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ABSTRACT I juxtapose a story of Aboriginal landowners demonstrating their firing strategies with a story of environmental scientists elaborating their regimes of burning. The firings are profoundly different, and maintaining those differences is crucial for both Aborigines and scientists. Yet it is also important for both these groups to develop links between the forms of firing. I argue for understanding both firing regimes as expressions of collective memory which embed evaluative witness. This sameness enables modest yet sufficient connection.

Acknowledging this translating form of 'sameness' would have scientists and Aborigines engaging an alternative form of generalizing, promoting a transformative moment in both knowledge traditions. This alternative form of generalizing embeds a politics different from the politics embedded in orthodox scientific and Yolngu forms of generalizing. I claim the tension made in articulating these alternative forms of generalizing as a 'postcolonial moment'.

Keywords Aborigines, Australia, environmental science, fire, generalizing, Yolngu

A Postcolonial Moment in Science Studies:

Alternative Firing Regimes of Environmental Scientists and Aboriginal Landowners

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In Northeast Arnhem Land, and Northern Australia generally, little rain falls in the months September to December. The drought is broken around year's end with the arrival of the monsoon, and occasionally a cyclone. The third quarter of the year is the time for firing the land, and through August to October a smoke haze hangs over the land right across Australia's top end. Scientists, pastoralists and Aborigines have interests in these lands. Firing is used as a resource management strategy in reserves managed scientifically for biodiversity preservation, in pastoral areas managed scientifically for cattle production, and on lands owned and managed by Aboriginal communities. The firing regimes differ, and disputes between practitioners of the different knowledge traditions can be bitter. Yet, over the past 10 years or so, many environmental scientists have come to recognize the effectiveness of Aboriginal land management, firing strategies in particular. Looking for ways to improve scientific land care, some have begun to investigate Aboriginal firing regimes.

Such moves provoke postcolonial moments: occasions for theorizing, for telling differences and samenesses in new ways [Hall (1992): 293].[1] In

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this paper, my aim is to tell some stories useful for the scientists and Aborigines struggling to work with each other, and with the bush, in Northeast Arnhem Land in Australia's Northern Territory. I hope my stories interrupt, and I hope they are generative for, both scientists and Aboriginal landowners. 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 hope of transformed contexts for the exercise of power. A postcolonial moment is not about retrieving a 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 making amends for past injustice. Elaborating a postcolonial moment involves both making separations, and connecting by identifying sameness. But 'sameness' here is not a dominating universalizing. On the contrary, sameness in a postcolonial moment enables difference to be collectively enacted.

In showing how an emerging postcolonial knowledge space [see Turnbull (2000) and (2003)] might be nurtured, I tell of an episode where environmental scientists were invited to participate in a firing staged by members of the Yolngu Aboriginal community. In participating, the scientists expected to benefit their science both practically and theoretically. Members of several Yolngu Aboriginal clans worked together to demonstrate to scientists their practices of what they call *worrk*, 'the work of setting fire to the bush and managing that fire'. More importantly from their point of view, the hosts explained how these practices of firing are justified in Yolngu terms. In the workshops, Yolngu Aboriginal landowners provided sessions of formal instruction and practical demonstration of firing a particular place. Participation involved camping in the bush. Over several days, periods were given over to lectures from Yolngu authorities and to seminar-type discussion, while other times were devoted to extended practical activity.[2] The workshops were brokered by two emergent Yolngu institutions: Dhimurru Land Management Aboriginal Corporation,[3] and Garma Cultural Studies Institute.[4] In describing this workshop, I tell of several incidents when scientists were thoroughly disconcerted by what their Yolngu hosts did, and by the justifications the Aborigines gave for their actions. Telling these vividly and in detail, I reveal what I take to be the orthodox forms of generalizing that feature in and allow Yolngu Aboriginal episodes of *worrk*.

I juxtapose my telling of this episode of *worrk* with a presentation of scientists' accounts of why and how they carry out 'prescribed burning', highlighting what I take to be epistemically significant incidents. A summing-up of my stories brings orthodox forms of generalizing in the environmental sciences into stark relief. We see that, in one sense, '*worrk*' and 'prescribed burning' are absolutely different. Coming to life within

disparate epistemic regimes, the forms of generalizing they embed are justified by incommensurable metaphysics.

The puzzle then becomes how to tell those episodes of burning managed by Aborigines, as the same as those managed by scientists. This seems at first to be the easy part, for everyone acknowledges that at some experiential level they *are* the same. But we need to be careful here. Experience and stories of that experience are not the same thing. To be useful, my story of sameness must do more work than crediting a vague sense of shared experience. For one thing, a story of sameness is required to agree on, and enact the differences, that the scientists and Aborigines explicitly claim in justifying their firings. For another, those differences, and the sameness that secures them, are the basis on which scientists and Aborigines might find ways to negotiate such grounded issues as where, when and with whom to light fires. The story about sameness should also expand collective imagination. It should contribute in working out how both sorts of firing regimes might be done better. Much depends on finding the right story of sameness in the firings. We need the right tool for the job [Clarke & Fujimura (1992)]. This is where a postcolonial moment might be made.

A useful story will enable participants to recognize and credit a sameness that nevertheless allows the sorts of differences that are important for Aborigines on the one hand, and scientists on the other. The story of sameness must eschew universalizing claims, and instead look for local, particular and contingent symmetry. Developing such a symmetry, I point to both '*worrk*' (Yolngu Aboriginal land management firing) and 'prescribed burning' (the scientific form of land management firing) as enacted forms of collective memory that embed evaluative witness. These managed fires perform collective memory and evaluative witness quite differently, but equally they carry a past into a future, and offer opportunities for judging whether the collective act of firing accorded with articulated standards of adequacy. Arguing for this as a story of sameness useful for scientists and Aborigines, I show how it enables land managers to negotiate in making arrangements for firings that might be credited in both traditions.

I acknowledge that taking up this novel account will challenge both scientists and Aborigines. It embeds an account of generalizing alternative both to orthodox scientific generalizing, and to accepted Yolngu generalizing. Pushing this, I elaborate the politics of this alternative generalizing *vis-à-vis* that lurking unacknowledged in those orthodox forms. I claim the articulation of this tension as a postcolonial moment in science studies.

Why Are Environmental Scientists Interested in Learning about Aboriginal Firing Strategies?

As a way of beginning, I consider the prior issue of why, after 200 years of often murderous and consistently dismissive involvement with Aborigines, government in Australia is funding scientists to learn from members of an

Aboriginal community. I also consider why, given the harsh reality of past relations, Aborigines are interested in teaching scientists about their practices.

Bushfires hold a special place in the Australian imagination, and this ensures that the rôle of firing in land management regimes is controversial both in popular culture and in ecology. One scientific response to this ongoing controversial status has been to incorporate the issue into a vast ecological mapping enterprise that is currently occurring in Australia. A database of all Australian habitat types is being assembled. Some ecologists hope that one of the many outcomes of this database construction will be the possibility of generating a standardized firing regime for every habitat. As part of this work, some environmental institutions are turning to Aboriginal communities. Understanding what they need as 'local knowledge of the environment', respectfully, they assume that Aboriginal communities are reservoirs where this commodity is to be found in high degree. They construe what they need to do as 'collecting Aboriginal knowledge', much as they would collect, say, animal or plant specimens. This is one reason that government agencies are willing to fund workshops like those I describe here.

The Northern Territory Parks and Wildlife Commission, for example, includes the 'collecting of Aboriginal knowledge' in its mission statement [Northern Territory Government (1994): 3]. Its ethnobotanists set about assembling lists of Aboriginal plant names, publishing these lists along with Latin names, small diagrams, habitat, and information on Aboriginal uses of the land [Yunupingu et al. (1995)]. These 'information hunters' often find some of the information volunteered by Aboriginal community members less than valuable as a resource for sound local environmental management practices. This element, perhaps telling how a plant or a place is associated with a particular Ancestral Spirit Being and hence how it embodies the world's relationalities established in The Dreaming, is often winnowed out in the early information-collection stage. However, as the scientists who attended the *worrk* workshops organized by the Yolngu Aboriginal community were to discover, collecting information about Aboriginal firing is a much more tricky project than collecting the Aboriginal names and uses of plants.

The move to learn from Aboriginal land management practices is taking place within a hot controversy over the efficacy of those very practices. It is now generally accepted that the landscapes the first Europeans met on arriving in what was to become Australia, were systematically managed by Aboriginal communities using sophisticated land management regimes. Like most issues associated with firing regimes, this acceptance is a site of controversy. Some ecologists blame Aborigines for 'mass extinctions' and 'destruction of rain forests' through their firing activities. These commentators often claim that past Aboriginal firing practices led to the development of the 'degraded', eucalypt-dominated ecosystems that currently characterize almost all Australian habitats. Some suggest that Aboriginal practices set off a self-perpetuating cycle of climate change

[Horton (1982)]. Others praise Aboriginal management practices for creating the Australian landscape as uniquely productive [Jones (1969); Jones & Hiatt (1988); Latz (1995); Pyne (1991)].

This disagreement amongst environmental scientists is set within a theoretical contest. In general, those scientists who subscribe to the notion of timeless, stable, climax ecosystems,[5] criticize Aboriginal practices. As they see things, working with Aboriginal communities compromises science. In contrast, environmental scientists who take ecosystems as dynamic and unstable systems, where any particular environment is a historical outcome of events and conditions, tend to credit the effectiveness of Aboriginal land management regimes [Whitmore (1990); Head (2000)]. They recognize particular management practices as generating specific environmental episodes, effecting unique historical outcomes in the environment. As these scientists see things, Aboriginal work with fire, and perhaps even their own work, is just like the 'accidental' firing of lightning strikes, part of the historical landscape.[6]

This newly-developing paradigm is beset with conceptual difficulties. The notion of 'place' as historical and emergent exacerbates the problem of uncertainty associated with the sheer complexity of ecosystems, begging questions around the notion's sociality. This is a theoretical problem where the sciences come up against their metaphysics. Recognizing the practical and material limitations of the notion of a singular steady-state ecosystem has plunged ecology into a period of revolutionary science. Some Australian scientists feel that learning about Aboriginal land management practices might bring into relief some of these puzzling theoretical issues.

Amongst the environmental scientists participating in the workshop I describe in this paper, were adherents of both sides to this controversy. One scientist in the group led his professional life administering a re-vegetation programme associated with the large bauxite mining operation that is a significant environmental and social factor of life in Northeast Arnhem Land.[7] This re-vegetation programme is predicated on the premise of recreating the steady-state climax ecosystem, and firing is banned. Some regenerating reclaimed areas have been maintained free of fire for up to 20 years. Another participating scientist cited his commitment to the emerging paradigm of an historicized environment as the origin of his desire to participate in the workshops. This scientist understood that for Aborigines the landscape is historical and, as he explained it to me, he wanted to work out how that historical appreciation informed Aboriginal land management.

Why are Aborigines Interested in Explaining and Showing their Use of Fire in Managing their Lands?

A variety of motives lie behind this Yolngu Aboriginal initiative in the area of land management. The nation-wide controversy over firing in land management is only one of a number of highly contested fronts on which Aboriginal communities struggle both to regain, and to retain control over,

their lands. Environmentalists, pastoralists, tourist operators, mining corporations, along with Aboriginal communities, are all stakeholders in a complex politics around Native Title, Aboriginal Land Rights, natural resource management and biodiversity issues. In part, these complex and often painful negotiations proceed through debates over firing. Intervening in the controversy over firing in Aboriginal land management in this practical way, is a form of doing politics in that context.

Trusting that their knowledge traditions are effective and beneficial, Yolngu clan leaders contend that they have a contribution to make to the development of Australian environmental sciences and, more generally, a rôle to play in the Australian academy. At the same time, by working with scientists, they hope to gain a capacity to turn scientific insights to their own purposes, and better fit their forms of land management to contemporary conditions.

For example, Yolngu landowners are now participating in Australia's Indigenous Protected Area (IPA) programme.[8] The proclamation of an IPA implies that management of such an area will meet standards of management practice laid down by World Conservation Union (IUCN) guidelines. These are practices defined in scientific terms, and they pivot on a scientific concept of place. While there are definite benefits to be gained from the declaration of an IPA for Yolngu landowners, certain structural characteristics of their working contain dangerous possibilities for disempowerment. Yolngu land management practices must, among other things, now take account of the existence of endangered species in their clan territories. In addition, some Yolngu lands must be actively managed for tourist operations: tourists need to be entertained and educated. They do not pay large amounts of money to explore blackened landscapes. As well, Aboriginal communities need to work with scientists overseeing regeneration programmes in the wake of huge mining operations if their land is to re-emerge as 'healthy', in the Aboriginal sense of the word. They want to find ways to make such scientists heed their advice.

For the groups and individuals espousing the prospect of working with science, offering ecologists first-hand experience of Yolngu land management strategies through having them participate in actual episodes, is an activity associated with community education. Young Yolngu men enrolled in tertiary environmental studies courses participated in these firing workshops. Their participation was an accredited part of their study. The workshops were also associated with the educational programme of the local Yolngu community school. School students attend these workshops as part of their work in the Garma curriculum.[9]

Despite these seemingly persuasive reasons for co-operating with scientists, it remains the case that within and between the Yolngu clans, the *worrk* workshops are controversial. The desire to contingently take on some scientific ways of land management is not shared by all members of the Yolngu clans. Clans and individuals vary in their support of the Yolngu land-management organization Dhimurru, and clans and clan members

sometimes vigorously oppose what they see as a diluting and polluting of their traditions with science.

Perhaps the most pragmatic reason for both Aborigines and scientists to participate in these workshops is a desire to find ways to negotiate over firing, in an everyday sense. In many places, Aborigines and scientists must co-operate, and both sides hold quite strong views on when and how to fire specific tracts of land. This can lead to serious tension and distrust, and sometimes confrontations, between the two sides.

A *Worrk* Workshop

The workshop I describe here had many agendas. In my telling of the Aborigines' showing how they fire a tract of land and explaining how they justify those practices, I focus on my agenda. I am interested in identifying the points in the proceedings where scientists evinced confusion and puzzlement, sometimes showing their pain as they struggled to come to terms with what they were shown and told. As we will see, at this workshop learning and teaching proved both tricky and elusive. Scientists discovered that:

> When [they] investigate Aboriginal knowledge of fire ecology, it is hard to pin down because it is so integrated into everyday practice. Fire ecologists working to develop effective practices for preserving biodiversity in the tropical savannas [find they] need to learn not only about land management, but also about knowledge itself. [Christie (2001): 16]

In developing that notion, I go on to juxtapose my account of the *worrk* workshop with two instructional texts from environmental science. I present an account of the protocols for a prescribed burn as elaborated in an environmental management textbook, and supplement this by recounting parts of a video showing the workings of a field site where scientific knowledge of the effects of firing habitats is produced. With this juxtaposition, I show how *worrk* and prescribed burning are profoundly different.

Planning for the Workshop

As things ended up, the 1996 *worrk* workshop was held late in the burning season, the dry season. The weather was already very hot, and the bush very dry. The reason for this late scheduling was the absence of the main facilitator for the project. He was on an international tour with his popular rock band. This meant that only late-season burning places could be considered as sites for the workshop.

The year before, the site for a similar workshop had been a Yirritja *wänga* – an area of land owned by a clan of the Yirritja moiety. This year, it was to be a Dhuwa *wänga*. Keeping such a balance is important here, where all things in the world are either Yirritja or Dhuwa, and there is no *a priori* separation of the social and the natural, of people and place.[10] After much canvassing of clans, associated not only by the timing, but also by

the necessary Yolngu politics, the particular clan to host the workshop had become clear just weeks before the scheduled time for the event.

The late stage at which the hosting clan was agreed on caused some consternation for the scientists assisting with the organization of the workshop, employees of Dhimurru, the Yolngu environmental organization hosting the workshop. This was exacerbated by a continuing vagueness about the actual place. Eventually, with just a few days to go, Wathawuy was agreed on. Wathawuy is just south of the airfield and the huge open-cut bauxite mine that dominates the landscape in the most Northeasterly tip of Northeast Arnhem Land. It is quite close by to Nhulunbuy, a mining town and the largest centre of population in the region. Wathawuy and its surrounding land are owned by the Ngaymil clan.

The Participants

The main instructor at this workshop was the most senior Ngaymil clan leader. He was helped by a much younger man from a closely related clan of the same moiety, and a senior man from a clan with quite different kinds of interests in this land – from the opposite moiety. No less important were four senior Yolngu women from clans with particular and strong interests here. The status of these people as instructors reflected the ways Ngaymil lands are placed in the relational mesh of multiple and various clan interests in all lands. The senior people were helped by two younger men, Yolngu rangers working in Dhimurru.

The invited Balanda (non-Aboriginal Australians) were diverse.[11] They included environmental scientists, rangers for the Northern Territory Parks and Wildlife Service; an ecologist employed to run a re-vegetation programme for the local, multinational mining company; the administrator of the local environmental organization, Dhimurru; and two of my graduate students, both trained as environmental scientists, who had worked in that capacity in the community for several years. A retired professor of anthropology expert in 'traditional ecological knowledge' (TEK), a long-time friend of the Yolngu community, was also there. In addition to these adult participants, Yolngu school children attended two days of the workshop. They arrived with their teachers in buses each morning.

I participated as a Balanda in the workshops. I was given various explicit locations as a woman, a senior person, and as an adopted member of a Dhuwa clan (the Rirratjingu clan), which had a strong presence at the workshop. I was also recognized as a philosopher of science, an ethnographer, a translator, and general helper. I am a founding member of the Garma Cultural Studies Institute, one of the Yolngu institutions brokering this workshop. I have been involved with members of the Yolngu Aboriginal community since 1987. My involvement began in the community school as a curriculum advisor and teacher educator. Working as part of a group with Yolngu curriculum advisors and Balanda and Yolngu teachers, we established a curriculum that spoke to the needs of the children in this remarkable community. We invented what came to be called a Garma

Curriculum in mathematics and science, one informed by two traditions of logic – Yolngu and scientific.

Organizing the Camp-site

Dhimurru and the Northern Territory Parks and Wildlife Service provided most of the camping equipment, and things were well set up. There was even a fridge and a generator. The day before the workshop started, the students pitched in and helped the Dhimurru rangers load up several trucks with tables, chairs, tarpaulins, sleeping swags, food and general equipment, making them ready for the journey to Wathawuy. Once at the place nominated for camping by the Yolngu elders, a site set alongside a small gurgling river, these same energetic young people busied themselves in preparing the site. Toilet holes were dug and secreted behind hessian and shade cloth screens. Areas were swept clear of leaves and sheltered from the sun with tarpaulins. One was designated as an instruction area, and another as a kitchen/eating area.

The instruction area looked so inviting to the first group of instructors, arriving mid-afternoon, that they set their sleeping swags up in its shade. Others arranged their bedding either in chosen secluded spots or, like us older women, in cosy proximity to each other. Over dinner, there was much discussion about what time to begin burning the next morning. The group divided: some thought dawn was the proper time, others that a much later start was called for. Eventually the senior Yolngu landowner settled the discussion by naming mid-morning. One of the Balanda ventured that this was because the dew would not lift until then. Others looked dubious. Would there be dew tomorrow? Someone else pointed out that the school children would not arrive in their bus until around 10.00am. The landowner was silent about the basis of his decision. Across the evening, more of the Yolngu participants arrived and dispersed themselves among the small knots of people gossiping or sleeping.

Instruction

The first warmth and light of the sun were felt before 5.00 am. The muddle of older women stirred and soon the fire too was stirred, and a large and a small billy of water set to boil for the first 'cuppa'. Breakfasts were a matter of individual taste, but soon most of the participants were awake, some lusting after real coffee, others enjoying the first cigarette of the day.

There were not enough chairs for everyone. The young people and the women sat quite comfortably on the ground. Our senior instructor occupied a chair in the centre of a group of (mostly) men in the designated eating area. He was keen to begin instruction, and the rest of us were keen to hear. Our translator explained in English that instruction would be in Yolngu *matha* (literally 'tongue'), and then he would repeat what had been said in English. Formal instruction began. Those for whom Yolngu *matha* was easy sat back and took pleasure in the accomplished presentation. Those who struggled with the language strained for familiar words to be

able to catch at least a flavour of what was being said. Those for whom the language was opaque sat in respectful attention. Although they understood absolutely nothing, they patiently waited for the English translation. Perhaps even for them the modulations and intonations of voice indicated that this was not a linear explanation.

Then our interpreter began. He began by naming this place in his language, different to the landowners' since he belonged to a different clan. *Watharrandji* was the name of this place in his language. He told us that our instructor had first outlined his relation to this place, by naming several of his fathers as the persons through whom his relation with this place is established. On his own side, our translator pointed out, he is related to this place through his mothers. He went on to tell us how he himself remembered coming to this place often as a boy, on a journey, walking from Yirrkala to Biranybirany, his clan's homeland. The first night of their journey they always camped overnight at this place. His mother always found delicious food for them to eat here, and told him wonderful stories of this place. Later, when the family was living at Yirrkala, he remembered they would sometimes borrow an old truck from the missionaries and come for picnics to this place. Then came what he announced as the significant section of our instructor's talk.

> The land around this area belongs to three Dhuwa tribes: *Galpu, Ngaymil and Djapu.* All other Dhuwa groups only associate with the land through the history of *Wukun* – the cloud which is an origin of meanings for Yolngu. The spear (the cloud) is called *Djäta, Milpiriny, Larrpan.*
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> The bay is called *Djarraran, Manybarrmi, Gawinymi*; sea in the colour of the rainbow. Here Dhuwa people sing the Ngamal the stingray and Bukumilan, the shark. The water is called *Dhara'mälami.* (The work) to reproduce the water and the sea in the bay is known as *Mälami dhara'mi.*
>
> History tells us that *Wukun* stood at *Wurrumba Galkirrwalkirr* and pointed to *Watharrandji.* Then pointed towards *Wotja*, and then towards the east to *Yirrkarpa Djawulpawuy.* Then it pointed towards the north to *Wayirri-wayirri Rarrakala.* Then it broke up into small clouds, into the many Dhuwa tribes of Northeast Arnhemland.
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> We were told that people must respect the land and celebrate it and the ancestors who made it, in taking from the land what was needed and in distributing it in the proper ways. That was what all young people must learn. Making sure that the respect for the land was given back through dancing, singing and holding proper ceremonies.
>
> And when this land burns, the smoke rises up across the day. And helps make that cloud – *Wukun.* By the end of today we will see the cloud forming and setting off on its journey. So here we are working together in ways we have always done, and remaking the connections between Watha-wuy and other Dhuwa places.

Many of the Balanda were now looking uneasy, but they did not show disrespect by wading in with questions. The demeanour of the Yolngu participants showed that this had been a significant exposition; they all

evinced appreciation. The Balanda tried to show that they, too, were appreciative, although they obviously found it hard to credit what they had heard. How were they to make sense of this apparently profound insight they had been given? Things seemed to be the wrong way around, and too mixed up for the scientists. In their understandings of knowledge, the land is quite independent of and separate from human acts. Humans as knowers might tell of the land in this way or that, but the land can only speak in a metaphorical sense. It was clear to all that our instructor was not speaking metaphorically. Where were the generalizations about habitat that the scientists saw as necessary to justify a firing?

How could this way of understanding knowledge possibly provide a satisfactory structure for developing justifiable protocols for burning the land, some of the scientists wondered aloud? As far as they were concerned, as a justifying account of habitat, this Yolngu 'theory' fails to do the job. Some of the scientists' discomfort over this talk related to notions of agency. In this account, it seems to be the land that orders and arranges the people – it tells the clans how they relate. Natural processes are mixed up with social practices. Knowledge of place and of salient properties of habitat seemed not to feature at all.

Quite properly, the scientists continued to refrain from intervening and trying to turn the focus of talk to what they were so anxious to hear from Yolngu – talk of plants and animals, rainfall and soil. The scientists curbed their impatience. Some consoled themselves by commenting that when the group got on to the actual work of lighting the fires, then things would become clearer for them, then they might begin to get some of the information they came here to get through observation of Yolngu actually working in the landscape.

Suddenly the talk was in English again. Our translator was telling about arrangements for travelling to the place for burning. Our work would not be here near the camping place at all, but quite far away. Too far to walk in this heat. The camp should have been established much further down the river. At first, he said, it had seemed OK to begin near here, but when you actually get to the place and walk around a bit and think and talk about this place and its connections to other places, you remember the names better. You need to be here to really remember the songs and dances and stories that tell about the place names, and in which they feature.

This caused more worry amongst some of the Balanda participants. Those who felt some organizational responsibility perhaps began to feel a little defensive. Had they made a mistake? One of the scientists bluntly expressed his confusion about why we were travelling to another place to burn. He asked the youngest of the Yolngu instructors why it was necessary, when land around this place obviously had not been burnt. 'It cannot be very much different to a place just a few kilometres down stream', he reasoned. In reply, the instructor helpfully explained about kangaroos, shellfish and yams. It seemed that the burning was in part about hunting. Well that made some sense. But, 'Shell fish and yams? Where do they fit in?', the confused scientist wondered aloud.

Beginning the Day's Tasks

I found myself in the first car of the convoy driven by the translator and carrying the senior instructor, leading everyone else to the now agreed-upon spot to start burning. The others dispersed themselves in the five or six vehicles and the convoy set off, back the way we had all come in the night before. We met the buses carrying the school children on the way. They turned around and joined the convoy. We drove past some of the bush regenerating on a tract of reclaimed mine land, an area under the care of one of the scientists in our group. Inevitably, the conversation between the two men I was travelling with turned towards it. How many years since it was burned? Neither could remember exactly. It looked to be tangled and impenetrable scrub, in contrast to the open woodland elsewhere. I asked my companions how they felt about those areas. 'Full of rubbish', the younger man replied. Since many of these areas are alongside roads, the issue has locals thoroughly divided. To some extent, divisions follow Yolngu/Balanda lines. Yet, I have heard many Balanda express shock and distaste at the sight of the unburned bush similar to that articulated by most Yolngu landowners. I have also heard some Yolngu people express mild curiosity in the 'experiment', while noting that they held only remote interests in those particular tracts of land.

After perhaps 30 minutes, we stopped at a clearing. The little river was wider here and flowed more swiftly. The following cars gradually arrived in the clearing. With 50 or so school children, it was now a significant group. Seated in our pick-up truck, we watched as the children cooled themselves in the river. Accepting the iced water which the Yolngu school teachers had thoughtfully brought, a small group of the older Yolngu women set off armed with their 'iron', a filed-down section of shock absorber. They were in search of the yams that they knew must grow long and thick in this little patch of jungle along the river. While the rest waded in the water to cool off, or sat in the shade, our senior instructor and translator drove slowly off – with me still seated in the back. They were chatting about *yothu* (child) fires and *yindi* (mother) fires. The older man was indicating with his arms: showing the directions of flow of the fires, supplementing this with what I understood to be series of names, presumably of places the fires would flow through.

We made a circuit of perhaps 500 metres around a small track running off east from the clearing. The older man borrowed an orange disposable cigarette lighter from the younger one, who lit up a cigarette before he handed it over. As they went along, every 50 metres or so the senior landowner leaned out of the window, over to the side of the track, and lit up a clump of grass or a straggly, dry bush. They went on talking, still on *yothu* fires and *yindi* fires.

When we arrived back at the clearing, everyone was looking refreshed. Most of the children were still in the, by now, very muddy river. The women had a pile of yams, one very long and fat, which the teachers were

admiring. The participants clustered together, anticipating a formal instruction session. The children crept closer to the assembled adults, their clothes still dripping. All available bits of shade were taken. Our instructors had to stand out in the sun. This time more of the talk was comprehensible to the English-only speakers, it was that mixture of English and Yolngu language that is common here in mixed language groups. Place names were rattled off. The plant and animal foods associated with them were listed, and the clans to which some would be distributed were identified. At our next stop, the men would light the *yindi* fire and hunt for kangaroos. The women and girls would be collecting clams from amongst the mangroves, and yams in the nearby jungle patches. The instructor admonished the children: 'This is what your forefathers and foremothers have always done. And this is what you must learn to do too'.

What emerged from this talk was a picture of repetition and ritualized proceeding. It seemed that each place has its particular sequence of operations when being burned. There is a particular place to set the first fire, and a particular sequence of further fires to be lit, all at particular named places, all related through *gurruṯu* – the kinship system. Lighting fires at the correctly named places at the correct times is a matter of achieving fires of the proper intensity and burning in the right direction. It was a matter of the right person setting fire in named places in the right sequence starting from the right spot. This turned on knowing many place names and how they related through the workings of the kin-based *gurruṯu* system, and who was 'boss' for those places. Equally, it was a matter of collecting the appropriate foods from each particular spot in the sequence and distributing them to the right families.

At this point in the lecture, smoke became evident. It was of course from the fires lit by the senior landowner, quite unbeknownst to most of the participants. Perhaps he had not wanted to drag the visitors away from the cool shady river into the hot scratchy bush, and had not trusted the children to behave. Perhaps it just did not occur to him that others would feel a need to observe him. The instructor and the translator pointed to their *yothu* fire, naming places and explaining in Yolngu language where it will flow and where the *yindi* fire will be lit, naming where the fires would meet.

Most of the Balanda participants looked like they could scarcely believe their eyes. Had they missed what they had come to see? It seemed that the fires had been lit without them. They rushed with cameras towards the smoke, but most of the participants were already getting into the cars to drive on. Reluctantly, they too climbed into their vehicles to follow.

Lighting the Main Fires

Our journey to the next place was suddenly interrupted. The line of cars stopped as we were passing alongside a patch of jungle. A small party of women alighted from the leading vehicle. Armed with their 'irons', they were off to collect more *ganguri* – yams. 'We need to do this well', the

senior instructor remarked to me in English. At the time, it was not evident to me how 'doing this well' – presumably the burning work – was tied up with gathering a good supply of *ganguri*.

At our next stopping place, it became clear that there was real work to be done. The participants divided into two groups. The boys and girls would accompany the women, collecting clams from the mangrove flats. A small party of men would walk around the loop of a creek, lighting fires as they went. Causing some small embarrassment, I attached myself to the men's group, along with a young woman who was my student.

This was serious fire-lighting. Our young demonstrators constructed an old fashioned firestick: smouldering bark attached to a branch from a small tree, to show how it was done in the old days. Helpfully, a Dhimurru ranger carried this heavy, hot implement through the bush, while another young man scouted in front with a spear: showing how things were done when they were small. The fire makers resorted to their cigarette lighters only when the smouldering bark caught on a pandanus tree and became detached from the stick.

After a walk lasting several hours, we arrived back at our departure point. The sausages and bread had been devoured by the hungry school children. Cooked *ganguri*, supplemented with a few roasted clams, had been saved for us. Most of the clams remained in their buckets. This feast was washed down with sweet orange cordial. We drove back to our camping spot, crossing a low fire front on the way, and collecting the party of *ganguri* gatherers on the way – their numerous bags bulging. I had completely forgotten about them. Arriving back at our camp, with some relief we saw that the sky had clouded over, affording some relief from the sun's rays. There were even a few drops of rain. As a prelude to dinner, we all soaked ourselves in the creek.

Concluding the Workshop

The next morning was given over to instruction. The 'instruction area' was duly vacated by packing up the bedding. The school children arrived, and paper and pencils were distributed. Hastily, wide strips of brown paper were taped together to make a large square for collective mapping. Amid talk I could not follow, and some confusion, the facilitator drew a large sketch map of the area we had traversed the day before. Positions of the fires were indicated. Most of the talk between the instructors seemed to concern place names. Which of these could and could not be placed on the map and where they should be located, was heatedly discussed. Some of the school children and all the invited Balanda copied the map.

By mid-afternoon, we were heading back to town. I accompanied one of the women as she delivered clams and yams to specific households. What seemed to matter here was ensuring that the right amounts were delivered to the correct families. My friend carefully explained to me how each family was located in *gurrutu* or kinship relations with the land we had just burnt.

Talk of the fires continued for several days around the community. One source of information was those moving between the various clan homeland centres in the small fleet of tiny planes and helicopters the community maintains. Arriving passengers were quizzed as to the whereabouts and size of the fire fronts they had flown over. For several days the passage of a plume of smoke was tracked along the horizon from convenient verandahs.

Taking the Pain of Disconcertment Seriously

Despite their best efforts to be polite and respectful, the scientists' dismay sometimes showed. Beginning to interpret the performance of the workshop, I specifically identify those occasions and consider them briefly. The first occasion on which I saw some of the participating scientists express anxiety was during the planning stage, over the decision of where the workshop was to be held. In part, this anxiety was due to the fact that arrangements over food and transport had to be made. For some of the participating scientists, travel requisitions needed to be completed and approved. Some anxiety related to this being a late burning. These scientists had ecologically justified ideas about which areas were suitable for a late burn, they cared about whether the burning would do harm or good. They worried that the decision about the site might be made solely on the basis of what they saw as 'Yolngu politics' – who would agree to what. As far as they were concerned, politics should not really come into it.

Another issue that caused scientists to baulk was the need to move to another spot to begin work, despite the fact that areas nearer the camp seemed to be equally suitable. And, when we all got to the named place, the senior Yolngu landowner had set about lighting fires seemingly without letting others know. Some of the scientists had begun to feel that too few people knew what was going on, or what would happen next. Perhaps some began to sense that the proceedings were the almost arbitrary decisions on the part of just one man. While scientists might be content to trust a scientific expert, it seemed much harder to trust the expertise of this old clan leader.

This feeling was in some ways contradicted by another characteristic of the proceedings that made scientists anxious. It seemed that a *worrk* episode was to some extent 'just a ritual' of lighting fires as accompaniment to a 'foraging expedition'. One of the scientists expressed anxiety over his perception that people were just blindly doing 'what they had always done', without appropriate consideration and planning. There seemed to be no general understandings of habitat, and without that how could any evaluation be made? The scientists were suspicious of their hosts' concern with food collecting. As far as they were concerned, this was an expedition to burn, not a picnic. Some of the scientists began to wonder if lighting fires was just an unconsidered side effect of hunting, not a purposeful management strategy at all. And further, while the talk of 'mother fires' and 'child

fires' was romantic, how could that metaphorical language be taken seriously?

Something else that made scientists feel uneasy was the 'theory talk' given over breakfast. In this account of their knowledge, Yolngu instructors conflated people and lands so that both had inherent relationality. Discomfort around this was exacerbated by everything seeming to have many names, with some names referring to a bewildering variety of figures. The cloud *Wukun* is also a spear, with the names: *Djäta, Milpiriny, Larrpan.* The bay into which the river beside which we stood emptied, is called *Djarraran, Manybarrmi, Gawinymi*, 'sea in the colour of the rainbow'. Science, of course, is often accused of the same sort of redundancy and confusion, but I felt the tensions were such that this was not the time and place to remind scientists of that. To sum up: in the *worrk* episode, scientists were able to recognize neither valid generalizing about habitats, nor justifiable strategies of burning them.

Burning in Scientific Land Management

The scientists witnessing this exposition of an Aboriginal form of land management burning were at times thoroughly disconcerted by their experience. Taking these disconcertments seriously, I go on now to explore how scientists would go about a 'prescribed burn', the scientific version of land management firing. I first present a copy of instructions for generating the protocols of a scientifically prescribed burn. I supplement this with an account of the workings of a field-site. The information that is collected in a field-site is worked into general understandings that both guide the development of a burn plan and provide a way of evaluating it. Study of an ecosystem through collecting data and devising models gives a general picture. Scientists tell their generalizations as mobilizing the properties immanent in the ecosystems they are studying.

Protocols for a Prescribed Burn

Here is how a recent book of principles and practices of land management instructs its readers on how to follow protocols for a prescribed burn [Worboys et al. (2001): 261].

> Undertaking a prescription burn
>
> The steps involved in undertaking a prescription burn are as follows.
>
> 1. **Initial planning**. A broad plan is devised to reconcile protection of property with conservation needs and cultural heritage. This is done well in advance. Local communities and stakeholders are involved.
>
> 2. **Preparation**. Boundaries are prepared for the fire (fire trails, walking tracks, streams that will hold a fire line, etc.). Where these do not exist, 'rake-hoe' or hand tools are used to construct fire control lines. Fire trails may be upgraded. Boundaries are made more secure. For instance, fuel is cleared from around trees lest they catch fire and fall across the control line or drop burning embers across it. This work can be done some time before the burn. Ecologically sensitive areas may need to be identified and

excluded by control lines. Fuel loads are assessed in detail for the entire burn.

3. **Detailed operational planning**. The fire's likely behaviour is modelled using computer simulations for that precise area ('the burning block') ... The managers know how they want the fire to behave, and from this they can deduce the window of weather conditions they will need.

4. **Setting a date**. A band of possible dates is set for which it is predicted that suitable weather conditions will prevail. Usually such burns involve local fire brigades and neighbours, so everyone's timetable has to be considered.

5. **Division of tasks.** Typically, the operation is divided up – different groups have different duties and work in different sectors. One team may be dropping incendiaries from a helicopter while a ground crew (supported by a firetanker) sets fires elsewhere at precise points along the established control lines. The operation may also be sub-divided into time stages. The organization that initiates the overall plan will probably be responsible for mopping up after the burn-off for the following days until it is declared safe.

6. **The lighting-up plan**. This involves deciding exactly where and in what order fires will be lit. The correct sequence matters; it determines what burns first, and in what direction fires can move. Fires can be volatile when moving up steep slopes so these areas are often lit from above. The fires then burn downwards to control lines (where possible) at the base of hills, or into pre-burnt areas. Humidity also affects the behaviour of fires, so 'time-of-day' lighting-up can help prevent hot burns in sensitive areas, especially if incendiary capsules dropped from a helicopter are precisely placed. This is very useful in getting a 'black edge' for rain forest gullies and stream-side vegetation communities, but one has to calculate precisely. The same technique is often used in remote areas for 'steering' fires.

7. **Informing the public**. Neighbours should be advised, and the burn pre-publicised through media such as local papers and on radio so that people are not alarmed when it occurs.

8. **Arrangements to suppress fire**. There have to be enough suitable persons and equipment on stand-by in case the weather changes without warning. Helicopters that can do water bucketing may be needed. They can help crews to hold the more difficult fire lines.

9. **Forward control arrangements**. A command structure and an agreed system of communications among all parties need to be in place. So too do arrangements for rescue or evacuation of persons who are injured or in danger ...

10. **Helicopter planning**. Aerial incendiary work needs to be precisely managed, with the navigator and bombardier operating as a highly planned and organised team. Incendiary capsules must be placed at intervals to minimise adverse fire behaviour.

11. **Positioning crews**. Fire control crews need to be in position to make sure fires do not get beyond control lines.

12. **Surveillance**. Some crews need to be on standby to patrol the fire overnight. The next day helicopters will be needed to survey the burn, and perhaps water-bomb flames that persist. Managers must make sure the burn is successful, safe and complete.

Developing the case for a prescribed burn depends in part on the accumulation of data about a particular habitat and the ways it responds to firing. Thus, such protocols represent an application of generalizations about interactions between plants, soils, fires and weather, information that is accumulated in scientific study of field-sites. The working of field-sites is the other important ingredient in devising strategies for scientific land management. I go on now briefly to present a scientist's account of how such generalization proceeds, by recounting sections of an instructional video.

The Workings of a Field-Site

I borrowed the video, *A Burning Issue: Management of Vegetation Using Fire*,[12] from the University of Melbourne library. The video begins with the voice of an unseen narrator: 'Fire plays an important role in determining the sort of vegetation that grows in a particular area. [In] Australia ... bush-fires are a frequent, and often disastrous event'. Images of bushes in flames and fire-fighters playing hoses on a burning tree. A few frames on, we meet our narrator: a young, pleasant-looking woman addresses us in a mild manner. Dr Robyn Adams is wearing a dull-green woolly sweater and khaki trousers. She continues her account of the ecological notion of habitat and the rôle of fire in an Australian bush habitat.

> Since the arrival of Europeans, the landscape has been dramatically altered, much of the bush has been cleared for agriculture and many people now live in rural and urban fringe areas where bush land and farmland meet.

She suggests that the maintenance of natural areas in national parks is significant, and part of this naturalness is fire.

> Australian bush has burned periodically over thousands of years, in fires probably started by lightning strikes. During this time plant species developed ways of coping with fire so that when they were burnt the species were not wiped out for ever. ... Fire is well recognized as a major ecological factor in many habitats, and the change in the frequency, the size and intensity of fires [an effect of contemporary land usage] has created a number of problems for the people responsible for the management of parks and reserves ... Because many of the vegetation types within parks would naturally have burned, rangers in National Parks must develop a programme which approximates the natural burning cycle and regenerates areas of aging bush.

The first example of using fire in habitat management that we are shown is the use of small, highly-controlled fires: 'Some areas are burnt to help reduce fuel levels. For this sort of management, the amount of fuel can be measured and the area burnt when it reaches a predetermined level. [Usually areas are burned to keep] fuel below 15 tonnes per hectare, or 1.5 Kg/square metre'. We see images of men carrying and placing a quadrat, plucking all the surface vegetation into a black plastic garbage bag.

> ... However using fire to manage the age and health of a vegetation type is more difficult. Before a programme can be developed, the rangers need to know exactly what plants are present in the area, their flowering and germination requirements, how long they usually live for, and the number of different plant species changes over time. ... To determine exactly what sort of vegetation they are dealing with, and to help predict what is likely to happen if the area is burnt, a small sample area is often investigated first – a field-site is established.

Accompanying this spoken information, we see a metre-square quadrat frame being hammered into place with sturdy tent pegs. Six scientists bend over it, and we catch phrases of their conversation. One stands filling a chart pinned on to a clip-board. 'That's that tussocky grassy, yes, but it's not a different species, it's the same'; 'That's 8 species of ...'; 'Is that 12 species altogether?'

Our narrator's voice returns:

> The plants in the area are sampled by using a number of small quadrats. The quadrat is marked with a tag so that it can be relocated [located again] after the area is burnt and all the plants present in the quadrat are recorded and plotted on a map. This allows individual plants to be relocated [located again] to see how they have responded to burning.

We see long rulers being placed over the quadrat, and again see scientists bending over it, snatches of their conversation seem to float up through caroling magpies. 'Underneath all this grass some of these are older plants ...'; 'But you've got an increase – see this sort of thing here'. Scientists are literally crawling along the ground identifying each type of plant in the grassy cover. Their fingers are gently and tenderly teasing out herbaceous seedlings to measure their height. 'We only had five things before it was burnt so that one's extra'; 'Does that look different? Or is that the same thing?' [13]

Back to our narrator: 'Re-sampling the quadrats will continue for many years so that plants' response to fire can be followed'. We are now watching a ranger hammer a steel post with a ledge welded on to it; we see that it is firmly wedged into the soil. The narrator tells us that:

> Changes in the vegetation over the years can also be recorded using photographs. A fixed photo-point is established so that exactly the same area is photographed at regular intervals after the fire.

Images of a scientist squinting through a camera fixed on top of the pole are juxtaposed with images of the bush-land scene at which the camera points taken across an unspecified time period. Scientists collect data and often develop a model to reveal general characteristics of the habitat, and yet:

> Even armed with all these data it is not easy to predict the outcome of any particular burning programme. The events occurring in an area after it is burnt have a great deal of influence on the new vegetation: temperatures ... not enough rain ... too much rain. ... Competition for water ...

> soil nutrients ... and living space. ... Seedlings are engaged in a struggle for resources. To account for these factors a [burning] programme may be developed whereby [just] part of an area is burnt at one time, leaving a mosaic ... Burning for habitat management aims to maintain high plant and animal diversity. ... The wise use of fire requires the careful collection and interpretation of data. With this preparation we will be well placed to develop a programme of burning which will maintain the quality and species diversity of our parks and reserves, and which will allow us to preserve both plant and animal habitat.

Differences between '*Worrk*' and 'Prescribed Burn' as Shown and Justified by Aborigines and Scientists

In this section, I make a particular sort of summing-up of the two previous sections, the long story sections of my paper. I restate what the scientists and the Aborigines showed and told about their land management fires, and how they might be justified as worthwhile. In my summing-up, I aim to highlight the generalizations scientists and Aborigines make, and how they justify them by reference to metaphysical frames – very different frames! I am translating both scientists and Aborigines here in offering, on their behalf, what might be understood as 'ultimate' explanations of why they do what they do. It is likely that neither scientists nor Aborigines have ever justified what they do in the terms I use here. Practitioners of a knowledge tradition very rarely need to justify what they do in metaphysical terms. Struggling to learn about the other's firing regimes is one such occasion where it is appropriate. I claim this is the sort of thing scientists and Yolngu Aborigines would need to say if they were ever to fully justify their firing regimes. In making that claim I am also saying something about postcolonial moments and how they might be nurtured.

The paragraphs below are general descriptions of prescribed burning and *worrk*. They articulate something that was not fully articulated in the extremely polite and well-intentioned atmosphere of the *worrk* workshop. They acknowledge that *worrk* and prescribed burning are profoundly different. As disparate regimes of generalizing, they are incommensurable. Here I reveal the contrasting metaphysical framings by which the forms of generalizing are justified. I am pointing to the epistemic significance of the actions and justifying statements of the scientists and the Aborigines managing firing episodes. The stories I have just told should be understood as my evidence of the workings of the alternative generalizing regimes I characterize here. That is why, in crafting my stories, I focussed on what I took to be epistemically significant incidents. Of course, 'revealing' the two regimes of generalizing as I do here begs questions about my generalizing about generalizing. I am putting off considering that until the final section of my paper.

Scientific forms of generalizing: In accounting for how scientists tell of protocols and field-sites, I sought to show how scientists do (perform) justified generalization. A prescribed burn works an ecosystem that necessarily has particular qualities or properties. An ecosystem is an integrated

area of land-matter set in space and time. It has singular biophysical properties which interact in complicated ways. Scientists establish these properties by measuring and counting many variables. The properties of the ecosystem are generalizations. Their interactions are complicated and dynamic, and can be represented in a model, a formal representation of the habitat.

The properties of habitats are real, abstract entities. It is the work of environmental science to reveal these. Properties of an ecosystem are immanent in land areas and transcend them, linking distinct areas across time and space. Properties, like the ecosystems that exhibit them, are reality: abstract structures inherent in the biological world. The various properties of ecosystems can explain how many habitats are like one another. Generalizing allows scientists to establish a formal relation where one abstract, real entity – a property – can stand in for, and represent, many actual land areas. A good prescribed burn tries to balance out the properties of the ecosystem, so that each property is recognized and credited as its singular self, while paying attention to the spacetime boundaries.

Yolngu Aboriginal forms of generalizing: Recounting the *worrk* workshop, I paid special attention to incidents I felt highlighted Yolngu forms of generalizing. In part, I did this by detailing the scientists' disconcertments. *Worrk* mobilizes *wänga*, what we might call in English 'people-places' or 'clans-lands'. Yolngu reality has people and place as one entity. *Wänga* express and embed immanent relationalities; they are 'people-places' with inherent vector-like qualities shown, say, in the movements of clouds. In the story I told here, the *wänga*(s) were named as the *yothu–yindi* or 'child–mother relationality'.

All *wänga* have such specifiable reciprocal connections. These relationalities are real, like the *wänga* they engender, by virtue of being established in The Dreaming – a domain that justifies and grounds Yolngu explanation, and for which there is no analogy in Western metaphysics. The Dreaming is *a priori* and separate from the secular here-and-now of doing *worrk*. Relationalities like *yothu–yindi* are both immanent and transcendent. They are generalizations – real and abstract. In the logic of Yolngu generalizing, there are 34 specifiable types of relations. Each one of these can stand in for the relations between many pairs of actual places. A good *worrk* primarily pays attention to relationalities, so that the collective act is a true expression of the *wänga's* Dreaming vectors.

When I summarize using metaphysical terms, something becomes obvious that was, carefully, not being said before, either during the workshop, or in my telling of it. A *worrk* justifiable within Yolngu knowledge traditions is profoundly, perhaps absolutely, different to a prescribed burn which scientists accept as proper. A *worrk* cannot be justified in terms which credit a prescribed burn, and a prescribed burn cannot stand in for a *worrk*. The metaphysics by which a *worrk* is justified are incommensurable with the metaphysics of a prescribed burn. Respecting the terms in

which scientists and Aborigines perform and justify their forms of generalizing, we see how *worrk* and prescribed burn are epistemically different. In nurturing a postcolonial moment it is important to recognize that, and it is important to be explicit that metaphysics is the basis of the difference.

Elaborating a Postcolonial Moment?

In the late 1990s in Australia's Northeast Arnhem Land, some Yolngu Aborigines and environmental scientists set out in good faith to learn to work with each other in burning the land. Does recognition of profound difference mean that their project is hopeless? My contention is that recognizing such difference is an important step in realizing a postcolonial moment. Now, in continuing to tease out that moment, I need to work out a way to tell how *worrk* and prescribed burning are the same. In doing that, I start from the principle that there are important moral, political, social and religious reasons to respect these epistemic differences. I must eschew an account of sameness that denies those differences. Much depends on those differences remaining strong.

Rather than dissolve difference, a useful sameness will strengthen separations. This means opting for a modest symmetry. Environmental scientists of the tropical savannas and Yolngu Aborigines need a way of reconciling prescribed burning and *worrk* that is robust enough to hold when and where it needs to hold. I need to find an analogy that is robust enough for limited purposes. I am not in the business of giving an explanation of how *worrk* and prescribed burn are the same, in a way that will hold (or rather can be made to hold) for all times and places. Rather than that sort of 'meta-sameness', what we need here might be called an 'infra-sameness', a sameness that is good enough merely for a few here-and-nows.

The need to argue for this sameness in addition to arguing for the difference I have just established, is one reason my stories about scientists and Aborigines going about their burning work must be so long and detailed. Those stories are evidence for two contradictory claims. *Wörrk* and prescribed burning are utterly (absolutely?) different. *Wörrk* and prescribed burning are really the same.

Developing what I propose as a useful symmetry, one which allows epistemic asymmetries to stand, I go on now to show that *worrk* and prescribed burn are equally expressions of collective memory which embed possibilities for evaluation. I claim that establishing this analogy achieves enough reconciliation to enable the project the Aborigines and scientists are struggling for to hold together and to 'pay-off' for both. This analogy, expanding empathy by enabling scientists and Aborigines to see in a new way that and how their firing strategies are really the same while being profoundly different, continues the torque of the postcolonial moment which began in acceptance of incommensurable difference. But, the analogy which sees both *worrk* and prescribed burning as collective memory will challenge members of both knowledge communities. In part, this

challenge lies in the fact that telling *worrk* and prescribed burning as the same in this way employs an alternative sort of generalizing. For knowledge practitioners, perhaps the most significant element of this alternative generalizing is its politics. The distinctness of its politics reveals something that perhaps neither scientists nor Aborigines were previously aware of: the politics implicit in their orthodox forms of generalizing.

Prescribed Burning Expresses Collective Memory which Embeds Evaluative Witness

I begin my modest reconciliation of *worrk* and prescribed burn by reviewing Dr Robyn Adams's account of doing a field-site, this time keeping my eyes firmly on the actual embodied activities, rather than highlighting the epistemically significant elements. The account of field-site work I give is probably familiar to many readers. Almost anyone who has studied some biology has experience of carrying out such detailed and painstaking routines. Through those routines living organisms are rendered as written texts, scientific reports. Training and bodily discipline are needed. In part it is the bodily experience of certainty associated with such practices that underlies the trust and comfort that many feel about the protocols for firing developed from such work.[14]

Science tells the work as 'accumulating information'. Scientists assemble observations and classifications, measurements and counts, into tables and graphs. They write up their 'methods' and discuss their 'results' in articulating a 'conclusion'. We can see that they are investing text as place – it might be titled 'The Floral Diversity of [Place Name] and the Effects of Fire'. The scientific report is a way of having a large number of scientists and land managers, who have never been to that place, perhaps never even heard of it, witness the outcome of the collective act of burning. Over a number of years, we can imagine that a series of such reports might be published. These reports not only allow a vast increase in the number of witnesses, they also allow evaluation by setting one text against another. The field-site and its associated protocols work as what I term a 'micro-world'.[15]

To generate those texts, scientists will return again and again to the square framed by the metal bars of the quadrat hammered into the ground. Using disciplined eyes and hands, they will count and classify, measure and assess the plants bounded by the labelled grid. They will do this many times. They will take photographs with cameras attached to the ledge on the embedded steel pole, and perhaps some of these will be included in some of the reports. A series of material practices and textual practices will be carried out. Such scientists have been trained to be assiduous – the routines have become second nature to them. On each repetition, the practices will be carried out in more or less the same way. There is a ritual-like quality to the work. Bruno Latour has been drawing our attention to this for over 20 years now:

> All sciences are defined first of all by the sort of elements they extract from the settings, and then mobilize, accumulate, combine and display: fossils, stuffed animals, photographs, trophies, questionnaires; everything which one way and another solves the problem of action at a distance, fills the gap, through the production of information. [Latour (1988): 159]

The move to see the working of field-sites and their associated management protocols as the working of collective memory and evaluative witness is to see them working as a 'micro-world': a specifically configured time-place specified through ritualized routines of acting. A micro-world features forms of interrogation, naming and tracking [Rouse (1987): 206].

One of the most significant figures in the working of the micro-world of the prescribed burn is that of linear, branching family relations. This figure, which took on a new life as Linnaeus made his way around the 18th-century Uppsala botanical gardens and Darwinian notions of evolution developed, is embedded in the 'keys' by which scientists classify the plants they so tenderly expose, as they feel their way across the tiny squares of bush contained within their permanently-sited quadrats. This linear, branching tree-like figure of 'botanical family', is taken by science as an ideal, immanent in the biological world, a found structure or pattern of the biological world. Here I am *not* seeing it in that way. I am leaving behind its epistemic significance. Agnostically, I take it to be a tool, a figure scientists use as an ordering device.

It is important to recognize that I am here using the terms 'collective memory' and 'evaluative witness' in an arcane, even technical way. They are everyday expressions, but I am investing far more in these phrases than a vague sense of doing something together and asking how good it was. Drawing on emerging shared understandings of science studies practitioners, 'collective' here picks up on the way John Law, Michel Callon and Bruno Latour used the term in launching actor-network theory.[16] Combining the term with 'memory', I allude to the work of those theorists who seek new ways to talk about bodies in place.[17] Both moves refuse *a priori* separations between human and non-human, living and non-living. The implication of my use of the phrase 'collective memory' is that ecosystems and the environmental science knowledge community together emerge as outcomes. Separation of 'knowledge', 'community' and 'place' is an outcome of the dedicated and extraordinary work of people-in-place doing the routines known, say, as 'doing field biology'. Similarly, 'evaluative witness' calls on strong and particular allusions: the Foucauldian insights on the generation of normativity, as well as specific accounts of how 'social, material and literary technologies' effect possibilities for a seemingly global evaluation.[18]

Reconciling 'Prescribed Burn' and '*Worrk*' as Equally Expressing Collective Memory Embedding Evaluative Witness

I return now to the *worrk* staging at Wathawuy. Just as I took the scientists I saw in the video as disciplined-bodies-in-place, so too I see the Yolngu

Aboriginal hosts of the workshop I described as, in their own way, 'disciplined-bodies-in-place'. They light fires in one place and then travel to another to light more fires. They collect yams from nearby patches of rainforest, and clams from mangrove flats that fringe the area. Importantly, they apportion the food, taking care to distribute specific amounts to certain families (having also eaten some themselves as they did the work).

Focussing on the bodily practices in specific times and places, we recognize that Yolngu 'disciplined-bodies-in-place' are not disciplined to negotiate the tiny terrain bounded by a quadrat frame, nor are Yolngu places marked with such frames. Disciplined Yolngu bodies dig up yams and clams and possibly kill kangaroos. Places for Yolngu are marked as names expressed and linked within a corpus of story, song, dance and graphic design. Shared experience of performance of these texts matches up with the small undulations and features noticeable when people are in-place. As the Yolngu Aborigines have things, the texts are the places in a different form. Welded together through familiar figuring, the routine doings, including the doing of story, make up Yolngu place. In contrast to science, where collective memory is mobilized as written texts often with tables and graphs, amongst the Yolngu community collective memory is experience of narrative, song, dance and design.

As witness to their being 'disciplined-bodies-in-place', those who carry out *worrk* distribute clams and yams in particular portions to those others who have formal interests in the places concerned, but who were absent. To receive the foodstuffs distributed is to witness the *worrk*. In contrast to science, where there is a dedicated concern to generate and distribute prolix written texts as evidence, in *worrk* there is an equally dedicated concern to collect and distribute specific foodstuffs as evidence.

Labelling both *worrk* and prescribed burning as 'ritual' recognizes the fact that, in an important way, each *worrk* is like every other, and that each prescribed burn episode has a significant similarity to all prescribed burn episodes. A complicated series of embodied actions in place must be carried out 'just so' for a *worrk* or a prescribed burn to be considered as such. In structuring the performance of those actions, much of the complexity around both people and place is excluded. In *worrk*, various clan disputes and disagreements are left aside. In environmental science, theoretical disagreements between scientists are left back in offices and conference rooms.

The ways *worrk* episodes work can be seen as having some parallels to the ways field-sites and their associated protocols for prescribed burns work. Different figuring features in these parallel micro-worlds, but equally they deal with and manage complexity of people-place. They manage on-going human/non-human associations in purposeful ways. In *worrk*, a recursive figuring of reciprocal family relations – as *gurrutu* – dominates. This is not a stretching linear, branching family tree of the biological sciences, but a recursive matrix of reciprocal family relations that folds back on itself, implying continual 'reincarnation' of a given set of Yolngu agents – human and non-human. This figuring is an alternative way of

managing what we might call the 'enduringness' (the time element) that is implicit in collective memory. No doubt offending Yolngu sensibilities here, I take it as just an ordering tool – a particular sort of configuration. I am leaving aside almost all the precious meanings it has.

Both *worrk* and prescribed burning emerge from micro-worlds that are equally specific, materially and socially arranged times/places where rituals, repeat routine performances, occur. The differing micro-worlds can be seen as alternative specific technologies of collective memory and evaluative witness. In micro-worlds, irrelevant complexity is temporarily excluded, and on-going collective life becomes rather simple. People know what they are doing now and what they will do next, and how they will tell if they did things well.

As rituals, *worrk* and prescribed burning equally bring to a head some tensions about managing complexity. In *worrk*, questions like: 'Where will the *worrk* be?', 'Who will be there?', 'When will it be?', are answered as a ritual which resolves tensions in collecting particular foods from specific places and distributing them in appropriate ratio. In prescribed burning, similar sorts of tensions are resolved in acting out established protocols. In both instances, a fire emerges from a simplified micro-world.

To render the working of field-sites and protocols of prescribed burning and *worrk* as equally amounting to expressions of collective memory and evaluative witness might seem utterly perverse to many scientists and many Yolngu knowledge practitioners. The move brackets off explanations of why they do what they do, and such justification is equally important on both sides. My intention is not to suggest that the alternative grounding explanations as might be given by both sides are inadequate, or that they are unimportant. It is precisely because 'the why' is so important that I set it aside here. Scientists and Aborigines in their distinct forms of generalizing necessarily mobilize specific and definitive metaphysics in referring to immanent ideals. As the basis for claim and counter-claim to cognitive authority within knowledge traditions, it needs to be set aside here. Reconciliation here must allow for metaphysical difference to be respected, while shared embodied and embedded concerns of specific times and places can come to be taken for granted grounds for respectfully going on together. This implies moving to a translating or borderlands framing of 'what we are doing here'. This frame is no more free of metaphysics than any other, but it is both minimalist – entailing notions of moving pasts into futures – and explicit about that framing.

Articulating Alternative Politics of Generalizing

As regimes of land management, 'prescribed burning' and 'doing *worrk*' must deal with the problems of bringing other times-places into 'this time-place where we light the fire'. Those who act need information about other times this place was burnt, and probably also about fires at other times in other places. Many people who have interests in the place being burned need information about how the burning was done. The time-place of the

firing needs to be 'brought to' times-places elsewhere-when. Other settings must be elided with the one in which a particular group of people go to a certain place at a specific time and set fire to it.

Lighting fires is dangerous. It always contains the possibility of fires getting out of hand, of management failing. The bringing in of information (forms of other times-places) is crucial. If the firing does damage, interested others want to know 'Who was irresponsible?'; 'Who can we blame for the devastation?' This being the case, those doing the firing have good reason for capturing something in the time-place they burn, and taking it away to show others that they had good intentions and took care in what they did.

The disparate orthodox regimes of generalization in prescribed burning and in *worrk*, with their various ideals and abstract objects, equally allow those possibilities for shifting times-places. In Yolngu knowledge traditions, the textual forms *dhäwu*, *bunggul* and *manikay* (narrative, dance and song) transform physical features and undulations: hills, bogs and streams, movements of clouds across a day in a particular season, are incidents in stories, formations in dances and verses in songs. The formalism of *gurrutu* is a dynamic map of relations between various *wänga*. The presence of clan leaders at a *worrk* authorizes the interpretations of the information. Similarly, scientists have spatial maps, models of the properties of ecosystems, and have elaborate ways of crediting knowledge authorities. In both cases, these transportable forms of other times-places – information or generalizations about them – are profoundly enabled by the disparate metaphysically-framed forms of generalizing I elaborated earlier.

There are, of course, significant and interesting differences between and within the orthodox scientific and Yolngu regimes of generalizing. These differences relate to the sorts of figures that predominate in formalizing processes. The difference, say, between '*gurrutu*', a recursively figured form of family relations, and 'family tree', a linear form of family relations, is significant in several ways. Some of that difference is evidenced in my story of the *worrk* workshop, but I am not pursuing that here.

When you do generalizing in orthodox ways – emphasizing the forms you have within you – you know the information is available and you know who has it. Orthodoxies do generalizing in ways that emphasize it as producing 'known-aboutness' through relating cause and effect, and identifying who can and should know the lines of accountability. And these are not bad things. When you are lighting fires and struggling to manage them, or trusting others to light and manage fires on your behalf, knowing that you/they know about the place in a cause-and-effect way, and knowing that you know who they are, and/or that they know you know who they are, are important and useful.

Recognizing that all knowledge communities need a way of doing generalizing which deals in 'information' – clean and accountable cause-and-effect knowledge – does not imply, however, that that is the only way of doing generalizing. And it does not mean that 'information generating

generalizing' is a politically and morally neutral way of doing generalizing. There are other ways of doing generalizing, and they shift other times-places in different ways, emphasizing other things, having an alternative political and moral character. Before I consider those other ways, however, I want to stay with orthodox forms a little longer. What are the political and moral characteristics of 'information generating generalizing'?

Doing generalizing to emphasize known-aboutness and accountability has these effects. It tends to obliterate, delete and hide actualities of other times-places – pasts and foreign lands alike. It empowers the participants of the setting to which the cleaned-up forms (information) are transferred, while disempowering those in other times and places. And while the appearance of accountability is maintained, because traces of connection are obliterated, blaming involves a scapegoat rather than a perpetrator.

So what is another way of doing generalizing? I have tried to exemplify it in this paper. I have struggled here to show a different sort of generalizing as I generalized about generalizing, one that embeds a different sort of politics. This generalizing shows the work of translation that is being done, *as* it is carried out. It makes obvious who is doing what to whom and where and when they are doing it. It shows up the ways other times-places feature in the here-and-now. It refuses to delete the 'how' in the known-about. In my recent book, *Science and an African Logic* [Verran (2001): 51–122, 123–75, 177–238], I showed these contrasting ways of doing generalizing three times, as I struggled to come to terms with the political and moral consequences of my relativist study of numbers in science and in Yoruba (West African) life. It is a different way of solving the problem of bringing 'then-theres' into 'here-nows'. It makes a virtue of the separation, acknowledging, even boasting, about the translations involved in the transfer and display.

The work of putting together this paper has proceeded over many years. I had first to do the work of getting suitable elements from various settings – attending the *worrk* workshop, following scientists and Aborigines around, listening and watching. Translating my experiences by crafting words into stories took many hours. The elements of scientists' work came more easily, from the University library, but I still had to find ways to translate appropriate bits in ways that stayed true to the scientists whose texts I translated. I transferred bits from many times-places into the text, accumulating, combining and displaying, while at the same time taking care to show the seams by which they are held together. I had to conjure up an author-in-the-text, and remain confident in the face of criticisms from referees that my stories are too long and of dubious value.

This is the sort of generalizing I have scientists and Aborigines doing when I characterize what they did in firing as collective memory embedding evaluative witness. I have scientists and Aborigines abandoning cause-and-effect stories and credible explanations of why they did this or that. Instead, I show them collecting various elements and translating, accumulating and displaying in various ways – through tables of results, scientific

papers; through telling bits of Dreamtime narratives, and foraging expeditions.

However, this story about what they do might have some scientists and Aborigines feeling stripped of their rationality, authority and agency. Perhaps they would not be comfortable with understanding themselves as 'merely' doing collective memory understood as a form of ritual. So why do this alternative, messy, perhaps heretical, form of generalizing? Why insist that other knowledge practitioners are also doing it, sometimes (often?) irritating them by that insistence? The short answer is that it adds a necessary antidote to orthodox forms of generalizing. It reveals the hiding and deletion. Being messy and seamy, it acknowledges the actualities of other times and places, and makes the generalizer's accumulation of power more evident – and, for that reason, less certain. It also has the capacity to make good the promise of accountability contained in orthodox forms of generalizing. When the links of translations are made clear, as they are in this alternative form of generalizing, the issue of who is responsible can be plotted out.

Accepting Alternative Regimes of Generalizing 'Pays off'

I have taken a particular move by some Aborigines and scientists as occasion for theorizing difference and sameness in the workings of their knowledge communities. In most places in Australia, relations between these two knowledge communities are stuck fast in power relations set rock hard in 200 years of often violent British colonizing, in which the intellectual ancestors of today's environmental scientists were at the forefront. How could the stories of difference and sameness I tell here, and understand as a postcolonial moment, interrupt, work to redistribute authority, and transform contexts where power is exercised?

A postcolonial moment offers ways to exit the relativist game of pitting one definitive metaphysics against another. Instead, it points to possibilities for trust in a common sense of embodied certainty in practice. I claim that this can develop through practitioners becoming familiar with the forms of others' figures: recursive or linear ways of configuring family, though I do not pursue that claim here. Learning to 'do' the other's figures is, among other things, good fun.

Focussing on ordered/ordering practices as bringing pasts into futures, I have been able to point to analogous broad strategies that attend and evidence prescribed burning and *worrk* as episodes of firing. We can accept that, equally, they would create lands as productive; help prevent wildfires; and produce a satisfying woodland aesthetic. I have elaborated a frame in which reconciliation is feasible, while difference is respected. This would suffice for reconciliation over practices of burning wide sweeps of land. Yet both Yolngu landowners and scientists must deal also with specific small areas that need to be maintained as free of fire. We could call these 'heritage areas'. For Yolngu Aborigines, indeed for all Aboriginal Australian cultures, there are specific, usually rather small areas that should never be

fired – 'sacred sites'. The exact whereabouts of these is known only to a very few members of the 'cleric class' of each clan. Part of the necessary evidence Yolngu clan members must provide is to witness the avoidance of firing these sites. Collected foodstuffs show where the groups doing *worrk* were and, by implication, where they were not. Ensuring that firing is under the control of a clan elder, who sets fires appropriately, and avoids compromising 'sacred sites' either with fire or inappropriate revelation, is another way to evidence good practice.

Science's heritage sites are likely to be sites of past or present habitation, and, increasingly, known populations of rare fire-sensitive organisms. Scientists too have means for both avoiding firing such sites and evidencing that avoidance, as we saw in the elaborated protocols. The point is that in both 'technologies of collective memory', there are established strategies by which fire can be excluded from specific small areas. From a practical point of view, recognizing that the other has an efficacious working technology of collective memory can lead to mutual respect. Within a climate of mutual trust, more specific, and utterly local, questions can more easily be negotiated. Among these will be questions of how scientists and Aborigines are to handle the need for absolute secrecy over sacred sites, and how to handle information about fire-sensitive endangered species populations, so that long-term exclusion from firing might be achieved for those areas.

We can recognize that this posited sameness between *worrk* and prescribed burning bears also on the theoretical puzzles that some ecologists hoped to attend to by participating in the *worrk* workshop. Some scientists sought inspiration from Aboriginal theories. Recognizing that theories on both sides are embedded in metaphysics, this move, which brackets off both definitive metaphysical schemes, makes it seem that participation at such a workshop as this can be of no help here. In my opinion, that would tell the benefits of participation too narrowly. Following through the difficulties raised by metaphysical commitments can be of help to scientists who are struggling over paradigms in environmental science. Their problems there are metaphysical, and becoming familiar with the forms of such problems could be an outcome of authentic engagement in a *worrk* workshop, and could be of real benefit to scientists. Such questions have been systematically deleted in their training. Scientists might find, for example, that setting their puzzles within a less definitive metaphysical framing can help. Opting for a framing that sets pasts against futures, and sees routine sets of collective acts as the significant unit, might well be fruitful as a way of re-conceiving ecology, and other sciences that study the ordering of complexity.

Notes

I am grateful to members of the *Ngaymil* clan for introducing me to their country, and to all participants in the 1996 Wathawuy *Worrk* Workshop. The Dhimurru Land Management Aboriginal Corporation and the Garma Cultural Studies Institute provide an institutional location for my work, and make a significant contribution to it. I presented earlier versions

of this paper in the History of Consciousness Program, University of California, Santa Cruz, in 1998; the Postcolonial Institute, Melbourne, in 1999; the Social Theory Program Seminars, Department of History & Philosophy of Science, University of Melbourne, in 2000; and a Workshop sponsored by the University of California Humanities Research Center, in 2001. In each case, I gained important insights from the responses of my audience.

1. This way of understanding the term 'postcolonial moment' links up with Hall's observation that the term postcolonial points to 'a notion of a shift or a transition conceptualised as a reconfiguration of a field, rather than as a movement of a linear transcendence between two mutually exclusive states. Such transformations are not only not completed but they can not be best captured within a paradigm which assumes that all major historical shifts are driven by a necessitarian logic towards a teleological end' [Hall (1996): 254].
2. For an account of another of these workshops, see Verran (2002). These hybrid workshops were invented by a group of Yolngu teachers and teacher-educators as part of an innovative school curriculum in this Aboriginal community in the late 1980s: see Marika-Munggiritj (1990).
3. The Dhimurru Land Management Aboriginal Corporation is established through a board comprised of clan elders, and set up according to protocols of Yolngu governance (see *http://www.octa4.net.au/dhimurr*). Dhimurru employs several Yolngu men as rangers and an environmental scientist as administrative officer. At the time of the workshop, several employees of the Northern Territory Parks and Wildlife Commission were located at Dhimurru: see Ayre (2002).
4. The Garma Cultural Studies Institute was established in 1994 by the Yothu Yindi Foundation, which in turn grew from an internationally famous rock band, *Yothu Yindi*. The Foundation grew from the success of the band, in that the band established an Education Foundation (legally, a charitable organization) with its profits. This was a way of promoting community development, and of recognizing the collective nature of the intellectual property rights that either directly constitutes their music, or inspired it. The Institute aims to become an accredited provider of tertiary level instruction in Yolngu philosophies within the Australian academy. With the Yothu Yindi Foundation, it stages the annual Garma Festival at Gulkula in Northeast Arnhem Land. In 2002, the forum focus is Indigenous Environmental Knowledge. The Institute acts as a broker in many educational and research activities in the region (see *http://www.garma.telstra.com/index.htm*).
5. This goes back to the original invention of ecology in the 1950s by the Odum brothers [Odum (1971)], but the 'naïve' paradigm is restated in a recent textbook [Ricklefs (1990)].
6. This recently developing strand in ecological theory, which abandons notions of a single, natural climax, has become necessary 'with the increasing recognition that natural disturbances are a feature of most environments. Whether originating in animal, wind or fire effects, they keep the ecosystem from ever reaching a stable equilibrium in any place. Instead, ecosystems come to be imaged as a patchwork or mosaic or ages of recovery from localised disturbances' [Fairhead et al. (1996): 281]. This controversy has recently been usefully summarized [Baker (2000)].
7. The existence of the mine, and the fact that the Yolngu Aboriginal clans now have freehold title to their clan lands under the 1976 NT Land Rights Legislation, are consequentially linked [Williams (1986)]. The fact that they have undisputed ownership of their lands is what enables the Yolngu clans to continue their traditions of land management, and generously invite scientists to witness episodes of that management.
8. Reserved lands in Australia are generally National Parks, or State Parks. Mobilizing the IUCN definition that indigenous resource use and customary land management contribute to biodiversity conservation, the Australian Government opted to meet some of its IUCN treaty obligations through an Indigenous Protected Area (IPA) scheme.
9. The Garma Mathematics curriculum of Yirrkala Community School is elaborated in a series of four videos entitled *Living Maths*. These videos were produced by Merle

Thornton, and published in 1996 by Boulder Valley Films. The four-video set, and an accompanying book, are distributed by the Australian Film Institute, in Melbourne.

10. The Dhimurru website explains the Yolngu cosmos this way: 'The Yolngu (Aboriginal people of Northeast Arnhem Land, Australia) universe is divided into two halves or sections, called Yirritja and Dhuwa. This includes people, plants, animals, land ... everything': *http://www.octa4.net.au/dhimurr*
11. 'Balanda' is a term Yolngu use to refer to non-Aboriginal Australians. They identify it as a Macassan word, and claim it is a form of 'Hollander'. Yolngu developed extensive links with fishermen from the island of Macassar (now part of Indonesia) over the 18th and 19th centuries. The Australian Government intervened to stop contact early in the 20th century.
12. *A Burning Issue: Management of Vegetation Using Fire*, Producer/Director Francis Treacey, Research/Script by Robyn Adams and Peter Box (Geelong, Victoria: Department of Environmental Assessment and Land Use, Faculty of Applied Science, Deakin University, Burwood Campus, 1985). This video was produced for the Department of Environment Assessment and Land Use by the Course Development Centre, Deakin University: 'An account of how and why controlled "cool" burning can be used to maintain and develop the bush environment'. It is distributed by Video in Education Worldwide (Melbourne).
13. Claire Waterton describes being inducted into these routines and rituals [Waterton (2002): 183].
14. A similar sort of description of the functioning of a field-site, far richer in detail than the one I give here, is found in Latour (1995).
15. I am taking up 'micro-world' from Rouse (1987): 105, who names laboratories as 'micro-worlds', elaborating the notion as a Foucauldian site of interrogation, normalization and tracking. Rouse confines his use of micro-worlds to laboratories. I am extending it not only to include laboratory-like field-sites, but further, to the most banal and ordinary sites of getting on in collective life. My alternative account of generalizing [Verran (2001): 159–62] develops Rouse's notion further. My notion of 'evaluative witness' derives from Shapin & Schaffer (1985).
16. 'The collective' is a crucial analytic unit in actor-network theory. It is seen as the outcome of translations. See Callon, Law & Rip (1986), Callon (1986), Latour (1987) and Latour (1999).
17. I am drawing on a notion of memory which recognizes the ways habitual actions become sedimented in disciplined muscles: see Connerton (1989): 102, and O'Shaughnessy (1995).
18. Shapin & Schaffer (1985): 76–79, point to 'three technologies' – social, material and literary – as reconstituting the nature of assent in the emergence of the 'experimental life' in 17th-century England. They also constitute technologies of collective memory.

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