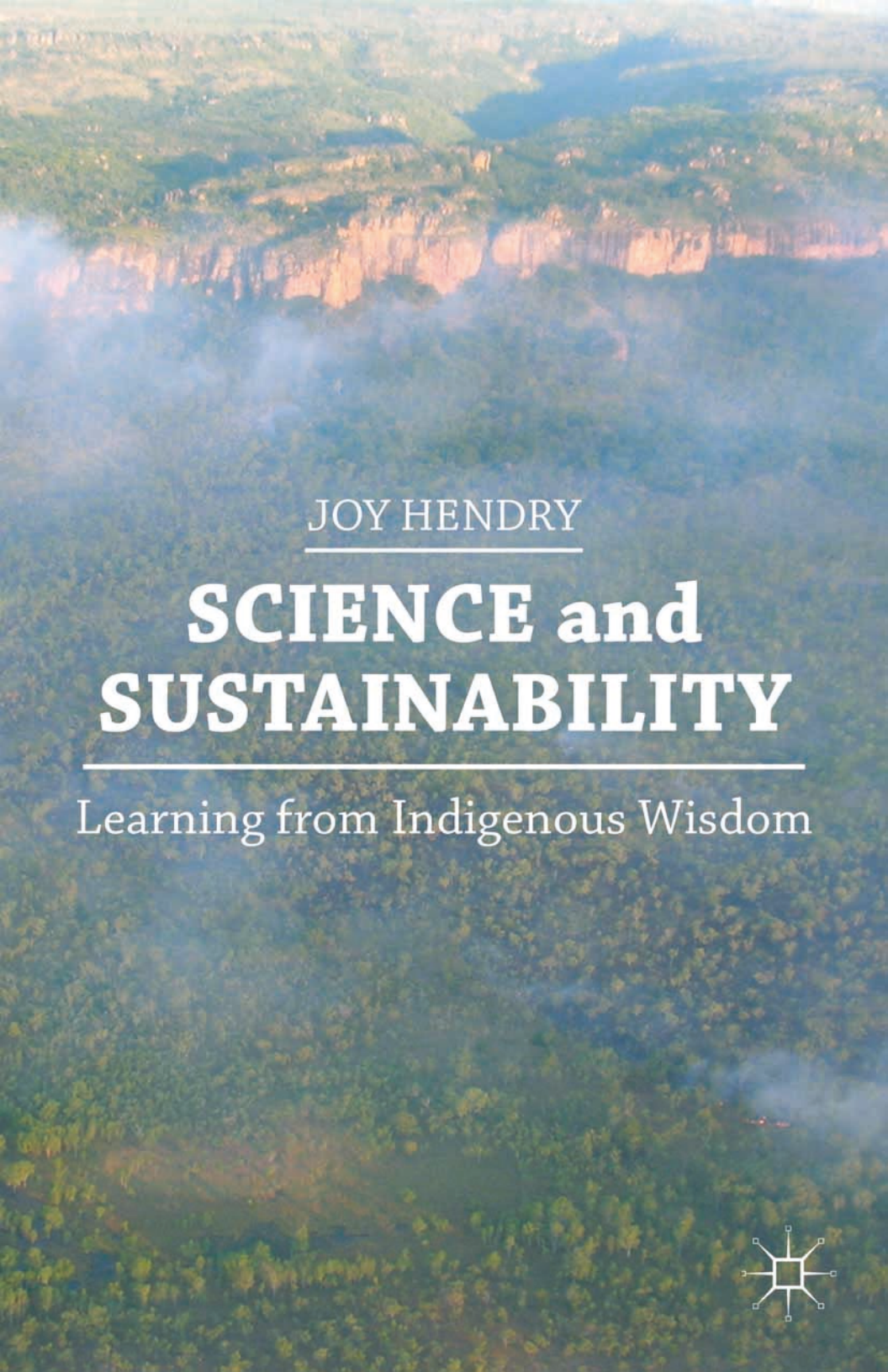
JOY HENDRY
SCIENCE and SUSTAINABILITY
Learning from Indigenous Wisdom

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Learning from Indigenous Wisdom

Joy Hendry

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SCIENCE AND SUSTAINABILITY

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In memory of my older brother, William Forbes Hendry, and his wife of 50 years, Chirsty Marie Macdonald, who appear in chapter 3. Bill had agreed to give me a medical scientist's view of the manuscript but sadly died suddenly just before I finished writing it.

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Prologue

Science and Sustainability

Can science ensure that elusive but popular notion we call "sustainability"? Can science sustain a world that also blames science for destroying it? Do we even really know what we are talking about when we use the word "science"? Or "sustainability," for that matter? In an influential essay entitled "We Have Never Been Modern," Bruno Latour suggested that we revisit some of the assumptions we make about the world we think of as enlightened and, therefore, modern, scientific, and different from that of our ancestors and other peoples we have yet to educate. "If Westerners had been content with trading and conquering, looting and dominating, they would not distinguish themselves radically from other trades people and conquerors," he wrote, "but no, they invented science, an activity totally distinct from conquest and trade, politics and morality" (La Tour 1993:97). And we, the Westerners, exported that science and taught it and tried to "enlighten" everyone.

As Marie Battiste, a First Nations scholar in Canada, has pointed out, "For as long as Europeans have sought to colonize Indigenous peoples, Indigenous knowledge has been understood as being in binary opposition to 'scientific', 'western', 'Eurocentric' or 'modern' knowledge" (Battiste 2005: 2). Was this division a mistake then? Can we learn something from this Indigenous knowledge? Is there some wisdom we could turn to there in order to find this elusive sustainability we now all seem to be seeking? Indigenous scholars have no doubt about this at all. In a special issue of the journal of the Pacific Peoples Partnership, *Tok Blong Pasifik*, guest editor Troy Hunter wrote as long as ten years ago, "It is time to recognize indigenous science because it is a cornerstone to sustainable living on this small planet we call earth." He reassures his readers that he does not

wish to discredit or devalue the scientific methods of Western civilization, he just wants to make sure that the value is also recognized of Indigenous science: "The time has come to share this planet and respect the peoples of the land who have spent thousands of years experimenting, testing and acquiring knowledge about the plants and environment around them" (Troy Hunter 2000: 1).

It is the aim of this book to demonstrate that it is indeed time to learn from the Indigenous wisdom that has been sidelined for so long.

Introduction

Science

Westerners invented science, according to Latour, but what do we mean when we use that term—*science*? We don't have to think very hard to remember that some of the things we call "science" came from the Middle East, from Babylon and ancient Egypt; others came from India, and yet others from ancient China. None of these places could be described as Western, so what can he mean? The term undoubtedly has different meanings for different people, depending partly on their own association with the field, but in the present day, in the part of the world described as the West, there is a popular idea that science is something to be relied upon. The subjects we describe as sciences—physics, chemistry, biology, and so forth—have rather recent histories, and they were established in Europe only a couple of centuries ago, so let us start by assuming that this explains his assertion.

The term *science* actually has various translations in the dictionary. A broad definition is that science is "a body of knowledge," but it is also described as something more rigorous: knowledge collected systematically, knowledge that can be tried, tested, and reproduced. Nothing I describe in this book will fall outside those definitions, but at this point I would like to ask you, the reader, to adopt a fairly broad definition as you follow my arguments and to try not to exclude too quickly things I might raise that don't immediately fit your twenty-first-century expectations. I also ask you to suspend judgment about two other more usual aspects of science. The first is the way it is recorded and passed on, and the second is about where and how it is collected and learned. And to put your mind at rest

about my own upbringing on this front, let me introduce you to a little of my journey in gathering material for the book.

Science, as we know it, was an important part of my school life. I found it interesting, relatively easy, and in keeping with the medical skills and training that my parents and older brother had received and that were therefore approved at home. It wasn't that I wanted to become a medic—quite frankly I didn't—but I was curious to know how the world worked, and studying science seemed to be the best way to find out. I pursued this aim throughout school and on into university, where I attended the required classes and labs and gained a degree. It was not a remarkable degree, and I admit that I was distracted by the life of the swinging sixties taking place around me in the center of London, but there was another reason for the mediocrity that characterized my final result: quite simply, I had lost interest.

It took me many years to work out why. At first I knew that there was more to this world than I had thought to understand through science, and I set about seeking others ways to find out. I didn't really know what I was looking for, and the next five years were spent living in a selection of foreign countries, learning languages that I had failed to acquire at school, teaching a little science but earning a major part of my living by doing some of the journalism I had picked up on as a writer for the university newspaper. One great job I managed to acquire was in Mexico, where I did some reporting of the activities of the British community; but more interestingly, I started writing features about the country. Wherever possible I volunteered for jobs that required travel and thus often found myself on an overnight train out of the city to wake in one of the diverse regions occupied by members of the complex combinations of people that have become known to the outside world as "Mexicans."

Some of that diversity was the focus of many of my articles, but the story I want to recount here is about a small incident that stuck in my mind, which I now think, though I didn't know it at the time, began to explain why I had become disenchanted with the study of science. The occasion was a visit to a town not actually that far from Mexico City, where I was walking around the local market observing the range of goods on sale. The story I was researching was about local specialties, and for some reason I didn't even follow

up this particular observation, but I noticed one or two salespeople sitting behind mats laid out with piles of colored powders and what looked like the dried leaves of various plants. I did ask the vendors what they were selling, and they began to explain the diseases and disabilities that their wares were said to rectify.

It seems extraordinarily naïve to think about it now, but I was at the time profoundly shocked to find that people in this apparently civilized country would pay money to buy the kinds of potions and powders that I had grown up to associate with quacks and charlatans. Did local people really believe in the efficacy of these things, I wondered. Did they not have access to "proper medicines"? My medical family had clearly had a strong influence on my thinking, and I had also been spoiled by being born and brought up in a society with a National Health Service, where attention to illness and injury could be acquired at no cost at all to the family or individual purse. To be sick was to seek "scientific" help from people who had submitted to long years of training, and to recover, one should take drugs that had been properly researched, tested, and packaged—certainly not laid out on a rug in a grubby open-air market.

Now I think very differently, and had I thought about things properly at the time, I might even then have noticed some chinks in this armor of scientific knowledge. For one thing, I suffered through quite a portion of my childhood from a variety of skin complaints—itchy dryness, chilblains, and the like—and it seemed that no one could find a cure. "I never was much good at skins," my Dad exclaimed brightly, and his colleagues in the profession did little better. A pot of green cream I bought recently in an Aboriginal health center in Alice Springs sorts out those and many other skin injuries and complaints with a speed that exceeds a regular antiseptic (for a cut, for example) by a couple of days! But no one around me took any notice of Indigenous cures in those days—indeed, even my own (Yorkshire) granny's suggestions were regarded with humor.

Then I had a winter of sinusitis, which kept me off school and refused to clear up until the spring. Antibiotics had been discovered, but I suspect they were not yet readily available, or perhaps it was at that time that my allergy to penicillin was discovered. Anyway my mother used her nursing skills to restore my health, and

our local GP was very attentive and prescribed tonics and medicines as best he could. His final piece of advice was completely to change the plans my parents had made for my future and eventually to offer another window into understanding my disenchantment with this thing called "science." "Send her to school by the sea!" he pronounced with vigor, and my parents, bless their hearts, took his advice and found an establishment within a few minutes' walk of the bracing North Wales coast. My sinus complaint cleared up completely for many years!

I am not sure whether medical training in those days included an element of attention to the environment in this way—the "fresh air" my tiny lungs were forced to inhale when I was put out in my pram as an October-born baby may well have caused some of the problems I still suffer with! It was of course the case that a variety of poets and even scientists, like Alexander Graham Bell, inventor of the telephone, were dispatched to places where it was thought that the climate might be of benefit to their ailing health. When my parents became older and visited me in the corner of Scotland I have adopted as a good spot for writing—with hills in the north and cheerfully running water in the east—they proclaimed it a place with good clean air and assured me that they had more energy when they visited. The place also apparently has good feng shui, by Chinese standards, and there is little pollution in the remains of the woolen mills that formed its main contribution to the Industrial Revolution.

It is also within easy access to the area where my father grew up, however, and to the place where my parents met and fell in love. My parents are buried near there now, along with some more of my forebears, and when recently I was studying the language and culture of the Māori people in New Zealand (or Aotearoa, as they call it), I discovered that they feel rather strongly that good health is also related to family connections, as I will explain in more detail in chapter 3. A self-introduction in Māori expects the provision of not only a name, but also a series of links with a mountain, a river, and one's ancestral heritage, and I chose this spot for my case. Māori people also make reference to the boat that brought them to Aotearoa, but sadly this is not something that my probably Viking heritage has passed on down to me. Still, my father always

did relish visits back to his homeland, good air or otherwise, and I was able quite easily to recognize this Māori conviction.

At university, I studied General Science, and in the second year, when it was necessary to make a choice of two fields in which to specialize, I picked physics, a rather "hard science," as it was called, and astronomy, which gave me a chance to discover what was at the time known about environments way beyond the climate of the earth. Now, looking back, the parts of my degree that stick in my mind are the stories associated with the often rather intrepid characters who made important discoveries in those fields: Newton and the colors of the rainbow, Galileo and his problems with the established church, and Ulugh Beg, an astronomer in central Asia (now Uzbekistan) who ran into trouble with the Mullahs of his faith for his "scientific" research. And who can forget the eureka moment said to have been experienced by the Greek scientist and mathematician Archimedes, in his bath, when he worked out that measuring the water displaced by parts of his body would be an accurate record of their volume—and that of any other solid object?

In my case, then, I discovered that I was more interested in the lives of the scientists and the societies in which they lived and worked than in the details of their findings. During the years that followed my graduation, I discovered the subject of anthropology, which has absorbed me ever since. It has taken me back to Mexico and for many years to Japan but more recently to visit and spend time with a range of Indigenous peoples who have encouraged me to think again about science. It was not science itself with which I became disillusioned, I have now decided—science is still a very interesting field for me—but there is so much more to it than I gathered as a young student. This is also a time when the world at large is beginning to realize that Indigenous peoples have a rather good understanding of living sustainably with the earth we occupy. In this book, then, I am going to set out to share with you some of the things I have learned and how valuable they might still be. These are not new things—many are very ancient—but I hope to convince you of some new and exciting ways to think about them. The next section is where I ask you to suspend judgment about how science is recorded.

STORIES, ART, AND PERFORMANCE

The conventional way to record scientific discoveries and to update them as they are refined is to write them down. Books and articles have been published since the invention of the printing press, and more recently, findings are reported and explained in a variety of cybernetworks. This has been a great boon for scientists, for their knowledge is constantly changing, and although they acquire libraries and try to read journals regularly to keep up with the latest discoveries, the Internet has made all this much faster. For lay people, television and radio programs have informed their understanding in recent years, and this may be a more successful way for them to learn, once their schoolwork is over. Newer technology has introduced media such as YouTube and other film clips, so much learning is now enhanced with images and illustrations.

The new technology also keeps scientists around the world in touch with each other's advances, and communication about new findings can be made instantly. In my own research—in anthropology—it allows us to read what the people we choose to study are saying about themselves. This has been something of a revolution, for previously we would be the ones to collect information and disseminate it on their behalf, especially for preliterate peoples. Bringing people into such close contact has enabled a new kind of learning then, a more inclusive, in-depth learning, and it has opened up whole fields of science that explorers and many early settlers never even imagined to be held among the people they thought "primitive," "backward," or simply "savage."

One of the problems was of course language, and even the science that was recorded in different forms of writing was only available to scholars who could read each other's scripts. Thus great discoveries in China have only rather tortuously come to the attention of European scholars, and only those who specialize in the history of science become aware of the enormous contribution made by scientists in Babylon, India, and other parts of the Middle East to the corpus of knowledge we now think of as so Western. This is to some extent still the case, and language courses are often offered alongside the study of science at an advanced level. In my generation we were offered Russian, and Oxford Brookes University first introduced Japanese language for the engineering students

struggling to make sense of Japanese success in the motor and other industries. These days Chinese has become valued again.

Preliterate peoples also have science, however, and although they could not pass on their learning by writing it down, they devised other ways to conserve and disseminate the knowledge they accumulated. Some aspects of their knowledge were recorded in paintings, and the nearest thing to a scientific diagram could be conserved in this way (see figure I.1). Other elements of their accumulated wisdom were simply learned and passed through the generations in the activities of everyday life, so while crossing a busy urban street might be quite easy for those of us who understand the way vehicles work and the rules of the road, a person from the Amazonian rain forest could quickly become confused. In their own environment, on the other hand, they would instead be quite at home—easily able to travel, to avoid danger, and to find and prepare food and medicines from the forest that could be quite frightening to an outsider from the city (celebrity or otherwise).

A tale by Richard Baker (1993:126), travelling in the Northern Territory of Australia with some Yanyuwa Aboriginal people, well illustrates the point. He was seeking to understand some of their environmental knowledge and travelling by boat to the islands they occupy in the Borroloola region, when the outboard motor seized up and they were cast adrift. For the next few days, they were forced to paddle through what he saw as "a frightening maze of mangrove-lined channels and sand bars," which he imagined would provide little food and no drinking water. When the meagre supplies he had brought ran out, he began to panic. However, this turned out to be the beginning of his learning, for his companions were "literally at home in this landscape," and he was introduced to their relaxed pleasure in living on the resources of the lands they had known since childhood (ibid.).

This kind of knowledge we can call *embodied knowledge*, and we do all acquire it, though we might not think of it as science. Learning to keep clean and healthy is one example that does in fact relate to our collective understanding of germs and other bacteria, though sneezing into a handkerchief or washing one's hands after going to the toilet may also be described as common sense or good manners. Our methods also vary from one society to another, and ways of washing vary quite widely around the world, though all

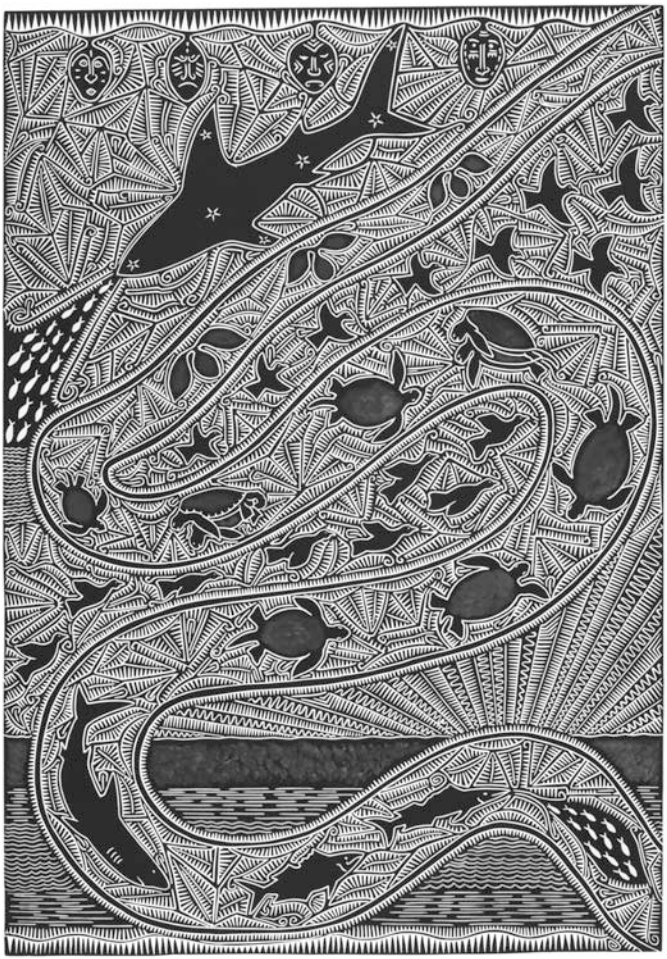

Figure I.1 This linocut print by the Torres Strait Islander Billy Missi is entitled *Zagan* Gud *Aladi*, which refers to a constellation of stars that appears in a particular season. The print illustrates the movement of living beings in land, sea, and air at that time. For example, the pregnant sharks can be seen chasing big fish that are chasing little fish (called "zagal") that are prevalent in that season (Missi 2008:12). See also chapter 5 for more examples of Missi's work.

Photograph courtesy of Kickarts Contemporary Arts, Cairns, Australia.

are concerned with keeping clean. Preparing food is another skill we gradually acquire, and although many ideas are written down or available on the Internet, some of the basics—where and how to go shopping or how to use a chopping knife, light an oven, lay a

table—are likely learned within the family at home and, again, vary from one society to another.

For people whose food largely comes from their own environment, rather than a local shop, children will pick up generations of knowledge by accompanying their parents and other family members on trips to catch fish, hunt animals, or choose plants to pick and prepare for consumption. They will learn when is the best time to find certain fish, birds, or other animals and how to catch them; they will know when fruits and nuts become ripe and how to select and preserve them. Knowledge increases with age and experience, so older people will have a greater range of skills to impart, especially for rarer occasions, such as how to deal with a storm at sea, to treat illness, or to entertain visitors at a festival. Making new discoveries about any of these activities can be quickly added to the repertoire, so it is not necessary to throw away the old books and buy new ones (or belittle a grandparent who cannot use a computer!).

Many people also encode their knowledge in stories, and these may bear a more or less direct relationship to the science that is being stored. Sometimes for reasons of secrecy, or to aid memory, the stories seem to bear a less than clear association with the science, but there are also various levels of understanding in the telling of stories, and this has been another major barrier to the communication of knowledge between peoples of different upbringing and heritage. In Aotearoa, I visited two professors at Auckland University. One was the newly appointed head of Māori research, a specialist in earth sciences; the other, an engineer. Both were bona fide members of a scientific community related to that export mentioned at the start of the chapter, but both also herald their Māori heritage, and they are well trained in their own science, or *mātauranga*. Each in their own way explained that Māori science has been undervalued because it is passed on in stories that sound unconvincing to the Kiwi community that has no background in their culture. Thus one of the challenges they face is to find ways to translate their knowledge and to share it to the benefit of both communities. Their work will be discussed in detail in later chapters of this book.

Another example was illustrated when I visited a re-created rain forest not far from Oxford with members of a South

American tribe who had been brought to visit the United Kingdom by some anthropologists who had been working with them in Colombia. We were taken around the huge greenhouses in a group, and various plants were picked out for discussion. They were plants used for food or sometimes medicine by the people concerned, and the anthropologists acted as translators. The tribal people talked a lot. I was in a group with the oldest, most respected man, and his talk was almost entirely encoded in stories. Each plant sparked a new story, and the anthropologist did her best to turn his stories into an understanding of the value of the plants. We learned about the plants, but it was also clear just how different the recording of scientific knowledge can be. Serena Heckler (2012), trained as an ethnobotanist, has examined various ways that she needed to adapt her understanding of "knowledge" when working with the Piaroa people in South America, including "performing" it.

All peoples have stories, and we pass them on through the generations. For those of us who have been brought up in the literate world of Western Europe and its heritage, we often need scholars to help us interpret them. Stories from the Bible or the Koran encode a moral system that is interpreted by priests, rabbis, and imams. Stories of miracles may be taken more or less seriously; they are not ignored, but neither are they necessarily "believed" wholesale. Their interpretation is open to discussion, and even those who would dismiss them become embroiled in controversy. One of the points of dispute is found in their translation from the different tongues that have been used to write them down. These stories are clearly powerful then, and our problem is that we are far removed from the original environment—linguistic and social—in which they were told.

Somewhat sadly, we apply the word *mythology* to the ancient stories of peoples who have influenced our own societies, and that word does not ring with a sense of truth. They may be interesting to read about, to recount, and to study, but do we imagine that they contain science? Very possibly not, but we may still recognize that these stories are in some way powerful, and it is to this power that I would like briefly to turn. The anthropologist Claude Levi-Strauss wrote several thick tomes about stories that people may classify as *mythology*, including nursery rhymes and other children's stories

and also tales that have been called "just-so stories." His idea was that the human brain is built in such a way that stories offer a powerful method to store knowledge and through those stories to resolve big issues in our understanding of the world. (I don't think it a coincidence that his obituary was one of the very few that ran to two full pages in *The Times*.)

My father came from Scotland, as I mentioned, but he moved down to England, and we—his children—were born and brought up in the south. He used, however, to drive us to Scotland almost every year to visit relatives and, probably more importantly, to make sure that we picked up a suitably Scottish view of history. This he recounted to us as we drove around the countryside, passing fields of battles and massacres, the birthplaces of kings and poets, and the sites of their inspiration and accomplishments. His stories were so powerful that when I came to face my O-level examination paper in history, they came back more swiftly and clearly than the lessons I had learned at school, so I took my pen in hand and answered the Scottish section of the paper. Luckily, my Dad must have been well informed, for I did just fine, and the memory of his stories worked better than the teaching of the classroom and textbooks!

This book will draw on quite a number of stories, then, as well as many written documents, and I plan to start each chapter with a story to help open up the different subjects we will consider. So please bear with me, and see if the power of the stories can convince you too of the science they hold.

Indigenous Wisdom and Acknowledging My Support

The materials for this book have been gathered over a period of some ten years since I started working on the subject of Indigenous cultural centers, funded by a THB Symons Commonwealth Studies grant and a Leverhulme Study Abroad award. These enabled me to travel around the world, as well as to live for several months in an Indigenous part of Canada. The project was then concerned with cultural display, picking up on a global movement of Indigenous resurgence and reclamation, so I was finding people in many countries collecting and displaying evidence of their own heritage, which had often been belittled and sometimes

destroyed by the colonial powers that had settled in their lands. The book I published was checked carefully with all my collaborators, for it was entitled *Reclaiming Culture: Indigenous People and Self-Representation* (Hendry 2005), so I was a little out of order to be doing the writing at all. Fortunately it was pretty well received, and the introduction to that book includes a long section acknowledging the help I received. The present section will follow that model and introduce you to the sources I have drawn on to write this book.

During that earlier research, I began slowly to realize what an enormous quantity of highly valuable knowledge we—the colonizers—had ignored and damaged as we settled around the world and introduced what we thought of as a superior way of thinking. Many of us still think of our scientific knowledge as superior. After all we believe we only learned to think rationally during the period we now call the "Enlightenment," and the disciplines we call "sciences" were all born during that same crucial period. Here I come to the third and final beef about my science degree, then, for had we been given any training in the history of science, alongside all that rational thinking, we would know not only the science, but also how culturally bound our learning is. Our science is not much more culture-free than that of the Indigenous scholars I am going to introduce to you, but only a few of our scientists have recognized this problem. F. David Peat (2012) is one who has, and I thank him for his encouragement in this project. Some of his work will be considered in chapter 7.

In anthropology, on the other hand, we do learn of our own history, and we read of the struggle our forebears engaged in to come to terms with the fact that there is more than one kind of rationality. In fact, each anthropologist chooses to specialize in a particular culture, and in my case, it was for a long time Japan. I was also teaching about Japan as Westerners were becoming obsessed with learning how this very different people could be so economically successful in the world that their people had only more recently industrialized, and the knowledge I gained by living in Japan and cracking the Japanese version of rational thinking was quite a commodity! In fact I didn't choose to sell that knowledge, though some of my colleagues did; instead I was able to persuade my students

and others that there are indeed different forms of rationality (though I have to say that some hard-nosed political scientists and economists are still proving tough to convince!).

Japanese scientists sound very similar to Western scientists if you read their work in English or German or any other European language, for one of the ways in which the Japanese have entered the wider world has been carefully to copy what they found out here and to apply it back home. And they have done it by engaging with us in our own terminology. As we know now, sometimes to the detriment of our own industries, they have also developed and improved many of the inventions and skills they thereby acquired, and it is no accident that much of our technology is now produced in the region we refer to as the "Far East." Their science is not identical, however, and one of the things that their anthropologists who specialize in Europe discuss is the extent to which we—the Europeans—are influenced and biased by our understanding of what we call the "Enlightenment" (Mori 2013).

Another field in which Japan's science has drawn away from ours, and indeed has influenced us, is primatology—the study of nonhuman primates—for Japanese scholars were the first to notice some of the social behavior that takes place between the Macaque monkeys that inhabit much of Japan. They observed mothers teaching their infants, for example, and monkeys washing potatoes before consuming them, behavior now accepted much more widely but first recorded in Japan. It is possible that some Japanese also think that we have been overly concerned to separate ourselves from the primates from whom we believe ourselves to be descended, for not all of them have the same conviction about Darwinian theory that we do in the West, and there is an alternative theory that actually sounds quite plausible to a nonspecialist, at least (Imanishi 2002).

This book will offer only a few examples from Japan, however, as Japanese have been literate for longer than many Europeans, and my focus here will be on peoples who were until relatively recently preliterate and therefore encoding their knowledge in stories, performance, paintings, and other ways that European settlers neglected to notice for a rather long time. The first examples

I gathered were in Canada, where I spent the best part of a year working with an establishment called the Woodland Cultural Centre, in Brantford, Ontario. It has several programs, one of which is to display collected examples of the heritage of the woodland peoples who lived in the area before the arrival of Europeans; another is an education program that arranges classes for local schoolchildren and sends out speakers to schools in the area to explain some of the knowledge they passed on to the wider society.

Through this experience, I learned (rather coincidentally at first) about the scientific knowledge that had been held by those native to the region that was indeed shared with the first explorers (or *voyageurs*) who ventured into their lands and needed to find ways to live and protect themselves in the winter months. A local story held here and throughout North America is called "The Three Sisters," and it relates to the staple foods that were grown successfully by many of the peoples who inhabited the continent, which I will recount at the start of chapter 2. At the time I was working in Canada and some of the northern United States, I was not collecting examples of Indigenous science, but I have maintained contact with friends there who have sent me links and printed discussions about the difficulties of having their scientific knowledge recognized within Native North America.

For example, I was introduced by my good friend and coeditor Laara Fitznor (Hendry and Fitznor 2013) to the work of scholars like Greg Cajete, who (more than anyone) inspired my approach to this subject, and Marie Battiste, who is quoted in the Prologue and who has also given a lot of thought to this subject. I will return to her work and that of other Indigenous scholars in the last chapter. Keith Jamieson, who helped me a lot with the first project, was also ready again to bring me up to speed with Haudenosaunee matters, and his story also appears in chapter 9.

Much of this book is based on two periods of more recent research I carried out in Australia and New Zealand, however, as well as a shorter but very fruitful period in the Cook Islands. Thanks to Mary Patterson, my original sponsor, I was lucky enough in Australia to be supported by a McGeorge Fellowship, administered by the University of Melbourne, which provided me with a splendid home in Ivanhoe, Melbourne, for two months, as well

as a visiting position in the Department of Anthropology, where my host, Tamara Kohn, and other members made me very welcome. I also received friendship and support from Ian Anderson, Jaynie Anderson, Christine Asmar, Ross Bowden, Richard Chenhall, Andrew Dawson, Sue Jackson, Susan Lowish, Wendy Smith, Carolyn Stevens, Dennis Trewhella, and the well-known Aboriginal anthropologist Marcia Langton, who also introduced me to her students and colleagues Lyndon Ormond-Parker and James Oliver.

Marcia is the author of *First Australians*, which was an influential book and (judging by the comments made by complete strangers in the street when I was out with her) a very influential television series as well. Another book that has come out since I returned, but which reinforces much of the material I will be presenting here, is entitled *The Biggest Estate on Earth*, an historical account by Bill Gammage of the Australia found by the first explorers, missionaries, and settlers who wrote of the country they observed before they took it over. My focus here is on what is left of the science those original Australians had and the efforts that are being made to save it, and even to value and use it—but the historical accounts are stunning and so sad for what we lost as we took our science around the world with us.

The generous funds for travelling enabled me to visit other parts of Aboriginal Australia and meet some of the scholars involved in the good work that is being done, guided in many of my plans by Marcia, her student Lyndon, and Richard Chenhall, who offered advice and introductions. In Adelaide, I was helped by Daryle Rigney, Chris Wilson, Steve Hemming, and Terry Magias at Flinders University, and a Japanese colleague, Shoko Yoneyama, who kindly drove me out to Camp Coorong, where there is an Aboriginal community that welcomes visitors to their museum and gamely opened up for us a restaurant closed for the winter. In Alice Springs, my visit was enhanced by the welcome of Marg Bowman, Mike Cawthorn, Jocelyn Davies, Lisa Stefanoff, Josie Douglas, Kathryn Gilbey, Pip McManus, and Daniel Featherstone, some of whom will reappear in later chapters, as will Michael Christie, Terry Dunbar, Glenn James, and Robyn Ober, whom I was privileged to meet in Darwin. There I was also entertained to a wonderful evening with Richard's friend and coauthor, Kate Senior, and her family.

I travelled on to the Yirrkala Cultural Center in Arnhem Land, this time inspired and encouraged by Howard and Frances Morphy (as well as Michael Christie), and several appearances of the Yolngu in the chapters of this book will be witness to the value of that visit. Kade McDonald took care of me, including letting me in to the center, which was closed because my visit sadly coincided with a local funeral, so I didn't meet many of the local artists, although Wukun Wanambi did come over briefly to greet me and tell me a little about the Mulka Project, which will be discussed in chapter 8. From there I flew to Cairns, where Terry Piper at Balkanu offered me much help, and I met the anthropologist Bruce White, who has sent me an abundance of helpful references since my return.

My visit to New Zealand was thanks to a generous invitation to be a de Carle Visiting Lecturer—hosted by Erica Baffelli and Murray Rae in the Department of Theology and Religious Studies at the University of Otago, where I also benefitted from friendly accommodation in St. Margaret's College. The visit was also supported by Henry Johnson in the Music Department, Paul Tapsell in Te Tumu (the Centre for Māori and Pacific Island Studies), and Jacqui Leckie in the Anthropology Department, to all of whom I am very grateful. My main job was to give some lectures about Japan, but everyone was also encouraging about my research, and the staff and some of the students at Te Tumu were particularly helpful. The University of Otago attracts many students to Māori 101, a course in Māori society and culture, and I attended this under the expert guidance of Suzanne Duncan, as well as the Māori language beginners' class, with the excellent teaching of Craig Hall and tutoring of Pounamu Jade Aikman-Dodd, all of which gave me a slightly more organized introduction to Māori thinking, including science, than I had had in Australia.

The story of science in New Zealand is a little better than in Australia, but different, because the Māori people who had settled there themselves were quicker and more successful at defending their ways of life, though much of it was still lost. They did communicate, though, often through missionaries who learned their language and enabled the drawing up of the Waitangi Treaty, which

in theory at least allowed them to maintain control of some of their lands and resources. A little like Japanese, Māori were good at learning from the people who settled there and joining their system of education, so Māori scholars became qualified in various fields, and some travelled abroad to pick up degrees that would impress the world at large. Paul Tapsell, for example, is the son of an early Māori chemist, who himself took a doctorate in Oxford, and he was head of Māori and Pacific Island Studies (Te Tumu) when I was there. Merata Kawharu also gained a doctorate in Oxford, and I would like to thank her for making me think clearly about how to pitch this book (though she may not think that I achieved what she hoped!).

One of the postdoctoral students, Michael Stevens, invited me to attend their seminar series and make a presentation of my own. He also shared his own research, which will be introduced in chapter 2. One of his supervisors, John Stenhouse, of the History Department, who is an expert on missionary science, happened often to join the theology departmental lunch on Fridays, and I would like to thank him for his stimulating company and for giving me some very useful insights into a side of the Māori situation I might not otherwise have gleaned. I would also like to thank Henrik Moller of the Centre for Sustainability, as well as Anne-Marie Jackson, Rua McCallum, and Michael Reilly of Te Tumu, for sharing their research.

I am grateful to a Māori scholar I met in China, Rāpata Wiri, who kindly invited me to visit the Awanuiārangi, a university that operates as far as possible in Māori language, which will be introduced in chapter 9. I would also like to thank Kepa Morgan and Daniel Hikuroa for making time to see me at the University of Auckland; Elena Kolesova, who took me to the Ngakau Mahaki *marae* at the Unitec Institute of Technology (introduced in chapter 3); and Nina Pelling, Māori Academic Advisor at the marae, who not only took time to show me around when I was there, but has been most helpful in providing photographs and permission to use one in this book.

During my time in the winter of New Zealand, I made a short trip to the Cook Islands, where I met Jean Mason at the Library and Museum in Rarotonga, and Rod Dixon at the University of

the South Pacific, both of whom offered me friendship and helpful advice, for which I am very grateful. Rod Dixon invited me on my way home to return to advise some Cook Islanders unable to attend a course he had been running to help them put together research proposals for a postgraduate degree. This was probably the most enlightening part of my research, for the islanders I met, especially in Atiu, were more aware of the continuity of their cultural heritage than any of the Indigenous people I met elsewhere. The reason for this is rather simple: they were still using their own native tongue, which had been maintained in the local schools alongside the English they were taught there, and at home many of them still practiced the science that had been passed down without a great deal of interruption from the outside British settlers. I would like to thank in particular Terangi Mokorua, who looked after my visit to Atiu, but the whole class was inspiring, and some of their research will be introduced later.

While I was in Melbourne, James Oliver reminded me that there remains some valuable Indigenous knowledge on the Island of Lewis, Scotland, close to his home in the Isle of Skye (and at the time home of my brother), as mentioned in chapter 3. Sadly, my brother Bill and his wife, Chirsty, died before the work for this book was finished, but Bill took a great interest in it from the perspective of a medical scientist and offered me space in his house in Lewis to work on it whenever I was visiting them. I would like to thank Chirsty's brother, Lewis Macdonald, and her cousin Angus Macleod and his wife, Kirsty, who also came from the Isle of Skye, for filling me in on some important details about island life (reported in chapter 3).

Finally, a few general thanks remain: first to my sons, James Kay, for helping me to get some of the photographs into an acceptable format, and William Kay, for turning over some ideas and early plans for the book with me when we were sharing my Scottish home; then to some PhD students (now graduated), Hannah Parathian, who included me on the tour of the artificial rain forest, Maureen Matthews, with whom I discussed some of the early ideas while she was in Oxford, Trina Ward, whose Chinese medical practice inspired some thinking about multiple realities, and Sebastien Boret, who forwarded me some interesting studies about Indigenous people and disaster

management; lastly Erica Buchman at Palgrave, who has been extremely speedy and efficient at answering my queries as I prepared this manuscript and its illustrations for submission, and Carol McGillivray who provided the same attention during the copyediting process.

CHAPTER 1

Fire and Water: Sustaining the Land

Fire as Friend or Foe?

In February 2009, a series of enormous fires raged out of control across 1.1 million acres of land in the Australian state of Victoria, north of the city of Melbourne. There were 173 people reported killed as a result of the fires, and many others were injured and/or lost their homes. The initial day of the fires became known retrospectively as "Black Saturday." This "bush fire" was recorded to have been responsible for the highest ever loss of life in Australian fire history, and among the causes cited were strong winds and an unusually rain-free summer.

An interesting aspect of the fires was broadcast at 6:50 a.m. on the following day on the BBC radio news in the UK, when it was reported that one house had been completely untouched because the owner had practiced an Aboriginal form of burning around it. Essentially he had systematically and regularly burned all the tinder in the area of his property, so there was nothing left to catch fire, and his home was saved. The report also mentioned that this practice was illegal under Australian settler law, and it was perhaps for this reason that the story was not repeated, nor could I find it in any UK newspaper or Internet accounts of the fire! I did access on the Internet a picture of a part of the area known as Yarra Glen, which may not have been of the same house, but it gave a good idea of how such a situation might have looked. The image was credited to a photographer named Nick Carson. Although I am not

permitted to reproduce it here, it was still available online (http://en.wikipedia.org/wiki/File:09_vic_bushfire_damage_Yarra_Glen_02.JPG) when this book went to press.

In fact, there is considerable evidence to suggest that for millennia it was common practice among the Aboriginal occupants of Australia to burn their lands regularly, in a controlled fashion that gave them benefits way beyond the rather obvious avoidance of bush fires. The scrub was maintained at a low level, for much easier traversing than is now the case; plants were revitalized for regular food harvesting; animals were herded for accessible hunting; and the whole of the land was generally managed rather scientifically. Indeed, a wonderful recent historical account of the Australia that flourished before European contact, based on early reports and paintings, is entitled *The Biggest Estate on Earth* (Gammage 2011) because many observed that the land they found there resembled the country parks of England of the time.

Bill Gammage's argument is rather revolutionary by Australian standards, and it may take a while to convince the general population just how much damage they've done to the land they settled. Still he has gathered a convincing collection of resources, which he claims is only a trickle compared to the "tsunami" available, and he is writing from the benefit of years of research. The science behind his descriptions of the complex system of land management that, he argues, was present in 1788 includes an assessment of the way that fire affects the plants that thrived in the land, an analysis of its effects on the various animals, birds, and reptiles, and a defense of history as a way to understand science. Present-day scientists, even in Australia, dispute this last idea, and he lists in an appendix the resistance he has encountered, noting that the default position regarding the environment Australian scientists study is that it was "natural" before the arrival of the Europeans (2011: 325).

Fortunately, not everyone agrees, and it is widely accepted that Aboriginal people practiced something described as "mosaic burning" to help them catch the animals they ate. Indeed, the visitors' brochure to Kakadu National Park, which is now conceded again to Aboriginal management, explains in some detail how much the land has recovered since the non-Aboriginal people have realized the value of "the age-old Aboriginal knowledge." It explains that conservation managers in this area are practicing "patch burning"

during cooler weather to prevent wildfires, "to repair country and to encourage biodiversity to recover." The low-level burning can be seen from the tour coaches, and indeed, I noticed from the Gahn, (the train that carries passengers rather elegantly from the south to the north of Australia) that burning of this sort was being practiced much more widely in the Northern Territories (see figure 1.1).

A detailed example of the benefits of burning was described by Richard Baker (1993) in the paper that was mentioned in the introduction to this book, about the Yanyuwa people who live in the Borroloola region of the Northern Territories. Apart from the benefits mentioned above, the Yanyuwa people explained that it becomes easy to hunt goannas and other lizards after burning because their tracks are visible in the ashes. Two or three weeks after the burning, the fresh, green grass attracts kangaroos, bush turkeys, and other game. Burning was seen as a kind of fertilizing process by one of his informants, Musso Harvey, who explained that when roots are being dug, it is important to leave small bits behind as these will grow up next time. Actually, when I visited the Captain Cook Museum in Whitby, Yorkshire, I was shown an enormous

Figure 1.1 Aboriginal burning in northern Australia.
Photograph courtesy of Parks Australia.

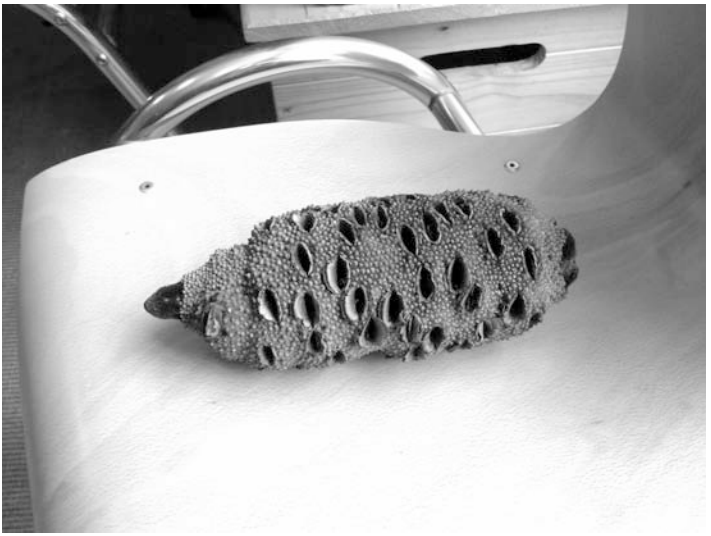

Figure 1.2 A banksia seed, named for Joseph Banks, the scientist traveling with Captain Cook, needs to be "roasted" to regenerate.
Photograph taken by the author at the Captain Cook Memorial Museum, Whitby.

banksia seed from Australia that required "roasting" to regenerate (see figure 1.2).

There are various Australian projects—government and non-governmental—that enable Aboriginal people, especially in the north of the country, to implement traditional knowledge in caring for their land, and some of these will be discussed in forthcoming chapters of this book. A nationwide government project, entitled Caring for Our Country, included funding in 2012 for 680 Indigenous rangers to be sustainably employed in environmental activities known as Working on Country, which are said to build on traditional knowledge to protect and manage land and sea resources. Specifically, regarding the management of burning, the Northern Land Council (NLC) website (http://www.nlc.org.au/articles/cat/fire-management/) explains that the Aboriginal method used for thousands of years was to burn land in the early dry season, a practice that was lost for a while with the impact of outside settlers and resulted in damaging fires that roared out of control in the late season. Implementing the old system has now become a priority across a wide

area of the North, and the land and its flora and fauna are beginning to recover, a practice that also considerably reduces carbon emissions.

A particularly successful example reported there is that of the West Arnhem Land Fire Abatement Project (WALFA), which comprises a partnership of five Aboriginal groups—the Jawoyn Association Aboriginal Corporation, the Bawinanga Aboriginal Corporation, Warddeken Land Management, Mimal Rangers (hosted by the NLC), and the Adjumarlarl Rangers (hosted by the NLC)—that work together in a system of mutual respect that sounds very much like the arrangements described by Gammage for the whole country when it was encountered by Europeans in 1788. The important difference now is that the settler government and private enterprise are involved too, and the contemporary description of the project involves "targets" for CO_2 abatement, which had been exceeded by 40 percent within the first five years of the project and doubled in 2010.

The North Australian Indigenous Land and Sea Management Alliance Ltd. (NAILSMA) is a not-for-profit company that prides itself in combining the strengths of Indigenous knowledge with contemporary science to the benefit of the Indigenous peoples, who manage some 40 percent of the land in the North. Their website cites as a positive example "the combining of Indigenous knowledge of fire management with Western science to reduce greenhouse gas emissions from savanna fires and enhance important cultural values" (http://www.nailsma.org.au/about/what-we-do). The language is again the very contemporary one of "controlling carbon emissions." Still, their scientists have discovered that Aboriginal burning methods do this very well, and Joe Morrison, the CEO of NAILSMA, is quoted on the site as follows: "Indigenous fire practices and knowledge have been confirmed by scientific research and now upheld as Government policy as an essential tool for the future conservation of northern Australia."

Another not-for-profit organization in northern Australia is, according to the website, owned by the Cape York Aboriginal Charitable Trust, on behalf of the Aboriginal people of Cape York (http://www.balkanu.com.au/), and directed by the Aboriginal leader Gerhardt Pearson. Known as "Balkanu," it is committed

to an agenda laid out by Pearson's brother, the Indigenous lawyer Noel Pearson, to give Aboriginal people the right to take responsibility for their own lives, and its projects are geared toward that purpose. My visit to their offices in Cairns in 2011 introduced me to an extremely helpful anthropologist named Bruce White, who is working with a number of Aboriginal people on various projects. He has subsequently forwarded me links to websites and video clips where I can see those people speaking for themselves. (These have proved excellent resources for this book, and further information will follow.) On the subject of fire, Bruce directed me to an account of two local Indigenous elders who had been awarded honorary doctorates by James Cook University for their traditional knowledge, including that of fire practice.

Dr. Tommy George and Dr. George Musgrave were recognized for their part in setting up a project with other Awu Laya (Kuku Thaypan) elders to draw on the ancient wisdom of their people, which they had learned as children. Entitled Traditional Knowledge Revival Pathways (TKRP), the collection of material is entirely for the benefit of the people of the local communities, and it is available in film and video clips for ease of consumption by the youngsters, who are also often present when the elders are being filmed so that they can be involved from the start. On the specific subject of fire, the Kuku Thaypan Fire Management Research Project (KTFMRP) and its cogenerative PhD "The Importance of Campfires to Effective Conservation Communication" was initiated in 2005 by Drs. George and Musgrave and their co-researchers in response to "routinized" fire management practices on their country that, according to Dr. Musgrave, equated to fire "in the wrong place at the wrong time." On their website, at http://www.capeyorknrm.com.au/projects/fire/kuku-thaypan_fire_management.html, the achievements of the project are described as follows:

- Describing Indigenous created and led research methodologies
- Recording traditional fire management knowledge
- Transferring fire knowledge within and between clan groups
- Developing Indigenous led training around fire scar mapping and remote sensing

- Using GPS and GIS with Government and non-Government fire management agencies on Cape York to support Elders aspirations for appropriate burning
- Sharing skills and knowledge from Traditional Knowledge and Western Scientific perspectives

Clearly these examples are confined to a rather limited area and, in this case, to the subject of fire management, but the principles are an excellent way forward, both for the Aboriginal peoples who have had their science ignored in the past and for the settlers in their lands who have suffered from the consequences of ignoring it. These Aboriginal scholars have certainly not ignored the wider science and technology brought to their country by those settlers—they have no problem using film and video clips, global positioning systems (GPS), and geographic information systems (GIS), which they do with great effect (for more examples, see chapter 8). Unfortunately, this is but one example of sharing that is still quite rare throughout the Indigenous world, but it is certainly a step in the right direction.

The Power of Water

Like fire, water is essential for human survival on this planet, but it can also cause devastation, and in recent years the consequences of enormous tsunami in various countries in the Far East have been portrayed in highly distressing detail on our television screens. In March 2011, many of us watched in horror as houses, people, cars, and boats were simply washed away before our very eyes in northeastern Japan. It seems that the disaster could be filmed, but people could not so easily be saved: thousands lost their lives, and many more, their land, their homes, their relatives, and their livelihoods. The earthquake that caused the tsunami also damaged a nuclear power plant, and the fear of leaking radiation closed down a huge area in its vicinity to life and the normal activities of growing food (see Gill, Steger, and Slater 2013 for ethnographic details).

A few years earlier, in 2004, we saw similarly horrific television footage of the tsunami in Aceh, Indonesia, and several other places, including popular holiday resorts such as Phuket Island

in Thailand, and again, many people lost their lives and livelihoods. The tsunami was caused by an earthquake in the Indian Ocean, and for a few days after it occurred, it was thought that some of the Indigenous peoples living in the Andaman Islands had all been completely washed away. In fact, the situation was quite the reverse; as it turned out, these people had been able to anticipate the tsunami before it arrived and had had time to head off for high ground. This knowledge had been passed down for generations, and signals such as a sudden silencing of the cicada insects and a subsequent extraordinary withdrawal of the tide sent them as far away from the sea as they could manage. They were all safe.

There were also reports that much of the coastline had previously been protected by mangrove swamps, which are said to absorb up to 90 percent of the force of a tsunami. Many of these had been cleared to build prawn farms and tourist resorts, and these turned out to be some of the worst hit areas. According to a BBC report (http://news.bbc.co.uk/1/hi/sci/tech/4547032.stm), two villages on the Sri Lankan coast affected by the tsunami in December 2004 were compared by the World Conservation Union (IUCN): while the one protected by a mangrove forest lost only two people, the other, which had no such vegetation, lost up to six thousand. The principle has encouraged local people to respect the wisdom of their ancestors and allow mangrove forests to regenerate along the coastline. A volume that was published not long after the 2004 disaster reveals many more examples of Indigenous knowledge associated with disaster risk reduction in the Asia Pacific region (Shaw et al. 2008).

It could be argued that this protection was not originally planned by those who lived near the coastline, but it seems unlikely that people would not notice its value when tsunami or severe weather phenomena have hit the shore in the past, even in previous generations. In general Indigenous peoples have long histories of contact with a place, and their science is related directly to that place, as has been pointed out by many Indigenous scholars (see, for example, Michell et al. 2008). Typically, careful observations were made over time, and people passed on the knowledge, possibly in stories or perhaps some kind of performance. The problems arise when big industrial projects are set up, often by outsiders, and

the most vulnerable may be people who are moved in to work for them. They might find themselves provided with housing, but they have no long-term knowledge of the area. Even less knowledge is brought by tourists, and stories of people going out to look at the sea bed as the ocean drew back before the tsunami came rolling in and washed them away in 2004 illustrate this perfectly.

There are many cases where the water supply of Indigenous peoples has been diverted, polluted, or dried up altogether for one industrial reason or another. In Canada, for example, the Mohawks of Akwesasne in southeastern Ontario fought against industrial contamination of not only their water, but also their air, land, fish, and animals, citing human health impacts as one dire consequence; in northern Manitoba, the Pimicikamak Cree Nation lost 1.2 million hectares of their land to hydroelectric development (Simpson 2002: 14). The construction of the Kinua dam in 1960s Allegany, Pennsylvania, displaced Seneca people from the last of their ancestral lands in that state, and they have memorialized the loss in the Seneca-Iroquois National Museum, in stories, and in regular walks, such as one that took place in October 2012 at Steamburg, New York, nearly 50 years since "the removal" (http://www.post-journal.com/page/content.detail/id/611294).

In all these cases, there will certainly be reasons, probably regarded as scientific, why the dams were built and the Indigenous understanding of the water supply and its use for their livelihood were superseded by the might of the settler powers and the sheer numbers of people who need water. On the northern island of Hokkaido in Japan, the Ainu community at Nibutani has been divided since the Japanese government dammed the Saru River, where salmon fishing had been the source of much of their livelihood, and to this day three museums exist there—two made by the government as so-called compensation for the loss, representing the traditions of the Ainu people and the history of the river; the third, an ethnographic museum built and maintained by Kayano Shigeru, an Ainu man who for years represented Ainu issues as an elected representative in the Japanese parliament. The irony of this situation was that a judge ruled in favor of the Ainu complaint after the dam was built, thereby making the ruling the first recognition of the Indigeneity of the Ainu people, but a museum hardly returns to them the lands they had managed in the past.

In fact, there are many water systems in the world that are disappearing due to insufficient scientific research or a lack of knowledge about the environment, and local long-standing views may well have been ignored time and again. One of the most famous is the Dead Sea, which is said to be disappearing at such an alarming rate that it will be gone altogether by 2063 if nothing is done to halt the industry that is harming it, and such a halt requires a lot more communication between the countries that share its shores than presently seems to be happening. The Jordan River has also been reduced to barely more than a stream these days, yet both these bodies of water have long histories shared by religious adherents around the world, so there would be no lack of spiritual support for saving them. When and how the Indigenous wisdom was ignored here is probably lost in the mists of time, but cases in the New World are perhaps better documented.

While I was visiting Australia, I signed up for an educational tour of Melbourne offered by the Koorie Heritage Trust, an establishment run by local people who identify with their Aboriginal heritage. The tour was called the Walkin Birrarung, or the Yarra Cultural River Walk, and we were to meet at a site on the river not far from the immigration building where many settlers had arrived from Europe and been granted Australian citizenship. A row of Aboriginal burial posts marks the spot, and about a dozen of us assembled there, waiting for our guide. We were a fairly elderly crew, all pretty white-looking and, except for me, all Australian. Our guide, Dean Stewart, was younger, but he did not look immediately Aboriginal, though he explained how his heritage had become mixed. He was well versed in the history of the area, however, and he set about sharing his knowledge, though he pointed ruefully at the immigration building and noted that when new arrivals were being given their Australian citizenship, his ancestors were still classed as part of the local flora and fauna.

There was a bridge close to where we were standing, and Dean explained that it marked the level at which the salt water had previously been separated from the freshwater coming downstream, by a weir. There had been a series of large stones running across the top of the weir, and people could cross in those days just as they could now but by the bridge. He showed us a painting of how the spot would have looked when it was "discovered" by one John

Batman, who is credited with founding Melbourne (although that is a matter still under dispute). The land on one side of the river was already recognized by the local people as a flood plain, useful when dry for corroboree festivals and other temporary events, but best avoided when wet as it would soon be underwater. On the other side of the river lay extensive wetlands where the Wurundjeri people harvested all kinds of fish, roots, and plants on a regular basis, so it was a prime source of sustenance for them.

Our guide showed us an artist's impression of how the land would have looked, as John Batman sailed up the river in 1834 (see figure 1.3), and another picture of what his schooner might have looked like as it approached. Batman was impressed with the spot and noted in his diary that it would be a good site for a village. He met a group of the Wurundjeri people who had come out to meet him and some kind of negotiations ensued, though it seems that there was no one who could understand both languages. It is recorded that Batman produced a quantity of goods, such as blankets, knives, scissors, mirrors, and handkerchiefs, and returned to Tasmania, where he had been living, to announce that he had acquired a large area of land. The Wurundjeri apparently thought they were giving him the right to travel along their river, or at least only to rent a portion of land—the interpretations are several.

Figure 1.3 Dean Stewart shows a tour group an artist's impression of how the spot where he is standing at the Yarra River, Melbourne, would have looked when Europeans first arrived here.

Photo by the author.

What is certain, as we had the evidence before us, is that John, or subsequent settlers, had decided to blow up the weir and to build the first of a series of bridges, hence destroying this longstanding protective barrier for the freshwater as it flowed downstream. They also began gradually to plant and settle the lands on both sides of the river, though they wrote disparagingly of the "swamp" conditions on the side that the Wurundjeri regarded as their source of sustenance. The flood plain on the other side would eventually cause all kinds of trouble as the city of Melbourne was constructed, and one of the older creeks was even buried under a main thoroughfare. Actually it is recorded that John Batman met an Englishman in the area who had been brought to Australia as a convict and had escaped to live for 20 years with these Aboriginal people, so it might have been possible to benefit from their prior long-term knowledge about their water systems, but as usual in these situations, nobody thought it worth asking.

Our guide, Dean, was a generous man, who pointed out that the buildings that now adorn the riverbanks at this spot are still used for making a living, for eating, and for celebrating, just as they were in the past. He was sorry that there is so little grassland left, and he took us to a slim patch of lawn running alongside the bank at one place and pointed out that the people there these days usually choose to walk on the concrete paths instead of the grass, though the latter is much more comfortable. He also showed us a small patch of Indigenous trees and shrubs that have been planted around the base of a huge sky scraper belonging to a large multinational company. There were even a couple of native birds in the trees, now rare apparently as so much of the foliage they prefer has been removed. When Dean first discovered this plot, he had been delighted to find it, but when he climbed over the small fence to enjoy it, he had been sent packing by a security guard. He joked that this was the price to pay for being recognized as a human being, whereas the flora and fauna were now valued!

There are now various Australian projects that recognize Aboriginal knowledge of the water system, and Melbourne Water has become involved in supporting them. As I wrote this chapter, in 2013, there was an art exhibition they have sponsored at the Koorie Heritage Trust Cultural Centre actually celebrating what the waterways meant from a Koorie perspective. *The Ganagan* (Deep

Water)*: Waterways in Koorie Life and Art* drew on the splendid collection of Aboriginal art held at the center, which features stories and three-dimensional works, such as eel traps and fishing spears, as well as some magnificent paintings. The exhibition was apparently inspired by an award-winning artistic work named Ochre Net (in turn inspired by the dream of the artist, Glenda Nicholl) and, according to a Melbourne Water press release, symbolizes the reclamation and reinterpretation of cultural practice (http://www.melbournewater.com.au/content/news_and_events/media_releases/media_releases/20130514.asp?bhcp=1).

While I was in Melbourne in 2011, I also visited a Wurundjeri Tribal Centre (housed in the former Abbotsford Convent), where I was introduced to a man named Ringo Terrick, who was asked to tell me about projects relating to the science of his people. He talked of various efforts being made to revive traditional ecological knowledge (TEK) about native species, such as the *murnong*, or yam daisy (a good root vegetable), and the old burning methods, so that they could pass these on to their young people. He reported that Melbourne Water was funding a year's research on the cultural value of the waters of a tributary of the Yarra River called the Merri Creek, and although I couldn't find reference to this particular project on the Melbourne Water website in 2013, there were reports of several plans to clean up the rivers and replant native species, such as gum trees, wattles, and bottlebrush (see Figure 1.4).

Various signs that report on the river's prior use by Aboriginal people, changes that were imposed by the settlers, and plans to revive native species have appeared along the side of the river system within the greater Melbourne area. Some recognition would appear to be being given to the Indigenous system that had largely been ignored, then, though I did not yet find any specific reference to the scientific knowledge that had clearly underpinned the practices of the people who made a good living thanks to the abundant water system that had actually been fresh until the separating weir was destroyed.

Nationally in Australia, there are many more such projects, and the organizations mentioned in the previous section of this chapter, on fire, are also very much involved with water. NAILSMA (North Australian Indigenous Land and Sea Management Alliance) is of course one of these for northern Australia, and its website is full of descriptions of projects working toward enabling Indigenous groups

Figure 1.4 Erosion and plans for improvement at Darebin Creek. Photo by the author.

in the area to become more involved in managing their resources of which water is of course a vital component. Under a section headed "Indigenous Knowledge (IK)," they write, "Indigenous knowledge is fundamental to the future of northern Australia. For 60,000 years Indigenous people have developed this knowledge that still goes largely un-noticed or ignored. NAILSMA believes that IK is fundamental to the future of northern Australia and the nation, and when combined with contemporary science has repeatedly demonstrated best practice approaches to problem solving" (http://www.nailsma.org.au/hub/programs/indigenous-knowledge).

Nevertheless, a quotation from a workshop held in 2011, casts doubt on the extent to which such policy is put into practice: "Statutory water rights for Australia's Traditional Owners and Indigenous

communities remain one of the major unrealised promises of the national water reform process," said John McKenzie of CDU (http://www.nailsma.org.au/hub/events/facilitating-indigenous-water-rights-northern-australia).

Marcia Langton drew my attention to a relatively successful example, however, and introduced me to her friend Sonia Leonard, who was coordinating the Kimberley arm of NAILSMA's Indigenous Water Facilitator Network, hosted by the Kimberley Land Council in Broome. Sonia explained that the project was to engage with the traditional ecological knowledge (TEK) of the Miriwoong people as a tool for the effective management of water resources in northern Australia, and a model was developed in the Keep River National Park. Recognition of the knowledge held by Aboriginal people living in the area about surface and underground water underpinned the project, which was developed with the Miriwoong people themselves toward achieving the twin aims of sustaining their culturally important sites at the same time as devising adaptation strategies by integrating the TEK with Western science (http://www.archive.riversymposium.com/index.php?element=T_s4_A1_Sonia+Leonard.pdf).

By the time I talked to Sonia, research had been carried out over several years, using qualitative ethnographic methods, thus gathering information from art, language, stories, and song, as well as holding focus groups to ensure that aspects of the local language had been properly understood. The results of the research confirmed the deep and valuable knowledge about the local hydrology held by the Miriwoong people, but I have yet to find evidence that it has been used in actual water-planning strategies in the region, though the Western Australia Science and Conservation Strategy for the Kimberley does include the following statement: "Immense traditional ecological knowledge has been handed down from generation to generation and this *can* be used in conjunction with modern science to inform land management practices and decisions" (my emphasis).(http://www.dpaw.wa.gov.au/images/documents/conservation-management/kimberley/kimberley_science_conservation_strategy.pdf, p. 20). The Kimberly Regional Water Plan for 2010–30 also has a section called "Aboriginal Recognition," explaining that nearly half of the population of the Kimberley region is Aboriginal and including the following statement:

"The Department of Water acknowledges the important role of Aboriginal people in the management of the Kimberley's water resources and welcomes the opportunity to continue strengthening partnerships and supporting the aspirations of Aboriginal people in water management" (http://www.water.wa.gov.au/PublicationStore/first/95832.pdf, p. vii).

Sonia explained that discussions with the Miriwoong people kept coming back to the complex seasonal calendar they had developed over their millennia of interaction with their environment; this is to be used by the Australian Bureau of Meteorology as a measure of climate change (an issue to which we will return in chapter 5). The state government has made significant changes to legislation relating to the involvement of Aboriginal people on land and water managed by the Department of Parks and Wildlife (DPaW). These changes recognize Aboriginal connections to lands and will enable Aboriginal people to become more involved in managing land and using parks and reserves for customary activities. The changes will also help DPaW build strong relationships with Aboriginal people and provide opportunities to resolve native title.

Another well-documented example of a project that seems to have been carried out very thoroughly is to be found in the 2009 approach of the Power and Water Corporation to the Yolngu Aboriginal Consultancy Initiative at Charles Darwin University to examine and improve engagement with the Milingimbi community over issues of water management (Christie 2010). Many meetings were held to gather the views of the Yolngu people who live in the community, and the report includes appendices that lay out all the interviews in both Yolngu language and English. The Power and Water Corporation also sent senior members to share its point of view. A positive outcome of the project, over and above a commitment to comanaging future water projects in the area, was expressed in relation to school-based education; the corporation pronounced, among other things:

- We are committed to the promotion of the ancestral knowledge of water, and the ownership and continued care of the resource through the new generation. We acknowledge that Milingimbi people see this traditional knowledge as essential

to the future health of the Milingimbi community and its water supplies.

- In aiming to promote traditional links we acknowledge the importance of traditional knowledge working together with contemporary hydrological and technical knowledge when developing and distributing educational materials.

Chapter 2

Making a Sustainable Living

The Three Sisters

In much of North America, before the arrival of Europeans, many Indigenous people from Canada to Mexico had already developed the basis of an agricultural society. The staple crops are still found in the native diet today, particularly in Mexico, and they comprise three components, known widely as "the Three Sisters." One of these is corn or maize, and its seeds are dried and ground up in Mexico for making the pancakes called tortillas. The second is a variety of beans, served *refritos* (or "refried") at the side of most traditional Mexican dishes; and the third is squash, or pumpkin. The interesting thing about the way these crops were cultivated is that they were all grown together in the same plot, and the name—*the Three Sisters*—also serves as a model of cooperation that adds substantially to our understanding of Indigenous science.

This is how the clever system works: first, the corn puts up tall sturdy posts to support its cobs and, at the same time, to provide poles for the beans to climb as they grow. The beans themselves provide nutrients that feed back into the soil and keep it in good condition for the other two crops, while the squash sends out big flat leaves to protect the soil from too much drying sunshine and hold in the moisture, at the same time as keeping down the growth of unwanted plants (which we call "weeds"). Thriving together, then, these three sisters enabled peoples all over the northern part

of America to supply many of their nutritional needs for thousands of years.

Settlers had different ideas, of course, and separated out these crops (as well as the ones they brought from Europe), and then gradually they introduced all sorts of manufactured aids, such as insecticides, fertilizers, and genetic modifications, which we have recently learned may be damaging the ecosystem tended so carefully for all that time. Leanne Simpson (2002: 14) lists several examples of toxic damage introduced to the lands of various First Nations in Canada, for example. Only recently are we beginning to admire again the organic quality of the age-old methods that had stood the test of time. However, the only public place I know where the Three Sisters can be observed growing together these days is in the Botanical Gardens in Montreal.

Living Sustainably

This story is just one example of the ingenious ways in which Indigenous peoples around the world have worked out efficient and sustainable ways of growing or simply gathering their food. There will be several other examples presented here, but it is interesting to point out first that a common feature of all of them is that they include mechanisms of sustaining the resources, a crucial feature that we "moderns" seem to have forgotten in our enthusiasm for the use of machinery, chemicals, and even the genetic modifications we have developed to increase the yield of crops. The notion of "Mother Earth" is not universal; indeed there is research that demonstrates a very recent usage of the term in some First Nations in Canada (Matthews 2010), but its widespread adoption by people around the planet reinforces a notion that is commonly expressed, albeit in different ways—namely, that we should tread lightly on the source of all our nutrients, anthropomorphically known as Mother Earth.

This idea has also been institutionalized in a variety of ways, sometimes associated with spiritual beings, but it is always built on the systematic observations of generations of people intent on conserving the resources they need to sustain the livelihood they share. A very clear example is found in many parts of the tropical rain forest of South America, often in the news and documentary

television programs for its destruction by loggers, road builders, and other "developers," where there is a longstanding practice known as *slash-and-burn cultivation*. This involves the slashing down of enough trees and undergrowth to make a plantation, and some outsiders have criticized the Indigenous inhabitants for what they perceive as destruction of the forest, partly because the process also involves burning the area once the crops have been harvested. As we have seen in chapter 1, however, fire is actually a method of regenerating the land, but more crucially, this plot of land will only be worked for a few years before it is abandoned for a new location and thereby allowed to regenerate.

Some critics suggest that the land is only used for a short period because it is of poor quality, and as big industrial development has pushed the Indigenous inhabitants of the rain forest into ever decreasing areas, this may have become the case; but when they were free to use their land carefully, it had plenty of time to regenerate and was not reused until it had properly recovered. Even today, people report that they can produce enough from planting once a year and criticize new settlers for pushing the land to give two crops in the same year (see quote from Merinto Taje, of the Trio people, in Hendry 2008: 194). Moreover, there is considerable archaeological evidence to suggest that people who have lived in this rain forest also collected ash, charcoal, and their organic waste to fertilize the land they were cultivating, a practice still found among the Kuikuru people who live on the Xingu River (Schmidt 2013). The fertilized soil is known as *terra preta* (Portuguese for "dark earth"), and great mounds of it have been identified over wide areas of the Amazon basin, suggesting not only that populations were much more numerous in the past, but that they were also adept at sustaining a supply of good quality earth.

Another example, found widely in Polynesia and other parts of the Pacific, is a practice known as *ra'ui*, or *rahui*, which involves prohibiting the exploitation of the land or sea. Te Tika Mataiapo (2000: 7) reports that in the Cook Islands, for example, if a particular species of fish grew rare, catching them would be prohibited; or if a large catch was needed to feed some visitors, the species would be allowed to multiply. *Ra'ui* used to be imposed for a fixed, fairly short period decided by local elders (perhaps a few months),

but in 1998, a council of traditional leaders became so concerned about the state of the marine environment in Rarotonga, a popular tourist destination, that they created a long-term *ra'ui mutukore* ("forever"); in other words they created a sanctuary for the coral and other marine resources, something that might also be called a "national park" (ibid.).

Since that time, there have been various efforts to combine the customary system with the European-style legal system that operates in the Cook Islands, and in 2003, an Environment Act introduced a national system of protection and conservation in order to maintain the environment in a sustainable manner. Locations throughout the islands that accepted this system were designated as Protected Areas (PA), and an interesting article by Anna Tiraa (2006) examines the relationship between these and the older system of *ra'ui* and compares their relative effectiveness. She finds a generational difference in attitudes, noting that her late father, who held a chiefly title, was not keen to allow the legal system to take over because it would undermine respect for the traditional leaders who made decisions about *ra'ui* and concede more power to the Island Council and Environment Agency. However, she also finds strengths and weaknesses in both arrangements and, in the end, concludes that while national funding is required to make the PA system effective, the government bodies need to educate the young about the benefits of *ra'ui* and the roles of those who know how to administer it (ibid.: 15).

The word *ra'ui* is also used in Aotearoa/New Zealand as *rahui* (sometimes translated as a *tapu*, or "prohibition") and is applied for similar purposes of regeneration of resources should they come under threat (Mead 2003), but also for protection from pollution, for example when a death occurs at sea until the body is found (Kawharu 2000: 357–58). It forms part of a wider Māori system of conservation called *kaitiakitanga*, a term denoting care and guardianship, applied legally to the rights and responsibilities of particular *iwi* (or tribal groups) for their ancestral lands, but also including a holistic element of care for the social and spiritual as part of the environmental aspects of their resources (ibid.: 349). For Māori, ensuring the health of the life force, called *mauri*, forms an important underlying part of maintaining a supply of sustainable resources, as we shall see in subsequent chapters, and

this needs to be considered alongside economic and technological factors.

On the specific subject of fisheries, I was fortunate in Otago to be introduced to a PhD student (now successfully completed), Anne-Marie Jackson, who was examining the various complexities of the system of fisheries from a Māori perspective. She explained that the customary practices of her people have to be placed alongside two other types of fishing. The first and by far the largest is the commercial fishing industry run by big national companies, such as Sea Lord, which claimed in 2013 a catch 117,000 tons of fish per year. The second is general recreational fishing, apparently one of the most popular activities of New Zealanders, and this accounts for approximately another 20,000 tons, while the Māori customary fishing, which is used to support Māori communities and their longstanding needs, takes only about 5,000 tons, or a mere 3 percent. While commercial fishing is subject to a quota management system, influenced by international regulations and applied to a big two-hundred-mile zone around the nation, customary practice is regulated by a much more local management tool based on prior knowledge of the area, called a *taiāpure*, set up through settlements made between the communities and the Ministry of Fisheries.

Another scholar at the University of Otago, a marine scientist named Chris Hepburn, leads a team working with Māori communities and their *taiāpure* to learn about the ecological marine environment and to ensure that the local *kaitiakitanga*, or guardianship, of the marine life and its habitat is not being adversely affected by bigger sea-management issues. He and Anne-Marie have worked together and their approaches (Anne-Marie, from Te Tumu: the School of Māori, Pacific and Indigenous Studies and the School of Physical Education, and Chris, from the Department of Marine Science) complement each other. This is a practice that is encouraged in general at the University of Otago, where there is also a thriving Centre for Sustainability (Agriculture, Food, Energy, Environment) (CSAFE), which hosts a number of scholars working at the interface between Indigenous knowledge and the science still regarded by many as "mainstream." The center holds regular seminars on a range of such issues. We will return to consider this center and its work in chapter 9.

Is This Science?

Indigenous writers express little doubt that their knowledge of the environment is science, whether it is couched in religious terms or not, but an outside scholar, Michael Christie, has for many years been advocating that Aboriginal science be taken seriously in the Australian education system. In a paper he wrote as long ago as 1991, he recommended Aboriginal science as holding keys to finding ecologically sustainable ways of living because it is "a mode of knowledge production which has evolved to allow human beings to fit into, rather than outside of the ecology" (1991: 26). His paper offers examples, but it also sets out to demonstrate fundamental similarities in the Western and Aboriginal scientific systems of thought, or ontologies. Arguing that "they both consist of complex webs of propositions and interpretations beaten out and finally agreed upon by groups of scientists" and that "both require some sort of faith or acceptance of a particular view of the world" (ibid.), he goes on to examine in detail two characteristics he proposes that they share.

One is that they are fundamentally based on a metaphorical framework, celebrated in the case of Aboriginal science (hence the stories), and the other is that they are both socially negotiated. He accepts that these propositions are less evident in the case of Western science but argues convincingly for their presence. In both cases, reality needs to be represented, he notes, and the form of representation is something that has been negotiated, or "constructed," over time. Thomas Kuhn's (1962) influential arguments about the need for science to be defined by the consensus of a community, rather than being made up of objective truths, is in keeping with Christie's approach—indeed may have influenced it—and we will return to consider an example of his proposals in relation to astronomy in chapter 6. Meanwhile let us pursue Christie's argument in considering how differences in this consensus may appear in practice.

Quantitative measurement is an example of one of the different outcomes because it assumes that the things or people or animals being counted can be regarded as functionally equivalent. Aboriginal scientists find this idea extraordinary because, in their view, different people, for example, have distinct roles in society, and they cannot simply be numbered as if they were all the same. A context

is always important, and "from the Aboriginal point of view, the Western ontology is hopelessly impoverished by its inadequacy to account for social, psychological, spiritual, economic and political realities of day to day life" (1991: 28). In contrast, "the Western scientific system has developed in a world that placed humanity apart from and above the natural world, and in command of apparently inexhaustible resources" (ibid.).

In his book *Native Science*, Greg Cajete (2000), a Native American from the Tewa Pueblo people, explains in a similar way that Western science is fine as far as it goes, but it lacks the ability fully to incorporate human beings, notably the scientists themselves, into the world they are describing. It also assumes that, given enough understanding, these same scientists will be in a position to control the world they are documenting, something we are all now realizing may well be beyond us. Thirdly, Cajete also criticizes Western science for being unable to cope with the spiritual side of life, something which is intrinsically involved with many Aboriginal systems. It is, I think, our tendency to separate religious or spiritual ideas from scientific ones that blinds us to some of the sensible, actually quite scientific activities of Indigenous peoples, but we will return to this issue in chapter 6.

Meanwhile, a good illustration may be found by examining ways in which Native Americans express a respect for their resources, which is part of their concern to use them carefully, destroying as little as possible. First, it is common not only to thank the Creator for the food that may be found in the immediate environment, but also to thank the plant or animal that will become food, and even to offer something in return. When a lovely young deer wandered into the grounds of the Woodland Culture Centre in Ontario, during the time when I was doing research there, the Mohawk librarian commented—probably to shock me—that his ancestors would have bagged it quickly, since it was clearly offering itself to be eaten. It would of course be thanked, he added, as we are all part of the same spiritual world. This world, of which humans feel themselves a part, is sometimes referred to as "all our relations," and conserving the overall life of each of the components is the way to conserve and sustain the whole, sometimes described as a *holistic worldview* (Michell et al. 2008: 62).

An explanation of this holistic worldview, based on an interview carried out for a University of Saskatchewan study on science and place, quoted by Michell above, includes the idea reminiscent of the Christie discussion of Indigenous science—namely, that "everything in creation has a role and a responsibility to play." A quotation from the interviewee explains that these responsibilities are reciprocal, so if we receive something of the spiritual energy of a tree (or a bird or an animal), then we need to ensure that the tree, say, will be able to continue to live in that environment and play its role—and we thank it for its food and, in this case, shelter. So the explanation may be couched in terms of shared spiritual energy, but the outcome of that philosophy is actually a very scientific system of ensuring the survival of the environment. We will return to consider that issue from another angle in chapter 7, and we will return to the Saskatchewan study in chapter 9.

A specific example of the avoidance of waste may be found in looking at the way that hunted animals would be divided up and each of their component parts put into some effective purpose. Meat would of course be used for food, but skins were used to make tepees, furs to make clothes, bones to make implements, and the sinews of the animals for sewing up the clothes and for making the basis of jewelry. An excellent display of the way buffalo were used in this way in the past is to be seen at Head-Smashed-In Buffalo Jump Interpretation Centre in southern Alberta, where there are displays of the products obtained from the animals and explanations about their uses. I also found a nice continuing example when I happened across preparations for a secondary school summer camp in Kimmirut, a town in Nunavut, the largely Inuit province of Canada. This was to be a science trip, camping and collecting in the tundra, and a highlight would be to hunt and catch caribou. The children would learn how to track and kill the animal, how to dissect it in order to learn about its bone structure and inner organs, and then how to divide up its components for food, clothes, and elements of further scientific study (Hendry 2005: 113).

The processing of the animal parts involves a high level of skill, which is still valued and taught to Inuit children as an important part of their culture and by some regarded as essential for comfortable survival in the extreme climate they endure most of the

year. For example, according to the website of the Pulaarvik Kablu Friendship Centre in Rankin Inlet, which runs courses for Inuit families, the caribou skin has different qualities depending on the time of the year, and it needs to be treated appropriately for its various uses. The skin collected in August is short-haired and relatively easy to manipulate, so it is scraped clean of fat and membranes, "worked," and used to make soft clothes worn next to the body, traditionally sewn together with bone needles and the sinews of the animal. As the weather gets colder, the animal's skin hardens, and the hair grows longer, so the leather taken is progressively used for parkas and trousers, worn with the fur outside, then bedding, mitts, and boots, and later for lining a sled or to roll out under the sleeping skins in a snow house (http://www.pulaarvik.ca/young-families/tradClothing.html#seasonfunction).

Of course, the Inuit have access to many other materials these days, and they may well buy them and use them to save some of the hard work involved in preparing clothing from animal skins, but there is no doubt that the clever way in which their clothes were constructed to protect them from their harsh climate expressed a fine understanding of the local environment. They also served as a model for others designing warm and stylish clothes from synthetic materials, as illustrated by the way we have adopted into English terms like *anorak* (from the Inuktitut language of people who live in Greenland) and its American adaptation, *parka*, (which came from the Aleut language, apparently via Russian) (Oxford online dictionary). This kind of recognition of the value of Indigenous knowledge is not as common as it should be, in fact, and it was probably the harsh climate that made clear just how scientifically well adapted to their environment the people who live in the Arctic were when they were encountered by outsiders.

It is interesting too, that long-established ways of living are still being used and valued, despite the ready recognition of new forms of technology, such as snowmobiles and global positioning systems (GPS), as we shall see in later chapters. The case of the Inuit actually illustrates rather well a principle of stability within their own environment that has been described as "resilience," basically an ability to absorb considerable change while at the same time maintaining a fair degree of control over the local situation. The theory proposed

is concerned with the value of biodiversity in the maintenance of a sustainable world. Foundational and active contributors to resilience theory, fisheries ecologist Fikret Berkes (from the University of Manitoba) and the Swedish anthropologist Carl Folke, set out the framework for looking at the interface between human societies and ecosystems in a book entitled *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience* (Berkes and Folke 1998). Folke has since become the scientific director of an establishment named the Stockholm Resilience Centre, and many researchers work through an international organization called the Resilience Alliance.

One of the basic building blocks of resilience theory is to value local environmental knowledge, and the title of this early book emphasized that the study of the environment, or ecology, cannot be separated from the social life of those who live within that environment. This is essentially the same argument as that applied by Christie, Cajete, and other Indigenous scholars in their criticisms of the assumptions of modern, or Western, science, but the neat thing about resilience theory is that it has come out of the world of that same Western science. The book mentioned above starts out by citing various criticisms of many of the world's mechanisms of resource management, indicating ways in which they have acted against sustainability by destroying the very foundation of the resource they are seeking. This approach, they explain, grew out of an exploitative worldview that assumes humans have dominion over nature. "In the historical process of converting the world's life-support systems into mere commodities, resource management science was geared for the efficient utilization of resources as if they were limitless" (1998: 1). At last there is a science that recognizes the fallacy of this idea, but it is sad to find that the books that develop these principles often seem to be unavailable.

I don't think that the basis of this idea of resilience has been forgotten, however, and we will return to consider how it is used in practical ways in chapter 6 when we come to consider climate change. It has, for example, been applied in various parts of Australia—in the desert regions and on the barrier reefs—and it was actually a scholar I met in 2011 in the Desert Knowledge Precinct, a research center outside Alice Springs, who introduced me to the main principles. Jocelyn Davies works the Commonwealth

Scientific and Industrial Research Organisation (CSIRO), which is Australia's national science agency with links in many other parts of the world, and she also sits on several committees and forums that recognize the importance of Indigenous science—or what has more technically been called "Traditional Ecological Knowledge (TEK)—in the pursuit of adaptability to change and sustainable ways of living. Jocelyn was just off to Nairobi after I met her, and she has more recently cochaired an Indigenous peoples' forum at the 9th International Rangeland Congress in Argentina in 2012.

It is important to remember that the science of Indigenous peoples in different parts of the world evolves just as does any science, and as practitioners are introduced to new ideas and new forms of technology, they are free to use them alongside their long-held local techniques for making a sustainable living. No one wants to conserve traditional knowledge as it has been used in the past if better ways can be contrived to live without damaging the resources that sustain it, but at the same time, let's not forget how valuable those centuries, or even millennia, of experience of living in a particular environment can be. In the last section of this chapter, we will look in some detail at an example of wild-food harvesting that has grown and developed through several generations of intercultural encounter.

Muttonbirding in Stewart Island

At the University of Otago, I encountered a Māori scholar who had recently completed his PhD on a subject that illustrates many of the issues raised in this chapter and more. Trained as a historian, Michael Stevens drew on a range of disciplines to examine and analyze a wild-food harvesting tradition that was practiced by his ancestors and continues to be practiced by his family. Economic history is of course an important part of his venture, but contact with outsiders brought missionaries, traders, and colonists, so religious history and imperial history play a part as well as the ethnohistory of his people. Most relevant for this chapter, however, he also became interested in the history of science, so his approach is comprehensive and appropriately holistic.

A strong first point in the introduction to his thesis is the importance of relating all his research to *the place* where it was

carried out. Thus, he introduces not simply a Māori system of knowledge and practice, but that of a particular branch of a local *iwi* (or tribe), in this case Kāi Tahu Whānui, whose tribal area has included a region known as Murihiku in the southern end of New Zealand's South Island for several centuries. Compared with most other Māori, southern Kāi Tahu had early sustained contact with outsiders who came exploring, mapping, sealing, whaling, and trading among the islands and along the rugged coastline that forms their home. It is crucial to understand the characteristics of that landscape and its climate, as we shall see. The arrival of outsiders, many of whom eventually settled, also meant that the people who live there have some variety of heritage, and Michael is no exception: his *Pākehā* or white great-great-grandmother having played a crucial role in passing on the knowledge (Stevens 2013).

A second point he makes then is that the science he presents is neither *mātauraka* (the local pronunciation of the word for Māori knowledge, *mātauranga*) alone, nor simply the science introduced by the visitors and settlers, but a dynamic, developing body of knowledge that nevertheless retains significant continuities with the past. In taking this approach, Michael points out that his work differs from that of many Indigenous scientists who, in emphasizing a bounded version of Indigenous knowledge, perpetuate an unhelpful binary opposition with so-called Western science, which he describes as an "ahistorical essentialism" (2009: 2). "Instead, I examine the syncretic result of an interface between two knowledge systems and the cultural consequences of this engagement for a particular Māori community living in a specific locale," he writes (2009: 18). In fact, the science I am going to describe illustrates well the need to understand the local landscape, the need to conserve the resources it offers, and a method of preservation that predates the introduction of outside ideas. Simultaneously, though, the introduction of European dinghies and new materials, such as steel, widened the possibilities for access and processing that underpins the harvest that Stevens focuses on.

This harvest has become known in English as "muttonbirding," which refers to the catching and processing of juvenile sooty shearwaters/muttonbirds (*Puffinus griseus*), known to Māori as *tītī*. This practice so characterizes the three dozen or so islands where

these birds are harvested that they are known as the Tītī Islands. According to Stevens, these birds were once prevalent throughout much of mainland New Zealand, but the rats introduced in the north destroyed their nests, and the people in Murihiku thus consolidated their reputation for catching and conserving the birds for exchange, as well as high local consumption. The birds provide a good source of protein and valuable oils (as did the fish and eels that could be caught in the area) but few carbohydrates, so their harvest provided credit toward offsetting that shortcoming in the local diet through further exchange.

The birds live an endless summer by following an annual figure-of-eight migratory route around the Pacific Ocean, but they nest and lay their eggs in New Zealand. The harvesting season traditionally ensured that there would be plenty of fledglings to fly away with mature adults and therefore maintain population levels. As mentioned, it is the fledgling *tītī* that are the focus of attention, and they are still collected in fairly large numbers. Michael himself continues to take part in the harvest, as do other members of his family who live elsewhere during the rest of the year (the islands being only seasonally occupied). There are two main methods of preserving *tītī*: by precooking them and sealing them in their own congealed fat or by salting and pickling them. Either way, the birds are then packed into bags made from hollowed-out and cured bull kelp (see Figure 2.1). These are made in various sizes and typically hold between 10 and 30 preserved birds (although there are records of very large ones holding several hundred birds). The base of each kelp bag is placed in a woven basket made of *harakeke*, a variety of lily (often called "New Zealand flax"), and the remainder of the kelp is covered with a layer of particular tree bark that is then tied in place with further strips of *harakeke*. The finished product is known as a *pōhā*.

Stevens points out that there are various modern ways of storing preserved *tītī*, now most commonly in 15-liter plastic pails with fitted lids. He and his family have not rejected all such changes, but they continue to use *pōhā*, partly because his great-great-grandmother, known as Big Nana, insisted that it continue. Michael and his younger sister Lara, along with their cousins, learned the techniques involved from their grandfather, who learned from his grandmother, Big Nana. Michael's own "apprenticeship" seems to

Figure 2.1 Michael Stevens inflates a freshly opened kelp bag in the port-town of Bluff in preparation for the 2006 *tītī* harvest.
Photo courtesy of Michael Stevens.

have started when he was barely five years old, after a first experience visiting their family's Tītī Island before the age of three! An interesting aspect of the learning process was that the methods and procedures were often memorized as little ditties that had been worked out in English, so illustrating Stevens's initial point about the need to see *mātauraka* as part of an evolving process, here neatly combining influences from all sides of his ancestral family and contributing to what he terms the "alternative modernity" of the southern Kāi Tahu people.

Figure 2.2 Kura-matakitaki Stevens, age three, learning to pluck a *tītī* chick on his family's island, Pikomamaku-nui, during the final stages of the 2012 *tītī* season. Photo courtesy of Michael Stevens.

Michael now has three children of his own, and when I asked him to send me a photograph of him muttonbirding, he also sent one of his eldest son learning at the tender age of three to pluck one of the birds (see figure 2.2). So it looks as though this time-tested practice may well continue for another generation into the future, though how it might be modernized remains to be seen!

Chapter 3

Architecture and House Building

The Isle of Lewis Black House

My older brother retired from London to the Isle of Lewis, off the west coast of Scotland. His wife's family came from the island, and she had plenty of relatives to make them feel welcome. Although it was her brother who inherited the family plot of farmland, or croft, my brother, as "Chirsty's man," was able to negotiate for a piece of land to work himself, and he built a beautiful home for their children and grandchildren to visit. I think he was inspired by his father-in-law, who had also retired to the island after 30 years of work in Glasgow and who had enjoyed another 30 years tending his lands there, visited frequently by descendants and more distant relatives who would return to the island from all over the world. There were many cousins in their family, and although a lot of them settled elsewhere, it was not uncommon for them to return from time to time to the land of their ancestors, where they were at once made to feel at home again.

My brother decided to rear Highland cattle on his plot of land, and he went into partnership with a neighbor to share the burdens and benefits of this way of life, which he carried out industriously for more than ten years. I enjoyed visiting him there and one year helped to bring in the hay for winter storage. It was hard work but good work, and we enjoyed a wonderful evening of celebration with other members of the family after the job was completed. My brother's house was oriented so that sitting at the kitchen table

offered a glorious view of the cattle in their field and the seashore beyond. The cattle were friendly, and in figure 3.1 they can be seen lined up to the camera, a position they adopted when they noticed that I was out taking their picture! They had food and water, so they were not waiting to be fed; they are simply rather sociable (or curious?) beings.

As I sat at breakfast one morning, the cattle were even nearer to the house than in this picture, and they seemed positively to be looking in at the window. They looked a little sad, as if they would like to join us inside, and I began to wonder whether animals have a collective ancestral memory, for in this part of the world, cattle have lived in the house with their owners for a lot longer than they have lived outside. Nowadays the health authorities prohibit the sharing of human homes with cattle, and from the nineteenth century, the government built "white houses" for the people of the island, and the last old-style home was given up in the 1960s. However, there are a couple of tourist sites on the Isle of Lewis that have conserved some of the old homes, later to be dubbed "black houses" in contrast to the new "white" ones, and there explanations can be found suggesting a longstanding design that demonstrated a few interesting principles of Indigenous science.

First, the part of the house occupied by the cattle was separated from that used by the humans, and it was constructed at a lower level so that the heat generated by the bodies of the animals rose through

Figure 3.1 Highland cattle lining up for a photograph.
Photo by the author.

the house and helped to keep it all warm. There was a drain running down the center of the house from the living area, through the byre where the cattle were kept, for getting rid of kitchen water and also for cattle "refuse." The houses were built of stone, with double walls and the space between them filled with earth and peat, so they were well insulated against the biting winds. The houses had no chimney, but there was a hole in the ridge, offset from above the hearth by a few feet. This provoked uninformed comments about the houses being smoky and unhealthy, but in fact that same smoke killed the annoying bugs; and as the roof was largely made of turf and oat straw thatch, the smoke was absorbed, and the smoke-saturated straw above the hearth was regularly removed so that it could be used to fertilize the potato fields. The thatch was carefully kept in place by heather rope going across from one side of the roof to the other, where it was tied to anchor stones along both sides. Steps were built into the stone walls to provide easy access to the roof (see figure 3.2).

The fires in these island homes used peat, a sweet-smelling surface fuel found abundantly all over the moors on the islands, and it is cut in the driest months from the end of April through May from strips of land shared out fairly between the residents of a particular community. The size and thickness of the peat slabs varies according to the conditions on the different islands, and Angus McLeod,

Figure 3.2 The "black house" conserved at Arnol, Isle of Lewis (note the steps built into the wall for easy access to the roof).
Photo by the author.

Chirsty's cousin, told me that he had to adjust his practice when he went to help out at his wife's home in Skye. In Lewis, the peat is allowed to dry beside the trench for about a month and then stacked in piles of five to allow air through it for a further three weeks. It is then built into a pile for another two months, by which time it will absorb no further damp, and is brought back to the home to supply the needs of the following winter. According to Angus, who explained all these details to me, the peat from different depths of the trench is used in different ways: that taken near to the surface burns quickly and is used to light or stoke up the fire; the darker part at the bottom is denser, so it burns slowly and is used to "smoor" the fire, with three blocks at night to ensure that it will still be burning in the morning.

The hearths in these earlier traditional homes used to be kept smoldering throughout the year, so the inside always remained warm and dry, and parts of the fire could be lifted out to be used for cooking. The Gaelic name for the main family room of the house is *aig an teine* (literally "at the fire"), and people worked and socialized in this area, while sleeping places were curtained off to the side. In the summer, when the croft was planted with oats and vegetables, the cows and sheep were taken up to the "shielings" so that they wouldn't trample the crops, and some, usually younger, members of the family would move to the smaller summer quarters to keep an eye on them and enjoy the fresh air. Toward the end of the nineteenth century, there was pressure from the landlords of these estates to separate the cattle from the people, and gradually houses were built with solid concrete walls, chimneys, and enclosed stoves at one end. These were not immediately popular and were only possible after the passing of the Crofter Act of 1886, which gave crofters security of tenure. Local people still speak fondly of these Indigenous homes, whose ruins remain visible alongside their present-day houses.

Indigenous Perspectives in Modern Architecture

In some parts of the Indigenous world, architects and engineers draw on their scientific heritage in the designs they create for today's use. On the Reserve of the Six Nations of the Haudenosaunee people on the banks of the Grand River in Ontario, Canada, for

example, there is a firm of architects who embody this idea in their very name—Two Row Architects—which refers to an agreement made in the form of a beaded belt that symbolized that they and the Europeans who arrived in their lands would live in peace with each other and respect each other's ways (see p. 155). The website of the architectural firm lays out the principles of "building science" they espouse in their designs, and these illustrate many of the ideas these days considered important way beyond the local Indigenous culture.

Building Science

- Design with the consideration of Seven Generations
- Sustain the Land, the Water and the Air
- Energy Efficient and Well Insulated
- Use of Passive and Active Solar Heating
- Use of Non-Toxic Construction Materials
- Incorporate Natural Ventilation
- Utilize Green Roofs Where Appropriate
- Respond to Seasonal Climatic Change and the Landscape
- Incorporate and Reintroduce Indigenous Plants (http://www.tworow.com/ourapproach.html)

During my research in this part of Canada in 2003, I interviewed Brian Porter, the principal and cofounder of the firm, and he described one concrete example of his work that illustrates much of the wisdom of his ancestors that he likes to incorporate in his work. It is a school in the same town where he lives and works, attended by children who share his Haudenosaunee heritage. It is a modern brick building supported by steel girders, but the bricks are of varied hues, representing the soil at different levels beneath the earth on which it stands. The girders are angled in such a way that the rain runs down them to be collected below, but bouncing playfully at the bottom so that the children can appreciate the beauty of the drops, Brian explained. The system thus conserves the water, which is recycled back into the heating system. In fact the school is partially heated by this water system, which sends pipes down six feet into the ground table, which remains warm even in the cold winter so that the circulating water returns at a reasonable

temperature. Along the roof of the school, there is also a glass panel that is oriented on a north-south axis to catch plenty of light. On a sunny day, it is possible to read the approximate time of day on a wall in the library, which could also be calibrated to mark the seasons of the year. It is this use of natural resources in the design of his buildings, as well as the sustainability in the recycling of water, that Porter feels reflects what his ancestors would have chosen had they had access to modern materials.

My sister-in-law's brother, Lewis Macdonald, who inherited his father's croft on the Isle of Lewis in the Hebrides, also chose to retire there, though he has spent much of his life working as an engineer in southern England. He designed and built a beautiful new house, just as my brother did, and Lewis has introduced some interesting ways of taking advantage of the local resources, which struck me as having an Indigenous edge to them!

For one thing, he has put seven hundred meters of pipes one and a half meters down into the ground so that he can circulate a solution of ethylene glycol and bring it back warmed, in part because the pipes run alongside the sewage system and recover heat from the warmer wastewater. The return pipes feed into a heat pump, which boosts the temperature to supply an underfloor heating system to maintain a comfortable, ambient temperature in the house.

Second, a wind turbine has been installed in the back garden to convert the continuous gales that blow around the area into electric power. Lewis has also installed hot water solar power panels to complement his domestic heating system in the summer months and later plans to augment his electricity supply with a ground-mounted photovoltaic array. Thirdly, he has placed large high windows into two south-facing walls, which results in a solar gain in these rooms of seven to nine degrees when the sun is shining. These windows also lose heat when it is not sunny, so he designed the house to be able to close off the rooms on cold, dull days. When heat builds up in these rooms on sunny days, the warm air is fed through ducts to colder parts of the house, taking greater advantage of the natural warmth, reminding me of the way that the old black houses benefitted from the warmth coming up from the cattle in the byre. Finally, many people living on the islands still collect and burn peat, but their fireplaces now draw on much newer technology, such as the convector system installed by Lewis. This brings fresh air in

through a duct underneath the floor to help combustion, and once heated, the warmed air circulates around the whole living space, having been convected out of the top of the fireplace. Peat burns at a much slower rate than wood and coal, so it is efficient and long lasting, whatever kind of the stove or fireplace is used to burn it. As in the old days, many people use peat to cook, but it is now being burned all over Scotland in newly designed solid fuel cookers, such as Agas and Raeburns, which they install in their kitchens.

A Māori example I collected also comprises a design that draws on local materials to create a more cost-effective construction model than had been introduced by settlers in New Zealand, and which has enabled Māori people to build their own homes in a sustainable fashion. The architect of this design is also an engineer, Kepa Morgan, now employed in the engineering department at Auckland University. While working as a professional, he found a way of making an earth composite known as *uku*, which is reinforced by the *harakeke* plant we met in the last chapter (long used by Māori for making rope and baskets). On a website about the materials, the construction is described as follows:

> This research has created breakthrough technology. The *uku* process involves the *harakeke* being mechanically stripped, cut to given lengths and combined with the soil cement mix to provide reinforcement. The combination of conventional rammed earth technology and the reinforced earth cement has many benefits including: low toxicity, warm during winter and cool in summer, lasts six generations, cost effective, soil from the surrounding land can be used and is easy to construct. It draws on traditional Māori knowledge, with similarities to *maioro* (fortifications) in *pā* construction.(http://mediacentre.maramatanga.ac.nz/content/whare-uku-sustainable-fibre-housing)

Holistic Thinking about Building

In 2011, I interviewed Kepa Morgan in his twelfth-floor office at the University of Auckland, where he explained some of the principles of his subject, which he attributes to the science of his Māori people. An important aspect of Indigenous knowledge is its lack of transferability, he began; there is always a need for specific applications that are suitable for particular locations, and his development

of cheap, sustainable housing is of course an excellent example. There is more, though—much more—and a deep understanding of local conditions is something that has been acquired over the centuries by Māori living in these lands long before the arrival of the settler Kiwis, which they have passed down in stories that the newcomers do not always take seriously.

During that year, Morgan had been quoted in several newspaper articles for warning of the importance of listening to stories told by Māori about something called *taniwha*. If you Google the word and search for images, you will be shown pictures of alarming-looking monsters, and reading a little more reveals that these beasts are said to live in dangerous places, such as deep pools, caves, and water courses with strong currents. Morgan explained that the places are the sites of an (often catastrophic) historical event, and the *taniwha* are guardians who ensure that people won't be injured there again. This long-held understanding of the local environment is enshrined in the stories that are passed down through the generations and should warn anyone against using the land, he affirmed.

Two examples had been given particular publicity: one that had and another that had not observed such warnings. The first was the case of a state highway, which had been rerouted from an initial plan to run around a swamp said to be occupied by a *taniwha*. It had cost 60,000 NZ dollars to move the highway, and some had complained that Māori simply wanted to protect their own lands; but later there was an extensive flood in the initial area, which Morgan estimated would have cost at least a million dollars in road repairs had it been built there. The second case was that of Ngawha prison, which was built against protests about a local *taniwha*, although the cost had increased substantially during construction. The prison has been sinking ever since and will require regular repairs, reported Morgan (see also *The New Zealand Herald* for Tuesday, June 14, 2011).

I asked Morgan whether he was able to use such Māori knowledge in his teaching at the University of Auckland, and he said that he did use it in a course called Engineering Decision-Making in Aotearoa, New Zealand: Cross-cultural Communication and Action, where he introduces what is known as the *mauri* model of decision making. It's a case of holistic thinking, he explained,

as we need to look at all knowledge sources, including not only the qualitative and quantitative, but also physical and spiritual sources. Money doesn't hold its value, he explained, so decisions based only on money will not stand the test of time. Instead, he explained, a cost-benefit analysis should include people and the environment. He proposes instead that a *mauri* model could be used because *mauri* is the life force that is pervasive, scientifically measurable, and can even use existing data. "However, it is still not always taken seriously," he added, and a proposal he had put forward to include more *mātauranga* in the courses they offer in the Department of Engineering had been making some progress until they had appointed a new dean to the faculty.—from England. Old problems die hard, it seems.

However, when I got in touch with Kepa Morgan as this book was nearing completion, he told me that they had launched the Mauri Model Decision Making Framework as an open-source tool on the Internet in August 2013. At a website (aptly named www.mauriometer.com), the principles are explained in some detail, and the concept of *mauri* is described as a measure of sustainability, in comparison to the conventional monetary-based assessment. "The use of *mauri* as the measure of sustainability allows for a more accurate representation of the impacts of certain actions/options," the introduction explains, and the website includes a step-by-step guide to using the mauriometer. These impacts may not always be best represented or included in monetary-based assessments of sustainability, and if put into place before a project goes ahead, more holistic assessment approaches could help avoid human disasters, such as the running aground of the cargo ship *Rena* on Otaiti in 2011. The *Rena* grounding is New Zealand's worst environmental disaster, and the picture of it still makes quite an impact on the front page of the website. The concept of *mauri* will be discussed again in chapter 7.

On the same occasion, I visited the Māori Research Department at the University of Auckland to meet a man named Daniel Hikuroa, who had just been appointed research director there. He is an earth systems scientist with a declared interest in "the integration of *mātauranga* (Māori knowledge) with science to realise indigenous development" (http://www.maramatanga.co.nz/person/dr-daniel-hikuroa). Daniel had been involved in some of the

same projects described to me by Kepa Morgan, and they have published together on the issue of integration (Hikuroa et al. 2011), which we will discuss in chapter 9. Daniel has built up a reputation in the field, and he told me that he is often called out to help understand disaster situations caused by natural phenomena, such as earthquakes. Māori knowledge could help people to avoid some of the problems, he explained (just as Morgan reported), but again he'd encountered decision makers that don't take seriously the oral narratives (or stories) in which that knowledge is transmitted.

A related issue is the way that houses and other buildings affected by earthquake damage are found to be on sites that had been deemed dangerous by Māori standards, and the situation in Christchurch after the two big earthquakes there illustrated this well. According to a local friend whom I visited there, it seems that certain areas of the town had been accepted as unsuitable for building, but corruption in the system had made it possible for underhand payments to secure the necessary planning permission. These were the areas that were worst hit during the earthquakes, and buildings that had not properly observed the regulations had also suffered serious ill effects. A similar situation was reported after the major earthquake in Kobe, Japan, where it was said that the owners of cheap, modern housing had been the worst to suffer and that some of the construction companies had finessed the local regulations as well.

In fact there are many types of longstanding Indigenous house construction that can withstand quite serious earthquakes, as I experienced myself when living through a few of them in Japan. The houses are built with a wooden framework, which simply moves gracefully along with the earth, if it is not too severe. The movement of these houses may also give prior warnings of seismic activity as we discovered when a volcano erupted several miles away over the sea. A gentle shuddering of the outside shutters brought a group of curious neighbors out into the street, though we could see nothing of the event that was taking place on the other side of the peninsula from where we were located. No one knew quite what was happening, and we had to be informed by someone who was watching the television rather than relying on Indigenous wisdom in this case.

Another time, while staying with some friends who live in Tokyo after the great earthquake/tsunami in the north of Japan in March 2011, I witnessed various aspects of the way their house moved during the aftershocks, which took place four or five times a day for a period. The first sign, and often the only one if the shock is minor, is the way that the light pulls begin to sway (electric lights in Japan are often turned on with rope pulls rather than switches). The shaking and shuddering of furniture is of course another major sign, but my friends were remarkably cool when I put out a hand to stop a glass-fronted case of shelves full of crockery from falling down. "Don't worry," my friend exclaimed, "I have fixed it to the wall." (He made a similar comment about a large wardrobe in the room I had been given for sleeping—though I did make sure my mattress was as far from the beast as possible, just in case!) It was important to read these signs, I suppose, because getting outside of a house had saved several lives in the initial 8.9 magnitude earthquake that hit the most devastated areas in the north, whereas my friends told me to sit back and enjoy the worst one that happened while I was with them.

Phenomena such as earthquakes, cyclones, and tsunami, as we discussed in the first chapter, undoubtedly make people intensely aware of the environment they live in and the dangers it can pose. To avoid notably weak spots in the local surface area is one obvious resort when choosing a location to build; to pick resilient materials for the construction is another, and there are nowadays many engineering firms that advertise their ideas on the subject. Indigenous or vernacular housing could provide some excellent examples, as we have seen, but the overall, holistic aim of designing a building to nestle into and even to use the environment as part of its protection is rather dependent on place and a long-term knowledge of the climate and its vagaries. We have a rather negative view of so-called cavemen, but the highly regarded civilizations of the Nabateans in Jordan and Etruscans in Tuscany have left archaeological evidence of some extraordinary uses of these examples of natural shelter.

An excellent instance of a contemporary Indigenous building (see figure 3.3) that draws on this very principle is the recently constructed Ngakau Mahaki *marae* at the Unitec Institute of Technology Te Whare Wananga o Wairaka, where an open space was

set apart for its construction, precisely so that it could form part of the landscape as a ceremonial Māori meeting place should. The award-winning master carver, Dr. Lionel Grant, who was invited to create the *marae*, explained, "I am creating a landscape design that will incorporate Māori studies and surrounding natural features." It has been recessed into land that is intended to become "an energy efficient working landscape that will promote climatic cooling" (*A Vision beyond Its Time*, 12). Materials were recycled and locally sourced, and low-maintenance "rain gardens" are planned to encourage awareness of environmental issues (ibid.). A green roof, providing a habitat for birds and insects, is designed to improve air quality and reduce storm water runoff by 75 percent (ibid.). In this case, as we saw in the Australian rationale for reintroducing Aboriginal burning methods in chapter 1, the Indigenous qualities have been couched in terms of very contemporary needs.

Marae are to be found all over New Zealand, and when I was in Otago, I was lucky enough to attend a talk by one of my hosts about a project that has been systematically mapping them. Among the nearly eight hundred tribal *marae*, more and more have been recently abandoned because of economic depression brought on by the nineteenth-century colonial alienation of surrounding tribal estates. Since World War II over 80 percent of Māori have

Figure 3.3 The front of Ngakau Mahaki *marae* is clearly constructed of recycled wooden slats.

Photo courtesy of Ngakau Mahaki.

permanently relocated to urban areas to seek work and raise their families. The speaker was Paul Tapsell, who is professor of Māori Studies at the University of Otago and chair of the not-for-profit organization named Te Potiki National Trust, which is assisting Māori youth in reconnecting to their tribal communities, represented by *marae*. Paul explained some of the history of *marae* and how they were central to Pacific navigation, exploration, and settlement for over three thousand years. Ra'iatea of the Tahitian Islands was a major hub to the East Polynesian expansion of the Pacific from around AD 500 to 1500. In particular, the *marae* named Taputapuatea was central to maintaining navigational knowledge and technology that kept the *marae* of the Pacific connected via great sailing vessels. We will return to consider this matter in more detail in chapter 6.

An important aim of Te Potiki Trust is the reconnection of urban Māori to their originating *marae* communities, both physically as well as virtually. Reconnection provides an opportunity to reunite with kin and reaffirm identity to ancestral landscapes via elders' narratives of their history and heritage. The ancestors of the Māori of Aotearoa travelled across the ocean by named vessels to settle there, and those who know their heritage are able to name not only their current family and their ancestors, but all of their predecessors back to the originating double-hulled sailing vessels on which their ancestors arrived twenty plus generations earlier.

Putting Māori in touch with a *marae* may also be a way to ensure their general health, as we will see in the next chapter.

The Architecture of the Inuit Parliament and Cathedral

A last example for this chapter is concerned with conserving heat and light in an extreme environment, while at the same time drawing on some cultural principles that have long underpinned social relations. The Inuit people, who have since 1999 been administering their own province of Nunavut in the north of Canada, used to live in very clever houses made out of the snow that formed their most abundant resource. The frozen snow was cut into big bricks that were built up into the walls of the igloo, gradually tapering inward so that the last ones would be firmly fixed into

a dome shape at the top, forming an airtight roof, again with no chimney. The house was heated from a small dish of whale oil, which burns slowly and efficiently, producing very little smoke. A tunnel was made for the entrance to the living area, which was therefore protected from drafts, and the inside of the igloo was kept so warm and comfortable that the occupants could remove their thick, animal-skin protective clothes and wear very little inside.

The circular shape of the inside of the igloo allowed the family to sit around the center, where they could see each other and share ideas during discussion. As elsewhere in the Indigenous world, these people were also rehoused by the national government into modern homes with divided rooms that they found much less congenial and possibly less well adapted to the local climate as well, though this is not the aspect I will discuss here. Instead I want to talk about aspects of the shape that have been adopted for two major public buildings in Iqaluit, the capital of Nunavut—namely, St. Jude's Cathedral and the Legislative Assembly Building.

The first looks like a giant igloo (see Figure 3.4), for it is white in color and dome-shaped, with an entrance cut into one

Figure 3.4 St. Jude's Cathedral, Iqaluit.
Photo courtesy of the Diocese of the Arctic.

side—possibly again to keep out the drafts—and a roof tapering neatly off into a cross atop an elegant glass spire, which lets in the natural light. It was initially built in 1970 on much the same model, but the original building burned down in 2005 and only officially reopened in June 2012, even larger and more impressive than before and with packed congregations for the dedication ceremonies. In the old cathedral (which I visited), there were curved benches arranged around its inside walls, as well as pews laid out in a more traditional church fashion, but the new cathedral, which can accommodate twice as many people, has gone for rows of pews curved around the altar. Both buildings also incorporated many symbols of Inuit culture.

As for the Legislative Assembly Building, the meeting hall is also built in the round, and the whole construction designed with smooth, laminated joints to minimize projections, which could capture windblown snow. The overall architectural plan laid out on the website of the company, called Full-Circle Arcop, is said to have been inspired by the Inuktituk word *Qaggip*, which means "meeting place," and it is also adapted to the extreme Arctic climate. Inside, the seats are again arranged in a circular fashion, and symbols of Inuit traditional living arrangements are displayed on a sledge in the middle of the space. Some concession has been made to the "mother of parliaments" in Britain, which influenced the Canadian and Inuit political scene, so there is a large central chair for a Speaker to administer the proceedings, and a mace is carried in to pronounce their official opening. However, there are no separated political parties; every member is symbolically equal in the circular seating plan, and the only other people who are allowed special seats are the elders who attend.

Other aspects of the form of the building—offices as well as the circular meeting hall—are also said to pay homage to Inuit traditions, so the entries at each side of the common meeting area are framed by large curved structures, which are designed to evoke the image of ice skates, a sleigh, or snowmobile runners. All the seats are covered in sealskin, an abundant local resource from animals that have long been used by Inuit for various purposes, except briefly when they had to respond to complaints of Green Peace Warriors who failed to understand the sustainable way that Inuit harvested the animals. The mace is made from a walrus tusk, decorated with

precious stones found in Nunavut, and the Speaker's chair contains Inuit art carved from caribou, walrus tusk ivory, and soapstone.

An article that appeared in the *Nunatsiaq News* (Wilkin 1999) shortly after the building was completed explained that the architectural team included Iqaluit resident architect Keith Irving, and its design followed much discussion about making a building that would fit the local environment, human and physical. According to the lead architect, Bruce Allan, "The building form is really trying to respond to nature," he said, "which demands minimum exterior surface, from the point of view of protection from the cold, and demands the minimum number of irregularities, in view of drifting snow; it also demands maximum opportunity to admit light." Dwane Wilkin, the author of the article, is impressed with the result, and writes, "Soaring ribs of thick glass bind the lobby to its associated parts and suffuse it in a welcome natural light. Two curved wooden walkways span the reception area like the rungs of a *kamotik* over a lead in the sea ice."

It seems that the architecture chosen by a people who have regained control over their lands well reflects the science that probably used to underpin vernacular architecture the world over!

Chapter 4

Health and Death

The Green Cream

During my visit to Australia in 2011, I was given quite a lot of help by the Australian Aboriginal anthropologist Marcia Langton, who introduced me to various Aboriginal scholars and even to some of her own relatives. She was keeping an eye on a "nephew" from the Kimberley region who was studying near Melbourne while I was visiting, and he came along with us on a couple of outings. The first time I met him, she had revealed that he wasn't a very talkative young man, so while we were having lunch, I made a bit of an effort to see if I could find a subject to interest him. We had visited a splendid art exhibition at the Victoria National Gallery, paintings by a European artist whose depictions of landscapes were very beautiful, but his only comment on these, while rather interesting, didn't lead to a long conversation. "They might as well be photographs," he said. Bearing in mind the amount of information depicted in Aboriginal paintings in Australia, this is actually a very culturally appropriate remark!

The subject that turned out to be a really good opener was when I asked him if they had many local remedies for sickness in the community where he lived. "We certainly do," he said, "and they are much more effective than the ones you can buy in the shops." He began to tell me about the many ways in which different types of eucalyptus may be prepared and used to treat ailments ranging from a common cold through stomach upsets to quite severe asthma. This young man had clearly been chosen to learn about these remedies for he went on to talk for some time about different

possibilities—perhaps that was why he was sent by his community to study in Melbourne. And indeed, I was left wondering why more people in Australia don't take advantage of all this wonderful Indigenous wisdom. Eucalyptus trees are certainly not in short supply!

A few weeks later, when I was travelling through the country, I happened across a collective of Aboriginal women healers in one of the side streets of Alice Springs. Named Akeyulerre after a nearby hill, it turned out to be a place that had been started by a group of Arrernte elders who felt there was a need for a place of healing in their community. It ran for seven years with minimal funding but now receives support from an organization called The Healing Foundation, set up in 2009 after the prime ministerial apology to the "stolen generations" of Aboriginal children to help heal the trauma caused. This has increased the capacity of Akeyulerre to provide healing to the Alice Springs community and to enable elders to conserve their Indigenous knowledge and pass it on to younger people. They also have a bush garden to grow the plants they need to make the medicines, and they specialize in producing a series of creams and massage rubs. Now they have a stall at the local Sunday market and offer their goods for sale to the general public.

People there were a little reluctant to answer questions: they were all quite busy and understandably somewhat nervous about sharing the kind of knowledge that pharmaceutical companies are very good at purloining for minimal recompense, but I was lucky enough to meet a young MA student from Sydney who explained these things to me and told me about the way the organization works. Others were quite friendly too, and I ended up buying myself a pot of green cream said to be good for skin complaints. There is no information about the plants used, but the cream is made with a basis of beeswax, and it is very easy to administer. Actually I still carry it with me, as I mentioned in the introduction to this book, for it heals all kind of problems a couple of days more quickly than a regular antiseptic cream and is effective for almost anything I have tried. A nasty coral cut on my big toe, for example, healed up in no time, whereas other Australians had reported coral injuries as notoriously slow and difficult to heal. Clearly again a local remedy works for a local injury!

Aboriginal Health Studies at Melbourne

As mentioned in the introduction to this book, a couple of months of my research for it were carried out at Melbourne University, where I was able to visit departments and people who might have an interest in Aboriginal science of one sort or another, and several of these interests were related to medicine and health. Quite early on (and serendipitously because I had missed a bus after a lecture), I met Professor Ian Anderson, a medically trained Aboriginal academic, who had been appointed to head a newly founded section of the university known as Murrup Barak: Melbourne Institute for Indigenous Development. Murrup Barak was named after William Barak, the best known leader of the Wurundjeri people who lived in the area now occupied by Melbourne, and the term in their Woiwurung language means the "spirit of Barak."

This institute offered support of various kinds to Aboriginal students at Melbourne, including links with Australia-wide Indigenous tutorials, newspapers and computer labs, and weekly lunches, sometimes with a discussion. I was invited to attend such a lunchtime gathering designed to give Aboriginal medical students a chance to share their experiences with each other, and with Professor Anderson and others, notably Marcia Langton. Actually, the occasion was quite distressing for several reasons. First of all, there were very few Aboriginal medical students, just three in attendance; secondly, the one who spoke most explained that he felt very much an outsider in a classroom that seemed to be full of groups of friends from the big private schools of the city; and thirdly, the course not only paid no attention whatsoever to Aboriginal knowledge, but the other members of the class seemed to think that all Aboriginal Australians were drunken layabouts who lived off the welfare system. I was moved to tell the student that studying medicine is difficult for everyone, but Marcia cut me off and gave him advice about how much worse life would get and how to build up defenses to deal with it.

Marcia Langton's appointment is not actually in the Anthropology Department, where I was located, but in the School of Population and Global Health in the Faculty of Medicine, Dentistry and Health Sciences. She had explained to me that she was interested in a job that would help to improve conditions for the Aboriginal

population, and this School's stated mission is "to strengthen the understanding, capacity and services of society to meet population health needs and to improve the quality and equity of health care," where population health is defined as "an approach to health that aims to improve the health of the entire population and to reduce health inequities among population groups" (http://pgh.unimelb.edu.au/about/profile). Marcia's work in the community goes far beyond her role in the School—she is often to be seen on television, making speeches, opening events, and even appearing in a feature film—but she did introduce me to some other people who were working in this department.

For example, Lyndon Ormond-Parker is a Research Fellow with the Centre for Health and Society, an Australian Research Council Discovery Indigenous Award recipient collaborating on the project entitled Local Aboriginal Community Archives: The Use of Information Technology and the National Broadband Network in Disaster Preparedness and Recovery. He has edited a fascinating book based on a conference he organized on the use of Information Technology in Indigenous Communities, and we will look at some of this work in more detail in chapter 8. He also played several other roles, such as helping Indigenous postgraduates through Murrup Barak and assisting Marcia with some of her projects. When I was due to set off traveling to other parts of Australia, he got in touch with Aboriginal scholars he thought might be able to help me and arranged for me to meet them when I arrived in Adelaide, Alice Springs, and Darwin, his own home territory, giving me some immediate access to people whom I might never otherwise have discovered.

In 2011, as chair of the Indigenous Graduate Students Association at the University of Melbourne, Lyndon organized the Inaugural Aboriginal and Torres Strait Islander Research Symposium on the theme "Putting Aboriginal and Torres Strait Islander Research to Work." In his welcoming address, he laid out the aims of the occasion to provide opportunities for Indigenous students from different departments to network, to enable other staff and students in the university to meet their Indigenous counterparts in the various fields, and—quite simply—"to showcase the breadth and excellence of Indigenous research being undertaken at The University of Melbourne" (symposium program). I wasn't able to

attend this meeting, but Lyndon sent me the program, and it is quite impressive. There were 39 papers presented, and nearly half of them were about research related to health.

Richard Chenhall is another member of this department, a medical anthropologist who has written a well-received book about a residential center for Aboriginal people recovering from alcohol and drug dependency. The book is quite theoretical, using various worldwide ideas about drug and alcohol addiction, and methods for treatment and rehabilitation (notably those used by Alcoholics Anonymous), but it is also grounded in detailed local ethnographic illustration. There is one chapter that addresses the question of culture in treatment, actually a much more common theme in the North American literature, but the aspect of Australian Aboriginal culture that he found most prevalent in the discussions of the staff and inmates has to do with spirituality. Chenhall reports that those who have succumbed to addiction feel that they have lost something of their Aboriginal spirit, a spirit that is also their link with their family, their land, and their people, so as they seek the road to recovery, they are also seeking to mend and strengthen that spirit. One of the residents put this neatly when he said, "We gotta take the spirit out of the bottle and put it back between us" (Chenhall 2007: 225).

There is an historical element to this argument because loss of spirit among Aboriginal people is also blamed on the disruption caused to their lives by the settler populations, and alcohol and drugs were introduced by them, so their use can be seen as both a rebellion against and an acceptance of introduced culture. The regaining of control, as addictions are conquered, especially if they are controlled by Aboriginal groups together, can be seen as part of a larger Aboriginal movement of self-determination, Chenhall argues (2007: 226). This is a theme that recurs in another part of the School of Population and Global Health called the Onemda VicHealth Koorie Health Unit, which is a department committed to enabling as much research as possible to be done by the Koorie (Aboriginal) community for the Koorie community (http://www.onemda.unimelb.edu.au/about-us).

The North American literature referred to above is recounted in the work of Maggie Brady, who published a paper (Brady 1995) that describes the speed with which the idea of using culture as

treatment in addiction rehabilitation programs for Native North Americans, including First Nations Canadians, was transmitted to Indigenous Australians (Brady 1995: 1487). She reiterates the political points made above and notes that solutions, for many First Nations and Aboriginal peoples, are often articulated in the form of programs that reassert native identity and stress that traditional cultural beliefs and practices constitute a form of treatment in themselves (ibid.: 1488). She and Chenhall are both cautious in their use of these ideas in the Australian case, and she is even a little skeptical about the efficacy of the idea in North America, but she does give a fair hearing to the arguments made in Canada and the United States.

She describes in detail, for example, the use of a Native American sweat lodge as part of treatment programs. These are constructions covered in blankets or skins, where stones are heated up over an open fire and water poured over them to create steam so that the result is like a kind of sauna. Participants sit together in them for up to 30 minutes. There are several positive outcomes, according to Brady's article. First, taking part is an expression of identity, embodying "a feeling of Indianness," so it gives people a sense of who they are. Secondly, there is a strong physical sensation of cleansing and detoxification (certainly part of the Indigenous rationale), but here it is also presented as offering a psychological benefit in that it represents a purification, a renewal, and a fresh start; it is also a definite rite of passage for those who have decided to reform. Finally, it has been reported as sometimes bringing about an intense spiritual awakening (ibid.: 1492–93).

Brady reports that the only real local equivalent of seeking cultural healing in Australia would be to go and spend time "in the bush," where "the land itself is understood to nurture and heal those who live upon it and who partake of its resources" (ibid.: 1494). Eating bush food is therefore also thought to be therapeutic, and some remote "outstation" communities are alcohol-free. However, this is not really much used as part of a healing program because localized healing knowledge is secret and not easily shared. A more recent paper by d'Abbs and Chenhall (2013) surveys a few more ideas about the relationship between spirituality and Aboriginal healing, including looking at places where Christian missions have addressed the problems and some new-age ideas associated

with Aboriginal dreamtime, but they have only located a few local cases of success in treating substance abuse and addiction with reference to Aboriginal ideas of spirituality. I suspect, however, that this might be a process that could still be developed.

In my own experience examining culture centers in different parts of Canada, I often heard the phrase "culture is healing," and the provision of language classes, performance possibilities, the revival of rituals, and the availability of elders to consult were all offered as examples of how culture centers could help with the process. Alcohol was often prohibited at the gatherings they organized, and the same was true of conferences to discuss such issues. Often these culture centers are largely oriented to the local First Nations, but in Winnipeg, where a variety of peoples congregate, including Métis, there is a center called Thunderbird House that offers "healing and healing ways" to anyone who ventures inside. It has an interesting circular shape, as a building, and nearby there is a splendid sweat lodge and even some tepees.

Another practice I learned about while living on a First Nations reserve in Canada was more directly related to using Indigenous medicines, although interestingly in an institutional context. I was reading in the local library in Ohsweken, the main town of the reserve of the Six Nations of the Grand River, near Brantford, Ontario, while the daughter of the librarian was giving birth in the nearby university hospital. I used to go regularly to check my e-mail messages there, so I made a point of asking after her daughter and the new grandchild when it was born. For a while, the child seemed not to be developing very well, and everyone who came into the library became concerned.

Then one day, one of the readers suggested that the librarian ask the hospital to let the daughter try the baby on some "Indian medicine" that she could recommend. The librarian was keen to find anything to help her daughter and agreed to procure and take along a supply of the proposed medicine. It seems that the hospital agreed to try out the treatment, and within a few days the baby was out of danger and soon allowed to return home to her family. During subsequent discussions, I learned that the hospital is actually quite open to the suggestions of members of the local First Nations, although I didn't have an opportunity to follow up the incident with any more serious research during my stay in Canada.

MĀORI THEORIES OF HEALING

In New Zealand, several Māori theories about healing have become rather well-known, and at a very minimum, hospitals need to equip themselves to respond to the expectations of their Māori patients. My first contact with Dunedin Hospital during my visit to the University of Otago was through Fiona Goodwin, the daughter of Angus and Kirsty McLeod, whom we met in the last chapter. Coming from Lewis, she was perhaps particularly sensitive to Indigenous issues, but she had received local training to ensure what was described as "cultural safety" for the Māori patients. She explained, for example, that there is a taboo among Māori about bringing food into the area where a person has died, and this is so strong that different elevators need to be used to move food and waste around the hospital and to move the bodies of those who have passed on. There is apparently also a system of using different colored facecloths and towels for appropriate purposes to avoid any pollution in Māori terms, and there is also always someone available in the hospital to take care of Māori spiritual needs when the occasion arises, notably in the case of death.

Moreover, Māori patients become very distressed if they suffer enforced separation from their families when they are ill, so facilities have been developed for the families to remain close, and there is always a *whanau*, or family room, in the hospital, which may be used at any time, including overnight stays. Indeed, a ruling, possibly sent out from the United Kingdom, about separating adult patients from their close kin during interviews with the doctor has been reversed in general in New Zealand, so strong is the idea that involving family will help the healing process.

The principles behind this idea, and several others, have been laid out very clearly by a retired Māori psychiatrist and university vice-chancellor, Professor Sir Mason Durie. Again there is a sense of holism in his theory, which is basically that personal good health requires attention not only to the physical body, but also to the spiritual, and at the same time the support of the family and the community. A well-known diagram that illustrates this principle is that of a house built in the shape of a *marae*, which has sections for each of physical well-being, mental and emotional well-being, social well-being, and spiritual well-being (see figure 4.1). Durie's

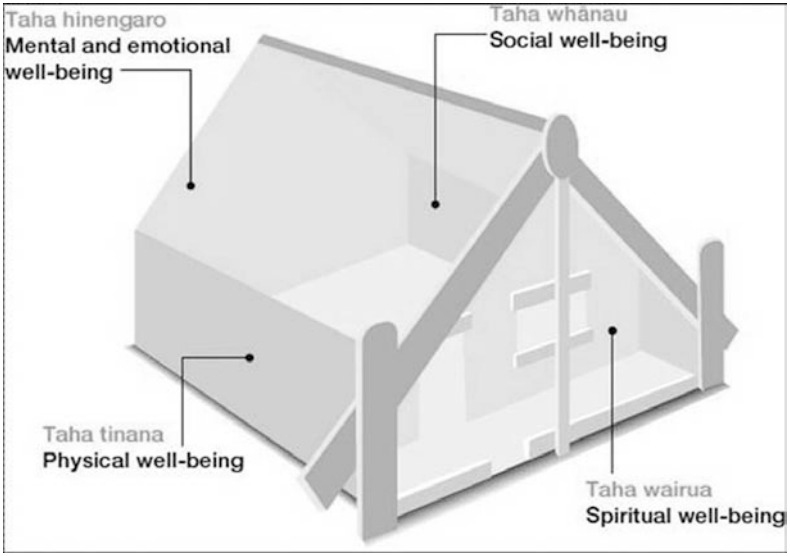

Figure 4.1 Te Whare Tapa Whā: Mason Durie's model of the requirements for personal good health.

Source: Ministry of Health 2013 (health.govt.nz).

work as a professor of psychiatry and university administrator enabled him to pass on these ideas widely, and evidence of his influence is clear in the way that hospitals now operate in New Zealand. The principles illustrated in figure 4.1 may also be found in various publications put out by the Ministries of Education and Health in New Zealand as I found out when seeking permission to reproduce it.

Durie was also concerned with the health of the whole Māori community, and another famous diagram he drew up was based on the model of the constellation of stars known as the Southern Cross, which was an important navigational aid in bringing the Māori to the islands of Aotearoa, or New Zealand. Here there are six major points, which include cultural identity, physical environment, and community leadership (see figure 4.2). Durie (1999) explains the model, noting the importance of the first appointment at the turn of the century of a Māori medical officer, Dr. Maui Pomare, to the New Zealand Department of Public Health. This enabled the involvement of Māori leaders in the planning of health

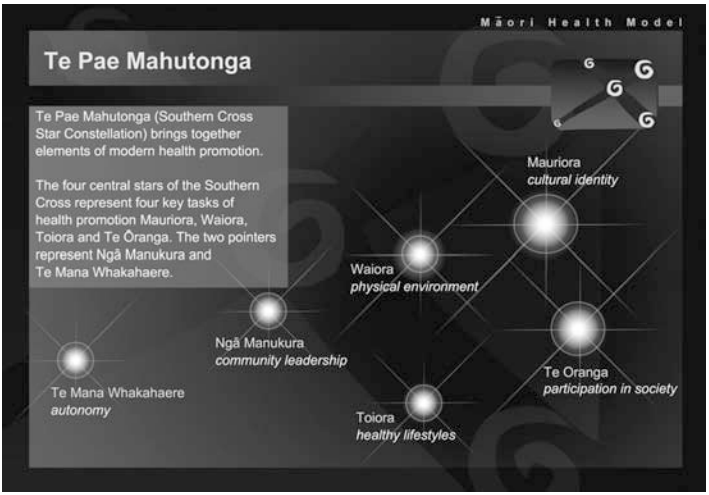

Figure 4.2 Te Pae Mahutonga: Mason Durie's Southern Cross diagram for Māori health.

Source: Ministry of Health 2012 (health.govt.nz).

projects, such as sanitation and a good supply of water for their communities, and also in other aspects of socioeconomic life, such as housing, employment, land development, and care of the elderly.

Crucial to the whole venture, however, was recognition of the value to Māori health of having access to Māori cultural identity, or elements of *te ao* Māori (the Māori world). According to Durie, this includes access to language and knowledge, culture and cultural institutions (such as the *marae*), land and other economic resources (such as forests and fisheries), and family, networks, and Māori services (ibid.). Durie (2005) has also written about the subject of Indigenous knowledge and the problems that arise when it is seen as distinct from a more widely accepted idea of science. Like other Indigenous scholars, he emphasizes the close relationship between Māori knowledge, or *mātauranga*, and the environment, but he also argues for research at the interface with more conventional scientific knowledge. Although his Southern Cross model includes an element of autonomy, he advocates mutual respect between the systems of knowledge and the ongoing discovery of shared benefits (2005: 18–19; see also Hikuroa et al. 2011, which we will discuss in chapter 9).

During my stay at the University of Otago, I was able to witness some more of the success of Durie's teaching, for at St. Margaret's College, where I was housed, there were many students of medicine and other health sciences, and they talked to me of the Māori parts of their training. For students of medicine in their second year, it was a complete week, and it was intensive, including visiting a local *marae*, where they were introduced to some basic Māori culture. I only found a couple of young men who actually claimed Māori heritage among the students staying there, but one of them was friendly and talkative, and he invited me to a theatrical production the Māori students were putting on while I was there. There was a good turnout then, and another evening he was off to a Māori student ball, so it certainly seemed to be the case that the university was taking care of the Māori aspect of health that involved community.

Toward the end of my stay, I was able to get an interview with Associate Professor Joanne Baxter, a Māori of the local Ngai Tahu *iwi* who held the position of associate dean Māori for the Dunedin School of Medicine and the Division of Health Sciences, and was director of the Centre for Hauora Māori [Māori health], Dunedin and the Health Sciences Division, and the Māori Health Workforce Development Unit. She was also involved in research into Māori health in the medical curriculum, Māori mental health, Māori medical workforce development, hazardous drinking among tertiary students, and ethnic inequalities in health, so she was both extremely well-informed and very busy. She was generous with her time, however, and I gained a much clearer understanding of the Māori situation after a valuable couple of hours with her.

First, she identified that most health-professional groups in New Zealand do have an expectation of cultural competency as part of their standards of practice, and many professional groups also recognize the Treaty of Waitangi as an important foundation for relationships with Māori and for influencing health policy and strategy. Cultural competence with Māori is a pivotal part of cultural competence within a New Zealand context. Within health-professional education, nursing initially led the way in training in cultural safety, and over recent decades there has been significant growth and innovation in Māori health teaching across the health

professions. Now there is a wide range of approaches and initiatives aimed at building cultural competency among health professionals and a focus placed on all professionals having awareness about Māori health.

Professor Baxter oversees the delivery of the Māori health curriculum in the Dunedin School of Medicine, and she explained that the medical school now has a comprehensive curriculum in Māori health spanning all years. The curriculum includes the historical, social, and economic contexts of Māori health, reflective practice, understanding Māori health status and its determinants, building positive relationships with Māori patients, *whanau* (family), and communities, and an understanding of Māori population health and research. This curriculum has been very successful, with the majority of students engaging positively. An example is the second year of the medical school curriculum where the class of around 290 students spends much of a week exploring aspects of Māori health in a number of environments. As part of this, they spend a day at one of the local *marae* experiencing concepts of health within a Māori cultural context. This includes *tikanga* (cultural beliefs and values) and *te reo* Māori (Māori language). On another day, students learn about the Treaty of Waitangi and its relationship to health. A strong thread across all the teaching is the aim of supporting reflection of students' own beliefs, values, and experiences in relation to what they are learning. Professor Baxter reports that the students are very diverse in background but on the whole respond and engage well with this experience. While in the past there were at times challenges to the need to learn about Māori health, this has now changed, and there is wide acceptance and valuing of *Hauora* Māori as a key part of medical education. Professor Baxter identified that this reflective practice aligned closely with the art of medicine; however, an understanding of Maori health within a scientific focus was also needed. This was evident in areas such as epidemiology, where students are required to understand Māori health status and be able to interpret research findings and analyses in relation to Māori health.

Supporting the recruitment and retention of Māori students into and through health-professional tertiary study has been an important priority for the Division of Health Sciences at Otago. As the director of the Māori Health Workforce Development Unit,

Professor Baxter talked about a range of programs and initiatives that have supported a significant increase in Māori students gaining places in health-professional programs in recent years. The University of Otago does not have a quota system or specific places in health-professional programs specifically for Māori. Rather, Māori students are supported to reach the required academic standard for entry to health professions through delivery of a range of programs that provide academic support in a culturally responsive environment. The medical school intake at Otago has in recent years experienced a large increase in Māori gaining entry, with around 15 percent of the intake being Māori in 2012 to 2014. This aligns with the proportion of Māori within the population and bodes well for having a medical workforce that represents the New Zealand population in the future.

Alongside the health curriculum and growing the number and outcomes of Māori students in health-professional programs, Professor Baxter also highlighted the important and growing role that research in Māori health is playing in contributing to Māori health policy, strategy, and services. Over recent decades *Kaupapa* Māori research (research undertaken within a Māori-centered and Māori-focused framework) has become recognized as an important approach for Māori researchers in health. Professor Baxter emphasized that *Kaupapa* Māori research does not specify a particular method of research and that it can encompass many methods both quantitative and qualitative. Examples of *Kaupapa* Māori research in health undertaken at Otago University includes research into inequalities in health service access for Māori when compared with non-Māori, factors affecting the health and well-being of Māori mothers and babies, and Māori oral health-care access and outcomes. These research projects, alongside many others, are making an important contribution to raising awareness about Māori health needs and approaches to addressing Māori health and reducing inequalities.

Death

Professor Baxter also reinforced Fiona's informal report above that, within the medical school, again there have been a number of important advancements supporting recognition of the importance

of understanding Māori spirituality and issues associated with dying and death. At medical school students receive a range of teaching in death and dying, including teaching in Hauora Māori about cultural views and practices. The learning from this session is reinforced when students learn about *tikanga* (traditional values, beliefs, and practices), and students are made aware of *tikanga* best practice when dealing with death and dying among Māori.

The Anatomy Department, in partnership with other areas within the university, provides a special service called a *whakawatea*, or "clearing of the way." This ceremony involves a blessing of the anatomy dissection room, undertaken by a Māori *kaumatua* (elder) and involving special *karakia* (prayers). Although this is not compulsory, a vast majority of medical students who are invited attend this *whakawatea* and appreciate the importance of this blessing. Again, Professor Baxter highlighted the importance of this process in supporting students to reflect on their engagement with *te ao Māori* (the Maori world).

In fact, there are several other issues related to the care of the dead and dying in any society, and this has become another matter for concern among the medical profession and other carers in societies with Indigenous populations. It may seem to be more of a spiritual or cultural matter than a scientific one, but in practice, methods of dealing with members of the community who are reaching the end of their lives are often rather carefully thought out to involve a minimum of pain, both to those who are dying and those who will be bereaved. I attended a lecture about hospices and palliative care by a lecturer in health promotion at Otago University Medical School, Richard Egan, and although he didn't mention much about the Māori influence during his talk, he did concede that the work of Mason Durie had made some profound changes to New Zealand ways of thinking about life and death. I guess that the qualifications of Professor Durie as a psychiatrist working within a system until that time largely introduced from the outside world gave him a voice other members of his people may not have achieved.

On the other hand, a novel by the well-known Māori author Witi Ihimaera introduces directly many important ideas associated with mourning in Māori society, and the title of the book, *Tangi*, indicates that this is the main theme, although there is much more

to be learned about family life within the Māori world from this moving story about the relationship between a son and his father. Ihimaera became famous even outside Aotearoa when the film of his book, *Whale Rider*, was distributed rather successfully throughout the English-speaking world, but I found when mentioning his book *Tangi* during my stay in New Zealand that many people had not only read it, but felt they had learned from it.

* * *

Although I started this chapter with a story from Australia, I think perhaps it is in New Zealand where the most wisdom has been adopted from the Indigenous people to the mainstream society. There too, Māori scholars express a sense of still fighting against the enormous edifice of Western medicine, but there seems to be more of an acceptance among at least the most intelligent *Pākehā* that they share their land with people who can offer some profound ideas to that body of knowledge they call "science." In Australia I found plenty of examples of people and institutions who were engaged in "helping" their Aboriginal populations in some way, but it was harder to find those who felt they could learn anything from them. It has been a while since I worked in Canada long enough to get a sense of what members of the wider population feel about their First Nations, but an idea that I hope may be out-of-date is that they are tolerated, rather than properly respected for the wisdom they have transmitted through the generations.

Chapter 5

Calendars and Climate Change

32 Phases of the Moon

Toward the end of my travels in 2011, I was engaged to help some people in two of the smaller Cook Islands to put together proposals for research projects. In both cases, the first language of these people was still Māori, and many of them retained and used a good deal of their Indigenous knowledge in their everyday lives. Some were planning to use that knowledge in their research projects, so for me, it was an enlightening experience. I was accommodated in local homes: in Mangaia in a kind of B and B, where I was treated to a variety of local specialties, which were always served up with interesting conversation from my host; in Atiu, a self-catering situation, but I was brought an abundance of fresh (and coincidentally organic), locally grown food. Generally, I was introduced in a most exciting way to life in communities that were linguistically related to the people in New Zealand with whom I had been working but who had become less integrated into a Western way of life. Christianity has taken off in a big way in the Cook Islands, but its practice has definitely been given its own character, and that aspect of life there was interesting in itself.

On the island of Atiu, one of the people in the group explained that she wanted to look into the way the phases of the moon are used to make decisions about planting and fishing. She was barely beginning the project, so there was still a lot of work to be done, but she explained a very complex and detailed process of decision

making that I think is worth raising in this chapter. The light of the moon in its fuller phases is of course important for nighttime fishing, and this was one aspect that is easily understood, but the people of Atiu also hold strong ideas about the best times for planting the various crops they grow. When I asked about the general principles used, thinking that maybe some things are planted as the moon waxes and others as it wanes, the student explained that they take into account 32 phases of the moon—so this is a pretty specific set of rules. Judging by the taste, size, and texture of the locally grown food I had been given, these ideas could certainly be expected to have a longstanding scientific basis, which the student planned to investigate.

In fact I have since found some published work on using the cycles of the moon for socioeconomic activities, and the Māori word *arāpō*, literally meaning the "path of the night," is used to describe this set of scientific knowledge (Moeka'a 1994). Rangitukua Moeka'a is a Cook Islander himself and has tabulated some of the ideas about phases of the moon that are beneficial for particular activities, and he adds from his own experience that following these principles does indeed bring success, both in fishing and growing good crops.

Indigenous Calendars in Australia

The Cook Island case is of course but one example of an Indigenous use of a locally devised calendar, and people all over the world have developed calendars to suit their own climate and environment. Many of the peoples of Indigenous Australia have now transcribed calendars that they had previously handed down orally or through symbolic paintings, and they usually include reference to the plants and animals that are to be found at particular times to enable the efficient and successful process of food gathering (see figure 5.1). A very detailed calendar was reproduced in a brochure handed out to tourists who visit the Kakadu National Park in the north of the country, and it illustrates both the detailed knowledge incorporated into its design and a view of seasons much better adjusted to the local climate than the more standard one introduced from Europe. Actually the seasonal calendar introduced from Europe, alongside various alien species of tree and other plants, is totally

inappropriate to the prior Australian ecosystem, as can even be seen in the urban developments of the first settled areas in the southeast, when Indigenous trees flower in the "winter" and bush fires rage out of control in the "summer" for which the land should have been prepared (as described in chapter 1).

Richard Baker's paper about the land use of the Yanyuwa people in the Borroloola region, mentioned already in the context of fire management, explains very clearly how the Yanyuwa calendar he illustrates is deeply embedded in a sophisticated understanding of seasonal variations in the lives of plants and animals and related changes in the use of land and marine resources. Whereas settlers in northern Australia refer to a "dry season" and a "wet season"—and it all felt pretty hot to a visitor from Northern Europe—all the Aboriginal groups in the area make much finer distinctions, identifying five or six separate seasons, along with the activities customarily associated with them. The local people are also acutely aware of the sometimes devastating changes to their seasons, their lands, and their activities resulting from the introduction of settler modes of life, such as rearing cattle, mining, and planting inappropriate crops, like rice.

To explain the complexity of the calendar, Baker prints and discusses three versions, each drawn as series of concentric circles, with the 12 months of the Gregorian calendar around the outside. The first one makes reference to the weather that is likely: the range of temperatures that are expected, the likelihood of rain and its quality, and the force and direction of the winds that will blow. There are five main seasons, but each has subdivisions, and their names are sometimes quite graphic; for example, there is one called "knock-him-down rains" and another "morning glory" (in reference to big clouds that roll along the coastline, sometimes lit up by sharp electric storms that can set fire to grassland if it has not been burned regularly). As the earth dries out and the temperature soars, so the water courses diminish, and islands and "capes" may appear in the channels between the more permanent landscapes.

A second version of the calendar enters all the animals that may be caught during the different periods, and Baker explains some of the details of why particular seasons are good for particular animals, perhaps because they migrate or they are easier to catch at certain times. There is, however, a ban on hunting animals when

they are breeding or weaning their young: flying foxes are avoided in February, for example. The rolling clouds seen in the "morning glory" season indicate that flying foxes and certain bird species are about to begin their migration. Baker's third version of the calendar illustrates all the plant food that is available at particular times and, sometimes, when it should be harvested or prepared. Like people everywhere else in the world, the Yanyuwa have a cycle of festivals and rites of passage, and these too find their place in the calendar, perhaps taking advantage of an abundance of a particular kind of food.

During my time in Australia in 2011, I was invited to give a presentation at the University in Adelaide, and I took advantage of being there to visit the Aboriginal gallery Tandanya. Fortuitously, there was an exhibition of linoleum prints by a contemporary artist from the Torres Strait region, which included much material that is highly relevant to this chapter. Sadly, the artist, Billy Missi, died at the young age of 42 in late 2012, but his work remains as a wonderful legacy, full of Aboriginal science. The prints were all accompanied by quite detailed explanations of the knowledge they contained, so this exhibition opened my eyes to the possibilities Aboriginal art contains for recording local knowledge and wisdom. Some of the prints also made reference to dances that were performed and songs that were sung to coincide with particular changes in the seasons, which adds a further dimension to the transmission of this valuable knowledge.

For example, one of Missi's prints, called *Gainau Au Kubi* (flock of Torres Strait pigeons), illustrates the way that the seasons, with their characteristics for harvesting good food from the sea, were marked by the sightings of migrating birds, animals, the progress of the growth of vegetation, and the arrival of rains. In this particular print, birds called *gainau* (or Torres Strait pigeons) are seen flying across the sky, depicting their annual migration south from Papua New Guinea's western province to the coasts of Cape York. This was an indication to people that the season had arrived when turtles would be mating and the sharks carrying eggs, according to the explanation alongside the print, so these beasts would be "very vicious and touchy" (Missi 2008: 22). Another of his prints, named *Zagan Gud Aladi*, which refers to a constellation of stars, links the same season to changes in the night sky and provides more very

graphic detail about the movement of living beings in land, sea, and air; so, for example, the pregnant sharks can be seen chasing big fish that are chasing little fish called *zagal* that are prevalent at this time (see figure I.1 in the introduction to this book).

Another of Billy Missi's prints, entitled *Gabau Ahgai Thonar* (yam dig up time), indicates not only the best time to dig up the wild yams, but various other aspects of the season, such as the position of *zugubai* (constellations) and the relationship between phases of the moon and the climate. Thus, although the yam vines grow green and abundant in the heavy monsoon rains, these will be followed by a dry season when the leaves of the yams start to turn brown, along with the grass. This is the time to dig them up (ibid.: 46), the time when they are ready to prepare and eat. The explanation alongside this print points to the significance of the yam harvest for marking the "rhythm of our region's ecosystem" and "the timeframe of seasonal changes" (ibid.).

Climate Change and the Value of Indigenous Knowledge

Because Indigenous peoples around the world have kept such detailed and accurate records of the various interrelated aspects of their environment, they are also keenly aware of change as it happens. They can thus talk both of the variety in different years, depending on the vagaries of unpredictability in their climate, and the longer-term changes that have taken place over time. Archaeologists have even found evidence in Australian Aboriginal stories and rock art to back up their theories about changes to the landscape thousands of years ago (Green, Billy, and Tapim 2010: 338–39). People who live close to the land, and especially those who identify themselves with aspects of the land, are also acutely aware of changes that have been caused by the introduction of outside ventures, especially where these cut through their food and water supplies, and Australian Aboriginal stories are full of the damage that has been done to deep, personified spirits that form part of their lands.

Something that has rather recently been noticed by the wider society is that this kind of understanding of the environment can be interrogated to seek evidence (or otherwise) of the climate

change that has become a global concern in the last decades. The starkest cases have been reported from those who live close to the Arctic Circle, where Inuit, Athapaskan, and other Indigenous peoples have been finding evidence of the retreat of the polar ice cap for some years now. In 2003 when I visited Whitehorse in the Yukon, a debate was raging about what should become of a "spruce-hat man" whose remains had emerged from a melting ice cap said to have held his frozen form for many hundreds of years. An important issue at the time was one of ownership: should these ancient bones be allowed to go to a museum, or should they be released for proper burial by people likely to be his descendants? Of course, it was also an example of the receding ice cap, and by 2009, Indigenous peoples from all the Arctic regions of Canada cooperated to present evidence at the Copenhagen conference on climate change.

Actually a major transnational study—the Arctic Climate Impact Assessment (ACIA)—already in 2004 claimed that climate change in the Arctic was happening at a faster pace than elsewhere on earth, with important implications for the rest of the world and with major economic and cultural impacts for Arctic Indigenous peoples (Martello 2008). The study is built on the cooperation of the eight nations with Arctic regions—Canada, Denmark (for Greenland and the Faroe Islands), Finland, Iceland, Norway, Russia, Sweden, and the United States. It specifically draws on the "special knowledge" of the many Indigenous people who have lived for generations in the Arctic region and also involves scientists with specialist knowledge from a series of other countries and nongovernmental organizations.

Examples of the early Indigenous observations quoted in the report include the thinning of ice and a reduction in the number of ringed seals by the Inuit hunters of the Canadian province of Nunavut, who have also noticed birds and insects not seen before in the area; dramatic changes in the weather systems and vegetation patterns reported by the Aleut, Athapaskan, and Inuvialuit peoples of Alaska and western Canada, where frequent thunder- and lightning storms were found when they had been rare in the past; and such strong and variable changes in the prevailing winds on which the Saami reindeer herders in the north of Norway relied for navigation that they have been forced to find new travel routes

(Arctic Climate Impact Assessment 2004: 92). All these peoples are known for their flexibility and adaptability, the report emphasizes, but recent changes have apparently brought quite unexpected challenges (ibid.).

All these peoples have political reasons for their contributions because their keen awareness of the dangers posed by these unprecedented changes—including very practical dangers like falling through unusually thin ice—also make them aware of the implications for their cultural survival. They can see the threat to their ability to continue their traditional ways of making a living, and indeed one of the chief aims of the ACIA project was to examine the environmental and social implications of climate change for peoples and animals inhabiting the area. However, an important aspect of this ongoing study is its awareness of the need to take account of the "special knowledge" of the Indigenous peoples and use it in order to make "scientific" assessments of the situation. According to Marybeth Long Martello (2008: 353), the images of these Indigenous peoples, along with their experience and expert knowledge, are also being held up as harbingers of the fate that awaits all of us if we fail to take account of this environmental degradation. Certainly reports such as that of ACIA make clear that invaluable science is being held—and now used—by Indigenous peoples.

In Australia, the Bureau of Meteorology now has quite a substantial part of its regular website devoted to Indigenous weather knowledge, which it describes as "a precious heritage," and it has initiated a Reconciliation Action Plan with a vision "to harness and celebrate the culture and skills of Aboriginal and Torres Strait Islanders for the benefit of all Australians" (http://www.bom.gov.au/inside/rap/reconciliation-action-plan.pdf). There is also an Indigenous Careers Program advertised, offering books and other materials, as well as holiday "cadet" work to help support the study of a range of fields, including meteorological and environmental science. The Bureau of Meteorology also made a contribution to the big research project into water management, headed by Sonia Leonard and discussed in chapter 1, which was largely cofunded by NAILSMA (the North Australian Indigenous Land and Sea Management Alliance) and the Mirima Language Centre in Kununurra.

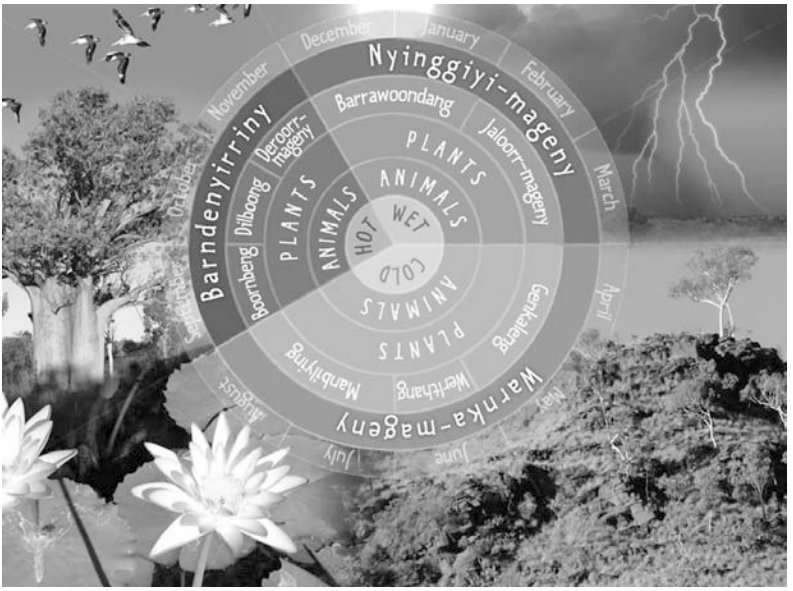

Figure 5.1 Miriwoong Seasonal Calendar developed by Mirima Dawang Woorlab-gerring Language and Culture Centre (www.mirima.org.au).
Photo courtesy of the Mirima Dawang Woorlab-gerring Language and Culture Centre.

Sonia explained to me that the project was not at first specifically about the calendar, but the local explanations of traditional ecological knowledge (TEK) that they were discussing always came back to the detail of the calendar. For Miriwoong people the calendar not only divides up the year, but links in reciprocally all the movement and activities of the flora and fauna in the area traditionally enabling people to find enough food, water, shelter, medicines, and other resources they needed to maintain healthy lives (see figure 5.1). Events marked by the calendar also triggered certain regular activities, such as harvesting, hunting, and the safe burning of the lands (Leonard et al. 2013a: 628). For example,

> The time to collect, hunt and fish is related to the season, the associated weather conditions, and phenological events. For instance during Derorr-mageny (a sub-season of the hot season) clouds begin to gather and thunderstorms are common in the late afternoon. Miriwoong people know the thunderstorms are coming through the observation of flowers on the Woolegalegeng (silver leaf paperbark

tree). The arrival of thunder in turn is an indicator that Garelng (bush melon) are ready to be harvested (ibid.)

More valuable to those interested in climate change, however, is that the Miriwoong people have recorded change in the way that their calendar works and adaptation to that change over long periods of time. Leonard, Parsons, Olawsky, and Kofod ibid.) were able to carry out in-depth analysis with Miriwoong specialists of the TEK they had collected, and this revealed considerable insight into ecosystem dynamics on a local level and, when coupled with other sources of knowledge, variations in climate over quite wide geographical and temporal areas (ibid.: 628). Several reports were produced in relation to this project, one of them by the National Climate Change Adaptation Research Facility, which also helped to fund the research carried out by a team from Melbourne University (see Leonard et al. 2013b). Kafod and Leonard (2013) also produced an illustrated publication with the Warmun Art Centre in Kununurra, which features paintings by the Gija Aboriginal people of aspects of their changing climate, alongside photographs taken of the weather features that the paintings illustrate.

In a Miriwoong worldview, however, people cause change to their environment by behaving disrespectfully, sometimes by failing to live in an appropriate manner, and the most serious recent damage was done to their ecosystem by white settlers. Miriwoong traditional lands encompass the floodplains of the Ord and Keep Rivers, and in the 1960s, a part of the Ord River was diverted into an irrigation scheme, which involved the construction of an artificial lake. Later, some 55 miles upstream, a big dam was constructed, which resulted in the flooding of approximately 98,000 hectares of land in 1972; and thirdly, a hydroelectric power station was developed out of the original dam systems to irrigate a greater area of land in 1996 (Leonard et al. 2013a: 625). These projects caused the flooding of many areas culturally important to the Miriwoong people, such as burial sites, meeting places, water sources, and rock art (ibid.: 626), beside which changes caused by more distant phenomena probably pale into insignificance.

It is understandable then if they and other Aboriginal peoples fail to distinguish the evidence of "global" climate change from much more local modifications to their ecosystems, and a study

in N. E. Arnhem Land with two groups of Yolngu people found that they blamed the "strange changes" they had observed in their ecological landscape on mining and tourism development, again introduced by the settler communities (Petheram et al. 2010). They also refused to separate discussions about adaptation strategies to climate change from other welfare needs that they had and sought solutions that would engage in more communication, less top-down institutional processes that allow little Indigenous voice, and a lack of recognition of Indigenous culture and practices. Their "preferences for strategies to strengthen community adaptive capacity tended to be those that lead towards greater self-sufficiency, independence, empowerment, resilience and close contact with the natural environment" (ibid.: 681).

The project headed by Sonia Leonard did, as described in chapter 1, involve as much consultation and involvement with the local Indigenous peoples as possible and, as mentioned above, includes a publication that features their art and therefore their own long-standing ways of recording their knowledge of science. The research included storytelling, song, dance, and painting activities, as well as participant observation and the more usual social scientific methods, such as semistructured interviews and focus groups, and it was carried out during camping trips "back to country" as well as in Kununurra township. The research team in Melbourne also included Aboriginal scholars, such as Marcia Langton and Lyndon Ormond-Parker, so the project was appropriately respectful of the Aboriginal views and will inform government decisions about adaptation to climate change that are properly informed by the people most likely to be affected in the area concerned.

Another example worth discussing here comes from Bruce White, of Balkanu, whom we also met in chapter 1 when discussing fire. He has been working with an Aboriginal group called the Kuku Nyungkal, and he sent me several links to their activities on the subject of climate change. For example, they made a "6 minute" film under a United Nations University Traditional Knowledge Initiative aimed at displaying traditional knowledge of climate change, in which their representative, Marilyn Wallace, explains the changes to their environment. Entitled *Walking on Country with Spirits*, the film offers details of the way that Marilyn was brought up to live off the land, using the freshwater of the river and all the animal,

bird, and plant "food" that was abundantly available there (http://ourworld.unu.edu/en/walking-on-country-with-spirits/). She then goes on to describe the way the temperature has risen, the flow of water has been drastically diminished, and the number of animals, birds, and fish that are disappearing along with the lack of water.

Marilyn took the film to Copenhagen at the time of the 2009 conference on climate change when the United Nations University organized a film festival at the National Museum of Denmark. Entitled *Indigenous Voices on Climate Change*, the show featured 22 films presented by people from around the world. In a media release about the situation she described, published by CSIRO (the Commonwealth Scientific and Industrial Research Organisation), she said that Kuku Nyungkal people "were actively seeking to develop research partnerships to confirm and respond to the worrying shifts and changes they are now seeing in their traditional seasonal calendar. We are very keen to combine science with traditional knowledge and lore to assess, monitor, measure, and if necessary develop strategies to intervene and mitigate threats to 'bubu'(country) caused by climate change." CSIRO responded in the same article that they were indeed keen to cooperate, and a paper published by the *Geographical Journal* reports some initial progress (Cullen-Unsworth et al. 2012).

Many of the stories taken to the festival in Copenhagen have been made available at the United Nations University website (http://ourworld.unu.edu/en/cop15-filmfestival/), and they bring an abundance of Indigenous knowledge to the issue of climate change. Some have sparked local adaptation, such as diversifying crops by Mphunga people in Malawi; others are less positive, such as that of the islanders of Carteret in Papua New Guinea, where the islands are literally being washed away so that the people who have lived there for generations will be forced to seek a new home. One story is inspirational: *The Forbidden Forests of the Dayak, Borneo, Indonesia* explains in local Dayak terms how they share out the land for cultivating crops strictly on a rotational basis to allow the land to recover and why they need to forbid any kind of use of part of their forest—principles they realize should be observed the world over, were climate change to be prevented.

Another powerful example is a 54-minute film entitled *Inuit Knowledge and Climate Change*, made by the Inuit filmmaker

Zacharias Kunuk (well-known for his depiction of Inuit life in *Atanarjuat the Fast Runner*) and Ian Mauro, a researcher. They filmed people from Inuit communities throughout the Canadian region of Nunavut, who speak of the knowledge they learned as children about the climate: how to predict the annual arrival of ice from the marks of the tide, how to predict the direction of the winds from the formation of clouds. Now these things have changed, and the overall temperature continues to get warmer. They explain how the behavior of seals reflects this change; for example, the angle at which they dive indicates the thickness of the ice, and the quality of their skin is affected by pollution in the water, drifting north from toxic industries. They look sadly to what will become of their "mud" lands if the ice continues to recede and the temperature to rise.

Actually, another impressive event that was held a year after the Copenhagen meetings on climate change was an even better attended gathering in Tiquipaya, Bolivia, organized by Indigenous president Evo Morales, The World People's Conference on Climate Change and the Rights of Mother Earth. Some 15,000–20,000 mostly Indigenous people travelled from all of Latin America and much farther afield to express their concern about the damage being inflicted on their shared environment by big industrial enterprises and the powerful nations that allow them to do it. Opening the meetings, Evo Morales pronounced that "the so-called developed countries had failed in their obligation to provide substantial commitments to reduce greenhouse gases" (http://www.democracynow.org/2010/4/21/evo_morales_opens_climate_change_conference), so they were there to seek alternative solutions, which they would present to the United Nations. His rhetoric was stark: either capitalism lives or Pachamama (Mother Earth) lives.

Since that time, the United Nations University Institute of Advanced Studies has pursued its Traditional Knowledge Initiative in two further international workshops: Indigenous Peoples, Marginalized Populations and Climate Change, held in Mexico City in 2011, and Climate Change Mitigation Meeting, in Cairns, Australia, in 2012. Marilyn Wallace presented again at this second conference, which was written up by Stephen Leahy in *National Geographic*, affirming the value of the knowledge held by Indigenous peoples for reducing carbon emissions and helping

to combat climate change. The Cairns meeting was addressed by Youba Sokona, a climate expert from Mali, who is cochair of the Intergovernmental Panel on Climate Change (IPCC)—a working group that will report to governments in 2014 on ways carbon emissions can be reduced. He emphasized the need for a change in economic behavior—in production and consumption systems—and he welcomed Indigenous participants who often live with the lowest of carbon emissions but who had hardly been consulted before. These, in turn, emphasized their need to be given the rights to their traditional lands in order to demonstrate the value of living in harmony with the land instead of dominating and exploiting it (Leahy 2012).

According to this report, the conference was not entirely successful at eliciting helpful information from the Indigenous participants, who commented negatively on the format of the meetings and the long-term unwillingness of hard-nosed scientists to take seriously knowledge gathered more informally and recorded orally (ibid.). One delegate, Tero Mustonen, head of the village of Selkie in North Karelia, Finland, holder of a doctorate and author of scientific papers, apparently commented: "Indigenous peoples' worldview and traditional knowledge can't be conveyed by numbers and charts. However, if the oral history of traditional people can be recognized as valid as science, that would be a major breakthrough" (ibid.). Indeed so, and it does seem as if some progress is being made, if slowly.

As my book is being wound up, I have found reference to numerous projects in countries around the world, where governments are finally taking account of the wisdom of their Indigenous peoples on climate issues. The Australian Bureau of Meteorology (BOM) has also started a project with Indigenous peoples of the wider Pacific, and the reports to date note not only how good people have been at forecasting their own weather phenomena, but how global climate change has been interfering with their ability to do this, and the BOM advocates a combination of TEK and meteorological methods developed elsewhere (Chambers et al. 2013). The project is partly one of Australian government aid, with the aim of helping people in the venture called "resilience," discussed in chapter 2, a similar concept to the one called "adaptation" in the Miriwoong project discussed above. Again there is an element of patronage in

the way big governments treat Indigenous peoples, but at least they are noticing that they have valid science that they have been using for a long time.

Pacific Island nations also have their own ongoing projects, of course, and the Pacific Meteorological Council is a body that meets biannually to discuss their own resilience and security in the face of meteorological phenomena. An important part of their meetings is about disaster risk management, and the one held in Fiji in 2013 was entitled Strengthening Resilience: An Integrated Regional Strategy for Disaster Risk Management and Climate Change for the Pacific. The aims of this program include devising regional strategies for coping with climate change, and a long list of future activities has been drawn up. Some Pacific Islands are threatened to disappear altogether if the present levels of rising oceans persist, and these are particularly vulnerable, but they too are seeking methods of adaptation and resilience (see, for example, http://www.climate.gov.ki/kiribati-adaptation-program/).

As might be expected from previous reports about New Zealand, there is quite a strong influence in attitudes to their climate from Māori knowledge, and the National Institute of Water and Atmospheric Research (NIWA) website contains several articles about the value of mātauranga Māori. However, the main one is still headed "Alternative Wisdom," and the thrust of other headings, such as Māori Environmental Research (Te Kūwaha): Our Services, is that this "crown-owned research and consulting company" is "sharing knowledge with Māori communities, and assisting Māori communities throughout New Zealand by providing the latest scientific knowledge, tools and resources to assist in their management of natural resources" (http://www.niwa.co.nz/our-science/te-kuwaha). The attitude still stops short of the major breakthrough sought by Tero Mustonen above "to recognise the oral history of traditional peoples as valid as science," but again, I think progress is being made!

One last interesting example of this resistance to recognize the sophistication of the knowledge held and handed on by people who did not commit it to writing is to be found in a surprising recent report from archaeologists that a pit alignment, recently excavated in Aberdeenshire, suggests that hunter-gatherer societies in Scotland may provide the earliest evidence currently available for "time

reckoning" (Gaffney et al. 2013). The structure in question, dated to the eighth millennium BC, "appears to possess basic calendrical functions . . . as the pit group appears to mimic the phases of the Moon and . . . also aligns on the south east horizon . . . [with] . . . a prominent topographic point associated with sunrise on the mid-winter solstice." This is evidence, they argue, that the people of the time noticed that the solar year and the seasons were asynchronous with the lunar one, "nearly five thousand years before the first formal calendars were created in Mesopotamia" (ibid.). It seems likely from the Australian evidence we have presented in this chapter that such knowledge could well date back a lot longer than that.

Chapter 6

Astronomy and Navigation Skills

Astronomy

Visitors from a variety of Indigenous communities come to the United Kingdom, and a place that many ask to visit is Stonehenge. I have taken several people there, often stopping along the way to see the White Horse, carved out of the hillside at Uffington, and the more scattered standing stones at Avebury. I prefer this latter site because it is less dominated by the tourist authorities and the national press than Stonehenge is, but Stonehenge is the one that my visitors tend to prefer. I even ventured out on the morning of the summer solstice when the date coincided with a visit from some Native North Americans one year, and we found Avebury a very popular site for locals who call themselves "Pagans," but its standing stones are less well organized and preserved, and my visitors still ask for Stonehenge. Another site that attracts the attention of visitors from the Indigenous world is Callanish, in the Isle of Lewis, and I have taken a very good Cree friend there, but it is a lot farther than Stonehenge to travel to from Oxford.

One thing I did discover—at that time—is that bookings could be made in advance for limited numbers to enter the site at Stonehenge before or after the official opening times so that the stones may be examined at close quarters. During normal opening hours, visitors were banned from actually entering the main stone circle, and they had to be content to circumnavigate it at a marked distance in exchange for their entry fee (see figure 6.1). After it is

Figure 6.1 Laara Fitznor, Greg Cajete, and Mark Henare during the regular daytime tour to Stonehenge in 2009.
Photo by the author.

closed in the evening (and apparently also before it opens), there is a period for the regular visitors to disperse, and those who have booked for an extra entry are expected to turn up some time later. When I made a booking to do this, we had time to go and have dinner at a nearby hostelry while we were waiting for the evening visit we had booked.

For our evening visit, then, we returned as the sun would be setting, if we had been lucky enough to have a clear evening, which sadly we did not. However, for Greg Cajete, who is well versed in the Indigenous astronomy of his own people, the Tewa Indians of New Mexico, it apparently made little difference. Once he was within the circle and could examine its construction at close quarters, he was able to work out its orientation for the ancestral people of Britain, even without the stars to help him, and Greg was delighted with his visit to Stonehenge. In fact Greg Cajete is the author of a book that introduces a broad view of Native science, including astronomy, and the picture on the front of the book shows a couple of flamboyant-looking characters observing

the skies through long telescopes, with a bright galaxy, probably the Milky Way, behind them.

Observing the skies is actually one of the most scientific activities that people around the world have done in a systematic fashion since time immemorial. The light-polluted world of the cities in which many of us now live conceals the extraordinary bevy of beauty and wonder that is simply out there as soon as the sun goes down on a clear evening, and its rather regular, if not always predictable, movements cannot fail to attract at least some of the people who live below it. Collecting information about the skies and passing it on from one generation to the next can be very helpful for many practical purposes, as we saw in previous chapters and shall see again in this one, but its transmission is also usually related to a people's cosmology. The sun is very clearly an important source of life, and the moon may well be part of a collective pantheon as well—many First Nations refer to her as "Grandmother Moon," for example. These spiritual or religious connections with observations of the skies have been found in almost all societies if we look back in time, but this does not negate the idea that they are observed systematically.

Stonehenge is attractive to visitors to the United Kingdom because it demonstrates an ancient ability to move large stones over long distances, but it also seems to represent a fairly accurate understanding of the annual movement of the heavens by a people who had not yet learned to write down their collective knowledge. In fact, perhaps the construction of the circle of stones was a way of recording that knowledge, once it had been tried and tested at the less permanent place we now call "Woodhenge," though we in Britain seem less certain of the purpose of the stones than my Native American visitor was. Books and websites offer various theories, summarized in the tape-recorded guide one can rent during a regular visit. The Pagan people who gather there at the summer solstice recognize our collective heritage as well, but many scientists in this country are determined to separate our "objective knowledge" from the activities of people who seem overly involved with their spiritual welfare.

There are of course historical reasons for this, and astronomers are more aware of them than many. Some of our most famous forebears suffered discrimination, exclusion, and even assassination for

taking too much interest in the scientific aspects of the study of the sky, especially when their studies appeared to undermine the orthodoxy of the time about their place in the universe. Ulugh Beg (1394–1449), the Uzbek astronomer who built a huge observatory and made measurements so accurate they weren't bettered for centuries, apparently incurred the disapproved of the local mullahs, though he did also build a Madrasah for Islamic education. However, he neglected the duty he had inherited to rule the land and was killed by his own son. Copernicus (1473–1543) ran into opposition from the Roman Catholic Church when he proposed the revolutionary idea that the sun stood at the center of the rotating cycles of the heavens, rather than the earth, as previous views had assumed. Galileo (1564–1642) encountered similar problems with the same established church for supporting and offering evidence for this heliocentric view, among other experiments and observations he made.

Copernicus and Galileo are strongly associated with the so-called scientific revolution, which some contemporary scientists, and philosophers such as Thomas Kuhn (1962), see as making an irreversible break with theories of the past—a "paradigm shift"—which paved the way for turning science into a kind of dogma that is now often opposed to religion. There were of course many other contributors to the change of thinking perceived in retrospect as "enlightenment"—Kepler's theories of the motion of the planets (of which ours was just one), Bacon's advocacy of an empirical "scientific method" essential to acceptable research, and Descartes's famous maxim "I think therefore I am," which underpinned a separation of mind and body and the idea of a self that could feel distinct from those observations. These men remained quite religious, of course, and it was only later, notably in the nineteenth century when Darwin's ideas began to challenge accepted Christian notions more directly, that the cult of atheism, or humanism, began to be adopted more seriously.

I throw out this inadequate summary of a few of the revolutionary ideas simply to build a picture of how we in "the West" came to think of ourselves as so central to a world that we can observe and measure in our own new and distinctive way. The ideas were of course developing alongside the inventions of engines and machines, and within a couple of hundred years, we were masters (they mostly were men in those days) of so much technology

that we drew well apart from peoples who lived close to the land and who therefore became easy to dominate. As Bruno Latour has pointed out (as quoted at the start of this book), our imperialistic activities didn't stop at looting and pillaging, or trading and conquering as it might more benevolently be expressed, but we took along that "science" that we had "invented" and worked very hard to convince people everywhere that it was universal.

We still admire the evidence of peoples who left impressive buildings behind them—the Mayas and the Incas, for example—and as with our theories about Stonehenge, we speculate about how they were constructed and what means were used to transport the materials. Interestingly, however, the ancient "cities" of these people were often largely composed of temples and other religious or religiopolitical edifices, and close scrutiny of their orientation reveals again an intricate knowledge of astronomy, based on belief systems about spiritual powers and their relationship to a complex calendar. The news in 2013 about the end of an era for the Mayan calendar brought some of the transmitted ideas into a public arena, and the people who claim descent from those who built the stone ruins now disentangled from the Mexican jungles of Chiapas and Yucatán were briefly given a voice on news programs far and wide. Their calendar may have been taken less seriously had they had no remains of buildings to visit.

The ancient capital of the Inca civilization at Cusco in Peru, now the focus of tourism for thousands of visitors, was apparently built radially to reflect the elements of the sky, and points on its circumference marked events taking place there. The agricultural system was organized according to the appearance of the sun between pairs of pillars built in the surrounding hills, for example, and a complex cycle of ritual occasions was triggered by the rising of the moon, stars, and planets recognized by the Inca astronomers. The rising of the Pleiades cluster marked the New Year according to their calendar, for example, and a series of windows in a central, gold-encrusted observatory caught the first and last rays of the sun for other special ceremonies. The understanding of the Inca astronomers was recorded in their buildings, just like Stonehenge records an understanding of ancient Britons, according to archaeoastronomer Anthony Aveni (1997), but a lack of ancient buildings doesn't indicate a lack of understanding, as we shall see.

Navigating the Sea

A good knowledge of astronomy is also necessary for those who navigate the high seas, and it is interesting that the annual return of the Pleiades cluster, also known as the Seven Sisters, marks the New Year for Māori and other Pacific Islanders as well. There are local variations, sometimes related to the phases of the moon, and some Māori *iwi* mark the arrival of another star they call "Puanga" (Rigel), in the Orion group. This all happens at the end of May or the beginning of June, so the middle of winter in the Southern Hemisphere and not long before their winter solstice, giving the practice an interesting parallel with the northern New Year, which also signals a change of seasons and a move toward spring. The Pleiades, or Matariki as they are called in Māori language, disappear from the sky for a period at the end of the old year, and it is their reemergence that is marked with various festivities. The Māori settled in Aotearoa several centuries ago, but they maintained their interest in the stars, and astronomy is apparently very popular in wider New Zealand too. Indeed, the government has been asked to make Matariki a national holiday, and many non-Māori, or *Pākehā*, know about and take part in the Matariki celebrations.

To this day, Māori recount stories about their origins in terms of the separation of Father Sky (Ranginui) from Mother Earth (Papatuanuku), by the efforts of their children, who became six gods manifest in various aspects of the environment—namely, the forest (Tāne), the sea and marine life (Tangaroa), cultivated foods (Rongomā-tāne), uncultivated foods (Haumia-tiketike), winds (Tāwhirimātea), and finally earthquakes and volcanic activities (Rū-au-moko) (Ta'ia et al. 2004: 14). The traditional Māori calendar has been displaced, but it was based upon a thorough knowledge of astronomy, which marked the start of each lunar month with the emergence of particular star clusters and in which each day was named and associated with particular activities (ibid. 40), as we saw in chapter 2 for other Pacific Islanders. As we saw in chapter 4, where the Southern Cross was used as a model for Māori health, however, the stars can carry important symbolism beyond the Matariki.

Throughout the Pacific, the skies are also important for navigation, and sharing ideas about astronomy was one of the reasons why Captain Cook was so impressed with the Indigenous peoples

he encountered during his voyages there. His first major expedition was actually to trace and measure the path of Venus from Tahiti, as it crossed between the earth and the sun, predicted by Edmund Halley to take place on June 3, 1769, and this he did. He and his chief scientist, Joseph Banks, also recruited a couple of Tahitians: Tupaia, an expert navigator, and his servant Tarheto, who travelled south with them to chart the coast of the lands later to become New Zealand. Tupaia seems also to have been a good linguist, so he could act as an interpreter with other Pacific peoples they encountered. Cook therefore became aware of some of the other navigational techniques they used, which are recorded in his diaries, but his recognition of the ingenuity of the local people was way ahead of his time, and understanding their navigation skills is still a work in progress for scholars.

That the peoples of the Pacific used many other techniques beyond astronomy for navigating the seas is not surprising since they still regard the ocean where they live as an integral part of their world. For a long time, Europeans have referred to the area and its peoples in terms of the islands they occupy, but locals take the ocean into account in speaking of their territory (an interesting word that still suggests land), and the artist/scholar Epeli Hau'ofa wrote an influential article (Hau'ofa 2008) that sought to have the area called "Oceania," rather than "the Pacific Islands." This makes much clearer the enormous area the Pacific peoples were able to navigate as they spread and settled over such a huge part of the globe, as opposed to emphasizing how small and far apart the islands are, and recently even outside scholars who work in the area have been using that word for their conferences and professional organizations. They have become known as "Oceanian specialists."

The ocean is called "Moana" in Māori and several other Pacific languages, and the Tongan anthropologist Tevita O. Ka'ili (2012) has explained that it is a pan-Polynesian concept that also includes a shared and rather different view of the world from those who think of themselves being based on, or returning home to, dry land. He has written an interesting paper about the way this Moanan view of the world is built on a different epistemology, which of course includes science, and in the last chapter of the book, we will examine his suggested (Moanan) solution for scientists to take advantage of both ways of thinking. Māori who live in Aotearoa

don't necessarily spend much time in boats these days, but they all trace their ancestry back to a named boat that they believe brought them to the islands, and in many ways, they still share the Moanan view of the world. Actually "Moana" is a Māori personal name, also sometimes used in English as "Ocean" (see one of the authors referred to in the next chapter).

In other parts of Oceania, there are many people who still use their navigation skills, and there are also local scholars in the whole region who are doing research on the ancient knowledge that their ancestors held about "wayfinding." While staying on the small Cook Island of Mangaia, I discovered that my host had grown up learning to navigate between the islands from his elders, though it was not something he regularly practiced any more. He talked of needing to "read" the ocean. Most of the islands are atolls of a few square miles, and when one sails off from one of them, there is quite a large area of sea to navigate to reach the next. The planes that fly between them nowadays take about 45 minutes, and the relative size of ocean to islands is very clear as one looks down over a seemingly endless seascape. However, the ocean behaves differently around the islands for a longer time than the eye can see, and that is one part of the reading process, to recognize when there is land in the vicinity. Another part is of course to be able to read the sky, in daytime to align oneself with the sun and note the behavior of clouds, at night with the stars, but Cook Islanders also have a good understanding of the swells and wave patterns linked to the currents in the ocean that makes up their world, and finding these makes for a much speedier journey than relying on the wind to fill their sails.

Pacific Ocean currents have been recorded in interesting charts made of coconut palm leaf stalks, which are arranged to represent their directions, and tiny shells, which stand for the islands in a particular group, although I have only seen these in museums. The one in figure 6.2 below was collected in the Marshall Islands in Micronesia and is on display in the Ocean EXPO museum in Okinawa, and I saw another in the Captain Cook Museum in Whitby, Yorkshire, but I was not permitted to photograph it. Apparently they are memorized by the navigators but not taken on the voyages because good navigators are expected to be able to read the movements of the sea in order to recognize the currents, and they didn't resort to such aids while actually out on the ocean (Mack 2012: 105).

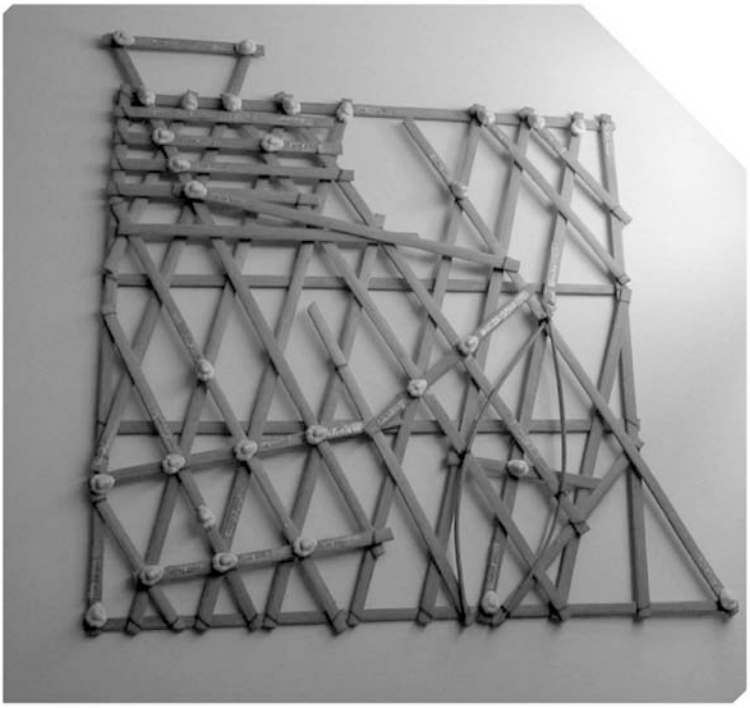

Figure 6.2 A "stick map" representing currents in the Pacific Ocean. Photo by the author.

I was lucky enough to be engaged to help some schoolteachers in another Cook Island, Atiu, to put together research proposals for postgraduate study, and my host at that time, Terangi Mokoroa, was a mathematics teacher at the local school. She thought it a good idea to research how the Indigenous navigational skills of the islanders could be used to help children learn mathematics, and she recounted sending out some of her pupils to see what they could find out. Apparently they found the task a lot of fun because they could ask the elders of their families what they knew about the subject, and this led to promises of sea trips, among other things. While I was staying there, the school inspector for the mathematics curriculum came to stay in the same house, and he explained that they were devising school programs to draw on local Indigenous knowledge, so Terangi's project was very welcome. Māori is the first language used in many families in the Cook Islands, and

this educational strategy was also designed to maintain its value in a world where increasing numbers of people travel away to spend time in English-speaking New Zealand and Australia.

One of my hosts at the University of Otago was Paul Tapsell, then director of Te Tumu, the School of Māori and Pacific Studies, whom we met in chapter 3 where I talked about his research on the revival of *marae* and their community value. He offered me various helpful suggestions about my research interests, pointing me in the direction of a book about navigation, for example, but he also recounted the theory mentioned in chapter 3 about the pan-Pacific navigational system centered on the island of Raiatea, part of the Tahitian group, and the *marae* there named *Taputapuatea*. It had been crucial to maintaining navigational knowledge and technology that kept the *marae* of the Pacific connected via great sailing vessels from around AD 500 to 1500, and it was apparently there that Polynesian scholars and navigators would gather and plan their voyages to other distant islands. It happened by fortuitous chance that when I visited the library in Rarotonga in the Cook Islands, I met a man from Raiatea named Tahiarii who confirmed this idea. He was traveling quite extensively to substantiate the theory, to raise awareness of it, and to seek funds for developing the island so that fellow Oceanians could come and visit.

Tahiarii, whose full name is Tahiarii Yoram Pariente, took a science degree at the Université Francaise du Pacifique in Tahiti and later spent time in Hawaii researching his Pacific heritage and working with highly recognized navigators, such as Nainoa Thompson and Onohi Paishon, who spend their lives trying to recreate the boats and revive the navigation skills of their Polynesian ancestors. Tahiarii, who was brought up in a French family, also took a yacht captain's license in Normandy in 2009 but then in 2010 joined a 3,300-mile trip from Auckland to Rarotonga, via Tahiti, in order to practice the navigation and wayfinding skills of his Pacific forebears. The canoe, or *waka* (or *vaka*, depending on the language), in which he accomplished this voyage, *Te Matau a Maui*, is one of a fleet being maintained and sailed by members of the Pacific Voyagers Foundation, a society of islanders whose aims are "to strengthen our ties with the sea, renew our commitment to healthy ecosystems for future generations, and to honor our ancestors who have sailed before us" (http://pacificvoyagers.org/the-voyage/vaka-moana).

Tahiarii has also worked in museums around the world, helping local curators to understand and in some cases to restore the canoes and other navigation equipment in their collections. For example, in 2009 he was invited to assist Māori carver and artist George Nuku with a restoration project of the rather unromantically named A.UC.767 canoe, which now hangs high up in the hall named Facing the Sea, in the National Museum of Scotland. Tahiarii's expertise is in the binding together of the wood, a technique known as *ka'a* or *sennit*, which creates a firm bond, and Nuku requested his help in binding the component parts of the canoe together (Knowles 2013). Below the canoe, named *Te Tuhono* by Nuku, is an interactive display demonstrating some of the differences between Pacific and European wayfinding skills, where visitors of various ages can manipulate moving parts to see how navigators would use natural phenomena such as clouds, stars, waves, and currents to move their boats across the vast areas of ocean.

Tahiarii also spent a month at the museum in Rarotonga, where I met him, restoring their *vaka*, an *Iekelima* (five-man fishing canoe) from Pukapuka in the northern Cook Islands, which had almost completely deteriorated over time. The curator there, Jean Mason, said that they were very lucky to have his skills as they had searched for five to six years previously for people with the specialist type of skill required for such a task but could not find anyone. During his employment there, Tahiarii lead a group of assistants (about five people in total) throughout the different stages of the restoration project—from selection of raw timber, cutting and preparing it, then lashing the pieces into place using the appropriate lashing styles for each piece, to the application of preservative chemicals on the finished craft (see figure 6.3). Upon completion of the project, he led a ceremony attended by members of the Pukapuka community, the Museum Society council, and other interested parties, which happened to include the visiting German ambassador from New Zealand (see Mason and Moekáa 2013 for further details).

Tahiarii also visited the Pitt Rivers Museum in Oxford; while he was there, and against a backdrop of Polynesian artifacts in their collection, he was interviewed for a BBC 4 program about maps, power, and plunder. He was asked to explain a map created by the Polynesian navigator Tupaia, who, as mentioned above, was taken on board to help Capt. James Cook on his 1769 *Endeavour*

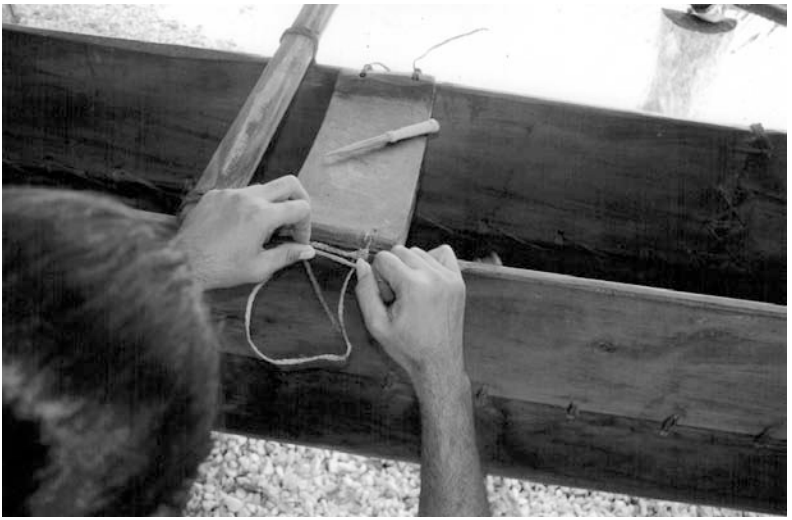

Figure 6.3 A close-up of the work of Tahiarii at the Cook Islands Library and Museum Society in Rarotonga.
Photograph by J. T. Mason.

expedition. In this program Tahiarii was able to use his own expertise to elucidate the mental cartography used by the Polynesians, who didn't even take along their stick maps when at sea but instead learned to recognize the significance of natural patterns of the ocean.

Several books have been written about navigation, and to focus only on Pacific navigation skills, we can be introduced to probably the best and most detailed accounts of using these "natural patterns" in a book by David Lewis (1917–2003) entitled *We the Navigators* (Lewis 1972). In his midforties, Lewis gave up a medical career in Britain to sail around the world in a catamaran called *Rehu Moana* with his second wife and two small daughters. Between Tahiti and Aotearoa (New Zealand), where he had grown up, he stowed his compass and modern navigational equipment and used swells, winds, and naked-eye observation of the skies to try to recreate those traditional skills. In the late 1960s, he was awarded a fellowship by the Australian National University to study navigation, and he set off to work with several Oceanian navigators still practicing traditional methods in various outlying islands of Polynesia.

Two more recent books provide some considerable detail about these seafaring methods, but they both draw on Lewis's work. *Vaca Moana: Voyages of the Ancestors*, edited by K. R. Howe, focuses on the Pacific, introducing many theories about the discovery and settlement of the lands of the Pacific Ocean by those who first arrived there some thousands of years ago. A chapter by the anthropologist Ben Finney is devoted to describing the skills required to find one's way around the huge swathes of open ocean and back to piloting the sea surrounding the islands, and he introduces the reader to well-known contemporary navigators that he has worked with, such as Mau Piailug and Nainoa Thompson, to illustrate the important principles involved. *The Sea: A Cultural History*, by John Mack (2012), is a more general book about the sea, which also draws quite heavily on Lewis and includes a long section about Arab navigators.

Using the sky, and particularly the stars, is common to navigation everywhere, and in the wide open spaces of Oceania, it was stressed that they need to be observed as they rise or as they set to give an accurate reading of the direction toward which a craft might be heading. Thus a good knowledge of the natural patterns of a heaven full of stars is a crucial start. Another important set of patterns relates to the nature of the ocean itself, and an ability to identify a significant swell among a whole series of contrary wave patterns is also crucial, particularly as the swell changes around land. The currents were also important to read, as mentioned above in relation to the stick maps, but this seems to be the part of Pacific navigation that is still less well understood by Western observers, according to Finney, though apparently a team of anthropologists are working with Marshall Islanders to try and revive this knowledge (2007: 177).

Pacific navigators report giving precedence to "the feel" of the waves over other factors, and Lewis recounts the practice of one of his informants, Tevake, who would lie down in the small shelter on the canoe's outrigger to concentrate on analyzing the motions of the waves, there being able to identify smaller swells in order to read the underlying structure of currents among the larger waves. The proximity of an island would interfere with these patterns from farther away than the eye could observe, apparently, but the existence of birds and marine life would also indicate when land

became near, though varying with the species of bird, the time of day, and the season, for good knowledge was held about the migratory patterns of birds. Apparently the taste of the spray was another indication of location for experienced navigators, and one story recounted in both books is that men could read the swell of the ocean through the feel of their testicles! Mack describes the skill of Pacific navigators as "a complete sensory engagement" (ibid.: 129).

Another serendipitous encounter I had in Rarotonga was when I visited a place advertised to tourists as the Highland Paradise Cultural Centre, or the "rediscovered Maungaroa mountain village." Missing the main tour of the day, which had been prebooked by a party of Australians, I was taken on a personal tour of the place by a very helpful guide, who showed me, among other things, a large rock pointing out to sea that he described as the "compass," or navigation, rock. This is described in the notes accompanying the tour as a pointer that identifies a line of stars that at certain times of year would show the sailing path to Aotearoa. Māori in New Zealand do reckon to have travelled there from the Cook Islands, and there is of course linguistic support for this idea, but my guide for the morning explained that they had recently been visited by Tahiarii, who had explained that this rock (see figure 6.4) was also part of a more complex system of navigation linking the *marae* at Maungaroa with the central one in Raiatea as well.

Figure 6.4 The navigation rock at Maungaroa Highland Paradise, Rarotonga. Photo by the author.

The Polynesian navigator Tupaia, taken on board the *Endeavour* by Captain Cook, was apparently not only from Raiatea (Mack 2012: 120) but also primarily a priest of the god Oro, the tutelary deity of the Taputapuātea *marae* there (Finney 2007:165), which could help to explain his wide knowledge of the location of Pacific Islands if the theory about it being central is correct. The map that he helped to make, which was explained by Tahiarii in his BBC broadcast described above, apparently demonstrated a knowledge of Polynesia so comprehensive that it seems to have encompassed the whole of the vast area from Fiji in the west to the Marquesas Islands in the east, a distance equivalent to the width of the Atlantic, and to have included all the larger island groups with the exceptions only of New Zealand and Hawaii (Mack 2012). (The former he went on to visit with Cook.) Finney thinks it unlikely that he had visited the whole area he mapped (ibid.), so there was certainly some amazing knowledge of their Moana held by those ancient Pacific Islanders.

How much Captain Cook himself appreciated this is not entirely clear, for Tupaia sadly died in the disease-infested port of Batavia (now Jakarta), and there is no record of the map being used on Cook's two subsequent voyages. Indeed, it seems to have lain forgotten for some time among the many other papers of Cook's scientist, Joseph Banks (ibid.). In the Captain Cook Memorial Museum in Whitby, near his birthplace in Yorkshire, there is a very good and detailed exhibition about his voyages and about some of the Pacific navigation skills he learned, and when I was visiting, these were being explained most informatively to a party of schoolchildren by a local guide. Interestingly, there was also an informative exhibition about Captain Cook at the museum in Rarotonga where I met Tahiarii, but then I suppose it is the capital of the islands that took his name. My mother came from Yorkshire, and I have to say that I feel a certain pride that a man from that great county was able to appreciate at least some of the superior knowledge that was already held by the Indigenous peoples of the oceans where he spent so much time!

Chapter 7

Physics and Mathematics

Physics would seem at first sight to be one of those "hard" sciences that requires as much if not more rigor than any. It is, according to the Free Online Dictionary, "the science of matter and energy and interactions between the two." The Oxford Dictionary gives a few more words but is essentially the same—namely, "the branch of science concerned with the nature and properties of matter and energy." Derivations are cited as from Latin (*physica* = science) and Greek (*phusika* = natural things, from *phusis* = nature). We have already considered various meanings of the word *science*, so we could perhaps apply them also to *physics*, but we have not really stopped to consider much what we might mean by "nature," although reference to it has popped up in all sorts of ways.

In this chapter, I would like to consider different ways in which Indigenous peoples think about that "nature" in which they live, how they describe and interpret it, whether they think of it as "matter" and "energy," and (whether they do or not) how they think about its "properties." The reader might be surprised to discover that there are several examples of Indigenous scholars who make direct comparisons with what we in European-derived societies call "physics," and even some who claim that their own languages are actually better suited to discussing certain branches of the field, like quantum physics, than English is. And for whatever reason, that "hard" science can gradually be discovered to have rather soft, endearing qualities that make it much more approachable than it

seemed to many of my school friends who turned their noses up at the very idea of studying it!

Every chapter so far has started with a story, and I have thought for some time about what might make a good story here. In fact the whole chapter might seem like a story, or even a fairy tale, to hard-nosed scientists, if any have penetrated this far into the book! So I have decided on a bit more of the personal realization for my story in this case—turning first to my understanding of the mathematics that I was taught is needed to underpin the study of physics—and then to tell you about those Indigenous scholars who have commented from their own Indigenous perspective on the subject that we call "physics." I think this rather appropriate actually as we need to see what our cultural perspective is in order to understand that of others, as F. David Peat (2012) has pointed out.

The British education system within which I grew up does a sort of informal ranking of disciplinary fields, and within that system of ranking, there are areas that are valued in different ways than others. There is also a ranking more or less accepted by members of the general public, who are wont to categorize people they meet according to their skills within those disciplines. These things change with time, of course, and the government is always trying to interfere with them to fulfil requirements that society might have at any one time, so as I write this book, the term "science" is being given all sorts of support in order to try to attract children to it (as I suppose we must be short of trained scientists). In any case, it has become a rather popular-sounding thing to find out about.

When I was at school, I believe I may have chosen to study science precisely because it was not popular. I did attend a girls' school, and we girls were not supposed to be interested in science, so I may have decided to rebel against that popular notion; but I do also remember thinking that this would be the way to find out about the world and how it worked. Actually I recently spent time staying with a professional astrophysicist, and as we compared notes about our respective childhood fantasies, we discovered many similarities, so perhaps there is an inbuilt tendency in children to find their bent and enthusiasm. An Indigenous view would probably point to spiritual guidance. However it may have come about, I was drawn to physics and also to mathematics: in fact, I would say

first to mathematics, for it comes first, of course, and then, it just seemed the purest and most satisfying study of them all.

As I recounted in the introduction to this book, I lost interest in science after taking my first degree in it, which included a year of mathematics, but as I was trying to work out what to do next and traveling to various foreign countries, I found the ability to teach mathematics (and science) quite useful in order to make a living. And it was in this way that I gradually discovered that there was more to the subject than I had realized. In England, many people feel quite comfortable admitting that they are "no good at maths," and being good at mathematics didn't even cut much ice with anyone except a government short of teachers; otherwise, I could almost go so far as to say that it held negative value! In other countries, notably in Japan, where I spent quite a lot of time, it is taken for granted that anyone, and indeed everyone, can simply do math, usually rather well. So how can this be?

Well, before I turn to Japan, let me explain that I did spend some time teaching math in Canada, where they had decided to introduce something called "new math," perhaps to overcome this problem that people seemed to have inherited from Britain of not worrying overly much if they couldn't do the subject. I actually had to struggle a bit to work out what new math was exactly and to translate the "pure" subject I had mastered into something more accessible, which I think was the aim. I taught in three different places: first an Orthodox Jewish girls' school, with a very high level of application from most of the students, and we worked well through the curriculum; secondly a "prep school" for mostly boys who had been expelled from the usual public school system for bad behavior, but whose parents wanted them to progress to university and were willing to pay for it. These boys were tough, but they were fun, and we did somehow manage to make our way together through some quite good work.

The third and last place was a private home, that of my godfather, whose son was having real trouble with his school math—and here is where I personally learned the most about the nature of the subject: how to pick it apart and how to help another person apparently with no "natural ability" to get a sense of what it was all about. We did rather well—or should I say, he did rather well—and his parents were grateful, but I had begun, by working through the

syllabus on a one-to-one basis, to discover how the field of mathematics, as we know it, was built up. Before, I had been able to do it—it had even seemed easy; now I began to understand *what* I was doing and how to pass on that ability.

In Japan, I had not at first intended to study the teaching of mathematics; indeed I studied many other things, but my children attended a Japanese school for a while, and I became interested in how they fared within a different system. They were young; indeed the younger of my two sons entered school in the first year when everything was being introduced. The older one struggled at first to fit into the math teaching in his class, but the teachers exclaimed one day, "He can do it, we have noticed; it just takes him a long time to work things out." Well, that was because our teaching method at the time was precisely to make children "work things out" rather than learning by rote, as had been a previous method, and in Japan, learning some of the basics by rote was one of the things they encouraged.

However, before they encouraged that, they did something very different, and interesting, and they did this in the first year, so I could observe it by keeping an eye on my younger son's progress. In the first year, the children are all given a box of mathematical toys, to put it bluntly: a brightly colored box full of brightly colored objects of various shapes, which can be laid out, lined up, arranged, and rearranged in all sorts of patterns and forms. Well, actually, not *all* sorts of patterns and forms, because although it may have seemed like play to the children, in practice they were learning some definite patterns and forms that were going to be necessary in order for them to proceed to pick up the things they needed from that time onward to join the throngs of Japanese children who can "do mathematics."

I have written elsewhere about the details of mathematics teaching in Japan (Hendry 2000), so suffice it to explain here that the base of the numbers the children were learning to use was decimal: they did a lot of playing with sets of ten blocks, for example, so that they could soon easily tell how many were missing out of ten if they saw a part of the set; they didn't learn any of the base-12 functions that I had learned at school (because in those days we still had 12 pennies in a shilling), but they did acquire a very accomplished facility with *number* and how to play around with it *before*

they learned to perform functions and before they were asked to memorize, in their second year at school, all the times tables within two weeks! This kind of "rote learning," about which we in Britain had become rather scathing, is simply seen as a way to avoid time-wasting trouble, and therefore offer the children a greater and faster ability to move into learning more difficult activities.

In fact, if I had paid more attention than I did to the Japanese way of introducing ideas of number and mathematical functions, I might have been able to identify some specifically Japanese history among the patterning arrangements, for there is much evidence of continuity in the way Japanese language influences thought, as there is with any living language. By the time children in Japan leave their primary school, their pure mathematics is probably little different from that practiced in many other countries these days, for the pressure of attaining international standards is powerful. However, the methods of teaching are demonstrably more successful than those found in many other countries, and it is interesting to work out some of the reasons why this may be.

A few years later, I visited a museum in the north of Japan where an exhibition illustrated some of the historical ways in which mathematical functions had been carried out. Firstly, the notation was completely different, based on a system that had been introduced from China but still working in a decimal fashion and so actually recognizable to an outsider who could read the numbers. Another important characteristic was that the functions were related to the practical needs they served, which is why an exhibition could be made of the material objects used to count, to measure, and to calculate. The Japanese *soroban*, or abacus, for example, is so swift and efficient to use that for some years after computers were introduced, shopkeepers and even the post office employees would check its workings with the abacus and, for a while at least, claim the abacus was faster.

Mathematics teaching is probably more successful anywhere if it can be related to local language, life, and history, and I heard a very impressive talk at a conference in Winnipeg on Aboriginal Education, when a man, who was actually from Africa, explained how he had worked out the best way to teach mathematics to children whose first language was Ojibwe. I don't know anything about this teacher's background, but he clearly had a sense of the

importance of cultural heritage, for he said that he had made little progress until he invested time in learning to speak Ojibwe. He had then worked out the importance of kinship networks, the way that relationships were calculated, and the terms that were used to separate and to classify people, including their degrees of distance from the speaker. An impressive part of the talk was when he wrote up a function entirely in mathematical symbols, which actually lost almost all of us in the audience, and then explained how this could be depicted in terms of Ojibwe kin relations.

In chapter 2 of this book, we discussed Michael Christie's ideas about the science of the Yolngu people in Arnhem Land in the north of Australia. He explained that quantitative measurement is something that Aboriginal scientists find extraordinary because it assumes that the things, people, or perhaps animals being counted can be regarded as functionally equivalent. To them, however, each thing or being has a distinct role to play in society, and they can see no purpose in numbering them as if they were all the same and without context. To a reader from a society quite obsessed these days with quantifying everything, this may seem an extraordinary idea, but the Yolngu regard our system as "impoverished" (and some of us may agree!). However, the Yolngu have been introduced to the Western education system, and their leaders—notably one very forward-looking, though now late, Dr. Raymattja Marika (1999)—have been prepared to discuss ways of enabling their children to learn "both ways," as we will discuss in more detail in chapter 9.

Meanwhile, however, it is worth taking a look at some of the material that was put out by Christie and the Yolngu elders who came to the local school to discuss ways of teaching what they called "Garma Maths" (Christie and Yirrkala School Action Group 1992). *Garma* is a Yolngu word for "a meeting place," where different ideas can be exchanged and discussed, and a means found to value them all. Actually the first Yolngu word that the elders brought to the discussion expresses very neatly the outcome that was being sought. It is *Gäṉma*, which also means "place," but a specific area among mangrove trees where saltwater coming in from the sea meets the stream of freshwater coming down from the land, and together they form a lagoon. Apparently, water is often used to express Yolngu philosophy, and in this case the spring water, "pure

and sweet" like Yolngu knowledge (ibid.), is said to come originally from the ground. The symbolism of the seawater representing outside knowledge is left open to interpretation.

This two-way mathematics education has become a rather large project, and several books and pamphlets have been produced over the years, but the basic principles set out in the Christie paper are to seek ways to use patterns familiar to Yolngu children to introduce mathematical concepts. Thus, kin relations again form a starting point, and children all know how they fit into their own, so they are encouraged to try to depict these pictorially. Moreover these links are all related to an understanding of the land surrounding the homes of the children, so the network of kin could be applied to a depiction of the land and bring in notions of space and measurement. Like in the Japanese approach, "sums" (like addition, subtraction, multiplication and division) as such are not seen as a priority in the early stages (ibid.), although they will eventually be taught once the children have become familiar with working between their two worlds (ibid.).

In the last chapter, I mentioned the Cook Island Māori teacher Terangi Mokoroa, who wanted to do some research on introducing the navigational skills of her Cook Island people into the teaching of mathematics there, and this would undoubtedly follow a similar path. In general, we don't need to come from any particular kind of background to take advantage of the living experience of children when we try to introduce new ideas to them, and one of the most fun classes I attended at a Japanese school was when the children had all been asked to bring things that they thought could enable the "measurement" of water. A bit of local knowledge is probably helpful, but children of any age have experience they can bring to the classroom, and asking them to offer solutions to problems before "teaching" the accepted method can be both fruitful and fun for everyone.

Physics

The teaching of physics can also build on the experience of the pupils, which is clear when we take more literally the Greek origin of the term—namely, that we are dealing with the properties of *nature*—and indeed, of course, it is only a few hundred years

since the field we are discussing was called "natural philosophy." From the beginning, if we start with the basics of light and heat, as my own course did, illustrations of the principles can draw on all sorts of life experience as they are explained. The introduction of Newton's division of the rainbow into seven colors (including an odd one I had never heard of called "indigo") could however also ring alarm bells about the cultural construction of the exercise, as indeed I believe it may have done for me at the time I learned it, but it was not until much later that I understood just how cultural his approach was.

In a report put together by a Collaborative Inquiry Committee set up in Southern Saskatchewan to discuss the inclusion of Aboriginal science into the school curriculum, one of the important things that the participating elders made clear was that they had always taught science through "lived participation in the natural world" (Sammel 2012). The report also explains from the start that they see Newtonian physics, where everything may be separated into parts and put back together again, as only one highly influential but definitely culturally bound way of understanding and explaining the world. They also note that the newer physics of quanta and chaos theory is much more in line with Aboriginal philosophies that emphasize relationships in a world that is all interconnected, holistic, and constantly in a state of flux and change.

Here they draw on the work of Greg Cajete, whose book *Native Science*, which we have already encountered, reminds us that we are part of that world, so learning through experience is particularly appropriate. He also confirms the Saskatchewan elders' idea that the truth (of science) is not a fixed matter to be found, but a question of balance that the person studying comes gradually to know. He writes, "Native science at its highest levels of expression is a system of pathways for reaching the perpetual moving truth or 'spirit'" (2000: 19). This spirit is said to be found in all things and to be interconnected through all things, so in keeping with the idea of the "butterfly effect" of chaos theory, people feel they can try to work together through ritual activity, such as prayer or a rain dance, to bring about change in the connected cosmos.

Cajete's book is introduced by a Blackfoot scholar named Leroy Little Bear (2000), retired professor of Native Studies at Harvard University, who has argued that many Aboriginal languages are

actually better able to explain quantum physics than can the English language. Using his own Blackfoot language, one of a collection known as Algonquin that spread throughout a large part of Native North America, he explains that it is more dynamic, with fewer nouns, so there is less concern with "things" than with movement. Thus the apparent ability of quanta to pass through barriers and even to be in two places at once is not a paradox but simply a part of the ever-connected holistic environment that the users of such languages understand to be their world.

British physicist, F. David Peat, who wrote a book entitled *Blackfoot Physics* (1995), describes the language as follows: "The verb takes centre stage. Within Blackfoot all is movement, process and transformation. Nouns as objects emerge in a secondary way through the modification of verbs. To them the English language is a strait-jacket which forces their minds into a world of objects, categories and restrictive logic." Peat invited Leroy Little Bear to London to address a large assembly of scientists and medics who had gathered to remember David Bohm (1917–92), who'd spent a significant part of his life working out different ways of thinking and "dialoguing" so that scientists could cope with the world of quantum physics.

During my period in Aotearoa, I took a course in Māori language and another in Māori Culture and Society, at the University of Otago. My language remains quite limited, but it was informative in many ways to study it, and the tutor I was assigned also took extra classes at my college for the Culture and Society students, so I came to know him quite well. Pounamu Jade Aikman-Dodd was proud to be Māori and proud of the knowledge he had acquired through his Māori family connections, and he brought this to his classes to help us think about the lectures we had received. One of the ideas he particularly liked was that Māori have known for a long time that we human beings and the table in front of him and the tree from which it was hewn—indeed all things in the world—are part of the same substance, the same "matter," so he had been excited to learn in atomic physics that this theory is shared by scientific research.

A Māori physicist who has written in more detail about the comparisons that may be made between physics and *mātauranga*, or Māori knowledge, is Ocean Mercier, of Victoria University of

Wellington, and she discusses the energy (*mauri*) that all things with body, or mass, are understood to contain in a Māori view, as well as in physics (Mercier 2007: 25). "This *mauri* makes inanimate things alive," she points out, "and gives all matter potentiality, whether they are biologically classified as living or non-living" (ibid.). This, she explains, is a Māori understanding of not only the laws of thermodynamics, but also the way "that matter itself can be dissolved into energy bites by relativistic quantum processes" (ibid.). Mercier goes on to discuss the way that the holistic ideas of Indigenous science also make it easier to understand another aspect of the quantum universe—namely, that the observer cannot fail to affect the outcome of his or her observations. She refers to Peat's work again here when he explains that a photon cannot be emitted unless there is something to receive the emission, a situation where it is less a matter of the photon leaving the star and entering the eye than each losing their separate distinctions. In other words, all are related, and "there can be no such thing as objective knowledge" (ibid.).

Mercier refers to the call of Western scientists, such as Fritjof Capra (1975), David Bohm, and David Peat (1987), for their fellow scientists to allow themselves to be "creative" in their thinking in order to make jumps such as that between Newtonian and Einstein's physics, but she goes on to ask them to consider where that creativity comes from. With several further examples of science that is finding parallels in Māori stories, and exasperation with the insistence of (traditional) science to be able to *measure* everything as if it were not thereby killing its potential, she writes: "Modern science is now putting into mathematical formalism a form of wisdom that seems second nature to indigenous peoples" (ibid.: 26). "Second nature"? Would that not just be "nature" according to this way of thinking?

At the University of Otago, I met a mature PhD student named Rua McCallum, who had decided to make her subject of inquiry the relationship between Māori knowledge and quantum physics. She was not new to research, having already assisted with a project about weaving textiles made from *harakeke* (the flax plant we discussed in chapters 2 and 3), and she was also involved with teaching bicultural theater students at the university. She explained her ideas to me as having similarities with some new disciplines—such as

"noetic science," or the science of inner perennial wisdom and subjectivity, and "morphic resonance," a phrase coined by American scientist Rupert Sheldrake to describe something that she explained resembled genetic memory. These ways of thinking have answers to big questions like how the universe came into being and what is the nature of God or gods.

Specifically on the subject of how ancient Māori knew the ideas mentioned above that resonate with the basic principles of quantum physics, she explained that these are imprinted spiritually, so the sense of being a part of the universe is not only gradually acquired through learning and experience, but is already prepared for in a kind of collective memory (which would clearly explain the sad faces of the Highland cattle that appeared in the photograph in chapter 3). Māori mythology tells of the way the universe was born out of darkness and brought into light, just as the story in Genesis does, and Rua's explanation of God or gods is that they are the source of all energy. She mentioned other writers in this field, such as Brian Swimm, director of the Californian Center for the Story of the Universe, and Glenn Aparicio Parry, of the SEED Institute in Albuquerque, which has been set up precisely to examine the links between quantum physics and Indigenous wisdom.

An article by Parry explains that we now need to talk of *sciences* in the plural because "in taking the scientific method full course [through understanding atomic structures to the realization of the continuous movement of quanta] Western science came full circle to a worldview that has been known for millennia in indigenous cultures" (2005: 30). Parry's article also explains how David Bohm came into contact with Leroy Little Bear and David Peat, and together they began the "dialogues" that Bohm had proposed were needed to overcome difficulties such as those experienced between Einstein and Bohr. Bohm's work also recognized that there is an "implicate order" as well as an explicate one, and we need to look beyond those things that are "manifest" to take into account those that are not—or those that are "unmanifest" (ibid.: 31–32).

Most societies have specialists who claim to be able to investigate or interpret that which we might call "unmanifest." Some are even regular, Western-style scientists, like physicians who practice the diagnosis of internal problems with the human body or psychiatrists and psychologists whose professed realm of inquiry

is the mind. In many cases, people concerned with the unmanifest are described as "religious specialists," such as priests and ministers, and there is a great variety of these in different societies, even indeed within the same societies. A new type of specialism within Western societies has taken its inspiration and practice from a third type of practitioner, until recently more likely to be found among any number of those peoples whose science settlers have belittled and, indeed, whose practice they regarded as highly suspect. They are collectively called *shamans*, after a word adopted from the Tungus language used in Siberia (Eliade 1972: 4).

As a new anthropology student, I chose for a particular focus the study of Latin American societies, and one of the characteristics of several of these is that they have these specialists we call "shamans," who are credited with extraordinary powers. Some say they can fly out of their bodies through the night, some can enter and use the bodies of animals, and others can visit parallel worlds. Most of them practice healing, of human individuals and sometimes of social ills such as quarrels and disputes, which they work out ways to resolve; they may also claim to be able to find things that are lost. They usually need to drink tobacco juice or some other stimulant or hallucinogen in order to activate these powers, but the idea is that they learn how to use these aids and to navigate the world that is unmanifest to others.

Of course there are people like this in many societies—in Japan I met a healer who claimed to be able to enter the body of a sick person who was not even present in order to diagnose and treat an illness. He listened to the symptoms, brought and explained by a relative, and then he went to his Buddhist altar and chanted himself into the appropriate state to carry out this activity. Another time I was advised to take my young son to such a person for he had been sick for several days and the hospital had been unable to cure him. It was a woman this time, and she chanted over my son directly, with her hands on his head. She did also hand me some tablets, which I did not give to my son, but he recovered anyway—as, of course, most people eventually do if the illness is not too serious.

I was skeptical, but we anthropologists are supposed to suspend our disbelief in things we do not understand properly, and this I have become quite good at, so I am now wondering again about those shamans. If visitors from a premodern world were to be told

that they could see, speak to, and even send drawings to someone at the other side of the planet, they might also be skeptical, for understanding the technology of radio waves, space travel, and satellite systems would require quite a leap of faith, especially if they still held the view that the earth was flat and the heavens occupied the realm above it. Or perhaps they might not. For in premodern times, people had yet to become fundamentalist about the science that still has a long way to go before discerning some of the capabilities and resonances of the human brain we all share, whatever our cultural heritage. As David Peat has commented: "A science seeking certainty, control, predictability and closure has ended up subverting itself. The world, we have learned is far more complex than our attempts to describe it. It contains regions of infinite sensitivity and absolute unpredictability" (online essay).

Multiple Realities

One last contribution to this chapter is strictly neither physics nor mathematics, but I include it here because it offers a parallel to Leroy Little Bear's assertion that his Blackfoot language could also cope with the need for quantum physics to be able to explain multiple realities. If things, such as quanta, can apparently be in different places at the same time, our understanding of the world is hard-pressed to translate. It is not only Blackfoot however that can deal with this, as I was provoked to realize during his talk, before which I had recently edited a paper about Chinese medicine, which seems to draw on a similarly inclusive epistemology. The title of the essay, by an anthropologist who practices Chinese medicine, Trina Ward (2012), signals the problem that she was to discuss, for it is called "Negotiating Contradictory Information in Chinese Medical Practice."

At the start of the essay, Ward explains that Chinese medicine not only operates with a different epistemology to Western medicine, but that it has itself to cope with different epistemologies within its own practice (ibid.: 128). This is less difficult than it might seem, however, because of two main divergences in the approaches. First, Chinese medicine is reluctant to let go of ancient ideas, even if newer ones seem to contradict them, whereas Western science will drop a prior one in the face of new discoveries as it

makes the assumption that there can only be one true reality. The second related idea is that Western science, at least until recently, assumed that reality, or truth, existed anterior to the knowing of it—in other words, that the knower does not influence the knowledge, which again diverges from a Chinese view.

Ward's essay describes in detail what she calls the "enactments" of two types of Chinese medical practitioners, chosen for the contrasting nature of their practice (although she explains that they are but two of six "enactments" that she researched in substantial detail). The first of these two she calls "biomedicine, the facts," for the practitioners, even though they may well be Chinese, use only medicine that can be explained in "biomedical" terms, a stance presently also supported by official bodies in the PRC. For some Chinese doctors, this approach would only be used for acute complaints, saving the other idea, which she calls "Chinese medicine, a way of being," for offering advice and treatments for general health. Practitioners of the second type rely entirely on the Chinese "way of being" and reject all kinds of Western medicine, even, for example, an X-ray photograph. These practitioners need to cultivate themselves as compassionate beings living in harmony with nature and the seasons in order to operate effectively (ibid.: 132).

In the end, all her types of practitioners except the first do accept and use contradictory explanations, for the biomedical reassurance cannot be applied to the ways of being that rely on an understanding of the nonmanifest but widely used notion of *qi*, a sort of circulating energy that a Chinese understanding of the body is said to need. In fact, she explains too that while the reality of *qi* is not disputed by the last type of practitioner, it is not necessarily referred to because the Chinese way of being involves so much more than this—actually something approaching the Māori descriptions we referred to in chapter 4. Ward even argues that the whole idea of examining medical systems as either/or possibilities betrays an epistemology that can only allow one thing to be true—either one thing or the other—but the Chinese way of being is able instead to accept multiple realities, and her research with six different enactments she compares to offering a series of "stepping stones" gradually giving access to these different world views (ibid.: 135).

The Chinese character for *qi* (氣, simplified in Japanese to気) is interesting to consider in this chapter for it does suggest a kind of

energy that I think can legitimately be compared with descriptions of energy, like *mauri*, we have encountered in other Indigenous worlds. *It* may also be translated as "spirit" in Japanese, when it is pronounced "ki," and the Japanese word for "well" in the context of being healthy (*genki* 元気) refers to the "origin" (*gen*) of *ki*, which can also be translated as "mind" or "mood." Other translations for *genki* are "vigor," "energy," "stamina," "spirit," and "pep," and a child is literally expected to be *genki*. Other words indicate further the importance of this concept: for example, "illness" is a "sick *ki*" (*byōki*); "feeling" or "mood" is the "ki part" (*kibun*) or to "have *ki*" (*kimochi*); and "insanity" is a "changed or altered *ki*" (*kichigai*).

Japanese views of nature also include the idea that trees and stones are imbued with a spiritual essence (see, for example, Asquith and Kalland 1997), and some are accorded a divine status in the order of things now classified as Shinto (literally, the "way of the gods"). Many Japanese consult Chinese medical practitioners, as well as making offerings to a Shinto shrine, when they are ill, although they also have a very advanced system of German-influenced Western medicine to which they contribute cutting-edge research. I haven't done research myself into Japanese approaches to physics, but it may well be my next project to see whether such ideas have any influence over the scientists now firmly trained in a European tradition.

CHAPTER 8

TECHNOLOGY AND SUSTAINABILITY

IN THE NORTHERN PART OF CANADA, WHERE THE LAND is for much of the year covered in snow, there is a relatively new province, which has been given the name of Nunavut. Its population is 85 percent Inuit; the local people petitioned the Canadian government for its creation and, since its establishment in 1999, administer it according to their own practice. There is a local parliament, which is built and run on Inuit principles, as we described in chapter 3 of this book. The language of the Inuit people, Inuktitut, is used in schools and many homes, and research projects carried out there have to be translated into Inuktitut to meet with local regulations. The population centers have reinstated their original names, so Frobisher Bay, according to the settler community, is now again called Iqaluit, Lake Harbour is now Kimmirut, and a place that was given the name Clyde River is Kangiqtugaapik, or "nice little inlet" in the local tongue!

In the summer of 2003, I visited Nunavut, where I travelled to several small settlements in the tiny planes that make their way over the large expanses of land and sea that lie between them, including one where the airstrip fitted so tightly that the incoming craft blew up dust all over the main street as it came in, at least in the snow-free summer season. I also spent time in the capital of Iqaluit, which is officially a city (although the population is less than 7,000 [6,699 in 2011]) and has a cathedral whose picture appeared in chapter 3. The city is equipped with several schools, including the postsecondary Nunavut Arctic College, a legislative assembly

building, and a fairly extensive airport, as well as a museum and a visitor center.

As it was summer, there was actually no snow when I was there, and some of the land was quite green. It is based on permafrost, so there are no trees, but there were some small shrubs and flowers, though much of the land is a sort of scrubby brown, and I imagined it would be more picturesque in the snow. There was one main asphalt road running through the city (named after Queen Elizabeth II, who came to open it), and there may be others now, but mostly people used the gravel paths or just the tundra for getting about. Many people own and use ATVs (all-terrain vehicles), and once the snow is established in the autumn, they can travel anywhere by snowmobile, guided these days by GPS.

One thing that shocked me about this place, however, was the extraordinary amount of litter that was scattered about. I thought about this for some time because I had been brought up to take home my rubbish, or at least to find a bin for it, whereas people here seemed to find it quite acceptable just to throw it down on the ground and, if there was a breeze, just to let it blow around. Perhaps there are no rubbish collections, I mused, but the Iqaluit website does say that there is a city dump and names the street—of course permafrost makes it hard to dig down very far, and the website also mentioned that the dump is full and another will soon be opened. Perhaps people just leave it because they know it will be covered in snow again before long, I also mused, and I don't know the answer to that question, but I suppose most of it would reappear anyway the next summer, having been preserved in the subzero temperatures.

While preparing this book, I came across a quotation from an organization called Silver Buffalo about Indigenous technology, which provided a possible answer to my deliberations. What follows is part of a longer statement, and it offers a clue to understanding the dilemma: "Indigenous technology has a different life trajectory than a fax machine. The Pukea (a carved Polynesian trumpet) will not find itself in a landfill replaced with something sleeker and faster. Its efficacy has not diminished over thousands of years of use. The Pukea is an authentic example of technological design coherent with the natural order" (http://silverbuffalo.org/SilverBuffaloITCharacteristics2.html).

Actually, a carved Polynesian trumpet might well find itself in a museum these days, as Polynesians too have adapted to introduced forms of communication, but other parts of the statement make clear the idea that Indigenous technology has been developed in harmony with its environment, like the architecture we discussed in chapter 3, and indeed the physics we discussed in the last chapter. In chapter 2, we considered the way that waste was avoided so that all the parts of an animal killed for food were also used in various practical ways, indeed forming the basis of much of the technology found in hunting societies. We gave the example of the Native American use of bison and the Inuit science lesson that showed the use of the caribou in this way. Thus I guess the Inuit society that administers Iqaluit is still working out how to deal with something so alien to their prior system of classification, and the people who throw things away may still be assuming that it will somehow meld back into the environment that provided it.

This may or may not be the case; I didn't have the temerity to ask what seemed like a rather impertinent question when I was in Iqaluit, but I do have another example of the kind of thinking that does expect that even the most elaborately constructed objects are thought best ultimately left to return to the environment—and here we encounter another clash with the societies that have built the museums that may be conserving that trumpet. In the Pitt Rivers Museum in Oxford, pride of place is allocated to a totem pole so tall that it stretches from the ground through three floors. It was constructed and carved by Haida people but purchased in 1901 and transported back from the Canadian Pacific Northwest by Edward Burnett Tylor, the first professor of anthropology in Oxford. When I visited the Haida Islands, I discovered that such beautiful carving work is still continuing and that an aim of local people, proud of their inherited skills, is to replace the old poles housed in museums with new ones. The old ones are tatty, they said, and they should come home and be allowed to return to the earth.

Of course this was not the plan of the Pitt Rivers Museum, and a PhD student was dispatched to do research in the Haida Gwaii not long after I reported this wish. Some years later she obtained funding to bring Haida visitors to Oxford to see and handle the pole and other collections, and they danced on the green in front of the museum. How they feel about the continuing display of

the pole their ancestors constructed I'm afraid I don't know, but I suspect they may have long-term plans to ask for its return. When last I was in touch with them, these people were busy arranging to bring home all the remains of their ancestors whose bones had been shipped off to museums "for research," and this was their priority, for human remains should also be allowed to return to the earth, and storage in a museum was definitely not an appropriate fate for them (as we saw for the "spruce hat man" in chapter 5).

CONTINUING INDIGENOUS TECHNOLOGY

First Nations of the northwest coast of Canada, like other peoples of that great Pacific Ocean (Moana) we discussed in chapter 6, have passed down carving skills for many generations, and their most impressive technological achievements have undoubtedly been the seagoing crafts they constructed to navigate that ocean. Commentators still wonder about how the ancient Pacific peoples managed during the enormous distances they traversed in order to be settled in such widely separated areas, despite various social and cultural similarities, and many attempts have been made to recreate their crafts and practice again the navigation techniques that we described in chapter 6.

Probably the most famous and widely reported voyages were the not always successful ones made by the Norwegian ethnographer and explorer Thor Heyerdahl, notably in a craft he named *Kon-tiki*, but these days many Pacific peoples are working to recreate and revitalize the technological skills of their ancestors by constructing large seagoing canoes. There are some differences in the ventures, however. One aim, and clearly that of Heyerdahl, was to work out how the peoples who now occupy various part of the huge Pacific Ocean travelled to the places where they settled, and in which direction. For some of the Oceanians, the aim is to recreate the voyages of their ancestors in order to understand their own heritage. For yet others, and the main interest in this book, the idea is to build on the skills passed down to them and use them alongside introduced technologies to create something new, but nevertheless valuing the older Oceanian technology.

We have already examined several cases of these traditions continuing despite the introduction of outside technology. In chapter

1, for example, we found Australian elders explaining their ancient knowledge of burning techniques using film and video clips. In chapter 2, we looked at the way that Inuit skills are still put to good use in catching animals and making clothes from their hides, while when traveling, these Arctic peoples are also very happy to adopt and use machines such as snowmobiles and global positioning devices. In chapter 3, we saw how the Inuit experience of designing the shape of constructions that best withstand the potential ravishes of their severe climate has been adopted for new public edifices made with materials entirely introduced from the outside.

We also saw in that chapter how modern architectural techniques, like seeking warmth by sending water six to eight feet down under the earth, may well have been influenced by the science and wisdom of peoples who have long adapted to living in places with very cold winters. And I don't think it a coincidence that my brother-in-law in the Island of Lewis has invested so heavily in the ever-available local energy source, which is wind, and in capturing for future benefit the less frequently available sunshine. In fact there was a serious proposal, supported for a while by the Scottish government, to build the largest wind farm in Europe on the Isle of Lewis, but local people objected for various reasons, including the protection of wildlife, and the plan has now been reduced considerably.

In complex societies there are always conflicting views about large-scale projects, and it is not going to be very helpful to those seeking sustainable solutions to the problems of big cities to learn how things work in the sparsely populated countryside, but a glance at some of the ways that outside technology was introduced into Japan and then married to existing Japanese skills and ideas will give us a sense of the enormous possibilities for technological fusion. First, it is important to understand that in Japan an important method of learning new techniques is first of all to copy them exactly, and for this reason, it was for some time thought by outsiders that the Japanese people simply adopted fresh ideas wholesale. They then work on adapting them to local needs, however, often making exciting innovations as they go, so the world was taken by storm when Japanese versions of the latest technology began not only to appear in the world market but also to drive out other businesses that had previously been at the top of their game (see Cox 2006).

Good examples may be found in high-performance motorbikes, a whole range of automobiles, top-quality cameras, all manner of kitchen equipment, and innumerable electronic devices, so for quite a long period in the late twentieth century, Japan held a strong if not leading position in the world market in all those spheres. For a country that had been virtually closed to outside influence for 250 years by the middle of the nineteenth century, when industrialization was taking off elsewhere, that was quite a feat, so it is interesting to see what kind of technology provided a base for such rapid development. Some Japanese people had for centuries been literate, so we are not necessarily talking of knowledge that had been passed on only through stories, art, and performance, but this exercise can give us quite a good idea about the possibilities for Indigenous peoples everywhere to build on their longstanding skills and wisdom.

First, let us look at that idea of copying as a method of learning, for to be able to reproduce highly tuned skills takes a lot of time and effort, and for centuries artists and artisans in Japan would spend literally years simply watching a teacher before even trying to accomplish the activities themselves. Thus for a chosen craft—let's say carving or potting—youngsters who wanted to learn would attach themselves to a master of the art and simply help with easy parts of the process until they could gradually build up the more complex skills required. There has been a lot of specialization in Japan, and even a cursory glance at some of the work displayed today in museums and galleries demonstrates extremely high levels of achievement, but the principle of learning by watching, and only gradually taking part, is found rather widely throughout the world.

Another aspect of Japanese art—in the sense of skill, or craft—is that people honed their manual dexterity to be able to work with very small objects (consider the beautiful netsuke that can be seen in museums or hanging off traditional garments), and this ability to work with tiny material things undoubtedly enabled people soon to work out how to handle transistors and the components of electronic devices when they were introduced. To make something in Japan was always to make it well and therefore to pay attention to any amount of intricate detail so that when factories were introduced there to mass-produce objects with numerous moving parts, there was already a throng of willing workers who could be relied upon to do a good job.

Thirdly, there was also a culture from ancient times in Japan for preserving examples of their art, rather than letting them rot back into the earth, as was customary with many other peoples. Indeed, objects regarded as valuable might be wrapped up carefully and protected from the climate, which is often very damp and could therefore be damaging to any number of materials. There has also been a practice for some 14 centuries of rebuilding one of the most sacred buildings in Japan, along with all its parts and contents, and this Ise Shrine, dedicated to the founding ancestress of the Japanese people, therefore stands extant to witnesses from outside that Japanese people have the level of technology and "civilization" that we mentioned in chapter 3 is accorded to peoples who make buildings.

This accolade is of course even assigned to peoples whose buildings have fallen into ruin, and we (Westerners?) look to Mayans, Aztecs, and Nabateans as having an impressive cultural heritage, which we can investigate using archaeology. In the case of Japan, however, the regular rebuilding (every 20 years) is arguably one of the most sustainable ways of conserving this technology—along with the skills required to achieve it (which points to another Japanese practice of designating highly accomplished craftspeople as "living national treasures" and ensuring that they have apprentices in order to pass on their knowledge)—and has enabled a very long cultural history to be maintained.

Now here we come to the final aspect of this excursion into the lives of the literate Japanese and its relevance to a study that has more usually been concerned with those who had yet to acquire the ability to transcribe what they do into script, for this practice of renewing material culture when (or even before) it becomes tatty is of course not confined to Japan, as we saw above for the American Northwest coastal peoples. In fact, script was introduced to Japan from China, and as usual they became pretty good at it. Still, they actually have many qualities that may be compared with other peoples who share the Pacific Ocean (see Hendry 2012), and one is rather common to Indigenous peoples everywhere—namely, that they make little distinction of the sort that has become strong in the English language between "art" and "craft," or technology.

Thus pieces of technology, which are made with a purpose, may also be made as beautifully as possible simply because it gives pleasure to both creator and user to have a beautiful object in their

hands. Western visitors, and settlers in many places, have often appreciated the beauty of the material culture they found, collecting examples of it and putting them in museums but less often noticing or using the clever technology embodied in the same object. One powerful example that in a way contradicts the idea (though as far as I know has not been adopted much elsewhere) is the boomerang, made in a variety of forms by Australian Aboriginal peoples throughout the country but now relegated in many places to the status of souvenir. However, in Melbourne University at Murrup Barak (mentioned in chapter 4), I heard about a project when I was there in 2011, which was to collect a record of ways in which Indigenous knowledge is used in the curriculum and in teaching, and Christine Asmar, who was putting it together, mentioned that engineering students do learn about the principles of the boomerang as part of their course.

Apart from the early use of script, then, none of the factors mentioned for the Japanese marks them as particularly different from many other peoples, but there are of course further reasons why the nation was able so to impress the world once it embraced industrialization. Unlike the case of First Nations people around the world, Japan was never occupied for very long by outsiders; except for the few years after World War II, Japanese people ran their own affairs. Also, in the nineteenth century, once they decided to take a look at what was happening elsewhere, Japan sent out quite high-ranking ambassadors to collect information and bring back examples of things that they wanted to reproduce. Interestingly, when they were earlier visited by Europeans, in the sixteenth century, Japan classified these foreigners as "barbarians" (*yabanjin*) and even made poorer quality goods for outsiders who wanted to buy from them than they made for themselves, as may be seen in European exhibitions (for example, at the Fundação Oriente in Lisbon).

In other parts of the world—like Australia, where Indigenous craftspeople were treated as little different from animals by settlers, or Canada, where members of First Nations did not think it important to preserve their material culture—the *voyageurs* and later settlers had limited opportunity to be impressed by the technological skills of the people they encountered. Some were, of course: Captain Cook and his chief scientist, Joseph Banks, and their discoveries of

navigation skills in the waters of the Pacific provide an example we have already mentioned. There were also anthropologists and other travelers and explorers who collected things to bring back to museums in their own lands, or later to set them up locally, but there was an idea prevalent during the period of imperial expansion that these "primitive" people—or "barbarians," again—would not survive the arrival of the conquerors from Europe.

Peoples may not have survived intact, but another misapprehension Europeans took with them was that such people had lived unchanged for centuries and that they would simply be absorbed into the new society as their own was destroyed. In practice, all peoples change all the time, both through their own endeavors (practices that we could call "experiments" and "discoveries" in their daily lives) and also through the introduction of new ideas from others with whom they come into contact. Thankfully, then, some at least of the Indigenous peoples whose lands were taken over did survive and even in some cases were able to maintain some of their sustainable ways of living. Others have set about reviving them, as we have seen in earlier chapters of this book. Now, as we are looking for renewable sources of energy and looking to save the earth from the waste and devastation we Westerners have imposed upon it, it would seem to be a good time to take a look again at those people we classed as so inferior.

Facility with Introduced Technology

In this section of the chapter, I will introduce some of the ways in which the very latest technology is being picked up and put to good and inventive use by Indigenous peoples around the world as soon as it becomes available. Just as described above for the Japanese when they encountered new technology, there has been no shortage of volunteers to experiment with the possibilities and indeed to find novel ways to use them. My own reaction has moved from an initial one of surprise, to generally remarking on the facility people almost everywhere seem to demonstrate, to a sense of embarrassment that I should ever have wondered why they should not. It may be that the reactions of some of my readers will follow a similar trajectory, unless you hold the very last idea already, but here I want at least to lead you all past the stage of surprise.

My own first encounter with this subject actually took place in Africa when I attended a conference in Arusha, Tanzania, and decided to spend a bit of time looking at examples of cultural display for an earlier book. I managed to obtain a grant (that time from the Nuffield Foundation), and I took a series of short trips by plane to visit various internal parts of Tanzania and then finally to go to Nairobi before returning home. This was a few years back, and although I had been using a desktop computer for some time, I had not graduated to carrying a laptop, even less to owning or knowing how to use a mobile phone, and a friend who had worked in Tanzania for VSO (Voluntary Service Overseas) some years earlier warned me that facilities might be minimal and that I should not worry if things didn't happen at the time I had arranged.

Well, Tanzania may have been a British colony (as part of Tanganyika), and it may have taken the independent government a while to settle into managing its own affairs, but my experience could not be faulted. I had arranged to be met at each port of call, and my guides were local people ready to explain their situation, always at the airport in good time for my arrivals, which were also all on time. The planes were small, but every aspect of the flights was managed expertly, and on one of them I met by chance the wife of a man—actually the only non-Tanzanian on the whole trip—who was in Tanzania to install pylons for a big mobile phone network so that the signals could be picked up throughout the nation. In fact almost all the people I met carried phones, and it seems that the mobile company had picked up good business because few of the same people had telephones in their homes, so they had left the landline system standing. Most of the people I met also had email addresses, but I am sure that by now they are well into other social networking activities that I have yet to embrace (if I ever do!).

My next such experience was also part of the previous research project, when I was invited by a First Nations friend in Canada to go along to a big public event in Toronto because she and her sisters (and I think her mother) had made a recording of some of the songs they liked and entered it into a national competition for Aboriginal music awards. She told me that they had made the recording in their bathroom as this was the place with the best acoustics, so I was totally bowled over by the size and extent of the occasion and the professionalism demonstrated by most of the

other entrants. The show was being held in a big Toronto venue called the Sky Dome, and it was packed full of supporters of the entrants, or at least those who had been short-listed.

Now, I had been to big Aboriginal events in Canada before, but they were mostly powwows or conferences organized in a park where participants brought lawn chairs to sit in and the atmosphere was pleasantly relaxed. This was quite different. It was high-tech and high maintenance, the sound system booming out to relay all the music that was presented and lights flashing on and off to spotlight the stars as they were made. The theme of the event seemed to be "This Is Aboriginal Time," and at every mention the lively MC made of the phrase, the audience cheered with gusto. The MC was a young female TV personality, and she and her older male colleague exchanged amusing banter about how the world had changed. And why not? Why should I even have been surprised? It was certainly something to celebrate!

It was not really a surprise to me a few years later in 2009 when I had the opportunity to visit some Minority regions of China on my way to a conference in Kunming, capital of the southernmost province of Yunnan. I was lucky enough to have a guide from a Minority people for a good part of this trip, and he was able to present a different view from the majority Han people, emphasizing each peoples' own achievements, rather than merging them into a general Chinese context. He took us to a small village populated by some people called Hani, who live in the mountains among a huge spread of rice terraces disappearing into the mist in each direction (see figure 8.1).

There a rather small but very interesting museum was open to explain the technology these people had used for many years: first to carve the terraces out of the mountainside, then to plant the seedlings and ensure that they received sufficient water during the growing period, and finally to harvest the produce and transport it down the mountainside. Most interesting of all, however, was the fact explained rather modestly that it has been these people, whose houses remained rather basic, who had led the now more general practice, in southern China and elsewhere these days, to find a way to take advantage of an appropriate climate for growing rice in a formerly inaccessible area. A Hani proverb expresses the debt these people owe to their ancestors who developed the skills: "Forests are

Figure 8.1 Rice terraces in the Longsheng area of Guanxi Province, China. Photo by the author.

the lifeblood of water; water is the lifeblood of rice terraces, and rice terraces are the lifeblood of the Hani people" (Liang 2011).

By the time of my visit to Alice Springs in Australia in 2011, I should have grown used to the ingenuity of Indigenous peoples and their ability to adopt any technology that happens to be available, but I have to admit that I was surprised by the speed with which the various Aboriginal groups in the remote areas outside the city had picked up on the possibilities of television when it arrived. Not only was it gladly accepted passively, but soon people were keen to obtain the equipment to make their own television programs and even to beam them out to the world at large. There are now three big organizations in and around Alice Springs that link these remote areas through broadcasting, collecting programs made in the communities, and putting them into digests that then get sent out within the region.

I had received an introduction to a man named Daniel Featherstone, who had worked for some nine years for one of these organizations, Ngaanyatjarra Media, named after a group of peoples living

in the desert regions of Central Australia. He had coordinated the setting up of radio and TV networks, as well as cultural video projects recording stories and dance events in remote communities and using the new media to disseminate broader knowledge about health and land management. When I met him, however, he was worried about a new digital TV switchover (completed at the end of 2013), a government program that installed direct-to-home (DTH) dishes on every household to receive TV services from the new VAST digital TV satellite but removed local TV transmission and the ability for communities to broadcast local content, as established in the late 1980s. It represented a shift away from local self-determination to more central regulation, he explained, and people in remote communities would now have access to 16 national stations but not to their local one. The Indigenous Remote Communications Association (IRCA), of which Daniel is now the general manager, is advocating for an alternative local-content distribution model.

Nevertheless, he described to me some of the successful ways in which the introduced media technologies have been used by Aboriginal peoples, for example to record popular music that has made an impression way beyond Australia. One band, Yothu Yindi, reached top-of-the-pops status in the 1980s and 1990s, and the songs of a related blind singer, Gurrumul Yunupingu, who was invited to travel the world, became known in the category of World Music. Sadly, the lead singer of the Yothu Yindi band, Dr. Yunupingu, passed away in 2013, but he had achieved much personal success in a university career, becoming the first Aboriginal school principal—of Yirrkala Community School in Arnhem Land—and being named Australian of the Year in 1978 [a program of the National Australia Day Council], for his ability to bridge Indigenous and non-Indigenous communities.

I had the opportunity to visit Yirrkala in 2011, where there is a very impressive cultural center known as Buku-Larrngay-Mulka. It houses a huge archival collection boasting some of the latest media technology that is being harnessed for the project (*mulka*) of protecting and preserving the heritage of the Yolngu people who live in northeast Arnhem Land, where they receive the first warmth of the morning sun (*buku-larrngay*). There is an abundance of material: photographs, videos, and a huge collection of beautiful material

culture. The local Yolngu people have so many skilled video-camera users that they were able unaided professionally to cover the visit of Julia Gillard, the Australian prime minister of the time, when she came to sign a lease for a new mine in the area. These are the people whose science was mentioned in chapter 2 and whose use of cultural knowledge in the teaching of mathematics was discussed in the last chapter.

Actually the popularity of television for communication among Indigenous peoples is certainly not confined to Australia, and I enjoyed watching the Aboriginal Peoples Television Network (APTN) when I was doing research in Canada, as well as Māori TV in New Zealand. Both are apparently rather popular among the general population for the quality of their programs, and they are also able to broadcast in native languages, which offers a good way for people who have not learned them as children to pick up some colloquial usage. Gaelic television is broadcast in Scotland as well, and the brother-in-law I mentioned in chapter 3 has been awarded the somewhat dubious status in the Isle of Lewis of having been the first to bring television to the island many years ago!

The Indigital Revolution

In chapter 4, I mentioned Lyndon Ormond-Parker, an Aboriginal PhD student at Melbourne University who introduced me to several helpful people when I went off traveling. In the last section of this chapter, I draw almost exclusively on the work that came together through a conference session and a subsequent symposium he was heavily involved with organizing and the resulting book he edited with his collaborators, entitled *Information Technology and Indigenous Communities*. The gatherings took place in 2009 and 2010, supported by the Australian Institute of Aboriginal and Torres Strait Islander Studies, and the book was published by them in 2013 (Ormond-Parker et al. 2013), but it draws on the introduction, rapid acceptance, and creative use of various forms of information technology throughout the Australian Indigenous world during the previous three decades.

In the preface, Marcia Langton notes, with some pleasure, the overwhelming numbers of people who turned out to attend the 2010 special symposium, representing a great range of fields—art,

media, teaching, language, mapping, archival research, dance and performance, ethnomusicology and museums—and "the sheer innovation, as well as the global reach of Australia's Indigenous communities working with these new technologies," that becomes clear in the chapters of the book (ibid.: v). She also notes, in a quote from a previous presentation, that the potential social benefits are extensive. "One of the most important is that it allows Indigenous peoples to position themselves outside colonial nation-states, in the new cyberspace" (ibid.)

The introduction to the book, by Aaron Corn, refers to the movement as an "indigital revolution," so impressive was the rapid and innovative take-up of digital media of one sort or another by Aboriginal Australians. The first chapter, which is about the adoption of mobile phone technology in Cape York and other areas, reports that these devices are soon used for playing music (along with MP3 players) and as cameras, as well as for telephoning and sending texts, and that almost as soon as they were introduced it was reported that "most people had them" (Dyson and Brady 2013: 14). Children sent away to school were given them "to keep in touch," and once the 3G versions were available, they were being used for playing games and for Internet use (for example, to send money to the children when they needed it). People who used them for work were soon claiming them against tax, and they were quick to pick up the possibility of sharing music and video files using Bluetooth (ibid.). For driving through rough terrain, this way of playing music was not only better than CDs, which tended to skip, but enabled each passenger to choose their own listening.

Chapter 2, by Daniel Featherstone, is entitled "The Aboriginal Invention of Broadband," in reference to a project he was involved with in 2004–08 to roll out a broadband network to 12 communities in the Ngaanyatjarra Lands of Western Australia, which covers about 250,000 square kilometers. He describes in some detail the way that Internet communications technology (ICT) has been adopted for all kinds of culturally appropriate usage, such as relating cultural events, language classes, media training, and recording the activities of elders to pass on their knowledge to children (as we described for knowledge of fire in chapter 1) (2013: 29–31). It has also been adapted for literacy development for adults in the absence of community colleges (ibid.: 38), to archive social history

and cultural knowledge, and to record garage band music, when the skills of recording were both learned very quickly and demonstrated long attention spans the young people had not been thought capable of because they hadn't got on very well at school (ibid.: 39–40; see the story at the start of the next chapter on this subject).

Another author in the Ormond-Parker collection demonstrates how digital tools have been adapted to reflect Indigenous epistemologies within their own frames of reference for education and cultural preservation. Barbara Glowczewski (2013) has worked with the Warlpiri people since the 1970s, and she describes how she and some artists from Lajamanu created a CD-ROM called the *Dream Trackers*, which can be negotiated by elders who cannot read or write by enabling them to move through the program using icons they recognize from their own cultural knowledge. She also describes how Warlpiri intermediaries, such as Steven Wanta Patrick Jampijinpa, the creative director of the Milpirri Festival at Lajamanu, creates video content for YouTube as a means of communicating traditional worldviews and Walpiri intercultural resonances to a global Internet audience.

Lyndon Ormond-Parker's own chapter in this volume, written with Robyn Sloggett, raises some of the possible problems related to the use of Internet technology, especially when it is regarded as a resource for archiving cultural material. The title, "Crashes along the Superhighway," refers both to the speed of development of Internet technology and its rapid rate of change, and therefore to potential fatalities to information, as methods for the retrieval of saved data are consigned to the roadside waste bins when new and more efficient storage facilities take over. As Aboriginal communities have also rapidly adopted digital technology for such recording purposes, Sloggett and Ormond-Parker warn that they must also be careful to put in place methods of conservation and retrieval to ensure that it is not lost.

It seems after all that some of those time-tested methods of passing on scientific knowledge through art, performance, and storytelling may not have been outsmarted! When I was visiting the research center at the Desert Knowledge Precinct outside Alice Springs, I met an Aboriginal scholar named Josie Douglas, who was writing a doctoral thesis about the acquisition and transmission of

Indigenous ecological knowledge. She explained to me that what she is looking at may be regarded as "data" by outsiders, but for Aboriginal peoples it is "lived knowledge" that forms part of people's lived experience. Aboriginal people are finding new ways to sustain knowledge amid rapid sociocultural change and disruptions to traditional lifeways. Using digital technology is one new way of maintaining local knowledge. In the next chapter, we look at some of the other ways in which this is happening.

Chapter 9

Facing Both Ways: Possibilities for Bicultural Education and Science

In the chapters of this book, we have examined various examples of Indigenous science that are based on ways of thinking and being that are usually quite alien to an outside view. In most cases they are also found among peoples who live within a broader, dominant society that may for long have ignored the value of their science and instead imposed on them an education system that is in turn quite alien and even inappropriate to them. Of course, we who have exported our education systems around the world probably felt we were doing these people a good turn, enabling them to "become educated" and thereby "civilized," and to this day, we in Britain at least still send young people barely out of school themselves to spend a "gap year" teaching in schools in "developing" countries. They have no qualifications to teach, and I often wonder at the sense of this, but schools seem to want them, and they go.

This chapter brings together some examples of how education can be devised to share the fruits of very different epistemologies and bring benefits to all concerned. The Indigenous people whose learning is valued find that the ways they have grown up with are at last being given proper respect, while at the same time absorbing some of the accumulated knowledge of those who have settled in

their lands. Those same settlers may also be able to benefit from knowledge gathered and refined over much longer periods of time than they have spent in the environment, and we have already mentioned some cases in previous chapters. This chapter looks toward a future when substantial numbers of graduates and school leavers will have had their minds opened to different ways of thinking, and many of the examples are taken from the wisdom of Indigenous scholars again.

Every chapter so far has started with a story, and I have one more to tell here. It is about a good friend of mine named Keith Jamieson, who lives and works in Canada. His father was a Mohawk, and he identifies with that status, having been born and brought up on a reserve in Ontario that was granted to the Mohawks and other peoples of the Six Nations of the Haudenosaunee, or Iroquoian peoples, who fought on the side of the British in the American War of Independence. The nearest town is called Brantford, after Joseph Brant (Mohawk name, Thayendanegea), who led the Mohawks to support the British and leave their ancestral lands, now in the eponymous Mohawk Valley of Upstate New York. The lands they were given in Canada border the Grand River, and the British also built a Royal Chapel of the Mohawks in 1785 at the order of King George III and helped Joseph Brant's son, John, to build a Mohawk Institute where, for a while at least, the language of instruction was Mohawk.

The Mohawks had befriended the British who settled in their lands, as they had the Dutch and the French who arrived before them, teaching them how to live in their country and sharing much of their preexisting science with them. They were also interested to find out about these new arrivals, and there is a word in the Mohawk language for someone (a little like an anthropologist) who is chosen to take steps to gather that knowledge. It seems likely that the elder sister of Joseph Brant, who became known as Molly, even attended a British mission school so that she could learn English and become familiar with the ways of the settlers. Molly later became close to the British governor of that part of prerevolutionary North America, Sir William Johnson, and they shared a very English house and had eight children together. Their home was said always to be full of Indian visitors, including her brother who led their support for the British defense.

One of the reasons why the Mohawks and the British had become friends was because their leaders had early on drawn up an agreement to respect each other's ways of life, and a beaded belt, known as the two-row wampum, symbolizes this accord. The two-row wampum, or *Gus-wen-tah* in the Mohawk language, depicts two ways of life in parallel purple lines running side by side but neither interfering with the other, and the white beads that run between them depict peace, friendship, and respect. This was originally made for a treaty between the Dutch and the Haudenosaunee Six Nations, represented by the Mohawks as "guardians of the Eastern door," in 1613, and later for treaties with both the English and the French. According to Keith, the most significant treaty specific to both the English and the Haudenosaunee and which advances the Two Row was a Covenant Chain of 1667.

In the early days of British contact, Mohawks were invited to visit the British court of George III, and to this day the people of the Six Nations of the Grand River celebrate the birthday of Queen Victoria annually. My friend Keith introduced me to this custom, and indeed to his whole family, and his mother put me up for six months in their house on the reserve while I was doing research there. Keith has also been to England more than once, and although he has yet to be presented at court, he has visited the college in Oxford where one of his ancestors was briefly a student.

The Canadian government, which eventually took overall control of these lands, did not have quite the same respect for the ways of the Native peoples, and they subjected them to an assimilation policy similar to that imposed in other parts of the postcolonial world. The aim was to "civilize" and "educate" all their citizens to have the same chances as everyone else who lived in Canada (or Australia or wherever), but the system was far from successful. The Mohawk Institute became a residential school for the children of families who could not afford to send them to the local establishments that were being set up, and its pupils were now expected to speak English, impelled by force if necessary. There are a lot of stories about the cruelty meted out in this and other residential schools, and it was a bleak period in the history of the Mohawk people, but let us return to my friend Keith, who was sent to an ordinary local day school but still on the reserve on the Grand River, in the town of Ohsweken, where his family lived (and, indeed, still live).

Keith was free to travel home at night, where he could hear the stories of his parents and siblings, but he found his schooling for a long time tedious and unfulfilling. He was being taught a Eurocentric version of history and geography that presented the country in which he lived as a new nation, built by people who had "discovered" it and "developed" its vast and plentiful resources. The political system that ran the nation had been imported from Europe too, along with agreements between the parent nations, Great Britain and France, which meant he was also expected to learn French. Little mention was made of those, like his ancestors, who had thrived here before the Europeans arrived, and no attempt was made to teach or explain any of their languages or cultures. Frankly, he was bored.

Then one year, a new teacher came to the school, and she asked the children whether they knew the meaning of the name of their town, Ohsweken. She began to present a different world, their world, one that had a parallel history that had involved their own ancestors and a perfectly respectable confederacy to run it, which had apparently even influenced Benjamin Franklin when he drew up a constitution for the United States. Keith told me that his life was transformed. Suddenly, education had meaning, a meaning that gave him a sense of who he was and where he came from. It would be another generation before a school in the town offered Mohawk-medium education again, but Keith was inspired to learn more of his Indigenous heritage, and indeed, he now passes on that learning to a new generation in the university and college where he teaches.

The Canadian government has since then revised its approach, and the Mohawk Institute has become the Woodland Cultural Centre, which collects books and artifacts about the people who used to inhabit those lands, and Keith has also worked there as an archivist and librarian. The center offers language classes and regularly puts on exhibitions of First Nations art, crafts, and photographs, as well as hosting dance performances, theatrical productions, and even a fashion show. It has become a place for the local Indigenous peoples to meet, share, and enjoy their heritage, and it also offers classes and outreach for children from local schools to learn about these ancestral occupants of the land they now regard as their own and the science they practiced before the ancestors

of many of them arrived in these lands. Keith arranged for me to spend time there too, and my book, *Reclaiming Culture: Indigenous Peoples and Self-Representation* (2005), records the research I carried out with the help of him and many other First Nations friends.

Felavai, or Interweaving, as a Model

To recognize the value of Indigenous culture, including science, is one very important step in the direction of rectifying some of the wrongs colonial powers have inflicted on the peoples whose lands they occupied, but it is not really enough to pay lip service to the great Indigenous knowledge they ignored. Fortunately, the authorities in many of the countries we have encountered have begun to realize their folly and are funding research and other forms of recognition, as we have seen in several of the earlier chapters of this book. More importantly for future generations, educational authorities are thinking about the value of including Indigenous, or Aboriginal, science in their curricula, and lively debates have been taking place about how best to combine this with what has become known as mainstream, or Western, science.

One problem is to accord them equal value, and an Oceanian model introduced at a conference I organized in Oxford addresses just this issue. The conference was entitled Seeking Bridges between Anthropology and Indigenous Studies (see Hendry and Fitznor 2012 for written versions of most of the presentations), and I arranged for this Oceanian paper to open the conference discussions, so important did I think the point that was being made. The author is the Tongan we met in the chapter on navigation, and his paper introduces another term from his language—*felavai*, or "interweaving." Tevita O. Ka'ili sees anthropology, as with other sciences, as constructed within a cultural framework that is often unrecognized by its protagonists, and his aim is to find a way to "indigenize" anthropology to be more appropriate for those who have grown up with a Moanan (Oceanian) view of the world—in other words, to share the two epistemologies.

According to Ka'ili, "The Tongan concept of *felavai* [which] means to crisscross, intersect, or to interweave" (Māhina, Ka'ili, and Ka'ili 2006: 21). In Tonga, beautiful intricate geometrical patterns—known as *kupesi*—are created through the symmetrical

Figure 9.1 This classical *kupesi*, "geometrical pattern," is known in Tonga as *Amoamokofe*.

Source: Kupesi Artist (Tufunga Tā Kupesi), Sēmisi Fetokai Potauaine, Aotearoa/New Zealand, 2010.

interweaving/intersecting (*felavai*) of lines, colors, strands of pandanus leaves, sennit ropes, and so forth (see figure 9.1). These aesthetic patterns adorn Indigenous art forms, such as tattoos (*tātatau*), carvings (*tātongitongi*), mats (*fala*), bark cloths (*ngatu*), and sennit lashings (*lalava*) (ibid.). Ka'ili pointed out in his presentation that the patterns depicted in all these forms "interweave" various components in such a way that none is given precedence, and all are given equal value. To be able to interweave the science drawn from different epistemologies in such a way would be an achievement indeed!

It is probably not a coincidence then that a study that offers an example of doing such scientific interweaving comes from another Pacific source—namely Aotearoa, or Māori New Zealand (although again it proposes the method as applicable more widely). The project was carried out jointly by a Welsh materials engineer, Debra Carr, and a Māori user of cultural materials, Rua McCallum (whom we also met in chapter 7, where we introduced her PhD research relating Māori ideas and quantum physics). The focus of this joint study was also concerned with weaving, this time in practice, because it was an assessment from both perspectives of the *harakeke* (*Phormium tenax*, or New Zealand lowland flax) for weaving purposes, in this case taking a sample growing at Te Nohoaka o Tukiauau (Sinclair Wetlands) in the southern island of New Zealand (Carr and McCallum 2007).

Actually the assessment of *harakeke* was a case study in the broader development of a holistic research philosophy that the authors called *turuturu*, a methodological framework that embraces both mātauranga Māori (Māori knowledge) and Western science and engineering. They explain that the idea had emerged as a result of changing perceptions of research methods by each of the authors and, in practice, was developed by examining the interface between

their two approaches (ibid.: 89). The paper they published together includes details of each of their own worldviews in addressing the subject, lays out their separate methods, and brings them together to conclude that they not only reach similar conclusions, but that they merge and ameliorate in the process (ibid.). Interestingly, the authors also start their paper with an incantation about weaving, which they offer as a symbolic representation of their work together (ibid.: 89–90).

Another of the researchers I met in the Cook Islands, Syaka Tairi, is working on ways to incorporate Indigenous knowledge constructs of *tapa* making into the learning of chemical-education curriculum concepts in school science teaching. *Tapa* is beautiful bark cloth woven locally, similar to the *ngatu* mentioned above by Ka'ili, and Syaka is a skilled weaver who also teaches science at Enuamanu School in Atiu, so she is well placed to carry out this project.

The Medicine Wheel as a Model

A model that was proposed by a collaborative inquiry committee set up in southern Saskatchewan in 2005 to work out a philosophy and framework for Aboriginal science teaching also works toward the aim of integrating it with existing scientific teaching. The committee comprised Aboriginal elders and a variety of other educators, including those from various levels in the formal Saskatchewan school and university system, and the aim was to provide practical ways for teachers—and indeed the curriculum—to integrate Aboriginal perspectives into Canadian science education (Sammel 2012 is the publication based on this report). Some important caveats to this aim were that the Aboriginal knowledge needed to be introduced on its own terms and that it is usually passed on orally or experientially, which gives it a degree of flexibility to make it appropriate to the learners, and so some key aspects of the work would take place outside the school classroom.

Saskatchewan has a larger Aboriginal population than many other parts of the country, which is an excellent reason for developing good practice within its schools, and it also means that there are elders in the local communities who can help with the teaching and learning. The report of the committee therefore includes a substantial section about protocols to be observed when approaching elders and some

very helpful suggestions about how and when to encourage school children to seek learning beyond the classroom. Four major themes emerged out of the discussions, and these are addressed in turn in the report, but essentially they are perceived to be inextricably linked, interconnectedness being one of the four and good pedagogy another. The other two, spirituality and science, express together the idea that all things in the cosmos have a spiritual component according to the Aboriginal view, and this needs to be respected and is indeed shared among humans and "all our relations."

The medicine wheel is a complex expression of this interconnectedness, known in various forms throughout Native North America, and it has been sketched in the report of the committee to incorporate distinctions of Western science, such as that between mind and body, and also to demonstrate how partial such a view becomes in the greater scheme of the whole cosmos. The wheel is composed of four quadrants but may have many layers running around the outside of these quadrants, with the individual self marked as a circle in the middle. The directions out from the center stand for north, south, east, and west, but the wheel is laid flat, so none is seen as higher than or superior to any other, and the cycle is cyclical so has no beginning or end. The quadrants also stand for spring, summer, autumn, and winter, and (in that order) spirit, heart, mind, and body, which, for a good education, need to be kept in balance. (For one account of some of its uses in human development, see Wenger-Nabigon 2010, and for a general introduction, see Bopp, Bopp, Brown, and Lane 1989.)

"Both Ways" Education

The model for bicultural education that has been recognized in Australia for some 30 years now, if not always used, was briefly introduced in chapter 7 when we discussed the mathematics teaching in Yolngu schools that drew on a local image of Gänma, a place among mangrove trees where saltwater coming in from the sea meets the stream of freshwater coming down from the land, and together they form a lagoon. The two types of water stand for the introduced and the local philosophies, respectively, and the lagoon for the "both ways" model of schooling that was explained to the wider Australian people by the Yolngu scholar and teacher

Ratmattja Marika, in the 1998 Wentworth public lecture given at the Australian Institute of Aboriginal and Torres Strait Islander Studies (Marika 1999: 7).

Another aspect of the "both ways" teaching described relates to the value of the Aboriginal languages, and part of this lecture was devoted to an appeal to the Australian government to rethink the way that children whose first language is not English are assessed. A system was described that gives little credit to children who are growing up bilingual—or actually in some areas multilingual—instead classifying them as second-class as early as fifth grade because their strength was not in English as a first language. Marika ended her lecture by saying, "Our job as educators is to convince the people who control mainstream education that we wish to be included. Until this happens, reconciliation is an empty word and an intellectual *terra nullius*" (ibid.: 9), a neat reference to the way that the lands of the Indigenous peoples of Australia and other countries were for a good while classified by the incoming settlers. In practice, she certainly seems to have convinced the Yolngu families of the importance of bicultural education for when it was denied them for a while in 2011, they simply refused to go to school until it was reinstated!

A number of institutions of higher education in Australia have taken up the challenge of offering a both-ways system appropriate for Aboriginal students, and a paper published by Robyn Ober and Melodie Bat (2007) lays out very clearly the principles drawn from Yolngu educators and other examples and used to underpin the practice of the Batchelor Institute, which offers tertiary education specifically designed for Aboriginal and Torres Strait Islander students. According to their published strategy, the philosophy of education espoused there "brings together Indigenous Australian traditions of knowledge and Western academic disciplinary positions and cultural contexts, and embraces values of respect, tolerance and diversity" (ibid.: 69), a position that Ober and Bat lead the reader gently to understand through what they describe as a *kapati*, or "cup of tea," approach.

This is actually a story, something along the lines of the way I have been introducing my chapters in this book, and I was encouraged to find that it offered a powerful way to grasp some of the issues and problems involved. The story is by Robyn, herself an

Indigenous educator with links to more than one cultural group, and it is about her father, who worked as a counsellor in the college, undoubtedly succeeding in helping students who were encountering difficulties but confounding one of the non-Aboriginal employees for the approach that for her seemed most unorthodox. The paper goes on to offer a series of explanations of the two-way system, including the Gänma model and other graphic and metaphorical depictions as well as a short history of the development of the concept.

Three important principles are drawn out of the paper. The first asserts that the two-way system is a "shared learning journey," with all participants learning and working toward different endpoints depending on where they started; the practice is thus collaborative rather than competitive (ibid.: 78), and it should involve the families and communities of the students throughout the learning journey. The second and third principles are that Batchelor is a student-centered institution respecting the culture and background of the adult students who come there and that it aims to strengthen their Indigenous identity by teaching "mainstream education" without their losing the Indigenous education they bring with them. All the students at Batchelor are from Indigenous backgrounds, but some of the teaching staff are not, so the process must also involve them in the learning practice.

I was lucky enough to meet Robyn Ober, and she fleshed out some of the ideas over a real cup of tea, explaining that the English language used by Aboriginal students does not always have the same meaning as that used by Australians who often have no other first (or even second or third) language, and an important issue is to avoid misunderstanding. The learning journey, on all sides, involves developing communicative competence for those living and working in cross-cultural spaces. Indeed her own research is on what she described as Aboriginal English as an academic discourse, and she has taught aspects of this topic in the education faculty to make teachers aware of the problems experienced by children who have English as a third or fourth language.

I had the opportunity to visit two campuses of the Batchelor Institute when I was in Australia, and at the first I discovered a problem that has arisen with the courses that are offered there, notably but not exclusively with a course on community nutrition. This

site—the Central Australian Campus—was located at the Desert Knowledge Precinct research center outside Alice Springs (which I mentioned in chapter 2), and there I met some students who were complaining bitterly that they had thought they were studying for a degree but had recently been told that they would only get a diploma. It was a matter of raising standards to meet new qualification guidelines introduced at a national level, it seems, something that meant that all universities had to revisit their courses and raise their standards, so it was not a revision aimed only at the two-way process, but of course not everywhere has invested so heavily in the two-way system.

A positive factor being put into place for the future is a new "collaborative partnership" to link Batchelor with Charles Darwin University in a new Australian Centre for Indigenous Knowledge and Education (ACIKE), where non-Aboriginal students could also study subjects such as Indigenous Writing, Conservation and Land Management, and Indigenous Public Policy (ACIKE brochure). I met a very helpful scholar at Darwin, who explained that her own upbringing had been almost completely Aboriginal and that women's knowledge was kept secret from the men; but they had, for example, very effective methods of childbirth delivery, and it was time now respectfully to share their knowledge of such science with non-Aboriginal students in the same way that mainstream science was being offered to them (while still, if necessary, keeping men's areas separate from women's). Terry Dunbar had been appointed to "map" the courses at Darwin, making sure that there were appropriate pathways for students to follow before they signed up for particular courses that interested them or that would provide them with the training they needed. She was enthusiastic about the new arrangements and said that these courses would indeed build teaching partnerships from diploma to postgraduate work as well as intercultural space across the workforce and student cohorts, which certainly seemed to be a step in the right direction. Courses are also offered flexibly, with online options and residential workshops, as well as face-to-face classes on campus, so people can fit them around their lives in remote locations if they don't happen to be near any of the campuses.

Another university I visited in Australia with an impressive department set up for Indigenous scholars was Flinders, just outside

Adelaide. There they had a dedicated building for the Yunggorendi First Nations Centre for Higher Education and Research (see figure 9.2). Here I met a long-term professor named Daryle Rigney, who explained that the name *Yunggorendi* comes from the Kuarna language and means "to impart knowledge, to communicate, to inform." He had been working there for 20 years, building up the student, teaching and learning and research program for Indigenous education/studies, Indigenous people, and their nations. During this time the student body had grown from 12 to 170, with 14 full-time staff and some 40 postgraduates. In 2014, there are close to 300 students and 50–60 postgraduates, and Yunggorendi First Nations Centre now reports to Professor Rigney as the Dean of Indigenous Strategy and Engagement (DISE).

Professor Rigney introduced me to some of the postgraduate students, who were also teaching Aboriginal studies there, and they explained a different aspect of learning within the two-way situation. "We need to understand how to survive the political and bureaucratic environment," one of them explained, "and to gain benefits for the community and the natural environment; we need to work alongside the law, preferably without going to the law." This conversation took place not long after an unpleasant and destructive legal case—pitting governments and developers against Aboriginal women and, in some cases, Aboriginal people against other Aboriginal people in reference to a site not far from Adelaide (the Hindmarsh Island Bridge at Goolwa, South Australia)—had been dragged through the press, and the name of this case was mentioned as having been a bad idea. "We need to change the way the system works," he said, and he explained that scientists and other "authenticating experts" working with the state exercised their power disproportionately to determine how much money is invested in what they do, and so they are still making decisions that overlook the possibilities of Indigenous science—even social scientists think they should be the ones studying us, he commented.

Another member of the group was Chris Wilson, a Ngarrindjeri archaeologist from the Lower Murray Lakes and Coorong in South Australia, working on the land of his own Ngarrindjeri people, and he explained that he goes straight to the elders and family and appropriate community members to listen to their advice about

Figure 9.2 Professor Daryle Rigney at the entrance to the Yunggorendi First Nations Centre for Higher Education and Research, on the campus of Flinders University, Adelaide, Australia.

Photo by the author.

the cultural value of the land where he proposes to work—whether it has been used as a burial site and whether it is a place associated with a specific gender, for example. He also reports his findings back to the community, and because he grew up knowing part of his Ngarrindjeri identity, he is able to communicate in a culturally specific manner with the community, including understanding concepts about family, culture, and land that are at the core of Ngarrindjeri epistemology.

In a paper coauthored with two of his colleagues at Flinders, Wilson has explained the need to adopt an Indigenous "standpoint" in their research because "these 'ways of knowing' continue to be undervalued within various academic disciplines, particularly by those who continue to draw upon 'scientific' approaches that colonize Indigenous peoples" (Ulaka Tur, Rosas Blanch, and Wilson 2010: 58). The paper offers a great introduction to the need for Indigenous scholars everywhere to be aware of the contested academic environments in which they find themselves, to remember they have a right to be there, and to use their work to challenge Western normalized research conventions and create alternative methodologies (ibid.).

A couple of schools I was put in touch with in Melbourne were making attempts to introduce their classes to Indigenous knowledge of one sort or another, and one example was the Melbourne Wesley College, which in 2010 founded the Yiramalay/Wesley Studio School near Fitzroy Crossing in the Kimberley region so that pupils could be exchanged with the Bunaba Secondary School in that area. One idea was that each could learn about the lives, languages, and ways of thinking of the other, and groups were selected to spend time at Yiramalay for various activities. A larger project was to bring some Aboriginal children through the studio school to Melbourne for two terms of their senior education so that they could complete year 12, which was unavailable at Bunaba, but the scheme did also encourage the Melbourne children to gain an insight into Aboriginal life and language. According to the Yiramalay school prospectus, "It focuses on learning by doing. It is providing a new pathway for Aboriginal students to access Australian mainstream education and to complete Year 12 successfully, and for non-Aboriginal students from Melbourne to learn 'on country' alongside Australia's first people." A friend who was a former pupil

of Wesley College took me along to hear a little about the project, and I was able to meet one of the children who had taken part.

The other project was also introduced to me by a friend, Natalie Davey, who showed me a video that had been made by a man named Simon Lindsay at the Melbourne Catholic Education office for another exchange project involving the Djarindjin Lombadina Roman Catholic School in Lombadina, Western Australia, and St. Mary's School, Williamstown, on the outskirts of Melbourne. The film tells the story of a young Aboriginal boy who had not been doing particularly well at regular school, but when asked to show children from Melbourne the land where he lived, he demonstrated a deep knowledge of the environment. It films and records his explanation of the land, the water, and all the plants and living beings to be found existing there and the way they contribute to the lives of his family. The bigger picture was a learning partnership between the two schools, and the students communicated through Skype to build more learning about each other's lives. Simon explained that the story particularly evidences how connecting Indigenous students with their own traditional knowledge builds self-confidence and self-motivation for learning, something that wasn't overly emphasized in their own school environment. "It took the exchange of children and cultures for the Indigenous children to recognize that they did indeed have something valuable to offer other Australians," he added. The idea of the film was also to demonstrate to children in the city what a wealth of education may be learned beyond the formal school environment, and it ends with their teacher, Nicole Sadler, explaining that such knowledge is needed to make "this place livable and sustainable for the future" (*Using Indigenous Perspectives in the Science of Wetlands*, St. Mary's School, Williamstown, Victoria).

In the case of New Zealand, Māori-medium education has been rather successfully set up throughout the whole age range, initially as a program of language recovery, but also to enable children to learn of and through their Māori heritage in a supportive atmosphere. In the 1980s, *kohangareo*, or immersion Māori "language nests," were introduced for preschool children, and these were followed by the introduction of schools with Māori-medium classes, gradually spreading in various forms through areas most densely populated by Māori families. There are now also

three Māori-medium institutions of higher education—*te whare wānanga*—where *mātauranga*, or Māori science, is taught as part of a curriculum that also trains Māori teachers. Thanks to the invitation of a Māori scholar, Rāpata Wiri, whom I met in China at a conference session on minority education, I had the opportunity to visit one of these—Te Whare Wānanga Awanuiārangi—in Whakatane, on the east coast of the north island, close to the landing site of the Mātaatua canoe, from which several tribal groups claim descent. It is open to all students, and its mission statement includes "establishing the equality of Māori intellectual tradition alongside the knowledge base of others. Thus we can stand proudly together with all people of the world."

Conclusion

"Seeing through Both Eyes"

"Seeing through both eyes" is a slogan that was adopted by CSIRO, the Commonwealth Scientific and Industrial Research Organisation, which is Australia's national science agency, in laying out its Indigenous Engagement Strategy. Its website states, "We value the contribution Indigenous knowledge adds to our scientific and social research. CSIRO is committed to encouraging more Indigenous people to work with CSIRO and contributing to the challenges and aspirations of Indigenous communities" (http://www.csiro.au/Portals/About-CSIRO/Who-we-are/CSIRO-Indigenous-Engagement.aspx). We have noted elsewhere in the book that strategies laid out on websites do not always coincide with what may be found on the ground, but I have introduced several people working for CSIRO in other pages of this book, and they all seemed to be highly committed to those aims. I am slightly dubious about using the word "both" at the end of this book because it would seem to perpetuate the binary division between "Indigenous knowledge" and "science" noted by Marie Battiste at the opening of the introduction, and there are innumerable Indigenous peoples in the world who hold their own science.

However, I would like to offer a final word to Battiste and some other Indigenous scholars who are addressing the extent to which their own knowledge still suffers alongside that weighty main stream "juggernaut," as one commentator on my project put it, and then mention a couple of people and places I came across who

would seem to be doing their best to overcome it. Perhaps this will inspire others to follow in their footsteps.

Marie Battiste is a First Nations Canadian scholar who has published an analysis of the tensions that continue to exist between Indigenous and Eurocentric ways of knowing and the challenges these present to educational systems, notably in Canada. Her paper (Battiste 2005) was part of a study that intended to inform the Canadian government about ways to improve the quality of Aboriginal life and education through a project entitled the Education Renewal Initiative. She criticizes commonly held ideas about how only Eurocentric thought can progress while Indigenous peoples are thought to be frozen in time, guided by knowledge systems that reinforce the past, thus representing them as backward and in need of "civilization." These misguided ideas informed an education system that for a long time ignored the wealth of valuable science held by the First Nations, along with their languages, and forced them into an aggressive assimilation program that nearly destroyed it. Although some Canadian law has now been passed to respect Indigenous traditions, she argues that the education system still needs to implement much of this learning. Her book *Decolonizing Education*: *Nourishing the Learning Spirit* (Battiste 2013) came out just as mine was going to press.

Battiste points out that Indigenous knowledge is tied to the landscape, to a local ecosystem, and that it is both passed down through the generations, but also tested as it is used and systematically improved in each generation. A potential problem is that such knowledge is often passed on in ceremonies, which the Canadian government classifies as art, rather than science, but in Battiste's own generation, she and a number of other Indigenous scholars have been working to make their own understandings gained through such rites recognizable to the Eurocentric system that dominates Canadian institutions of higher education. Battiste is thus able to report that the value of Indigenous knowledge is at last being recognized, notably by scientists interested in biodiversity and its maintenance through conservation and sustainable development. Thus the United Nations supports various bodies that collect and value Indigenous knowledge and encourage governments with First Nations to promote its understanding. Incorporating this valuable science into education systems is the next important stage, and Battiste's paper

encourages young Indigenous scholars to be aware of the prejudice that was meted out to their ancestors and work toward making "space for Aboriginal consciousness, language and identity to flourish without ethnocentric or racist interpretation" (ibid.: 9).

Another paper that addresses the divisions between Indigenous science and the mainstream variety but also offers a way of integrating the two was published jointly by five well-known Māori scholars—namely, Daniel Hikuroa, Kepa Morgan, and Mason Durie, whom we have met already, Manuka Henare, and Te Tuhi Robust. Their paper examines the reasons for mutual mistrust and rivalry between holders of Indigenous knowledge and scientists, including some of the same reasons pointed out by Battiste, but argues that "there are an increasing number of workers who use the interface between science and indigenous knowledge as a source of inventiveness and inspiration" (Hikuroa et al. 2011: 109). Having access to both systems offers opportunities to integrate them into something that goes beyond both and can bring benefits not only to members of the Indigenous community who live at the interface, but also to the global community.

The advantage of the Indigenous science we have been examining in the book is also pointed out by Hikuroa and his coauthors—namely, that it has long been more aligned with sustaining the environment in which it is found than mainstream science has—and they note also that this fact is being increasingly recognized internationally: "With increased pressure on the world's resources and ecosystems, the importance of employing indigenous knowledge for the security of biodiversity and the realization of sustainable development is becoming recognized internationally" (ibid.: 105). This change of attitude "affords the opportunity for discussion of a sustainable future for the planetary ecosystem and consideration of more holistic approaches to decision making worldwide" (ibid.: 106). The paper then lays out the principles of the *mauri* model that we introduced in chapter 3. They explain that this model is appropriate for New Zealand, where sustainability legislation has included reference to culture as well as society since the Treaty of Waitangi (although in practice not always used), but it looks toward a positive future at this time.

One example of a scholar who has been working in the area of the integration of science and TEK hails from an establishment

far from the lands we have been discussing—namely, the Sustainable Places Research Institute in Cardiff, Wales. Leanne Cullen-Unsworth worked with Marilyn Wallace, of the Kuku Nyungkal people (who appeared in chapter 6), and two CSIRO scholars also attached to James Cook University in the Wet Tropics World Heritage Area of Far North Queensland. The four of them published a paper together about the process required to integrate Indigenous and scientific knowledge in what they describe as a "cultural landscape" (2012: 351); they identified several important factors, including "building relationships" and "cooperative problem-solving"—these would seem to be obvious, but clearly were not always evident—and the paper's abstract states, positively, that "starting the research process with this task [cooperative problem-solving] can assist the equitable convergence of IEK and contemporary natural resource management thereby potentially enhancing social-ecological system resilience and sustainability" (ibid.). If only a few earlier researchers had made these discoveries, we might have less of a global crisis on our hands.

The second example is of an institution that was housed just around the corner from where I was staying at the University of Otago. Known as CSAFE, its full name is the Centre for Sustainability: Agriculture, Food, Energy and Environment, and just under the title on its website, it announces, "Sustainability transitions through collaborative research." I did meet the director of CSAFE, Janet Stephenson, and thank her for her welcome, but most of my dealings were with Henrik Moller, who was introduced to me by Michael Stevens (whom we met in Chapter 2, reporting on his work with harvesting muttonbirds). In response to my request to meet him and hear about his research, Henrik organized a seminar of staff and doctoral students working in a variety of ways involving Indigenous science along with the mainstream and sent me a veritable cornucopia of collaborative work he had been involved in with intriguing titles such as "Cross-Cultural Environmental Research and Management: Challenges and Progress" (Stephenson and Moller 2009), "Matauranga Maori, Science and Seabirds in New Zealand" (Moller 2009), "Guidelines for Cross-Cultural Participatory Action Research Partnerships: A Case Study of a Customary Seabird Harvest in New Zealand" (Moller et al. 2009), and "Use of Mātauranga (Māori Traditional Knowledge) and Science

to Guide a Seabird Harvest: Getting the Best of Both Worlds?" (Newman and Moller 2005).

This center has many other people working at the interface between different epistemologies, including international visitors. When I visited in 2011, for example, there were students from Kenya, Cambodia, and Mexico, each working on projects relating to the science of their own communities. I am sure there must be other centers of this sort around the Indigenous world. I certainly hope so, but it remains for another project for me to find and investigate them, and I am also aware that I have left out a large number of Indigenous peoples and their science in this book. It was just a start, and it has been immensely fulfilling to examine some at least of the elements of my science degree that had certainly been left out. I hope at the same time to have done a little justice to some of those many peoples properly working at that exciting interface between their own neglected heritage and the vast edifice of what I see I have been calling "mainstream science" in these last two chapters. Shame on me! Why should ours be the "main stream" in a world where we have clearly destroyed a good few healthy flowing streams around the world? Some of us still need to broaden our idea of what we mean by "science."

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