary neo-liberal bureaucracies. Institutional accountability involves procedures of assessment that are designed to bring business practices to light to evaluate efficiency and fiscal responsibility. If we embrace the figures of institutional accountability and apply them too quickly to empirical STS research, we run the risk of encouraging the kind of social theory that places its faith in exposure (Latour, 2004; Sedgwick, 2003). The 'protocols of unveiling' (Sedgwick, 2003: 143) that have dominated the tradition of critical theory, like the audit, work by revealing the hidden workings of power. We can also see this at work in the more empirical strands of STS that aimed to open the black boxes of science to describe their hidden machinations. 'Accountability' could further strengthen the academic culture that privileges critique and revelation over other, more subtle and creative, approaches. However, in *Science and an African Logic*, Verran severs the association between critique and exposure, rerouting the associative pathways of accountability.

In her decomposing chapters, Verran exposes the hidden assumptions that informed her original analysis. However, her ultimate goal is not transparent and certain knowledge. Instead, the moment of exposure acts like a railroad switch; it allows the analysis to change track, to tell different stories, to articulate different objects. Being accountable for colonial histories does not guarantee the truth of her explanations. Verran (2001) writes, 'I do not claim this new account should be accepted because it tells the way generalizing "really" is' (p. 158). She does not move from how the world 'seems' to how the world is. The action is not one of unveiling. Verran performs what she calls a 'generative critique', a critique that enables something new to happen: 'A generative critique offers the possibility of innovation, a way that things might be done differently to effect futures different from pasts' (p. 20). Of course critique and revelation have often served this purpose: opening black boxes, for example, allows us to learn about scientific practice in a way that can give us purchase to think about how it might be done *otherwise*. With her term 'generative critique', Verran amplifies this sometimes quiet potentiality, making it harder to think of critique as an end in itself and instead as part of an 'ecology of practices' (Stengers, 2010). When Verran (2001) suggests that generative critique can help us

'do things differently', I believe her meaning to be quite literal; it is about enacting objects in unfamiliar ways (p. 236). As the Yoruba number system is decomposed, a new way of figuring numbers emerges. Thinking with Verran, I want to develop a sense of accounting that is about remaking objects, rather than just laying bare the relations that produce them.

Verran borrows the term 'decomposing' from Marilyn Strathern (1992). Strathern describes it as a kind of analysis used by people in New Guinea, a way of taking things apart. In an essay about how the Hagen people came to recognize white Australians as human through the trading of shells and pigs, Strathern explains how she understands decomposing: '"Things" are forms in which relations appear. The premise is an aesthetic one. Forms appear out of other forms, that is, they are contained by them: the container is decomposed, everted, to reveal what is inside' (p. 249). In her reading of Strathern, Verran adopts decomposition not as 'an exotic form of indigenous analysis' (Verran, 2001: 42) to serve as an antidote to colonial knowledge, but as a methodological provocation for postcolonial theory: 'the resonance interests and inspires me, helping me name what I do in this book' (p. 43).

Animated by this resonance, I feel encouraged to introduce a trope into the mix. Verran's decomposition suggests to me the organic biodegradation that happens in a backyard compost heap. Composting is both an empirical and political practice, as Maria Puig de la Bellacasa (2010) explains: 'The techniques of composting are an important part of earth activist trainings. Not only how to keep a good compost going, but also how to become knowledgeable regarding the liveliness, and needs of, a pile of compost' (p. 160). In opposition to metaphors of bringing stuff to light, the compost heap draws us into the (sometimes smelly) darkness where recognizable forms are broken down by hungry critters. Following a mantra I learned from Donna Haraway (2008) – 'I am a creature of the mud' (p. 1) – this decomposition engenders a kind of analysis that demands we get epistemically dirty. Armed sometimes with just a pitchfork, the composter must learn to replace the question 'how can we be sure?' with 'how to live with doubt?' (Mol, 2002: 165). Thinking with compost is more about aerating than illuminating, opening up material and epistemic spaces without the presumption of sight.

In *Science and an African Logic*, Helen Verran adds some tasty clippings to her heap, chapters carefully written for an abandoned book. Deep in the warmth of compost, the decomposer communities of STS and postcolonial theory that Verran reads and cites digest the objects from her unpublished manuscript. As these objects are decomposed, Verran's generative critique produces nutrient-rich soil from what was previously refuse. Thinking decomposing with composting helps us to grasp what Isabelle Stengers (2008) means when she writes, 'critique must present itself as an ingredient of the assemblage, not as critically examining/dismembering the assemblage itself' (p. 44). Decomposing is not valuable on its own or as such, but is an important element of a flourishing ecosystem and a necessary condition of life on Earth.

The term 'generative critique' invites curiosity: 'what is this critique generative *of*?' In the simplest sense, we might think of Verran's composting process as generative of writing and writing as a kind of worlding. As Haraway (2008) writes, describing Isabelle Stengers' engagement with Whitehead, 'Abstractions, which require our best calculations, mathematics, reasons, are built in order to break down so that richer and more

responsive invention, speculation and proposing – worlding – can take place' (p. 93). In *Science and an African Logic*, the decomposing of old stories about numbers enables new stories about numbers, new stories that are nourished by the passions and energies that animated the old. In *The Gender of the Gift*, Strathern (1998) draws our attention to this work of composition in decomposition:

> Anthropological exegesis must be taken for what it is: an effort to create a world parallel to the perceived world in an expressive medium (writing) that sets down its own conditions of intelligibility. The creativity of the written language is both resource and limitation. By language, I include here the arts of narration, the structuring of texts and plots, and the manner in which what is thus expressed always arrives… already a composition of sorts. Decomposing these forms can only be done through deploying different forms, other compositions. (pp. 17–18)

Decomposing is, thus, both a form of critique and of storytelling. When micro-organisms and insects have broken down the available organic matter, we are not left with nothing, but with humus, an earthy substance that enables and nurtures new life. The stories that emerge from Verran's decomposition offer new kinds of companion narratives (Frank, 2010: 42–43) that orient her within postcolonial projects, informing richer and more responsive participation.

In *Science and an African Logic*, decomposing is integral to Verran's accounting practice. In the process of accounting for how wonder constituted the Yoruba number system as her original object, decomposing allows Verran to pay attention differently, giving her different objects. If, following Strathern, decomposing is always also composing (and composition is sometimes writing), then our nutrient-rich accountability needs to attend to the arts of narration and the structuring of plots. Accounting, in this sense, refers not only to 'rendering a reckoning' but also to the creative practice of 'narration and relation' (Oxford English Dictionary (OED)). Giving an account does not have to look like performing an audit; it can also look like telling a story. Storytelling is a practice of relating, of forging connections with words. These relations are not just between actors and events within the story, but between those who listen, repeat, and adapt it.

If we look at storytelling as a relational as much as a representational practice, it becomes possible to resist the cartoon version of empirical research as opening black boxes and revealing their contents. It becomes easier to see what *else* is going on. Even in a theoretically playful field like STS, the conventions and codes of academic realism have the potential to hide the creative work of composing and naturalizing the subjects/objects in the account. Verran, however, helps us see ethnographic writing conventions as generative, not of true representations (tracings of real relations) but of promising fictions, echoing Strathern's definition of ethnography as an 'effort to create a world parallel to the perceived world' (p. 17). Verran (2001) explains that the stories that begin her book are imaginative reconstructions:

> Mr. Ojo and the other teachers I tell of are fictional characters. I have abided by the conventions of changing details in telling of them and their pupils. In some cases, the episodes I tell of are composites of several incidents; in others, they allude to a specific occasion. (p. 239, n. 3)

Here, the ordinary ethnographic convention of changing a subject's name to preserve anonymity is deployed explicitly as an element of story-crafting. The story of Mr Ojo and the other classroom vignettes are best read not as realist ethnography but as 'fables of attention' (Kenney, 2013: 1–9). Fables, like those of Aesop or La Fontaine, are social stories that orient their readers around moral questions. Verran's fables present an empirical orientation that offers a different mode of attention to other practitioners reading her book. As the people (including the ethnographer herself) are fictionalized, disconcertment, an otherwise cumbersome and unfamiliar signifier, is brought to life and imbued with meaning. Verran's fables of attention are about narration and relation. Through these charismatic narratives that are fun to re-tell (I often do!), Verran names and fosters an alternative way of figuring and paying attention to differences that may enable different forms of response and participation. Verran and other scholars she has inspired with her stories continue to use disconcertment to orient themselves in projects where worlding-together is very much at stake (e.g. Law and Lin, 2011; Postma and Postma, 2011; Verran, 2002: 730, 2007a: 114). Fables of attention, in this way, are also fables of response-ability (Barad, 2007; Haraway, 2008; Schrader, 2010). They act as powerful relays for ethnographic 'economies of attention' in the making (Daston, 2004: 443). And, it is important to emphasize, fables do not just *illustrate* social theory; social theory is a storytelling practice (Verran, 2001: 119).

In the next section, we will see Verran tell another kind of theoretical story to explain her disconcertment. In this second framing, Mr Ojo's lesson disconcerted Verran by creating palpable tensions between two different practices of measuring length, which she comes to describe as 'competing ways of ritualizing in quantifying microworlds' (p. 172). Despite being introduced in a realist academic style, Verran's microworlds and the tensions they produce are also inventive stories. In this part, Verran's simple and elegantly wrought fables are joined by different aesthetic strategies that employ more troubled language – clunky translations, awkward terminology (e.g. quantifying microworlds), and 'redundant detail' (p. 100). In places, Verran's theoretical descriptions test the limits of intelligibility, not as avant-garde or experimental writing but in the strange banality of describing familiar things in unfamiliar ways (p. 243). Shuttling between writing styles and accounting strategies, between laughter, disconcertment, and competing ways of ritualizing microworlds, Verran draws our attention toward all of the coordinating work involved in narrating and relating.

Praxiography

The predominant narrative style Verran employs in *Science and an African Logic* is praxiography. A praxiography is 'a story about practices', to use Annemarie Mol's rather unwieldy signifier for a simple concept (Mol, 2002: 31). It is a genre of writing that complements an STS mode of attention to practices and processes in technoscientific worlds. By foregrounding relations, it becomes 'possible to say that in practices objects are *enacted*' (Mol, 2002: 33). In this kind of account, objects cease to be abstract, singular, and absolute. They become material, multiple, and mutable. Praxiography is a genre of storytelling that is skilled at expressing worlds relationally, and as Verran shows, it can be a useful narrative style for practicing relational empiricism.

In the second set of chapters (6, 7, and 8), Verran shifts from describing objects to narrating routines, as she recounts an experiment she conducted with Yoruba and Australian children. In this experiment, she passed a substance (Coke, peanuts, or water) from one large container to two small containers. She then asked the children whether the total amount of the substance was the same or different than before. Recording and analyzing their answers, Verran discovered how children successfully or unsuccessfully solve problems by quantifying.

In Chapter 6 (one of the chapters from her original manuscript) Verran focuses on her findings. The experiment showed that young English-speaking children, older English-speaking children, and Yoruba-speaking children utilize different concepts when they quantify substances. Verran called these three different concepts 'thingness', 'volume', and 'unicity', respectively. She argues that each of these concepts provides children equally good, logical, and abstract ways of quantifying. Verran uses these findings as the basis for a policy recommendation: 'Modern Yoruba education should be bilingual and as part of that program, alternative forms of quantifying should be separately taught and learned in school' (p. 142).

Revisiting the experiment in Chapter 7, the decomposing chapter, she focuses not on the results but on accounting for her own experimental practice. Verran's methodology required intricate choreography: 'I messed around with children, words, water, Coke, peanuts, bottles, bowls, beam balances, tape recorders, translators, transcriptions, index cards, tabulations of numbers, and so on, ordering them all into an almost smooth operation' (p. 146). However, all of these elements were missing from her original chapter: 'Telling of my experiment as searching for already-existing entities – the abstract objects of quantifying – hides a vast amount of laborious but creative work' (p. 146). By providing the equipment list and narrating her experiment as praxiography, Verran decomposes her found objects. In this account, the coordination of children, words, water, Coke, peanuts, and so on *materialize* thingness, volume, and unicity. They are not simply found; they are made through collective action, which includes (but is not limited to) the actions of the anthropologist. Here, we have a kind of accounting guided by the phrase scrawled in red ink in the margins of algebra tests – 'show your work!'

However, Verran's task is not finished when she writes herself in the scene. This is not the kind of reflexivity that prescribes 'self-vision as a cure for self-invisibility' (Haraway, 1997: 33). It is a relational empiricism based on accounting for how she participates in shaping her objects of knowledge. Like in the first set of chapters, this accounting practice is a form of generative critique that remakes Verran's empirical objects. As thingness, volume, and unicity are thrown onto the heap and begin to decompose, she describes how children who can successfully quantify have learned to perform specific routines. They are able to track the peanuts, as they move between containers, while keeping their eyes fixed on boundary-making (p. 169). The three groups of children employ three different practices of attending to boundary-making, which they learn through participating in different (although not fixed nor mutually exclusive) microworlds.

The term 'microworld' for Verran comes from Joseph Rouse (1987), who developed it to describe the laboratory as a space where protocols and equipment are standardized to facilitate the emergence and stabilization of new objects. As Verran takes it up, she expands its definition, using 'microworld' to refer not only to the laboratory but also

other 'banal and ordinary sites of getting on in collective life' (p. 257, n. 2). For Verran, marketplaces, classrooms, and laboratories are all examples of quantifying microworlds where enumerating activities happen and cohere into reliable routines of quantification.

The difference between these microworlds, in Verran's account, is not one of kind but one of power. Taking a lesson from Latour's (1983) iconic story of Louis Pasteur, Verran (2001) writes, 'If science's explanations are to be made as general claims, its microworlds must be infinitely extended' (p. 210). Pasteur, as the fable goes, extends the microworld inside his swan-neck flask, remaking the world through germ theory. While Latour focuses on explaining the success of Western science, Verran is concerned with the imperialism implicit in this infinite extension. Because Yoruba quantifying is vulnerable in the face of the English standard, Verran finds it difficult to side with the epistemically powerful. As S. Leigh Star (1991) writes, offering a feminist reading of Latour's story, 'By experience and by affinity, some of us begin not with Pasteur, but with the monster, the outcast' (p. 29). Similarly to Verran's comparing her first manuscript with the collecting practice of Captain Cook, Star uses a canonical STS figure (Latour's Pasteur) to propose an alternative set of empirical and narrative practices for situated worldings and re-worldings. These practices are proposed not as a general theory or as a policy to be applied uniformly but as a part of a relational empiricism where what counts as a good social and epistemological story is always contextual and at stake.

Praxiography is one technique for resisting what we could call (with tongue firmly planted in cheek) the Verranization of Nigeria. Rather than insisting on the solidity of her found objects (thingness, volume, and unicity) and fixing them in educational policy, Verran (2001) tells 'stories about the lives of objects and how these lives proceed in reliably managed microworlds' (p. 210). Telling about her own practices helps account for her role in materializing her empirical objects. In doing so, her objects are re-materialized, now outcomes of collective practices: 'An object clots when the repetitions and routines of its generating microworld become a ritual' (p. 62). In this way, Verran is participating in the microworlds she describes, performing a relational empiricism that is attentive to the labor required to stabilize objects.

Although her new account can no longer rely on the stability and authority of found objects to argue for the value of Yoruba quantifying, she is still able to do important empirical and political work on 'power objects' like numbers. Decomposing thingness, volume, and unicity by telling about her own coordination work allows Verran to develop an alternative knowledge-making practice that is more mindful of the Empire working inside of empiricism. This does not make Verran's work innocent. As Haraway (1997) soberly reminds us, 'feminist inquiry is no more innocent, no more free of the inevitable wounding that all questioning brings, than any other knowledge project' (p. 191). However, it does make possible a different way of doing politics.

Ontological politics, or narrating as aerating

As Verran's objects decompose, a politics of administering discrete objects – *do* teach *this* number system, *don't* teach *that* number system – is no longer suitable for her relational world. Moving away from the found objects of her original account (the Yoruba number system, the English number system, thingness, volume, and unicity), she finds

herself drawn to Annemarie Mol's concept of 'ontological politics'. Mol argues that if we understand objects not as discovered but as enacted, we can formulate a different political question: which version of an object should be performed? She suggests that we (people who inhabit, attend to, and narrate worlds) move away from the representational question – 'is this knowledge true to its object?' toward the ethical and practical question – 'is the practice good for the subjects (human or otherwise) involved in it?' (Mol, 2002: 165). The ontological politics Mol describes requires attentiveness to the different ways an object is or can be performed at different places and times, and what these performances enable and foreclose.

In *Science and an African Logic*, Verran does ontological politics by narrating her encounters with numbers in specific and deliberate ways:

> By telling stories of Yoruba and English numbers as I have here, I have linked them in a way that is quite different from the links in practice that I have been narrating. Linking through telling stories effects an explicitness that enables another sort of politics. Such explicit storytelling effects a politics centered on the choice about *how* to go-on; the question can be discussed. (p. 118)

Verran writes herself into her book, not as participant-observer but as participant-storyteller, coordinating disparate parts into a narrative designed to foster new kinds of discussions around teaching numbers in Yoruba classrooms.[3] In this shift from participant-observer to participant-storyteller, the activity of participation is reconfigured. The participant-observer participates in order to observe. The participant-storyteller 'tells stories as part of her participation' (Verran, 1999: 151). Her stories are crafted to make a difference in the worlds she inhabits. They are worlding stories.

Verran re-composes her narrative in order to shift the locus of decision. In her original account, the differences she describes between the two discrete number systems are not open to management by those who are most directly affected (p. 20). As she revisits her account, the actors change from government policy makers to the people who work with numbers and students in their everyday lives: 'These are empirical and contingent matters. They need to be worked out with teachers and their curriculum advisers, and discussed in schools' communities' (p. 119). Verran's stories about quantifying open up a space for more people to share in Mol's question: 'is the practice good for the subjects involved in it?' There are more choices about which versions of numbering to enact.

Choice, at first, is a strange word to use in an account where we are asked to think of subjects and objects as materialized relations. It has a way of naturalizing the human subject as a privileged actor who can make rational decisions. This seems opposed to the kind of subject enacted in a dance of relating (Mol, 1999: 87; see also Thompson, 2007). However, if we decouple agency from intentionality, as Karen Barad does in her own consequential feminist storytelling, the problem begins to feel less intractable. In *Meeting the Universe Halfway*, Barad calls for 'a new sense of aliveness' (Barad, 2007: 177) where all matter is understood as dynamic, not immutable or passive (p. 155). Agency within this dynamic universe is a doing, not a property of the human or of a discrete individual; there are always a multitude of agencies unfolding as the world is continuously reconfigured through ongoing intra-action. As we learn to dwell inside Barad's

agential universe, it becomes clear that one story or one narrative style cannot capture all of the liveliness of this dynamic world; we need to deploy multiple stories about agency, some meticulously empirical, some imaginative, some on the quantum scale, some on the people scale. Different agential narratives enable different forms of engagement.

Praxiographical writing about how numbering is enacted in microworlds opens up a space for discussion among the people who teach and learn mathematics. Although this kind of storytelling can be powerful, ontological politics might be too grandiose a name for Verran's more delicate practice. To return to the smelly trope of the compost heap, perhaps it is better to think of narrating as aerating and the ontological storyteller as a worm, a Red Wriggler tunneling through the compost, creating pockets of air, spaces of agency – spaces to move and spaces to breathe. The worms eat as they burrow, excreting casts that enrich the humus; thus, worms are both contributing to and facilitating the labor of the bacteria, fungi, nematodes, mites, snails, and slugs in breaking down organic matter (Puig de la Bellacasa, 2010: 160). Some of the agencies that narrating/aerating facilitates may be called 'choice' or 'management'; some might be called 'bacterial growth' or 'aerobic decomposition'; others have names that we, unaccustomed to the lively diction of naturecultures,[4] are still struggling to articulate with clumsy tongues. Thinking of the participant-storyteller as a sticky red worm wriggling through the compost, nourishing and nourished by the heap, might help us better imagine academic storytelling (theorizing) as one of the many 'material practices of intra-acting within and as part of the world' (Barad, 2007: 90).

One important tactic in Verran's aeration work is paying attention to what usually is explained away. 'Explaining away' happens when significant differences are elided rather than attended to, when bumpiness is smoothed, when multiple objects are collapsed into one. In the first part of this article, I wrote about how staying true to laughter and starting from disconcertment helps Verran focus on and narrate differences she had first explained away. Disconcertment as a mode of attention allows her original objects to decompose, which, in turn, enables her to compose new stories, stories that make the differences in numbering practices open to management (rather than erasing them or treating them as essential).

Creating openings for management, which I have been calling aerating, is a useful practice in situations where microworlds collide on uneven footing. Some of these collisions can lead to what Verran (2002) calls 'postcolonial moments':

> Postcolonial moments are made where disparate knowledge traditions abut and abrade, enmeshed, indeed often stuck fast, in power relations characteristic of colonizing, where sciences usually line up on the side of the rich and powerful. Postcolonial moments interrupt those power relations, redistributing authority in the hope of transformed contexts for the exercise of power. A postcolonial moment is not about retrieving lost purity by overthrowing and uprooting an alien knowledge tradition. Rather, it might effect an *opening up and loosening*. Increasing possibilities for cooperation while respecting difference, postcolonial moments can lead to amends for past injustice. (p. 730, emphasis added)

For the participant-storyteller, these postcolonial moments are 'occasions for theorizing, for telling differences and samenesses in new ways' (p. 729). Postcolonial theory, in this

formulation, is a kind of writing we do when the accustomed stories about similarity and difference are contributing to ongoing practices of subjugation and getting in the way of meaningful engagement.

In the next section, I will explore how Verran's translations are sites where sameness/difference is continuously being managed and, indeed, could always be managed otherwise. Using disconcertment as her guide, a mode of attention to the unsettling differences that are often explained away, Verran's aerating work includes crafting translations with ontological traction, building empirical tools that make their translation-work visible, and identifying powerful translations that go unnoticed. Each of Verran's engagements with translation works to reconfigure sameness and difference, to effect an opening up and loosening, to create spaces to move and spaces to breathe.

Clunky minimalism: An aesthetic for postcolonial moments

Beginning with Verran's original manuscript, her method includes a careful attention to the practice of translation. In Chapter 9, the culmination of her first study, Verran highlights the importance of staying with linguistic difference as a way of investigating the ontological commitments embedded in language. 'Ontological' in this sense is about worlding – about how language participates in shaping our lived worlds in some ways and not others. 'It is not common for speakers of a language to examine what types of material objects their language commits them to. Rather, the difference will be noticed as a difficulty in translation' (Verran, 2001: 187). Instead of smoothing over the difficulty in translation, Verran accentuates it. She translates a Yoruba phrase that would normally be understood as the equivalent of the English phrase 'He saw three dogs' as 'He saw dogmatter in the mode of a group in the mode of three' and the even clunkier alternative: 'He saw matter with the characteristics of dogness manifesting here/now as a collection divided to the extent of three' (pp. 194–195). Verran brings out these linguistic differences in order to argue that Yoruba and English have two different ways of arranging space, time, and matter when speaking a sentence. She argues that each language figures space, time, and matter into different kinds of objects – 'spatiotemporal particulars with various qualities' (English) and 'sortal particulars in various modes' (Yoruba) (p. 50).

In Chapter 10, Verran then decomposes 'spatiotemporal particulars' and 'sortal particulars' by pushing her original theoretical strategy further, by lingering in the space of difficult translation. According to Verran, her first attempt resolved the translation difficulty by making recourse to a world of common referents (space, time, and matter) that are simply arranged differently in Yoruba and English. In her second attempt, however, she does not maintain there is an essential sameness underlying the different grammars; she shifts to praxiography to narrate how differences and samenesses are generated through practice. In Chapter 11, the nouns of the English language (which were previously spatiotemporal particulars) are narrated as outcomes of specific relational rituals. The three different outcomes Verran describes are extensions, durations, and resistances (p. 232).

This new story does not require us to replace one foundation (objects) with another (interactions, practices, or collective acting). While praxiography threatens to enforce the understanding that actions are foundational or pre-linguistic, my reading of Verran's

theoretical move is that she is building a metaphysical translation tool for taking *serious* ontological differences *seriously* when shuttling between two worlding practices. Durations, extensions, and resistances are not saddled with the history of Western metaphysics and do not require that common ground be located only in Western territory. Therefore, they offer more promise for cross-cultural translation than the more conceptually nimble space, time, and matter. Awkward to our ears, these strange terms announce themselves as translation tools.

As she continues to follow this line of analysis, Verran jokes: 'It is difficult to say this without sounding quite daffy' (p. 232). Trying to talk about the ontological assumptions embedded in the English language is difficult to do while writing in the English language. In response to Thomas Kuhn's notion of incommensurability, Helen Longino (1979: 54) argued that objectivity requires a robust practice of articulating and discussing the background beliefs with which we assess evidence and make sense of the world. Verran (2001) shows us the kind of uncomfortable linguistic pretzeling it takes to stammer about even some of our most basic assumptions. For example, in Chapter 11, familiar entities like English nouns become 'space-time bits' or 'duration-extensions' (p. 232). The compounding awkwardness of these words allows ontological commitments of the English language to take on sharper contours. They can be discussed. Alternatives (e.g. Yoruba ontologies) can be considered more seriously. One more daffy translation has 'freed us from the modern myth that space, time, and matter are given and must be represented' (p. 233). This is a big claim. But the way she gets there is unassuming. Verran stubbornly picks at seams of her translations. The method is simple but not tidy. I imagine her ripping at seams, pulling out invisible threads with fingers and teeth, surrounded by scraps of fabric, like Catullus' Parcae, with bits of thread clinging to her lips (Catullus, 1999: 64, line 316).

Without someone to pick at the seams, bad translations can sabotage opportunities for learning; postcolonial moments can be missed. In her article, 'A Postcolonial Moment in Science Studies', Verran (2002) describes a workshop in Australia in which environmental scientists had the opportunity to observe and learn about w*orrk*, an Aboriginal practice of using fire for land management. The scientists, although eager to learn from Yolngu landowners, were frustrated and perplexed (disconcerted) by what they saw during the workshop, especially by the unfamiliar practice of gathering clams and yams at each of the firing sites. Disconcertment quickly yielded to bad translation: 'It seemed [to the scientists] that a *worrk* was to some extent "just a ritual" of lighting fire as accompaniment to a "foraging" expedition' (Verran, 2002: 743). Verran, as aerator-narrator, travels back into the fertile site of disconcertment and begins to craft ontologically thick translations that better express the metaphysical commitments of both the scientists and the Yolngu landowners.[5] She narrates resonances and dissonances between these two firing regimes differently in order to facilitate better understanding between them. Talking about these traditions together requires ongoing translation that enables partial connections but refuses to ignore the ontological friction: 'Reconciliation must allow for metaphysical difference to be respected, while shared embodied and embedded concerns [can act as] grounds for respectfully going on together' (p. 754).

While she is telling new stories about the practices of scientists and Yolngu landowners, Verran does not occupy some ontological no-man's-land outside of these two

microworlds: '[My] frame is no more free of metaphysics than any other, but it is both minimalist…and explicit about the framing' (Verran, 2002: 754). Verran's theoretical rigging[6] is slight – she pays attention to moments of disconcertment and takes them to signify a clash of microworlds – but it announces itself loudly. The stories generated by staying with disconcertment present themselves as provisional constructions: 'Being messy and seamy, [they] acknowledge the actualities of other times and places, and make the generalizer's accumulation of power more evident – and, for that reason, less certain' (p. 757). Her rig does not hide its presence, nor do the stories let you forget about their role as an aerating technology. Haraway (1997) captures this feminist resistance to seamlessness nicely when she writes, 'I try to make words – like all meaning-making tools – to stumble, to make a lot of racket, to generally resist naturalization' (p. 306, n. 36). Verran's clunky minimalism is an aesthetic that helps resist peaceful naturalization.

This aesthetic does not only apply to meaning-making tools like words and theoretical rigging but also to digital technologies like software. From 2003 to 2006, Verran worked as part of a team of researchers called Indigenous Knowledge and Resource Management in Northern Australia (IKRMNA). One of their primary projects, TAMI (Text, Audio, Music, Image), was a computer program intended to facilitate Aboriginal collective memory projects. In the process of developing TAMI, they tried to avoid encoding Euro-American epistemic categories into software meant for organizing indigenous knowledge. Verran's (2007a) explanation of the TAMI project shows the same aesthetic sensibility as her stories about the firing regimes:

> TAMI is designed as a clunky piece of software. All its 'mechanical' processes lie on the surface. It is a learning/teaching surface designed to recognise and manage ontic incoherence, interference, and interruption, and to make that managing obvious and explicit. Consequently TAMI will never be a very comfortable experience either for teachers or learners. Users would be constantly aware that representations stored in TAMI, and the various configurations in which they might be arrayed, are mutable. (p. 122)

Uncomfortable software seems counter-intuitive, especially since one of the team's primary goals was to allow people with little print or computer literacy to use it. However, TAMI's awkwardness was intended to protect some of the ontological concerns of Verran's Yolngu collaborators. The danger in using software to archive indigenous knowledge is that it would act not as a lively collective memory tool but as a museum or graveyard. Slick and seamless computer software runs the risk of making its digital objects appear as self-sufficient representations, cut from their living contexts, archived, and frozen in time. TAMI, however, was designed to make it difficult to understand the text, audio, music, and images as standing alone. Here, Verran brings the clunky minimalist style she developed in her theoretical writing to bear on her participation in this collaborative project. Although the project did not receive enough funding to reach completion, it constitutes, I believe, an important attempt to address the question of how digitized indigenous knowledge can resist appropriation and translation into an idiom that will not sustain its metaphysics. Despite the fact that TAMI never became a stable artifact, Verran's descriptions of the collaboration offer her readers the practical tactic of

building intentionally creaky technologies as one way to do ontological politics in a postcolonial context, where one way of doing worlds is in danger of being obliterated by another.

Conclusion: Counting, accounting, and accountability

This brings me back to numbers. Although numbers are particularly smooth and trustworthy meaning-making technologies that hide their seams well (Porter, 1995), like words and software, they are meaning-making technologies nonetheless. The numbers Verran gives us in *Science in an African Logic* and elsewhere (e.g. Verran, 2010, 2013) are numbers always figured as 'materialized relations' (Verran, 2010), numbers in need of equipment lists (p. 171). Accountability, in this context, is about tracking, highlighting[7] and narrating these relations, about not allowing them to maintain the illusion of self-evidence. Although I have been emphasizing accountability's narrative valences, here I want to argue that it is important not to lose the quantitative sense as well. Working well with numbers as materialized relations requires the skills of a talented accountant, someone who is as familiar with mathematics as she is with storytelling. Just as composting requires serious microbiological and agricultural savvy, not just tossing things randomly onto the heap, effective accounting requires precise mathematical techniques and a feeling for the liveliness of numbers.

Accounting in this sense is a critical counting practice that recognizes that numbers do important relational work but do not stand alone. In this view, quantitative methods lose their authority and self-assuredness (although not their creative ability, nor even their precision). Verran reminds us that counting is never certain and always political. Therefore, we need to conjure lively numbers to count with and count on.[8] Alongside our commitments to critical social theory, which Verran has taught me to understand as participatory storytelling, we can also conjure other forms of academic participation that engage with the kind of worlding that numbers do, 'challenging official equivalences with alternative calculations of worth' (Nelson, 2013). Feminist quantitative methods, postcolonial statistics, and queer accounting come to my mind as playful names that might whet our political and epistemic appetites as we learn from Verran's work with numbers.

Together with a renewed appreciation for counting, Verran also gives us an important lesson in accounting and accountability. Accounting figured as writing the equipment list may too easily be interpreted as an exercise in representation and reproduction or in critique and audit. Verran gives us a way of understanding accounting that is not about faithful representation or bringing hidden relations to light, but descending into the darkness of the compost heap. The accounting she practices does not present itself as unveiling but as storytelling, as decomposing, as highlighting, as aerating, as stitch-ripping. In her books and articles, Verran demonstrates a kind of accounting where 'show your work!' acts as a reminder to resist naturalization and the will to infinite extension (the Pasteurization of France, the Verranization of Nigeria), where critique is only important as an 'ingredient of the assemblage' and decomposing is also about composing – composing new stories specifically designed to facilitate understanding between different knowledge traditions. This is a kind of accounting that encourages theoretical rigging to be clunky and minimal, and all meaning-making technologies to show their seams, while

straining to carry their equipment lists with them, creaking and groaning under the weight. This rich set of accounting practices helps us to envision what accountability could mean for a robust relational empiricism.

This article has been an exercise in turning over the compost pile again and keeping Verran's objects, concepts, and insights in a state of generative transformation. As we struggle to remain accountable to the worlds that we participate in creating, revisiting and revising our own work and the work of those who inspire us can be important and useful practices for doing intellectually and politically engaged work on and in techno-science. Ongoing untidy recursive theory, theory that is looping and tangled, full of uneasy returns, disconcerting encounters, and decomposing compositions, could be our best bet for doing STS explicitly as a worlding practice, for crafting accountable stories. As Adrienne Rich (1986) once wrote, using another earthy metaphor, 'Theory can be a dew that rises from the earth and collects in the rain cloud and returns to earth over and over. But if it doesn't smell of the earth, it isn't good for the earth' (pp. 213–214).

Acknowledgements

I would like to thank Karen Barad, Donna Haraway, Mike Holohan, Lilly Irani, Ruth Müller, Jenny Reardon, Lucy Suchman and three anonymous reviewers for their comments and suggestions for this article. I would also like to extend my very special thanks to Helen Verran for inspiring me to think more slowly and carefully about how we do what we do.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Notes

1. Another definition of accountability comes from the tradition of ethnomethodology (Garfinkel, 1967), where accountability refers to the ways in which everyday routines and interactions are made intelligible to others within specific communities of practice. For a discussion of ethnomethodological accountability in relation to recent developments in Science and Technology Studies (STS), see Suchman (2011).
2. Verran's 'relational empiricism' draws on the STS analytic of 'relational materiality' (Law, 1999: 4) – the proposition that objects like genes (Haraway, 1997), arteriolosclerosis (Mol, 2002), TSR2 aircraft (Law, 2002), quantum phenomena (Barad, 2007), and humanlike machines (Suchman, 2007) are the outcome of relations rather than things-in-themselves (Verran, 2013: 4). Using this framework to consider her own research practices, Verran figures herself and her analysis also as an outcome of collective action.
3. The Yolngu community that Verran (1998) currently works with call her their 'consultant philosopher' (p. 258); this title also draws attention to theorizing/storytelling as participating.
4. 'Naturecultures' is Haraway's neologism for fighting the persistence of the nature/culture dichotomy in thinking and in speaking. By jamming together the rhyming verbs narrating and aerating, I follow her lead in order to locate human choice and bacterial digestion in the same sphere of agency.
5. For example, Verran (2002) gives us two different translations for the Yolngu *wänga*, which usually gets tritely translated as 'sacred sites'. She uses 'clan lands' to evoke the sense

of belonging in *wänga*; she uses 'people-places' to evoke an inherent relationality (p. 749). Giving two translations, both unfamiliar to Anglophones, makes it more difficult to ignore the ontological commitments that *wänga* carries.

6. Here, I use 'rigging' instead of 'framework'. Although they have similar meanings, 'framework' has become a sleeping metaphor in scholarly writing. Along with the nautical meaning of 'rigging', I want to add a second association, inspired by the television show *MythBusters*; on *MythBusters*, the hosts build elaborate and clever technological rigs to test modern myths. Each rig is a provisional construction, set up for a specific myth, and dismantled after they finish the episode. Sometimes bits of old rigs are reused or repurposed for new rigs.
7. Although 'highlight' could easily be understood as a metaphor of disembodied vision, I imagine it as part of a material reading practice, like the one I often perform with my fluorescent Sharpie. Highlighting in this sense is not about making things clear but about scribbling as a mode of attention – more *Harold and the Purple Crayon* than Descartes' 'natural light of reason'.
8. While the verb-heavy grammar of praxiography seems to erode numbers into a silt of practices, they return in Verran's work, re-enchanted (see Suchman, 2007: 256–258). Verran (2007a) writes that she has learned to see numbers in the spaces between collective action: 'I imagine numbers pulsating and quivering there in these intervals, always in potential, apart from their brilliant, ephemeral realization or clotting in enactment, time and time again' (p. 112). It is these fleshy numbers that capture my quantitative and political imagination.

References

Asdal K and Moser I (2012) Experiments in context and contexting. *Science, Technology & Human Values* 37(4): 291–306.

Barad K (2007) *Meeting the Universe Halfway*. Durham, NC: Duke University Press.

Catullus (1990) *Catullus: The Complete Poems* (trans. G Lee). Oxford: Oxford University Press.

Daston L (2004) Taking note(s). *Isis* 95: 443–448.

Frank A (2010) *Letting Stories Breathe: A Socionarratology*. Chicago, IL: The University of Chicago Press.

Garfinkel H (1967) *Studies in Ethnomethodology*. Oxford: Prentice Hall.

Haraway D (1991) *Simians, Cyborgs, and Women: The Reinvention of Nature*. New York: Routledge.

Haraway D (1997) *Modest_Witness@Second_Millenium.FemaleMan©_Meets_Oncomouse™*. New York: Routledge.

Haraway D (2008) *When Species Meet*. Minneapolis, MN: University of Minnesota Press.

Kenney M (2013) *Fables of attention: Wonder in feminist theory and scientific practice*. PhD Dissertation, UC Santa Cruz, Santa Cruz, CA.

Latour B (1983) Give me a laboratory and I will raise the world. In: Knorr-Cetina K and Mulkay M (eds) *Science Observed: Perspectives on the Social Study of Science*. London, SAGE, pp. 141–170.

Latour B (2004) Has critique run out of steam? From matters of fact to matters of concern. *Critical Inquiry* 30(2): 225–248.

Law J (1999) After ANT: Complexity, naming, and topology. In: Law J and Hassard J (eds) *Actor Network Theory and After*. Oxford: Wiley-Blackwell, pp. 1–14.

Law J (2002) *Aircraft Stories: Decentering the Object in Technoscience*. Durham, NC: Duke University Press.

Law J and Lin W (2011) Cultivating disconcertment. *The Sociological Review* 58(2): 135–153.

Longino H (1979) Evidence and hypothesis: An analysis of evidential relations. *Philosophy of Science* 46(1): 35–56.
Martin A, Myers N and Viseu A (eds) (2015) *The politics of care in technoscience*. *Special issue of Social Studies of Science* 45(4).
Mitchell T (2002) *Rule of Experts: Egypt, Techno-Politics, Modernity*. Berkeley, CA: University of California Press.
Mol A (1999) Ontological politics. A word and some questions. In: Law J and Hassard J (eds) *Actor Network Theory and After*. Oxford: Wiley-Blackwell, pp. 74–89.
Mol A (2002) *The Body Multiple: Ontology in Medical Practice*. Durham, NC: Duke University Press.
Mol A, Moser I and Pols J (2010) *Care in Practice: On Tinkering in Clinic, Homes, and Farms*. Bielefeld: Transcript-Verlag.
Müller R and Kenney M (2014) Agential conversations: Interviewing postdoctoral life scientists and the politics of mundane research practices. *Science as Culture* 23(4): 537–559.
Nelson D (2013) 'Yes to life=no to mining': Counting as biotechnology in life (Ltd) Guatemala. *S&F Online* 11(3). http://sfonline.barnard.edu/life-un-ltd-feminism-bioscience-race/yes-to-life-no-to-mining-counting-as-biotechnology-in-life-ltd-guatemala/
Porter T (1995) *Trust in Numbers: The Pursuit of Objectivity in Science and in Public Life*. Princeton, NJ: Princeton University Press.
Postma M and Postma D (2011) Who is laughing last in the South African classroom? A critical reflection on language in education. *Southern African Linguistics and Applied Language Studies* 29(1): 43–54.
Puig de la Bellacasa M (2010) Ethical doings in naturecultures. *Ethics, Place and Environment* 13(2): 151–169.
Puig de la Bellacasa M (2011) Matters of care in technoscience: Assembling neglected things. *Social Studies of Science* 41(1): 85–106.
Rich A (1986) *Blood, Bread, and Poetry: Selected Prose 1979–1985*. New York: W.W. Norton.
Rouse J (1987) *Knowledge and Power: Towards a Political Philosophy of Science*. Ithaca, NY: Cornell University Press.
Schrader A (2010) Responding to *Pfiesteria piscicida* (the fish killer): Phantomatic ontologies, indeterminacy, and responsibility in toxic microbiology. *Social Studies of Science* 40(2): 275–306.
Sedgwick E (2003) *Touching Feeling: Affect, Pedagogy, Performativity*. Durham, NC: Duke University Press.
Singleton V (2012) When contexts meet: Feminism and accountability in UK cattle farming. *Science, Technology & Human Values* 37(4): 404–433.
Star SL (1991) Power, technologies and the phenomenology of conventions: On being allergic to onions. In: Law J (ed.) *A Sociology of Monsters: Essays on Power, Technology and Domination*. New York: Routledge, pp. 26–56.
Stengers I (2008) Experimenting with refrains: Subjectivity and the challenge of escaping modern dualism. *Subjectivity* 22(1): 38–59.
Stengers I (2010) *Cosmopolitics I* (trans. R Bononno). Minneapolis, MN: University of Minnesota Press.
Strathern M (1992) The decomposition of an event. *Cultural Anthropology* 7(2): 244–254.
Strathern M (1998) *The Gender of the Gift*. Berkeley, CA: University of California Press.
Suchman L (2002) Located accountabilities in technology production. *Scandinavian Journal of Information Systems* 14(2): 91–105.
Suchman L (2007) *Human-Machine Reconfigurations*. Cambridge: Cambridge University Press.

Suchman L (2011) Practice and its overflows: Reflections of order and mess. *Tecnoscienza: Italian Journal of Science & Technology Studies* 2(1): 39–48.
Thompson C (2007) *Making Parents: The Ontological Choreography of Reproductive Technologies*. Cambridge: MIT Press.
Verran H (1998) Re-imagining land ownership in Australia. *Postcolonial Studies* 1(2): 237–254.
Verran H (1999) Staying true to laughter in Nigerian classrooms. In: Law J and Hassard J (eds) *Actor Network Theory and After*. Oxford: Wiley-Blackwell, pp. 136–155.
Verran H (2001) *Science and an African Logic*. Chicago, IL: The University of Chicago Press.
Verran H (2002) A postcolonial moment in science studies: Alternative firing regimes of environmental scientists and aboriginal landowners. *Social Studies of Science* 35(5–6): 729–762.
Verran H (2007a) The educational value of explicit noncoherence: Software for helping aboriginal children learn about place. In: Kritt DW and Winegar LT (eds) *Education and Technology: Critical Perspectives and Possible Futures*. Plymouth: Lexington Books, pp. 101–124.
Verran H (2007b) The telling challenge of Africa's economies. *African Studies Review* 50(2): 163–182.
Verran H (2010) Numbers as an inventive frontier in the knowing and working Australia's water resources. *Anthropological Theory* 10(1–2): 171–178.
Verran H (2013) Numbers performing nature in quantitative valuing. *Nature Cultures* 2: 23–37.

Author biography

Martha Kenney is Assistant Professor in Women and Gender Studies at San Francisco State University. She earned her PhD in the History of Consciousness at the University of California, Santa Cruz in 2013. Located in the tradition of feminist science studies, her work explores the politics of storytelling and other methods in scientific practice and in Science and Technology Studies. Her current project examines and intervenes in the narratives emerging from the new field of environmental epigenetics.