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NATURE AND HUMAN SOCIETIES

AUSTRALIA, NEW ZEALAND, AND THE PACIFIC
An Environmental History

Don Garden

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SERIES FOREWORD

Long ago, only time and the elements shaped the face of the earth, the black abysses of the oceans, and the winds and blue welkin of heaven. As continents floated on the mantle, they collided and threw up mountains or drifted apart and made seas. Volcanoes built mountains out of fiery material from deep within the earth. Mountains and rivers of ice ground and gorged. Winds and waters sculpted and razed. Erosion buffered and salted the seas. The concert of living things created and balanced the gases of the air and moderated the earth's temperature.

The world is very different now. From the moment our ancestors emerged from the southern forests and grasslands to follow the melting glaciers or to cross the seas, all has changed. Today the universal force transforming the earth, the seas, and the air is for the first time a single form of life: we humans. We shape the world, sometimes for our purposes and often by accident. Where forests once towered, fertile fields or barren deserts or crowded cities now lie. Where the sun once warmed the heather, forests now shade the land. One creature we exterminate only to bring another from across the globe to take its place. We pull down mountains and excavate craters and caverns, drain swamps and make lakes, divert, straighten, and stop rivers. From the highest winds to the deepest currents, the world teems with chemical concoctions only we can brew. Even the very climate warms from our activity.

And as we work our will upon the land, as we grasp the things around us to fashion into instruments of our survival, our social relations, and our creativity, we find in turn our lives and even our individual and collective destinies shaped and given direction by natural forces, some controlled, some uncontrolled, and some unleashed. What is more, uniquely among the creatures, we come to know and love the places where we live. For us, the world has always abounded with unseen life and manifest meaning. Invisible beings have hidden in springs, in mountains, in groves, in the quiet sky and in the thunder of the clouds, and in the deep waters. Places of beauty from magnificent mountains to small, winding brooks captured our imaginations and our affection. We have perceived

a mind like our own, but greater, designing, creating, and guiding the universe around us.

The authors of the books in this series endeavor to tell the remarkable epic of the intertwined fates of humanity and the natural world. It is a story only now coming to be fully known. Although traditional historians told the drama of men and women of the past, for more than three decades now many have added the natural world as a third actor. Environmental history by that name emerged in the 1970s in the United States. Historians quickly took an interest and created a professional society, the American Society for Environmental History, and a professional journal, now called *Environmental History.* American environmental history flourished and attracted foreign scholars. By 1990 the international dimensions were clear; European scholars joined together to create the European Society for Environmental History in 2001, with its journal, *Environment and History.* A Latin American and Caribbean Society for Environmental History should not be far behind. With an abundant and growing literature of world environmental history now available, a true world environmental history can appear.

This series is organized geographically into regions determined as much as possible by environmental and ecological factors, and secondarily by historical and historiographical boundaries. Befitting the vast environmental historical literature on the United States, four volumes tell the stories of the North, the South, the Plains and Mountain West, and the Pacific Coast. Other volumes trace the environmental histories of Canada and Alaska, Latin America and the Caribbean, Northern Europe, the Mediterranean region, sub-Saharan Africa, Russia and the former Soviet Union, South Asia, Southeast Asia, East Asia, and Australia and Oceania. Authors from around the globe, experts in the various regions, have written the volumes, almost all of which are the first to convey the complete environmental history of their subjects. Each author has, as much as possible, written the twin stories of the human influence on the land and of the land's manifold influence on its human occupants. Every volume contains a narrative analysis of a region along with a body of reference material. This series constitutes the most complete environmental history of the globe ever assembled, chronicling the astonishing tragedies and triumphs of the human transformation of the earth.

The process of creating the series, recruiting the authors from around the world, and editing their manuscripts has been an immensely rewarding experience for me. I cannot thank the authors enough for all of their effort in realizing these volumes. I owe a great debt too to my editors at ABC-Clio: Kevin Downing (now with Greenwood Publishing Group), who first approached me about the series; and Steven Danver, who has shepherded the volumes through delays

and crises to publication. Their unfaltering support for and belief in the series were essential to its successful completion.

—Mark Stoll
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Lubbock, Texas

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My first expression of gratitude must be to Mark Stoll, the series editor, whom I met at a conference of the American Society for Environmental History and who subsequently offered me the opportunity to write this volume. It has been a stimulating challenge and has opened for me vast new geographical and conceptual areas of knowledge, understanding, and interest in environmental history. I have particularly enjoyed the travel and research I have been able to make in Australia, New Zealand, and a small sample of the Pacific countries.

The University of Melbourne, its libraries and librarians, and specifically the Department of History and Philosophy of Science and its former Head, Professor Janet McCalman, have provided me with the opportunities and facilities to undertake the work.

I am very appreciative of the time and valuable comments from several people who have read all or part of the manuscript including Kerry Howe, Tom Brooking, Gary Presland, Janet McCalman, Wendy Garden, and Claire Brennan. Claire was not only something of a critical editor, but as a New Zealander she was able to facilitate my introduction to that country and the development of an understanding of its environmental history. For all the contribution of these scholars, any remaining errors or problems are my own.

Finally, to my wife, Wendy, whom I met at about the time I commenced work on this book and who has traveled with me through its research, "landscape research," and writing, I thank for her companionship, love, and advice.

—Don Garden
Department of History & Philosophy of Science
The University of Melbourne

INTRODUCTION

When I was asked to write an environmental history combining Australia, New Zealand, and Oceania I was excited at the opportunity, slightly overwhelmed at the scale and diversity, and a bit puzzled. How would those three regions fit together—a large, arid land mass with little water; an elongated archipelago with volcanoes, thermal pools, and glaciers in the South Pacific; and the world's biggest body of water with thousands of islands that total only a small amount of land? It took little time to realize that the contrasts and similarities made it a fascinating opportunity to examine human relationships with nature over a large area and a very long time period. While the places and peoples of Oceania, New Zealand, and Australia are very diverse, there are observable patterns in their environmental histories—and lessons that can be learned.

This study casts light on the process of human settlement of new lands. In one sense it is a history of three waves of human migration that formed an incoming tide into Australia and the Pacific. The first was a small wavelet that reached northern Australia perhaps 55,000 years ago and carried a small number of dark-skinned Australoid people across the Australian continent as well as into New Guinea and part of what is termed "Near Oceania." The second was a stronger, seaborne wave of brown people that commenced perhaps 4,000 years B.P., eddied around Australia, and over a period of 3,000 years, splashed across the Pacific islands. The third was an all-engulfing white wave (a tsunami perhaps) that crashed onto the shores of Australia and Oceania between two and two and a half centuries ago and has since inundated, engulfed, and at times severely degraded them.

As diverse as these human waves have been, and as chronologically spread, they had much in common because of their shared membership of the human species. They demonstrate patterns of behavior that provide insights into the nature of our species and its interaction with the global environment. The development of humans from hunter-gatherers on the plains of Africa to a position of dominance of the planet and its biota, has resulted from the possession of and selection for certain characteristics. Clearly prominent among these attributes

have been intelligence and a high capacity to manipulate the environment, but arguably they have also included capacities for aggression, greed, and acquisitiveness as well as more positive ones such as social order and cohesion. In combination, these characteristics have enabled humans to master environments and to outcompete most species wherever they have gone. The breadth of this study, both chronologically and spatially, underlines these shared responses to environment and the patterns of human migration and "resource" exploitation that frequently result in profound environmental degradation.

Nevertheless, this is an environmental history of what is essentially an artificial or Eurocentric construct or, perhaps more accurately, a number of diverse constructs. Australia and New Zealand have a great deal in common politically because of their British colonial past, marginalization of indigenous peoples, and shared democratic nationhood. Historically and culturally, the term *Australasia* also embraces these fellow new Britons, but it is a term New Zealanders prefer to avoid. Environmentally, these two European outposts encompass an enormous diversity of natural environments, from the fjords and snow-covered mountains of southern New Zealand to the sunbaked gibber deserts of central Australia. Nevertheless, while New Zealand is politically and culturally "Australasian," geographically and in its pre-European history, it is part of Oceania.

The term *Oceania*—for the purposes of this study the area within the perimeter marked by Hawai'i, Rapa Nui (Easter Island), New Zealand, New Caledonia, the Solomon Islands, Palau, the Northern Marianas, and the Marshall Islands—covers an even larger diversity of racial, historical, and political backgrounds. For the last two and a half centuries, Oceania has been described as having three regions marked by different ethnic and cultural occupants: Melanesia, Micronesia, and Polynesia. There has been some racial and geographical justification for the terminology. Melanesia (black islands), so-named because of its generally dark-skinned people, is substantially made up of relatively large volcanic and uplifted islands in the west of the Pacific. Micronesia (small islands) consists of thousands of tiny atolls and other small islands in the northwestern Pacific. Polynesia (many islands) contains essentially the remaining far-flung diversity of islands, a mixture of atolls, cays, coral islands, volcanic peaks, isolated isles, and archipelagos, which were occupied by the people known as Polynesian. In recent decades, these terms have come to be seen as increasingly problematic—there are too many gray areas, overlaps, and variations (Kiste 1994; Kirch 2000, chap. 7). Studies of language, genetics, cultural archaeology, and anthropology have shown that the human history is too complex for the tripartite division to have much human meaning, except perhaps in

the case of Polynesia. Melanesia's human history stretches back over at least 40,000 years, with diverse tides of migration giving a complex ethnic, linguistic, and cultural picture—more a piece of Picasso cubism than a Constable landscape. Micronesia is nearly as complex, with two main language groups and evidence of at least four migrations into the region over many thousands of years. By contrast, the scattered islands of Polynesia have been occupied in much more recent centuries and show much greater uniformity in the cultural, linguistic, and genetic origins of their human inhabitants. Marshall Sahlins asserted that "the Polynesian cultures derive from a common source; they are members of a single cultural genus that has filled in and adapted to a variety of local habitats." (1958, p. ix) Allowing for reservations about the limited applicability of these terms, they are nevertheless a useful and widely accepted shorthand and will be used when appropriate in this text.

In the modern political world, Oceania is equally a patchwork that includes the relatively large and principally white nation of New Zealand and some of the smallest and most geographically fragmented nations on the globe, such as the greatly scattered Republic of Kiribati with a population of fewer than 90,000 people, the Cook Islands with fewer than 20,000 people, and Niue, a single island nation with fewer than 1,600 people. Most are independent, although France has retained a semicolonial presence in New Caledonia and French Polynesia, and the United States similarly in the Marshall Islands and Samoa. However, statehood has been granted to Hawaii, the Pacific island fragment of the world's major superpower.

There are three particular issues that shape this book and deserve some preliminary discussion. The first is the dilemma that nearly all environmental history is preoccupied with those aspects in the past which have degraded the environment. To use an Australian term, it is a form of "black armband history" in its concern not with the heroics of development and human achievement, but rather with the environmental repercussions of human "progress." There are those who will criticize or even try to deny the message of environmental history, but it is inescapable. From the 11,000 people in Tuvalu whose islands threaten to disappear under the rising Pacific as a result of global warming, to farmers in the wheat belt of Western Australia faced with a rising ocean of land salinity, the results of past attitudes and actions are inescapable. It is an uncomfortable message that many do not want to hear; it is far easier to shun the message and attack the messenger. The environmental historian, like the environmental activist, frequently becomes the target of hostility. This work makes no apology for its portrait of the negative, but sees it as a past reality and a necessary antidote for those who seek to bury their heads in the sand.

A second issue relates to perceptions of what will be termed the "hybrid landscapes," which result from extensive replacement of indigenous species with exotic or alien species. There are hard-nosed, objective scientific-types who will point out that, in nature, ecosystems are never static but are constantly changing and that the arrival of new species is not uncommon. They argue that these are natural realities and, as we cannot turn the clock back to some imagined "pristine" previous age, we should just accept our current reality. They point out that there is really no such thing as true "wilderness" on the planet, in the two senses that humans have already impacted upon all parts of the globe and that humans should not be seen as being apart from nature. While on one level these views are sensible, on another they can be likened to a pedestrian watching a car hurtling toward them and objectively calculating its velocity and time of impact, rather than getting out of the way. Equally, such views also provide a good excuse for doing little or nothing to try to amend the actions of the past or to prevent their repetition in the future. Even worse, they may also feed the diversity of environmental vandals with a justification for their depredations. This study is based on a belief that a hybrid landscape, one with mixed indigenous and human-introduced species, is a degraded landscape because it represents the destruction of preexisting ecosystems, often with the loss of species, and almost inevitably with a decline in biodiversity. While nature is always changing and species redistribute over time, human intervention has reached such a speed and extent that it has disturbed or destroyed natural balances. It has gone beyond what can be termed "natural processes."

Third, it will be argued that there are observable patterns in the way human societies interact with their environment, especially in the early stages of arrival in new surroundings. From Australian Aborigines to Pacific Islanders to Europeans, the three waves of migration into Australia, New Zealand, and Oceania have shown significant elements in common. First, there is their shared experience of "advent abundance"—their arrival in environments that are "resource rich" because they have not previously been exploited by the technology brought by the immigrants. Such new environments have generally offered a period of high nutrition and prosperity as they are plundered. Overexploitation frequently resulted in a "satiation slump"; that is, not only a disappearance of the "resources," but often also a collapse or decline of ecosystems and sometimes of the human societies based upon the "resources" and ecosystems. Tim Flannery has used the term "future eaters" to describe peoples who have behaved in this way (1994). Societies that have reached a point of exhausting their abundant resources then face two possible paths: They either develop a more sustainable way of living within the environment, or they decline further toward disintegration. Australia and Oceania have examples of both of these.

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1

THE WIDE BROWN LAND

I love a sunburnt country,
A land of sweeping plains,
Of ragged mountain ranges,
Of droughts and flooding rains.
I love her far horizons,
I love her jewel-sea,
Her beauty and her terror–
The wide brown land for me

—Dorothea Mackellar,
"My Country" (1908)

My Country" has been read and learned by generations of Australian schoolchildren since it was published in 1908. Perhaps more correctly, it has become a favorite with Australia's European population; one doubts that many indigenous children would have been introduced to it even though, for them, the sentiments of affection for and connectedness with the landscape perhaps rang truer. This verse provides strong hints of the nature of that landscape and its challenging environment, for Australia is the harshest continent after Antarctica for human settlement. It is a "wide brown land," rugged, fragile, and possessing "her beauty and her terror."

Australians tend to take a perverse pride in the harshness of their landscape and its challenging environments. It is a large land, about 7.78 million square kilometers (compared with mainland United States 7.87 million square kilometers) and is often boasted as being the largest island and/or smallest continent on the planet. While its harshness is frequently apparent (the annual average rainfall for about a third of the country is less than 250 millimeters), it is also a land of great diversity. The island state of Tasmania lies between the latitudes

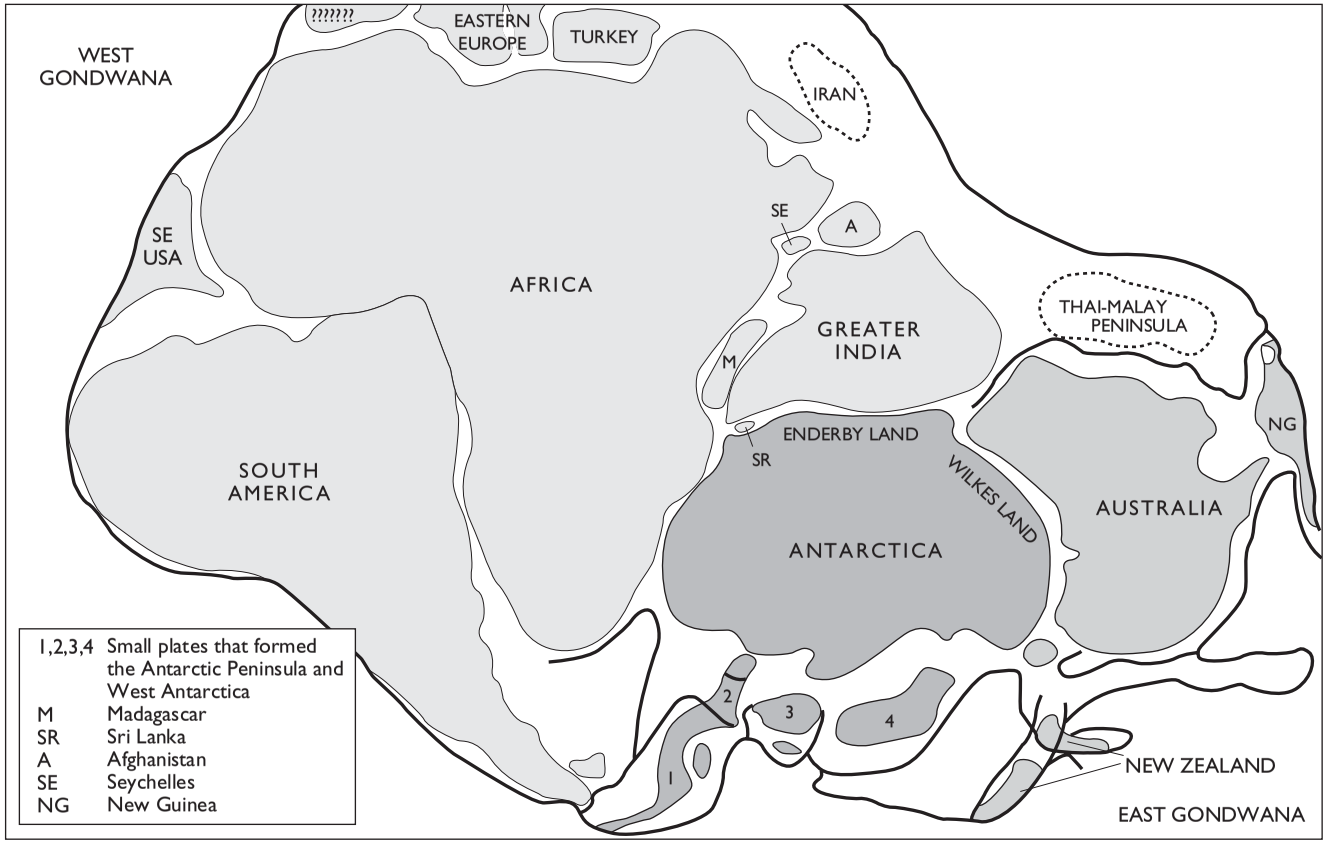
of 41 and 44 degrees south and is cool and moist, especially in winter. Those remnants of its mountainous terrain that have not been cleared for agriculture or wood chipping are covered by dense temperate rain forest. At the other extreme, the north of the continent stretches well into near-equatorial latitudes (12 degrees south) and has a tropical climate marked by long dry winters and wet, cyclonic summers. The ecologically rich Kakadu wetland is a product of summer downpours. Although most of the tropical north is characterized by open scrubby plains which are parched except in the wet season, parts of the eastern coastal fringe in the latitudes north of the Tropic of Capricorn boast tropical rain forests. The Great Barrier Reef, off the coast of Queensland, contains the world's largest extent of coral reef.

The majority of the continent consists of the "typical" Australian landscape—flat and generally with the red sandy soil and stunted vegetation of an arid climate. Only a narrow triangle in the southwestern corner of the continent and a sliver running from the southeastern corner along the eastern coast offer the comfortable mix of a reasonably moist climate, areas of slightly mountainous terrain, and a mixture of forest, woodland, and wooded grasslands. Running parallel to the coast for much of the length of this sliver is the Great Dividing Range. While not great in height, the Range certainly is long. This strip of intermittent ranges, plateaus, and outlying highlands stretches the full length of the east coast from Cape York Peninsula in the north to western Victoria in the south. It acts as a major watershed, dividing those rivers that flow to the coast and those that flow inland. The Range is at its most dramatic in the high cliffs and forested valleys of the Blue Mountains near Sydney, and in the Australian Alps, which occupy an area in northeastern Victoria and southeastern New South Wales. The Alps are not high by world standards with Mount Kosciusko, the tallest peak, a mere 2,230 meters. However, in breadth, the Alps cover a significant area and, for a few weeks in winter, boast what is claimed to be a greater extent of snowfields than the European Alps. It is an indicative response to this environment that 80 percent of the Australian population of 20 million (compared with more than 290 million people in the United States) live within 30 kilometers of the coast. The indigenous flora and fauna that occupy this diverse and challenging land are highly adapted to its peculiarities.

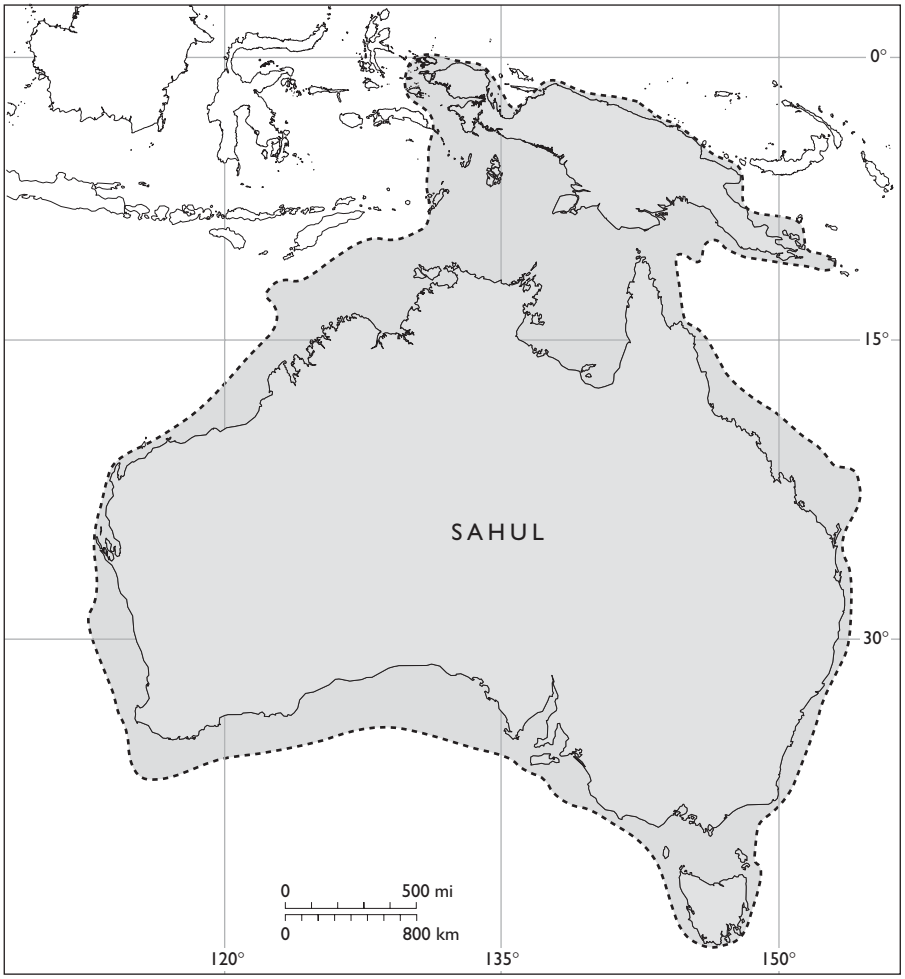
The reasons for Australia's harshness, and the accompanying uniqueness of much of its biota, lie in an overlay of geological, climatic, and other factors which have accumulated over hundreds of million years. Human "knowledge" of these matters is still evolving as we develop new technologies, make new discoveries, and learn how to interpret them. Much is still disputed and contentious, but a synthesis of the most generally accepted understandings gives the following explanation of Australia's origins. Australia was part of the super-

continent of Gondwana 500 million years ago, which included the now-separate continents of Antarctica, South America, and Africa, as well as the Indian subcontinent and Southeast Asia. Over millions of years, Gondwana fragmented; first, parts of Asia and then Africa and South America broke away and the rest began drifting southward into Antarctic zones. Somewhere between 80 and 45 million years ago, Sahul, a land mass that contained Australia, New Guinea, and Tasmania as well as a considerable area around and between them, split from Antarctica, and this "great southern ark" drifted north. Small fragments also broke away from Gondwanaland and drifted northeast to become the foundations for New Zealand, New Caledonia, and Vanuatu. Sahul continued its slow drift to the north until it collided with Southeast Asia, and is calculated still to be pushing toward the equator at 7 centimeters per year. Over the geological ages, the area of Sahul that extended above sea level ebbed and flowed according to movements in the earth's crust and fluctuating sea levels. At their lowest levels, the seas exposed an extended land mass linking Australia, Tasmania, and New Guinea. At higher times, the oceans flowed in and separated New Guinea and Tasmania as well as covering large areas of low-lying land. This most recent rise in ocean levels happened within the last 14,000 years, and the continent of Australia and its neighboring islands took their modern shape only about 8,000 years ago.

Over long periods, much of Gondwana had been relatively lush and green, with substantial parts covered with water systems and forests inhabited by a diversity of prehistoric reptiles, birds, and animals. These ever-changing flora and fauna were the ancestors of some of the biota that are still found on and shared by the smaller land masses into which Gondwana fragmented. The flora is represented by the southern beeches (*Nothofagus*), which are distributed in Australia, South America, New Zealand, New Caledonia, and New Guinea, and the *Auracaria* of Australia, Norfolk Island, New Zealand, and South America. Similarly, the Gondwana inheritance included large flightless birds that evolved in the form of the ostrich of Africa, the rhea in South America, the emu in Australia, and the moa in New Zealand (made extinct by human action within the last millennium). By contrast, whereas Gondwana had been occupied by many species of marsupials and monotremes, after fragmentation, these species were replaced in most of the new continents by placental mammals. Only in Sahul (and in South America in small numbers) did marsupials survive. In Sahul, they continued to dominate the mammalian niches in the ecosystems. Australia and New Guinea had no land-based placental mammals (although there were bats and seals) until the arrival of humans 50,000 to 60,000 years ago, and then the dingo in Australia 4,000 years ago (Morrison 1988; White 1986; White 1994; Vandenbeld 1988; Flannery 1994; Kirch 2000; Kirch 1997; Taylor et al. 1997).



Gondwana. The great southern megacontinent of Gondwana began breaking up about 130 million years ago, and about 45 to 80 million years ago the section containing Australasia known as Sahul broke away and began drifting north toward the equator.



Sahul. The section of Gondwana containing the Australian continent, Tasmania, and New Guinea began drifting north millions of years ago and now pushes up against Southeast Asia. For most of its existence a much larger area rose above sea level, and it is only within the last 10,000 years that the current levels were established.

Three of the major determining factors that shaped the selection and evolution of the biota on the Australian continent were changing climatic conditions, geological stability, and isolation. As Sahul moved north into lower latitudes, it became warmer and drier. Central Australia, while experiencing climatic fluctuations, was essentially on a long path toward desertification, and only biota that possessed appropriate survival mechanisms or had the capacity to adapt to the new conditions have survived into modern times. There is also another climatic factor that does much to shape life in Australia but whose length of influence is unknown, although it probably stretches back for many

thousands of years. This is the El Niño Southern Oscillation, or ENSO. When warm waters from the western Pacific are periodically able to force their way down the coast of South America they cause significant changes in ocean temperatures. There are many repercussions, both ecologically and climatically, across both hemispheres. In South America, notably Peru and Chile, El Niño brings heavy and even torrential rainfall. For much of Australia it has the reverse effect, causing a period of below-average rainfall in the southern regions of the continent and sometimes wetter periods in the tropical north (See A to Z; Philander 1990). Such extreme dry periods in the south reduce vegetation, expose soil, and contribute to soil degradation. They are often followed by reverse, or La Niña, episodes: short bursts of above-average rainfall that might bring floods to further denude the exposed soil—Australia's droughts and flooding rains. Their impact has required particular adaptation of the flora and fauna. In all likelihood, there have been El Niño and La Niña episodes throughout the period of human occupation (Grove and Chappell 2000).

Another influence on Australian biota was that the majority of Sahul experienced little new geological activity after its separation from Gondwana. Except in southern and northern fringes, there were few glaciers or volcanoes to renew the soils. Australia therefore lays claim in geological terms to be the oldest continent. One penalty paid for that boast is that over millions of years, the leaching effects of rain, wind, heat, and fire have eroded the fertility of the aging soils and flattened the landscape, bequeathing its biota and its later human occupants an essentially flat, worn land and infertile soils. To fly across this continent today is a fascinating experience. Set out below are the marks of age and wear, its withered surface, colored in myriad shades of red and brown, and pockmarked with pale gray salt pans, stretched over the aged and brittle skeleton. Lines of once-great mountain chains scar across the land, age-old impact sites of meteors appear as saucers, and marvelous extrusions of rock protrude where their surroundings have weathered away. The most spectacular of these, in the center of the continent, is Uluru, or Ayers Rock, which has long been exposed to the sun and wind and, in more recent millennia, to Aboriginal veneration and climbing tourists.

There is plenty of time to observe this landscape if one is flying from one of the southern capitols toward Southeast Asia and from there to Europe. Sitting cramped in an aircraft seat, the four hours it takes to leave Australia can seem interminable. One is keenly aware of what a large country it is and conscious that until modern transport largely conquered distance, it was an isolated land. Historian Geoffrey Blainey (1966) coined the phrase "tyranny of distance" to describe the impact of both internal space and Australians' remoteness from their European forebears. This isolation forms the third major factor that has shaped

Uluru, or Ayres Rock, in central Australia, is a large sandstone monolith, nearly nine kilometers in circumference. Over aeons the surrounding land has been worn away, leaving the weathered outcrop that is so revered by Aborigines and photographed by tourists. (John Carnemolla/ Australian Picture Library/Corbis)

Australia's biota. The nineteenth-century naturalist Alfred Wallace identified a line of demarcation between the biota of Australia-New Guinea and that of Southeast Asia (Shermer 2002). The so-called Wallace Line lies northwest of Australia where environmental differences and the deepness of the seabed between Sahul and Southeast Asia made the transfer of terrestrial biota very difficult. Only some avifauna were able to easily cross the line. There were some species that crept within Sahul so that New Guinea shares many species with northern Australia, but apart from periodic links with New Guinea, the Australian continent has been isolated from other lands for probably more than 40 million years. There were very few immigrant species prior to the arrival of the Aborigines some 50,000 years ago and the British at the end of the eighteenth

Physical map of Australia. The vast majority of the Australian continent is flat, arid, infertile, and covered by unique vegetation, which is adapted to those conditions. Monsoonal rains flood part of the north from November to February and enable lush tropical wetlands and forests in some places. Cold winter rains bring moisture to coastal areas in the southwest, to the southeastern fringe, and to Tasmania, and as these regions are also relatively hilly or mountainous and contain pockets of fertile soil, many areas are covered with temperate forests.

century. However, one notable exception is the bottle-shaped Australian Boab tree (*Andansonia gregorii*), which is found in the Kimberley region of Western Australia and the Victoria River area in the Northern Territory. Its origin in Australia is subject to speculation but it is related to the African baobab and possibly arrived when a few nuts floated across the Indian Ocean from Madagascar many thousands of years ago.

The continent was essentially isolated, increasingly arid but with irregular climatic fluctuations, and with a soil that was becoming nutrient poor. Special adaptations were demanded of biota if they were to survive. Through a process of natural selection and evolution, those species that could not adapt became extinct or were confined to small isolates. Only those that could adapt to the unique combination of arid, hot, and erratic conditions survived. Australian biota

*The Australian Boab tree (*Andansonia gregorii*) is a great rarity as it is not a Gondwana descendant but appears to have found its way across the Indian Ocean from Madagascar. Their fibrous trunks can store large volumes of water, an asset used by the Aborigines, while older trees generally become hollow. This wonderful specimen near Derby in Western Australia was used in the nineteenth century to hold Aboriginal prisoners. (Photo courtesy of Don Garden)*

undertook major physiological adaptations, one result of which is that 80 percent of the plant species and 30 percent of the genera in Australia are endemic (do not occur elsewhere) (White 1986, p. 43; White 1994; Vandenbeld 1988).

Of particular importance for floral adaptation was scleromorphy—the selection for leathery or spiny hard leaves as a response to low nutrients and the hot, dry climate. Sclerophylls came to dominate the Australian flora in such species as eucalypts (generally known as gum trees because of their viscous sap), banksias, and acacias. Adaptation to naturally occurring fires was equally important over most of Australia as fire-sensitive species died out and only those capable of regenerating after fires survived. Many adaptive mechanisms developed. Some trees have thick, insulating bark; some shed their bark so there is little flammable material on the trunks to burn; some have dormant buds below the bark, which spring forth when the foliage is burned; many mallee species shoot from lignotubers in their large root bolls beneath the soil (large areas of arid Australia are principally covered by species of short, branching eucalypts known collectively as mallee or mallee gums); many have hard woody seeds, which can lie dormant for long periods before splitting open after a fire. In fact, so complex did the relationship with fire become that some species encouraged or depended on fires—eucalypts are very flammable because of volatile oil in their leaves, which burns intensely and even explodes under extremely hot conditions. Some flora became dependent on periodic fires of the right frequency and intensity to maintain both individual species and ecosystems. The mountain ash (*Eucalyptus regnans*), for example, sheds viable seeds only during a fire, and these regenerate in the ash of their parents (White 1986; White 1994; Vandenbeld 1988; Flannery 1994; Griffiths 2001; Pyne 1991).

Australian fauna also adapted in many ways to these severe conditions of aridity, heat, and low nutrition flora. Perhaps most striking is that until the arrival of humans, Australia had no large placental mammals. The niches they would occupy in the ecosystems of other continents are filled in Australia by about 125 species of marsupials (young "born" in embryo state and crawl from the birth canal to maternal pouch where they attach to a teat while they develop, such as kangaroos and koalas) and monotremes (egg-laying mammals—echidna and platypus). Tim Flannery has exhibited a rare example of humor in the generally dry landscape of Australian environmental history. He points to the koala as an extreme yet informative example of fauna adaptation to the low nutrition of Australian flora. The koala subsists on eucalypt leaves, which are low in nutrition and contain dangerous chemicals. Its survival adaptations include energy minimalization such as slow movement, lots of sleeping, low rate of reproduction, and a tiny brain:

> The brain is one of the greatest energy users of all the organs. . . . It is therefore no surprise that the koala has made some major reductions in brain volume in order to save energy. The strange thing is that the koala brain is much smaller than the cranial vault that houses it. Its hemispheres sit like a pair of shrivelled walnut halves on top of the brain stem. . . . It is the only mammal on Earth with such a strangely reduced brain.
>
> The koala is an extreme, but marsupials in general are not known for their large brains, nor intelligence. The fact that they won over early placental mammals in Australia suggests that it may indeed pay to be dumb in Australia (Flannery 1994, pp. 86–87).

Marsupials, together with reptiles, avifauna, and other biota, evolved numerous energy-saving adaptations. Many marsupials, like kangaroos and wallabies, hop rather than walk because it is a very efficient form of locomotion, especially at speed. Many species tend to have low rates of reproduction, which eases demand on limited food sources, or have reproduction spurts at times when food sources become plentiful (Flannery 1994).

Kangaroos, like many Australian marsupials, hop rather than walk or run because it is a very energy-efficient form of motion. They also raise their young from early embryonic stages in stomach pouches which come equipped milk with teats. This Eastern Grey Kangaroo is in full movement, with its joey partly protruding from the pouch. (Photo by Rod Druce)

While these adaptations occurred over millions of years, suddenly another factor intervened—the arrival of human beings, the Aborigines. Their immigration is a subject full of significance and controversy—scientific, racial, and political. Scientifically, the issues of debate are when the Aborigines arrived, from where, whether there was just one or more arrivals, and their environmental impact. Archaeological evidence and better dating techniques have revolutionized understandings since World War II. In particular, the development of radiocarbon dating in the 1950s made it possible to calculate the age of Aboriginal artifacts and other evidence such as their middens or food rubbish dumps. Steadily, these pushed back the estimated date at which the first dark-skinned, flat-faced, and curly-haired humans known as Australoids arrived from Southeast Asia to the north of Australia, and from there moved onto the continent. Calculated arrival dates were pushed back to 40,000 years, 60,000 years, and, in some rare estimates, to even more than 100,000 years ago. However, problems with radiocarbon dating, notably its rapid decline in accuracy beyond 40,000 years and with the provenance of the materials that are tested, have meant that many of these calculations remain speculative and controversial.

New dating techniques in the 1990s, however, tended to confirm the general pattern established by radiocarbon dating, though not the extreme arrival ages. Optical luminescence, which can be used to calculate when grains of sediment around bones and artifacts were last exposed to sunlight, and another new technology that calculates the age of crystals in stones around bones or artifacts, confirm the likely arrival of humans at about 56,000 B.P., plus or minus 4,000 years (Roberts et al. 2001).

How the first humans arrived has also been a source of debate. Traditionally, it was held that, as they lacked the capacity to cross significant ocean distances, the Australoid migrants to Australia and New Guinea must have migrated at times of low sea levels, using land bridges and short ocean crossings. More recently, it has been argued that as the most likely time of migration, more than 50,000 years B.P., was also a time of high sea levels, it was not accidental but purposeful voyaging from Southeast Asia that first settled Australia, New Guinea, and the western Pacific (Kirch 2000; Lourandos 1997; Irwin 1992).

Having arrived in the islands to Australia's north, the Australoids appear to have spread rapidly (within 5,000 years) across Australia and perhaps within a similar timeframe to much of the extent of their settlement in Near Oceania, the western Pacific. In doing so, they exhibited a capacity to adapt to a wide diversity of environments; from the highlands of New Guinea where some thousands of years later they established a sedentary agricultural lifestyle with limited animal husbandry; to the tropical islands of the western Pacific where they much later combined hunting and gathering with slash-and-burn agriculture;

and across Australia in the multitude of environments from the baking central deserts to the cool coasts and mountains of Tasmania, establishing variations of a largely nomadic hunter-gatherer lifestyle. Adaptations or blending of different waves of peoples led to the emergence of somewhat distinct human groups who are roughly divided into the Aborigines of Australia and the Melanesians of New Guinea and Near Oceania (Kirch 2000).

Within Australia, Aborigines have lived through intense and trying environmental change. At the time they are believed to have arrived, the continent was much moister than today, and there were substantial rivers and inland bodies of water. One of the most important of these was the Willandra Lakes system in South Australia and New South Wales. At Lake Mungo, for example, Aborigines established an existence based on the rich aquatic and wetland food sources. It was here that some of the oldest skeletal remains have been found, nearly 40,000 years old and in a condition that indicates sophisticated cultural burial practices (Flannery 1994; Mulvaney and Kamminga 1999; Bowler 2002).

From about 30,000 years B.P. until about 14,000 years B.P., the planet experienced its last ice age. At the last glacial maximum (the coolest point), about

As the climate became drier, and as naturally occurring fires were more frequent, large areas of forests died out and the remnants were restricted essentially to southern regions and the eastern coastal fringe. Lake Mungo became a dry bed, its former shores marked by the bone- and shell-ridden windblown sand lunettes, which now attract tourists and archaeologists. (Photo courtesy of Mary E. White)

18,000 years B.P., the weather was colder by about 6 or 7 degrees than it is now. As a result, the polar ice caps grew, and more moisture was retained on the planet's land masses in the form of ice and snow. Rainfall declined and the Australian continent became much more arid, its inland waters largely drying up. Lake Mungo became a dry bed, its former shores marked by the bone- and shell-ridden windblown sand lunettes, which now attract tourists and archaeologists. As the climate became drier, and as naturally occurring fires were more frequent, large areas of forests died out and the remnants restricted essentially to southern regions and the eastern coastal fringe. Sea levels fell by up to 150 meters below their present height, and the Australian continent was much larger, with land bridges linking it to Tasmania, New Guinea, and Kangaroo Island. Port Phillip was a grassy plain and the Yarra, Melbourne's river, flowed over dry land across what is now Bass Strait, finally to enter the sea south of Tasmania, several hundreds of kilometers away from its current entrance into Port Phillip. Aborigines lived on the plain and migrated into Tasmania (Lourandos 1997; Presland 1994).

With the ending of the ice age about 14,000 years ago, the ice caps began to melt and sea levels to rise. Probably about 10,000 to 8,000 years ago, the oceans began to take over the land between the continent and Tasmania and New Guinea, isolating the island peoples who no longer had the capacity for ocean voyaging. Flora and fauna were also isolated on Kangaroo Island, and on the islands of Bass Strait such as King and Flinders Islands. During this warmer period, the seas eventually rose to about 2 meters above their present levels, which meant that large areas of the modern low-lying coastline were under water. Then, about 5,000 years ago, sea levels receded to their present height and the coastline was essentially established as we know it.

Although the climate had become warmer, it was no longer as moist as it had been prior to the ice age and much of the continent remained arid—and aridity has continued to dominate the ecology. Only one significant river system now exists, the Murray-Darling, whose watershed, the Murray-Darling Basin, encompasses one-seventh of Australia: "it includes all of the Australian Capital Territory, 75 per cent of New South Wales, 56 per cent of Victoria, 15 per cent of Queensland and eight per cent of South Australia" (Powell 1993, p. 7). Despite this vast water catchment, because of low rainfall and high evaporation, its flow is only that of a third-rate river on the other continents. The impact of these climatic changes on Australian biota in both genera and distribution, and on Aboriginal economy and culture, has been intense.

During their 50,000 years of occupation, the Aborigines developed a culture, belief system, and an economy (although with a myriad of local variations) that were highly attuned to the complex and generally arid environment. As hunter-gatherers, the Aborigines brought no cultivation plants or domesticated

animals, and were dependent on what they could extract from the environment. Fire was the only tool they brought, except perhaps for some stone implements. Significant adaptations were required to enable them to live with aridity, with flora that offered limited human nutrition, and with ongoing changes in the biota. But Aborigines, like all human societies, also modified the environment to meet their needs (Lourandos 1997).

Until the middle of the twentieth century, a particular set of beliefs prevailed among white Australians about their indigenous predecessors. In essence, it was held that the Aborigines were a primitive, nomadic people with a Stone Age technology and economy who, although tied spiritually to the land, had little physical impact on it. The British assumed that they were encountering a "pristine" landscape, little influenced by its transient human inhabitants. It was either as created by God, or as shaped by the action over time of climate, soil, plants, and animals. Among other results, this view reinforced an assumption that, as Australia was technically *terra nullius* (an open and empty land, not effectively utilized), the British had the right (or even the God-given duty) to appropriate the land and make it productive.

That mythology about the Aboriginal relationship with the land prevailed until the middle of the twentieth century when another view began to prevail. Anthropological studies and changing community attitudes combined to produce rather different views of both traditional and contemporary Aborigines. A better understanding of the sophisticated spiritual ties between Aborigines and the environment developed, as well as the technical complexity of their culture. However, out of this flowed an equally distorting mythology about Aborigines. In a hearkening back to eighteenth-century ideals of "noble savages," the Aborigines were increasingly idealized in educated circles as having lived in symbiotic, sustainable harmony with the natural world, and of having an understanding of the environment that enabled them to interact gently with it and to nurture it. Their traditional lifestyle, so it was averred, had minimal environmental impact. The Aborigines were true conservationists. This misconception was as unjust in its depiction of the Aborigines as the previous dismissive one had been.

In the last decades of the twentieth century, both of these earlier views were challenged by more sophisticated understandings drawn from anthropological, archaeological, and historical research. As discussed above, the date of Aboriginal arrival in Australia was more accurately established and it was increasingly (although not universally) recognized that over their thousands of years of occupation the Aborigines had a complex impact on the land. While the details are still hotly debated among scientific and archaeological scholars, in general it has come to be accepted that Aborigines significantly modified the landscape to meet their needs and to support their hunter-gatherer economy.

When the First Fleet sailed into Botany Bay in 1788, its passengers encountered not a pristine environment, but a significantly human-modified landscape. Such assertions have had great political and legal significance, challenging the notion of *terra nullius* and its repercussions.

The details of the chronology, nature, and extent of Aboriginal-induced modifications are the subject of ongoing research and dispute. The debates revolve essentially around two main issues: the Aboriginal role in the extinction of the Australian megafauna and environmental modifications through Aboriginal use of fire.

There seems little doubt that when Aborigines first moved onto the Australian continent they encountered the twenty-four or so genera of megafauna that inhabited the landscape. These were giant forms of Australian animals, defined as megafauna by weighing more than 100 kilograms. They included reptiles, birds, and marsupials including diprotodons (marsupial "rhinoceros") and kangaroos up to three meters in height. All of these, apart from some of the smaller kangaroos but as well as some fauna that were less than 100 kilograms, became extinct within the last 60,000 years. The timing and causes of the ex-

Diprotodon optatum *is one of the species of megafauna that roamed Australia until about 40,000 to 50,000 years ago. (DK Limited/Corbis)*

Australian Aborigines used fire as a land management tool, but in doing so they significantly modified the species of flora in the Australian environment, and thereby the habitat of the indigenous fauna. In some remote regions, as shown by this photogtraph from Arnhem Land in the Northern Territory in 1977, traditions of "firestick farming" have continued. (Penny Tweedie/Corbis)

tinction have been the subject of much debate. When did it happen and why? Was it caused by Aboriginal fires that transformed the floral distributions or by human predation or by climate change, and what role might natural fires and dwarfing have played? Among the problems have been uncertainty about the timing of both the arrival of the first humans and of the extinctions, a dilemma made complex by the fractured nature of the evidence. Nor should the Australian extinctions be seen in isolation, as similar extinctions (and debates) have occurred in other parts of the world, including North America. The prominent American scientist Jared Diamond has remarked that in the last 100,000 years or so "extinction waves of large animals swept across all of those parts of the world that had previously not been inhabited by humans. The two largest such waves occurred in Australia and the Americas" (Diamond 2001).

One of the leading participants in the Australian debate is mammologist and environmental historian Tim Flannery. In various works but notably his

best-selling 1994 book, *The Future Eaters* and its spin-off television series, he argued strongly that Aborigines had a high environmental impact and were the principal factor in causing the extinction of the megafauna. His very complex argument interweaves a diversity of evidence and hypotheses; the following is a very simple summary, which can hardly do justice to the complexities of his theory in just a few lines. Flannery is an advocate of the "blitzkrieg hypothesis," that extinctions followed rapidly upon human arrival, at least partly because the fauna had no previous experience of humans as predators and therefore lacked fear and were easy prey. Only species fast enough to outrun the Aborigines—like kangaroos, wallabies, and thylacine—or those that had other forms of protection—like koalas, which climbed trees, and wombats, which lived in burrows—survived. Predation and overexploitation of the megafauna by humans, not climatic factors, was the principal cause of extinction.

To Flannery, however, predation did not always result in extinction. He believes that the Aborigines tended to kill the largest beasts because they carried more meat, one result of which was the "dwarfing" of the survivors of the species; that is, the effective selection for and therefore reproduction of the smaller specimens. A few modern species, such as the Eastern gray kangaroo and wallaroos, are understood to be dwarfed descendants of the megafauna.

A further and even more complex twist in Flannery's argument relates to the intimate relationship between Aborigines and fire. On the basis of sediment cores and other evidence, it is known that, until Aborigines arrived, vast areas of the continent were covered by forests and relatively dense woodlands. Flannery argues that this vegetation provided food for the large herbivores, which recycled it quickly in their stomachs and returned it to the ground where it helped maintain some level of soil fertility. Charcoal and pollen evidence in sediment cores indicates that coincidental with the arrival of the Aborigines there was an increase in fires and a decline in forests. Flannery does not believe this was the result of Aborigines burning the land, as others have argued. Rather, with the decline and extinction of the megafauna herbivores due to Aboriginal predation, less vegetation was consumed and there was an increase of combustible material. The combination of large volumes of combustible material, ENSO episodes, and fires resulting from lightning strikes, produced much larger and more intense fires. These furthered the process of dominance of Australian flora by fire-tolerant species, which were capable of surviving bushfires and existing on increasingly nutrient-poor soils.

> The situation can be summarised thus. Large herbivores return nutrients to the soil quickly and with a bonus. Fire returns nutrients to the soil only after a long period—and then at considerable loss. As a result, fire and poor soils act to promote each other. Together they can produce an ecosystem which is spi-

> ralling ever downwards as nutrients become fewer while fires become more important. (Flannery 1994, p. 233).

Flannery's theory has not gone unchallenged and there has been a substantial reaction against many aspects, notably Aboriginal hunting of megafauna. There are problems caused by an absence of supportive evidence, notably the absence of kill sites and of butchering marks on bones, which would verify megafaunal predation by Aborigines. Some scientists have argued that megafauna did not disappear soon after Aboriginal arrival, but survived in some regions until 16,000 to 18,000 years ago, and perhaps even until 7,000 years ago (Wright 1986). It has also been argued that, rather than extinction, it was climate-induced dwarfing that caused the disappearance of more species of megafauna than even Flannery allows for. There is also a strong body of scientific opinion that argues that it was dramatic climate change in the last glacial period which was the major factor in causing the extinction of the megafauna. Climate change brought desertification of large areas of the continent, transforming the environment at a pace too rapid for megafauna to adapt. A weakness with that argument is that the megafauna had survived several other ice ages.

Studies of the evidence on Aboriginal impacts on the megafauna by John Mulvaney, Harry Lourandos, and James Kohen have cast doubt on the influence of human predation and a blitzkrieg impact. Kohen concluded that:

> The strongest evidence seems to support the model that climate change was the dominant factor in causing the megafauna to become extinct. Aboriginal use of fire may have had some marginal effect, but it probably had no effect at all. . . . In any event, it appears that the additional pressure of an Aboriginal presence in Australia may have tipped the scale in favour of extinction rather than recovery after the last glacial maximum, where previously the populations had recovered. (Kohen 1995, p. 58; also Mulvaney and Kamminga 1999; Lourandos 1997)

Another survey by Jim Allen is also somewhat skeptical of the extent of human environmental impact in Australia and Melanesia, and on the specific issue of the megafauna in Tasmania finds that "there is no evidence at all to implicate humans in the extinction." He sensibly points out that "no single explanations for extinctions need necessarily hold for all of Greater Australia" (1997, p. 30).

An important addition to the debate is a study that has more firmly identified the time of megafauna extinction, disputing the previously more diverse estimates and identifying a relatively short period, which was well outside the last ice age. In 2001, a group of distinguished Australian scientists (including Flannery), from a wide range of academic fields, published in *Science* the results

of a major study of megafauna extinctions. Using the new dating techniques of optical luminescence and crystal dating in stones, their findings were generally in accord with carbon dating and gave the arrival of humans at about 56,000 years B.P., plus or minus 4,000 years. They also found in a study of twenty-eight megafauna sites that there was a wave of extinctions across the continent about 46,000 years B.P., with a 95 percent confidence that the extinctions occurred between 51,200 and 39,800 years B.P. Three conclusions followed. First, extinctions occurred in a short period among all species and across all areas of the continent, which indicates the likelihood of a common cause. Second, that as this was in a period of mild climatic conditions, 25,000 years before the arid phase caused by the last glacial maximum, the cause was not likely to have been climatic. Third, that as the time of extinction was, at most, slightly more than 10,000 years after the estimated date of human arrival, human predation was a highly likely cause. However, while their study ruled out extreme aridity as the cause of extinction, it left open the possibility of other climatic impacts, as well as a "blitzkrieg" impact of human-induced extinctions or an extended period of anthropogenic ecosystem disruption (Roberts, et al. 2001).

Patrick Kirch, who has written of the parallel extinction of megafauna in New Guinea, has summed up the state of understanding in words that apply equally to Australia:

> To what extent hunting was responsible for the extinction of these great beasts is debatable, although the combination of hunting and human-induced fires resulting in grassland expansion is likely to have been important, in conjunction with climatic changes. (Kirch 2000, p.74)

As the quotations from Jared Diamond and Patrick Kirch indicate, one form of evidence for understanding the initial impact of the Aborigines on the Australian environment, as well as subsequent adaptations, is to examine comparable changes that have accompanied the spread of humans across the globe. While the details of evidence can and will be debated, there is an apparent pattern that upon human arrival in a new high-nutrition and high-resource environment, an advent abundance, they initially prosper and multiply, but by overexploiting the resources they generally degrade the environment, ravage the biota, and often cause the extinction of vulnerable species. It will be demonstrated in Chapter 2 that this was the case in New Zealand and Oceania, and James Belich has colorfully described this phenomenon in the case of the Maori as having cut through game like a knife through butter, causing a rolling wave of extinctions (Belich 1996).

A certain amount can also be extrapolated about likely Aboriginal environmental impacts and adjustments from broader understandings of hunter-gath-

erer societies. Some authors prefer to call them gatherer-hunters because gathering was often a more significant, easy, and fruitful way of life than hunting, which depended upon skills, available technology, and the environment. It seems that after their initial and often dramatic impact, hunter-gatherers—or gatherer-hunters—needed to adjust their economies. Excess population might move on to new regions if at all possible, while those who remained behind established a much more sustainable way of life. Elements of conservation were often achieved through taboos on when and how resources might be taken from the environment, and often there were forms of population control through extended periods of weaning, infanticide, and abandonment of the weak and elderly. For these reasons, hunter-gatherers were able to achieve a level of compatibility and sustainability with their environments, which helps to explain why they have dominated, as Clive Ponting has indicated, "ninety-nine per cent of human history" (Ponting 1991, chap. 3).

It is logical, then, to conclude that Australian Aborigines followed a similar path as new arrivals who encountered an advent abundance in "pristine" environments. Even if their role in the extinction of the megafauna was limited, it can be speculated with some confidence that through hunting and fires the Aborigines had a substantial initial impact on Australian biota. A land that had few large predators and many small and vulnerable species would have experienced substantial impact from efficient hunter-gatherers. There would have been a level of satiation slump, a transformation of ecosystems, and quite possibly the decline of available food. It can be conjectured that resulting social pressures were a major factor in the relatively rapid spread of Aborigines across the continent. Smaller groups were left behind to live within the changed environment, evolving a lifestyle and economy that were highly adjusted to local resource bases. Lacking placental grazing animals and plants suitable for intensive cropping, and with growth potential limited by the harsh climate and infertile soils, they established and maintained a seminomadic hunter-gatherer lifestyle that was very closely associated both spiritually and economically with the environment. Aboriginal population numbers remained relatively small, although there is ongoing debate about population size. The issue is made more complex by evidence that smallpox traveled in advance of the British frontier in many places, devastating the population and making estimates of numbers particularly unreliable. However, a pre-contact population of about 500,000 people appears likely.

Whatever their initial impact, it is now generally accepted that over their thousands of years of occupation, the Aborigines, like the indigenous people of North America and elsewhere around the globe, substantially modified their environment while also developing a sustainable balance that was dictated to a

significant degree on their terms. One of the principal methods they used to assert control and to maintain an environment that suited their needs was fire. Attention was drawn by many of the early British colonizers to the frequency with which Aborigines set fire to their country, but it was not until 1969 that archaeologist Rhys Jones clearly identified fire as a land management tool which he described as "firestick farming" (Jones 1969; Mulvaney and Kamminga 1999).

While there is still argument about the extent and degree of the impact of Aboriginal fires, there is clearly sufficient evidence to accept that the Aborigines consciously used it to modify and manage large areas of the landscape. They burned the land to promote fresh grass to attract game, to make it easier to hunt that game, to manage food plants, to keep paths open, to signal, and to use as a weapon against enemies. One effect over thousands of years was to modify the genera and distribution of Australian flora to cope with fire-prone conditions. Their actions continued the natural selection of fire-adapted species of flora and the process of causing extinctions or driving into residual pockets those species that were not as well adapted. Aboriginal fires probably turned, and at least maintained, large areas in the southern half of the continent into open woodland—grasslands frequently dotted with trees and shrubs (Flannery 1994; Pyne 1991; Kohen 1995; Lourandos 1997; Hallam 1975). Ironically, this created a landscape that was very attractive both aesthetically and agriculturally to the British invaders. There are numerous examples of early European travelers commenting that the open country so resembled a gentleman's park, they soon expected to come upon a suitably grand residence (Frost 1975; Ryan, Ryan, and Starr 1997). Through their landscape modification and control, Aborigines unconsciously sowed the seeds of their own downfall, assisting the creation of grazing land that was ideal for colonists' sheep. It is estimated that at the time of European arrival, about 10 percent of the continent was covered by forests and 23 percent by more open woodlands (Beale and Fray 1990, p. 31). The Aborigines had played a part in reducing the tree cover to this level.

Inevitably, this modification of the flora and Aboriginal hunting impacted the habitat and species distribution of Australian fauna. However, we know little about the detail of these effects. We are a little more confident about the introduction and impact of the dingo, a descendant of the dogs of Southeast Asia, which became an Aboriginal agent in changing the fauna. It was most likely introduced during periodic visits to the Australian coast by Indonesian fishermen about 4,000 to 5,000 B.P. It was a domestic animal that the Aborigines incorporated into their hunting and camp life, but most likely it was feral escapees that had the principal ecological impact. There had been no equivalent carnivore

predator in Australian ecosystems, and the dingo soon outbred and outcompeted the marsupial predators such as the thylacine and Tasmanian devil, both of which became extinct on the mainland and survived only in Tasmania. The impact on smaller marsupial and avifaunal prey species can only be speculated upon (Breckwoldt 1988).

In other ways, the landscape clearly revealed the hand of human beings when Europeans arrived. While their lifestyle was often nomadic, Aborigines would settle for extended periods if food was available. At times, they modified the landscape to ensure the food supply. Sophisticated systems of fish traps were formed in tidal estuaries in places such as the King and Kalgan Rivers near Oyster Harbour in southwestern Western Australia. In various places, eel traps were built in streams and wetlands using stone walls, trenches, races, pools, weirs, and woven baskets, the most complex of which were in the Western District of Victoria at Lake Condah and Lake Bolac. In that region there are remains of what were described as stone houses clustered in "hamlets" (Coutts, et al. 1977). While Aborigines were not farmers in the European sense, in many places they conserved and replanted food plants and tubers to ensure future harvests (Hallam 1975).

The unfolding evidence of the impacts of Aborigines on the environment is fraught with political and racial significance. On the one hand, it shows that, while the Aborigines conserved their environment and lived in a general state of sustainable balance, like any other human society they exploited and impacted upon their environment. This has challenged the view of the original inhabitants as neo-noble savages in both white and black communities. There have also been significant legal implications as the old mythology of *terra nullius* has been exploded. Two major court decisions in the 1990s, in the Mabo and the Wik cases, were influenced by these new archaeological and anthropological understandings which negated *terra nullius* and led the way to the recognition of traditional Aboriginal land rights (Broome 1994).

When the British arrived, they found a challenging, intriguing, and eventually bountiful wide brown land. Nature and humans had combined to give it that form and color.

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2

THE BROAD BLUE OCEAN

Bali Ha'i may call you any night, any day
In your heart you'll hear it call you:
"Come away, come away."
Bali Ha'i will whisper
On the wind of the sea:
"Here am I, your special island!
Come to me, come to me!"
Your own special hopes,
Your own special dreams
Bloom on the hillside and shine in the streams.
If you try, you'll find me
Where the sky meets the sea.
Here am I, your special island,
Come to me, come to me.

—Oscar Hammerstein, Bali Ha'i,
from the 1950s musical, *South Pacific*

It is common for people studying the Pacific to be the brunt of expressions of envy. On one level this is justified, for these islands can be wonderful. Many of them boast the idyllic golden sands, crystal waters, waving palms, green hills, and warm sun of the fictional Bali Ha'i. Superficially, they appear to be among the most environmentally idyllic of places. But such a picture is by no means universal; it is a distortion of the often much less ideal—even harsh—reality of these diverse islands and their history. Expressions of envy unconsciously reflect the European paradise mythology, which began in 1520 when Ferdinand Magellan named the ocean "Mar Pacifico," and which was then perpetuated by explorers and writers in the eighteenth century. The mystique of

the Pacific lives on in popular culture and imagination, from the musical *South Pacific* to the dream of a holiday in Tahiti or Hawai'i (Howe 2000, chap. 2). However, cold winds, rain, volcanoes, earthquakes, tsunamis, and hurricanes are arguably just as common natural phenomena as sun-drenched peace, while the human history has similarly been turbulent and destructive.

The basic facts of the Pacific Ocean are well known. At 162,250,000 square kilometers, it is the planet's largest (and deepest) ocean, covering one third of the earth's surface, an area greater than all the world's land masses combined. It is some 16,700 kilometers wide at the equator, and even wider at other points. It is clearly the dominant feature of this vast region despite the splattering of 25,000 islands across its waters, mostly in its western half. These comprise less than 1,300,000 square kilometers, most of which (1,100,000 square kilometers) consist of the large island masses of New Guinea, New Zealand, and Hawai'i.

The paradise mythology of the Pacific islands celebrates their blue seas, charming green vistas, and pleasant climate. There are many visual delights, such as this stretch of coastline adjacent to the Kalaupappa Peninsula on the island of Molokai in the Hawaiian Islands. (Photo courtesy of Don Garden)

The vast majority of the islands are atolls, little more than tiny dots in the ocean (Lal and Fortune 2000). It is the islands, however, which will be the subject of most attention in this examination of Oceania, a useful term that includes both the islands (and perhaps their human societies) as well as the vastness of the sea.

For the environmental historian, the islands can be categorized as consisting of four main types according to their geological formation and consequent suite of "natural resources." These are continental islands, high volcanic islands, atolls, and makatea islands. The key to these landforms is encapsulated in four words—plates, uplift, volcanoes, and coral—which in various combinations have created and fashioned the islands, determined their biota and therefore shaped much of the human history (Rapaport 1999; Lal and Fortune 2000; Kirch 2000; Whittaker 1998).

Continental islands, which include parts of New Zealand, New Caledonia, Vanuatu, and Fiji, as well as New Guinea and much of the Bismarck Archipelago, are fragments of the great southern megacontinent of Gondwana, which split off and moved with the drift of tectonic plates into the Pacific. They have been added to, rearranged, and reshaped by earth movement (notably uplift) and volcanic action over millions of years, and are generally larger, higher, and have greater biodiversity than other Oceanic islands.

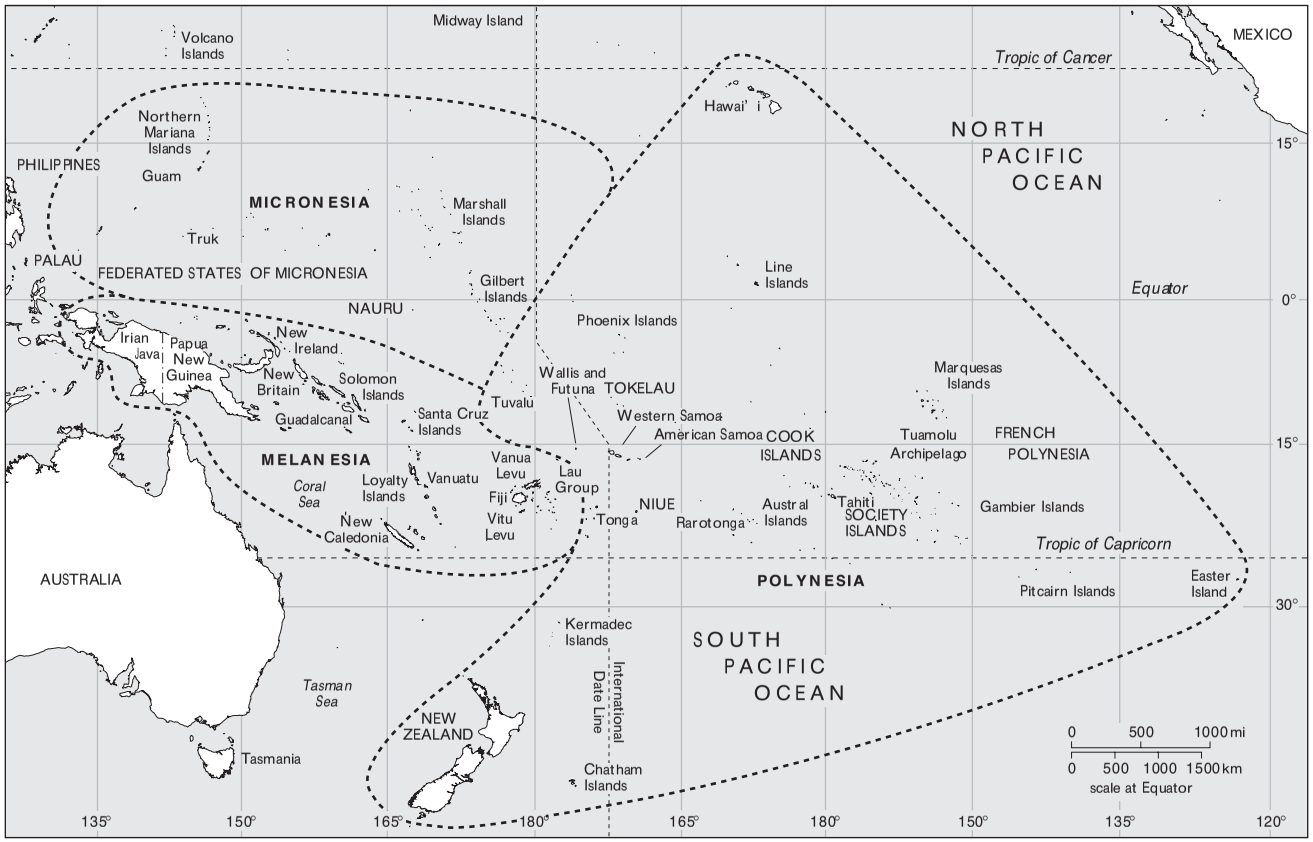
The Pacific floor is divided into a small number of moving tectonic plates. In some places where they rub against each other, they have forced shards of the plates upwards, forming new islands like Esperitu Santo and Pentecost Island in Vanuatu, or uplifting the highlands on continental islands, such as the alpine regions of the South Island of New Zealand. The huge pressures of colliding plates can also turn rock into molten lava which escapes to the surface in the form of volcanoes. One of the best examples of this phenomenon is found in the North Island of New Zealand where the line of the Pacific Plate sliding underneath the Indo-Australian Plate can be traced north to south through White Island in the Bay of Plenty, the thermal areas around Rotorua and Lake Taupo, the three volcanoes in the Tongariro National Park (Mount Ruapehu, Mount Ngauruhoe, and Mount Tongariro), and Mount Taranaki on the west coast. The extent of ancient volcanic activity in New Zealand is also illustrated by the remnant peaks of fifty or so volcanoes in the Auckland area (Hicks and Campbell 2003).

The geological instability of the earth's crust in Oceania has long caused volcanoes and earthquakes (and the consequent tsunamis) both around the edge of the Pacific and across the ocean itself. Thousands of enormous volcanoes have grown thousands of meters from the ocean depths, some to break above the surface to form high volcanic islands, but even more have become guyots—

White Island (Whakaari) in the Bay of Plenty on the North Island of New Zealand lies on the line where the Pacific Plate is sliding underneath the Indo-Australian Plate, and is one of many volcanoes that have resulted from the enormous pressures. It is also a fine example of the high proportion of Pacific islands created by volcanic action. (Amos Nachoum/Corbis)

extinct peaks that never made it to the surface or have sunk back below it. Volcanic islands such as Rarotonga, Tahiti, and Hawai'i tend to be relatively large, fertile with volcanic soil, and rich in biota. Those in warmer latitudes eventually have coral reefs growing in a ring around them. As will be discussed in Chapter 7, Rapa Nui (Easter Island) is also a high volcanic island, but does not conform to the general expectations of such formations. There are several volcanoes that are still active in the Pacific, including Mount Ruapehu in New Zealand, Kilauea in Hawai'i, and Mount Yasur on Tanna Island in Vanuatu.

Many volcanic islands are clustered in archipelagos, often in the form of arcs caused by the slow movement of a tectonic plate over a stationary hot spot in the earth's crust. Magma is pushed through these weak points, above the ocean floor, and at times above sea level. One of the best examples of an archipelago resulting from a hot spot is the Hawaiian chain, where the hot spot currently lies under the Big Island and volcanic action continues to reshape the island and enthrall tourists (Ziegler 2002; Juvik and Juvik 1998).



The Pacific Ocean and Oceania showing the main islands, current national groupings, and the frequently used but now questioned tripartite division into Melanesia, Micronesia, and Polynesia.

One of the many volcanoes still active in the Pacific, Mount Yasur, Tanna Island, Vanuatu. (Photo courtesy of Lucinda Sargent)

The Cook Islands provide examples of the two other principal types of islands—atolls and makatea islands. Over millions of years, high volcanic islands generally cease to be high or volcanic. Once volcanic activity has ceased, the action of rain, wind, sun, and waves gradually erodes them away while their enormous weight causes them to settle back toward the sea floor. Eventually, they may disappear below the ocean surface, but prior to that, they may form an atoll. As the central island slowly sinks, the fringing coral reefs continue to grow and, on higher points, islets, or *motu,* can be formed by the accumulation of debris and vegetation taking root. Eventually, what is left is an atoll, an empty enclosed lagoon with a ring of *motu* marking the line of the fringing reef (Yonge 1958). Most of Micronesia consists of such low atolls with their tiny *motu.* Another beautiful example is Aitutaki in the Cook Islands. Here, however, there is still a rump of the old volcano, which stands sufficiently high in the corner of the lagoon for Aitutaki to be termed a "near atoll," and for the vis-

Many Pacific islands contain mountainous areas as a result of volcanic activity or geological uplift. Oahu in the Hawaiian Islands is notable for the jagged peaks of the mountain spine that runs along the length of the island. (Photo courtesy of Don Garden)

itor to be able to climb the hill for breathtaking views over the superb lagoon and its ring of *motu*.

A short flight away from Aitutaki lies Atiu, a prime example of one of the most fascinating island forms, a makatea. From the air, Atiu looks somewhat like a sombrero. In the middle is what remains of the aged, ancient volcano, while around the edge is a broad flat brim. Once, it was a conventional aging volcanic island surrounded by a reef, but thousands of years ago, a tectonic uplift raised the island and its reef a few meters above its previous height. This action exposed the former reef, or makatea, as a kilometer-wide limestone plain surrounding the volcanic hill. The makatea is very rough and jagged, and originally would have been bare of vegetation. Over time, there has been sufficient buildup of soil for vegetation to become established over much of the makatea. Between the makatea and the central plateau lies the depression that once lay

Atiu in the Cook Islands is a classic example of a makatea island. Between its old volcanic center and the rough, coral-limestone coastal platform known as makatea, which was created when the island was lifted above sea level, there is a depression. Eroded volcanic soil from the mountain has accumulated in the depression, forming a fertile agricultural ground. Rainwater also accumulates, forming a lake and keeping the soil moist for the cultivation of crops such as taro. (Photo courtesy of Don Garden)

between reef and shoreline. It now encircles the volcanic hill as a wetland into which rainwater drains and rich volcanic soil has been washed, forming an ideal bed for tropical agriculture (Parkes 1997). Most Tongan islands are also of the makatea type, as is Mangaia, to which we shall return.

There are both great similarities and considerable diversity in the ecosystems that evolved on the islands of Oceania. The Gondwana fragments still carry some small floral and faunal remnants of their biota, notably a cuscus, or marsupial phalanger, and freshwater and saltwater crocodiles in the Solomons. The biota of these continental islands has also been extensively modified by evolution, adaptation, and the arrival of new species. By contrast, when vol-

canic and uplifted islands emerged from the ocean, they possessed no terrestrial life but over long periods, winds, ocean currents, and the feet, feathers, and digestive tracts of birds brought the seeds of flora and a few species of fauna. Only those species either possessing or with access to appropriate dispersal mechanisms were able to undertake the long journeys, and the various factors at play resulted in diverse combinations of new colonists on the islands. One estimate is that the distribution of plants was 75 percent by birds, 23 percent floated, and only 2 percent by wind (Lal and Fortune 2000, p. 105).

The migration of Oceanic biota was generally from west to east, with four major factors influencing their distribution and establishment. The first was the size and fertility of the islands on which they landed, with larger continental and volcanic islands able to provide hospitality for a wider range of species. Second, the further east the islands, generally the less the species diversity, largely because of the distance that had to be crossed and because the eastern islands tended to be smaller, more scattered, and remote. This easterly decline in species diversity is well demonstrated by avifauna and coral fish. It is estimated that there were over 550 species of birds in New Guinea, 127 in the Solomon Islands, 54 in Fiji, 17 in the Society Islands, 4 on tiny Henderson Island in the Pitcairn group, and 31 on the somewhat larger Rapa Nui (Lal and Fortune 2000, p. 4; Steadman 1997; Bahn and Flenley 1992; Rapaport 1999, chap. 7). From the west across the Pacific, the Bismarck Archipelago and the Solomon Islands have more than ninety families of shore fish (with many species within the families), Fiji has fifty families, and the Society Islands have thirty (Kirch 1997(a), pp. 31–32). Third, the latitude of the islands also influenced the biotic mix, as those islands in relatively cooler latitudes, notably New Zealand but also including Hawai'i and Rapa Nui, were unsuited to supporting some of the tropical flora with which Pacific islands are generally associated.

Finally, a fourth major factor in species distribution, and indeed in the shaping of Pacific ecosystems, was wind. It is demonstrated by Philip Houghton (1996) and Geoffrey Irwin (1992), and it takes little experience on Pacific islands to be aware that there are prevailing winds. Between the Tropics, to the north of the equator these are north-easterlies, while to the south they are south-easterlies. Further south, from about 30° south, the winds are generally the "Roaring Forties" from the west. One result is that on nearly every island of significant size there is an ecological difference between its windward and leeward sides. Apart from wind action itself on flora and soils, a major effect of wind is on rain distribution. The Big Island in Hawai'i offers a prime example; I have left Kona on the dry leeward side in brilliant sunshine, driven across to the windward side where Hilo was blanketed in mist and rain, and escaped back to the leeward side for a day of sunshine (Ziegler 2002).

While such localized biota and climatic variations are very noticeable, over Oceania as an entity there is relatively little biodiversity, and the smaller the island and the further east it lies, the less there is likely to be. When humans moved beyond the islands of Near Oceania, they encountered no indigenous mammals except for flying foxes or fruit bats and seals on some islands, and other vertebrate species were restricted to avifauna and a few small reptiles. However, local adaptations and evolution over long periods of insularity promoted fascinating species adaptation to local conditions. Perhaps most notable, in the absence of mammals and other predators, are the many species of flightless and ground-nesting birds. Another consequence was that many small environments boasted their own endemic species, often small in number, unused to serious predation, limited in range, and therefore vulnerable to disruption. In Hawai'i, the highly adapted 39 species and subspecies of honeycreepers, several hundred species of fruit flies, and more than 750 species of tree snails are often cited to epitomize the extent of localized Oceanic endemism. Most had tiny ranges and were highly adapted to a particular source of food and microclimate (Ziegler 2002; Juvik and Juvik 1998; Carlquist 1980). New Caledonia had a similar dispersal of lizards. Such insular ecosystems are highly fragile, and the more highly specialized the fauna and flora, the more vulnerable they are to disruption.

Insular ecosystems, perhaps especially those in the Pacific, have long intrigued scientists, and research leading to understandings such as those outlined above has played a major role in the gradual human comprehension of nature. Since the eighteenth-century scientific voyages of Cook, La Perouse, and others, the Pacific has been a source both of intrigue and discovery (MacArthur and Wilson 1967; MacLeod and Rehbock 1994; Kirch 2000). Arguably most significantly, on the *Beagle* voyage in 1836, Charles Darwin visited the Galapagos Islands and other places further west in the Pacific. He was intrigued by the biota, and his observations formed an element in the development of his theory of evolution. He is also attributed with working out how coral atolls are formed (See A to Z, Darwin).

* * *

As we have seen in Chapter 1, Australian pre-European history is an area of ongoing debate. Pacific pre-contact history, especially of human migration and settlement, has the reader looking for more dangerous metaphors. It is an area of changing understandings, new discoveries, and sometimes weird speculations. Genetic, linguistic, anthropological, archaeological, geological, ecological, and other studies provide a morass of often conflicting theories and conclusions. Besides the ordinary issues of evidence and interpretation, there are other modern influences such as indigenous beliefs, racial overtones, religious frameworks, po-

litical correctness, and postcolonial perspectives. In addition, there are the added complications arising from the way the region has been imagined and mythologized since European contact. To write about the peopling of the Pacific is a bit like walking into the proverbial minefield, with the extra complication that potshots might be taken from all sides, though generally in the nicest possible way. Fortunately, New Zealand historian Kerry Howe has bravely synthesized the state of the scholarship in his masterly 2003 study, *The Quest for Origins.*

The environmental historian need not become deeply embroiled in debates over the exact timing and sequence of human arrival and spread in Oceania. A generally safe, although by no means universally accepted, version is as follows: Pre-European migration into Oceania can be seen as having taken place in three main waves or stages. The first, as has been noted in Chapter 1, was the Australoids who arrived in about 50,000 to 60,000 years B.P. and inhabited Australia, settled the coastal areas of New Guinea, and spread slowly into the Highlands and into the Bismarck Archipelago—the corner of the Pacific that includes New Britain, New Ireland, and Bougainville. They also reached as far as the Solomon Islands, possibly about 25,000 to 30,000 years B.P. The greater ocean distances beyond there, and the inappropriateness of most small islands for their hunter-gatherer existence, prevented further spread for many thousands of years. Over their millennia of occupation of Near Oceania, these people significantly modified the ecology of the islands. Their burning practices changed floral distributions, while burning and hunting contributed to the extinction of megafauna and marsupial species (Kirch 2000; Kirch 1997(a); Rapaport 1999; Lal and Fortune 2000).

Very significantly, there is evidence that these people were among the vanguard of one of the major transitions in human history: from hunter-gatherers to early forms of sedentary societies based on agriculture and animal husbandry. Around 10,000 years B.P., adoption of plant cultivation and the domestication of a small number of animals, particularly in the Middle East and Asia, facilitated the emergence of humans as the planet's dominant species. Humans were increasingly able to shape the "resources" in their environments to meet their needs, and the subsequent population explosion and technological innovations have since transformed the world (Ponting 1991; Wright 2004).

It is now understood that early forms of manipulation and cultivation of food plants commenced in New Guinea and other settled parts of Near Oceania within a similar period. The region was a place of origin of many edible roots, tubers, and fruits, which in time became tropical crops, including species of bananas, taro, sugarcane, and breadfruit. From as early as 9,000 years B.P., it seems many of these food plants were being cultivated. In the New Guinea Highlands, raised garden beds were constructed on the former wetlands of valley bottoms,

a technique that was later commonly used on many Pacific islands. Whether this embryonic agriculture was a spontaneous development or if it resulted from interaction with Southeast Asia is not clear. However, the introduction of the Asian pig around 5,000 years B.P., probably the first form of animal husbandry in the region, suggests that there was some contact and sharing of knowledge and species. Despite the increased and potentially more reliable food sources, there was not a major increase in human populations. Human settlements remained small and scattered, perhaps principally because of tropical diseases such as malaria (Kirch 1997(a); Golson 1997).

About 3,500 to 4,000 years B.P., a second wave of people, known as Austronesians after the family of languages they spoke, arrived from Southeast Asia in oceangoing outrigger canoes, perhaps having originated in southern China and Taiwan. By that time, human societies in Asia had become much larger and more technologically sophisticated and the immigrants brought with them new cultural elements including tools, food species, more advanced agricultural knowledge and sailing technology, and new ways to exploit their environments. They moved around the fringe of New Guinea and from there began to spread eastward through the Bismarck Archipelago and the Solomons, intermingling with the earlier settlers and producing the genetic and cultural synthesis that is often known as Melanesian (Bellwood et al. 1995; Bellwood 1975; Kirch 2000). From perhaps 3,200 years B.P., their outrigger canoes began a rapid movement beyond the previously occupied islands. Some seem to have headed north into Micronesia. Others sailed southeast to reach Vanuatu in 3200 to 3100 B.P., from there sailing south to New Caledonia (2800 B.P.) and east to Fiji (3000 B.P.) and within a century or two, from there to Tonga and Samoa (Kirch, 1997(a); Kirch 2000; Howe 2003; Diamond 1988; Diamond 1997; Irwin 1992).

The northward flow of Austronesian migration into Micronesia contributed to the occupation of the more than 2,000 generally tiny islands—mainly atolls—which lie to the north and northeast of New Guinea. In human terms, Micronesia shows a considerable mixture of genetic and linguistic heritage and it seems most likely that there were several streams of migration over many centuries, possibly from the Philippines, Southeast Asia, and Taiwan, as well as Austronesians from both the Bismarck Archipelago and Vanuatu.

The Austronesian migrants who voyaged to the south and southeast are now usually referred to as the Lapita people. The name is taken from the place in New Caledonia where a distinctive pottery that they manufactured was first found. Lapita pottery was a significant element in their culture but gradually evolved into other forms of pottery in some parts of the islands of Melanesia, while they faded out of use in others (Kirch 1997(a)).

The newly occupied islands of both the northern and southeastern migrations were generally smaller with significantly scarcer amounts of floral and faunal species than those of Near Oceania, and therefore unsuited to hunter-gatherer existence. Apart from birds, fish, and shellfish, they offered little in indigenous foodstuffs. However, the immigrants were subsistence agriculturalists and carried with them a mixture of food species they had brought from Southeast Asia and had adopted in Near Oceania. These included about twenty-eight species of tubers, fruits, and tree crops as well as chickens, dogs, and pigs, all of which were of Asian origin (Kirch 2000, pp. 109–10). These food resources enabled the establishment of new forms of subsistence on the diversity of islands. On larger islands, the immigrants frequently adopted a swidden agriculture, or shifting cultivation, supplemented particularly in the early period of settlement by the hunting of local avian and aquatic species. On smaller islands, notably coral atolls, fewer introduced species could be supported and considerable agricultural ingenuity was required to create suitable growing conditions. The people tended to live in settled villages, and there is evidence of continuing trade between the islands across the region.

One of the greatest anthropological debates is about the origin and dispersal of the next wave of people who extended the occupation of the Pacific—the Polynesians. Various theories have been advanced about possible places whence they came—generally in Asia or South America. Possessing an impressive capacity for long distance voyaging, it was perceived that they probably sailed in stages from some distant homeland, perhaps skirting around those islands already occupied in Near Oceania and by the Lapita, commencing their occupation in the central Pacific. However, in recent decades it has come to be widely, although not universally, believed that the Polynesian people and culture evolved from the Austronesian/Lapita in the central Pacific (Howe 2003). In the Tonga-Samoa region, they developed the linguistic and cultural characteristics known as Polynesian, possibly during a "pause" of a millennium or more. They then undertook one of the most impressive migrations in human history. Centuries before Europeans exhibited a similar capacity in sailing technology and navigational skills, they crossed and recrossed the vast expanses of the Pacific, occupying virtually all the remaining habitable islands. From Samoa, perhaps two or three centuries before the Christian era, they reached the Cook Islands, Society Islands, and the Marquesas. Most theories see these as the main Polynesian departure points from where they spread across Oceania, reaching the extremes of Rapa Nui and Hawai'i by 300 AD, and New Zealand between 1100 and 1400 A.D.

Geoffrey Irwin has challenged the idea of a long pause before the Polynesian diaspora. His impressive study of the voyaging skills of Oceanic peoples

leads him to believe that there was a more constant progress of migration. Largely on this basis, he argues for patterns and chronology of colonization into areas such as the southern Cook Islands as early as 2700 B.P. He has also demonstrated that, whatever the timetable, perhaps even more impressive than the spread of Polynesian migrants is evidence of repeated return voyages and trade interchange between their various outlying settlements, a feat that demonstrated great endurance and navigational skill (Irwin 1992). DNA studies of lizards and Pacific rats that accompanied Polynesian voyages confirm the rapidity of the spread into and across the Pacific, the extent of interconnections within Polynesia, and the likelihood of some return voyaging even perhaps to the apexes of the Polynesian triangle, Hawai'i, Rapa Nui, and New Zealand (Matisoo-Smith et al. 1998; Austin 1999). Another interesting theory provides an explanation for the impressive bulk of many Polynesian people. Philip Houghton links these voyages to a physiological adaptation by Polynesians to the cold conditions at sea and the cool breezes of the islands to account for their often large physiques (Houghton 1996; see A to Z, Polynesia).

Unlike the Australian Aborigines who walked, therefore physically carrying very little into new environments, the large Polynesian vessels, although not quite Noah's arks, certainly had a complement of nonhuman passengers. Like their Pacific predecessors, the far-voyaging Polynesians were agriculturalists and carried a considerable baggage of biota, both consciously and as stowaways. This included up to thirty food and utilitarian plants such as taro, bananas, kava, coconut (although some will point out that it was spread mainly by currents), breadfruit, hue gourd, paper mulberry, tropical cabbage tree, plantain, pandanus, turmeric, and arrowroot. Not all adapted or were adopted equally. The yam was less important to the east of Tonga where taro and breadfruit became staples, while yams and breadfruit became staples on the more marginal atolls of Micronesia. The most mysterious transplant was kumara, or sweet potato, which is a South American plant. How, when, and where it entered the Pacific and was adopted by the Polynesians is unknown but is the source of numerous theories. Its presence indicates some contact between Polynesians and South America, most likely by Polynesians who returned to the Pacific with this new and prized vegetable (Howe 2003). Kumara became a key component in the diet of many communities, and arguably enabled the survival of Maori in New Zealand. The Pacific peoples had created hybrid landscapes on substantial areas of their islands long before Europeans arrived.

Polynesians also carried all or some combination of four sources of protein—pigs, chickens, dogs, and Pacific rats. These did not always survive the voyage or naturalize once landed, so their presence on the islands was not uniform. The pig was, for many societies, the most important animal and was very

widely dispersed, although notably absent from a few places such as New Zealand and Rapa Nui. The Pacific rat appears likely to have been deliberately transported at times as a source of food, but also to have stowed away. Other stowaways included many species of insect (including mosquitoes), weeds, land snails, as well as a number of geckos and skinks.

Environmental factors played a very significant, although not uniform, role in the cultures and economic systems that evolved during the hundreds or even thousands of years of occupation by the Pacific peoples. Subsistence horticulture varied greatly and depended on such variables as climate, topography, soil fertility, population pressures, and cultural preferences. The resources of individual islands, particularly soil, water, and climate, did much to determine the economic production of the societies that were established and developed on them. Large continental and volcanic islands offered much greater return than the coral and sand of small islands and atolls. Substantially, although not universally, such environmental economics determined not only the population that an island could support, but also the complexity of the social organization. The richer the resources, the larger the population and the more hierarchical and complex the social organization was likely to be. Several island societies produced sufficient surplus to support a leisured elite, a chiefly hierarchy, including Hawai'i, Tahiti, and Tonga. Others, even when surpluses were adequate, were less hierarchical. Jared Diamond, very much an environmental determinist, has argued that there were at least six sets of environmental variables among Polynesian islands that shaped the societies: climate, geological type, marine resources, area, terrain fragmentation, and isolation (Kirch 2000; Diamond 1997, chap. 2).

All the Oceanic communities shared variations of swidden or sedentary agriculture supplemented by animal husbandry and local hunting and fishing. They planted their gardens and orchards and, over time, in many places developed such techniques as sophisticated irrigation systems for taro fields (very common), extensive ridge and hill terraces such as those on Palau, and the stone-faced taro pondfields that were constructed in the valleys of the Hawaiian islands. The most complex irrigation system in Oceania was the terraced hills, valley floors, canals, and ditches on La Grande Terre in New Caledonia, a region that also boasted large areas of dryland terracing and mounding for yams (Kirch 2000).

As with Australia, a mythology long prevailed that the indigenous people of the Pacific had lived in harmony with their islands and had little environmental impact. The European paradise mythology perpetuated this notion and depicted the islanders as true environmentalists. Also like Australia, the fragility of insular environments was not recognized, nor the extensive effects of the arrival of humans, especially their initial impact, the satiation slump. This view

began to change during the 1960s as archaeologists and others began to look in detail at the relationships between the islanders and their environments. Botanist Raymond Fosberg (1963) was a major pioneer in this field, while in more recent decades American archaeologist Patrick Kirch has been one of the most important scholars synthesizing the evidence. As Kirch observed:

> Working collaboratively with palynologists, avian paleontologists, geomorphologists, and other natural scientists, Pacific archaeologists have now amassed a substantial body of data, demonstrating that the nonindustrialized peoples of the Pacific often exerted major impacts on island ecosystems. (2000, p.59)

Judith Bennett's study of the Solomon Islands led her to conclude that future research will reveal that practically all of the Solomon Islands' landscape, as well as the interface of land and sea, were transformed to some extent before the arrival of Europeans:

The ancestral Solomon Islanders were not ecologically noble savages, practising some kind of Green Primitivism. There was a tight restraining relationship between settlement patterns, population and the method and means of gardening. The people lived in small, relatively isolated societies, producing few surpluses, but trading regularly. . . . They thus made limited demands on the environment. Their environmental knowledge was deep, but almost certainly localised and utilised to benefit themselves and their families. (Bennett 2000, p. 35; see also pp. 19ff)

The extent of Islander impacts on their environments is, not surprisingly, a matter of some ongoing dispute. It is argued, for example, that population densities were seldom sufficiently high to cause much change, a position which is not convincing if only for the fact that it ignores the virtually indisputable impact of the introduction of pigs, rats, and dogs. More plausible is Patrick Nunn, who asserts the role of climate change as well as human action, especially the onset of the Little Ice Age in about 1300 (initial short-term increase in storms and precipitation followed by long-term higher aridity), in modifying environments and causing depopulation and social decline in many Pacific societies (Nunn 2000, 2001). Despite the evidence of accompanying factors, the subsistence demands of human populations upon the fragile and vulnerable oceanic insular systems, population densities that at times were high, and the character of their land use clearly imposed stresses upon many Pacific islands. Put simply, these can be narrowed down to four main aspects—extinctions of indigenous species (particularly avifauna), clearance and transformation of vegetation communities, degradation of water systems, and erosion.

The impact of hunting, agriculture, and introduced species on the indigenous fauna of the islands is immeasurable, and much of it appears to have occurred

within the early period of settlement. During the initial phase, while plants and seedlings were being nurtured into sustainable production, new immigrants relied heavily on the islands' advent abundance of birds, fish, and shellfish. This often led to swift extinction or the impoverishment of a range of species and ecosystems, and a resulting satiation slump. Atholl Anderson has explained that:

> Migration into new environments releases a powerful instinct to expand as rapidly as possible, using the richest resources with pitiless energetic efficiency. Evolutionary fitness drives lineage competition in the use of unowned resources towards levels of overexploitation described as the "tragedy of the commons." (Anderson 2002, pp. 32–33)

Archaeological studies of early Pacific settlements have indicated substantial presence and consumption of species of avifauna that no longer exist or became rare or threatened before the arrival of Europeans. The many species of flightless or near-flightless birds in Polynesia were particularly vulnerable. They had evolved or adapted over hundreds of thousands of years as a response to the absence of major predators, and were particularly vulnerable to habitat destruction and egg foraging by pigs and rats, predation by dogs, human hunting, egg collection, and fires. Not only flightless birds, but also land and sea birds across a diversity of species were driven to extinction or greatly reduced as demonstrated by David Steadman (1997), in particular. In addition, feathers became highly prized in many societies for decoration and adornment.

Once food plants were established, a period of agricultural expansion began on most Pacific islands as initial soil fertility in newly cleared land supported a steadily growing population. When satiation, or the carrying capacity of the island, was reached there were three possibilities. First, excess population might emigrate, and there is evidence that this was one of the reasons for the continuing expansion of Pacific peoples until all available islands had been inhabited. Once such emigration was no longer possible, a crossroad was reached. Some island societies readjusted to a system of sustainable environmental exploitation. Tikopia in the Solomons was one of these, as is discussed below. Others continued to overexploit their environment until an ecological crash occurred, populations slumped, and social crises ensued, such as Mangaia, which is discussed later in this chapter, and Rapa Nui, which is outlined in Chapter 7. What enables some human societies to modify their behavior to achieve sustainability while others continue to move inexorably to ecological disaster, is one of the great questions facing our species. Among the contributing factors, the most likely are the quality of leadership, the size of populations, and the nature of social organization in individual communities—some islands had leaders of vision and populations that were small enough and sufficiently peaceful and cooperative to be reorganized

into more effective economic and social systems supported by evolving religious beliefs and taboos. Jared Diamond has extensively analyzed this fundamental issue in his study of "how societies choose to fail or survive." He delineates four categories of factors that explain the poor decision making in a society that can lead to environmental and other disasters:

> First of all, a group may fail to anticipate a problem before the problem actually arrives. Second, when the problem does arrive, the group may fail to perceive it. Then, after they perceive it, they may fail even to try to resolve it. Finally, they may try to solve it but may not succeed. While all this discussion of reasons for failure and societal collapse may seem depressing, the flip side is a heartening subject: namely, successful decision making. [Diamond, 2005, p. 421]

Like me, Diamond identifies as one of the keys to survival the presence of courageous leaders who perceive the problems and who then make courageous decisions to find ways to overcome them. Historically, these have been unfortunately rare attributes in human leadership—pursuit of power, acquisition, and aggrandisement have been more to the fore.

As Austronesians and Polynesians advanced across the Pacific, they cleared native forests by fire and chopping to make way for gardens and orchards. Swidden or shifting cultivation took a heavy toll because even where forest areas were allowed to grow back, the damage to local ecosystems was intense. Once cleared, land tended to dry out and, over time, as it was burned and reburned, an atypical regrowth occurred. Studies of charcoal and pollen changes in soil core samples indicate that human arrival was generally accompanied by increased fires and changes in vegetation distribution. Flora was prevented from recovering and, as in Australia, fire-resistant species sometimes came to dominate. Major floral changes linked to human land use have been identified on many islands (Bennett 2000; Brookfield and Overton 1988). On the largest scale, substantial areas of New Zealand were converted from temperate forest to open terrain as a consequence of Maori-ignited fires (McGlone 1983; Kirch 2000, pp. 59–60).

Where soils were thin and poor, as on atolls, such burning and clearing of vegetation seriously modified or damaged the environment. Forest clearance on steep islands with a high rainfall accelerated erosion resulting in increased sedimentation in the valleys and on coastal plains. Through sedimentation of streams, erosion could also impact on the inshore marine ecology. Like the Aborigines, islanders then had to learn to live within their modified environments and adjust their lifestyle to a more sustainable form if they were to survive. Some societies did so more successfully than others, and when Europeans

arrived, many gave the impression that the people were living prosperously with minimal work in a Pacific idyll. However, there were some islands, most notably Rapa Nui, where the people lacked sufficient food and lived in a degree of privation. Whatever the condition of the people, the first Europeans who arrived in the Pacific did not, as they thought, "discover" pristine landscapes, but rather highly human-modified ones.

* * *

It is not possible in this book to discuss in detail the range of environmental experiences, factors, and impacts across the vastness of Oceania. However, the following four examples offer some representation of the different patterns. Mangaia is indicative of a society that overexploited its environment, with profound environmental and social results. Tikopia is the opposite—a society that adjusted after a satiation slump and adopted sustainable customs. Hawai'i, one of the largest and most complex Pacific communities, built upon exploitation of a substantial resource base but also at the cost of considerable ecological impact. At the time of European arrival, the Hawaiians appear to have achieved a level of sustainability. Finally, New Zealand can be seen either as a society that was heading for disaster because of its overexploitation of the environment, or one that was in the process of transition to sustainability.

MANGAIA

(The following is informed by: Kirch 2000; Kirch 1997(b); Steadman and Kirch 1990; Kirch "Changing Landscapes" in Kirch and Hunt 1997.)

Mangaia in the southern Cook Islands is a makatea island, only 52 square kilometers, with a weathered volcano at its center surrounded by a 2-kilometer "brim" of makatea riddled with limestone caves. Research led by David Steadman and Patrick Kirch has shown that its history in many respects has parallels with Rapa Nui, which is often cited as a classic example of human overexploitation of the environment (See Chapter 7).

Prior to the arrival of Polynesians in about 2,400 to 2,200 years B.P., there was significant forest cover in Mangaia's volcanic interior, notably on the slopes of its long-dead volcano. The settlers brought practices of shifting cultivation, clearing the land with fire to create cultivable plots. Because of soil deficiencies, the forest proved unable to regenerate and, over several hundred years, the soil on the hills was exposed and eroded, accumulating in the valley bottoms. The hills became less suitable for agriculture and were increasingly taken over by plants capable of

withstanding fire, notably *Dicranopteris* ferns and scrub *Pandanus.* In about 1200 A.D., shifting cultivation on the volcanic slopes was abandoned and the islanders were forced to concentrate their agriculture on the small area of accumulated soils in the valley bottoms. These were suitable for intensive agriculture, especially taro, but as they contained only 2 percent of the island's land surface, they proved incapable of supporting the Mangaian population and a satiation slump occurred.

The island's resources were overexploited in other ways as well. Excavations have shown that before human arrival there were at least nineteen species of land birds and twelve of seabirds. Predation on this advent abundance (perhaps increasingly resorted to because of the decline in production on the volcanic hillsides), habitat loss, and the introduction of predatory fauna contributed to the reduction and extinction of this avifauna. During the period of Polynesian occupation, species fell to five land birds and six seabirds, and marine fauna also severely declined from overexploitation.

The Polynesians introduced into Mangaia the full range of their vertebrate food sources—pigs, dogs, chickens, and rats. While rats survived, the other three had disappeared by the time of European arrival, perhaps overexploited, although it has also been suggested that pigs might have been deliberately removed because they competed directly with humans for vegetable foods. There is evidence that the islanders then relied on rats for protein, and perhaps even on other humans.

The decline of food resources placed great stress on the island's society and culture. The hereditary hierarchical society broke down, replaced by one in which competing groups used military power in order to control the limited and valuable agricultural land. There were outbreaks of warfare and raiding, which forced people to take shelter in the limestone caves of the makatea. In Kirch's words, it became "a society obsessed with terror" (Kirch, 1997(b), p. 34).

> A telling index of the ferocity of intertribal raiding and war was human sacrifice. The archaeological record suggests that cannibalism, or cannibal-like practices such as roasting and dismembering of captured enemies, if not their outright consumption, occurred with increased frequency in late prehistory. (Kirch 2000, p. 255)

To vary Tim Flannery's term, after eating their future, in their altered circumstances the islanders perhaps resorted to eating each other.

When Europeans arrived, the people of Mangaia were in an apparent state of economic hardship and social collapse as a result of the satiation slump and ecological crash.

TIKOPIA

(The following is informed by: Kirch 2000, pp. 143–147; Kirch and Yen 1982; Kirch 1997(b); Steadman, Pahlavan, and Kirch 1990.)

In early 2003, the eyes of the world focussed briefly on Tikopia, a tiny island in the Santa Cruz group in the far east of the Solomon Islands. A massive cyclone had blown through the Solomons, passing over Tikopia and breaking communications. The first reconnaissance aircraft over the island found all the buildings destroyed and no sign of life. There were gloomy predictions that the population had been swept away by the ferocity of the storm. However, the first rescuers to arrive by boat a few days later found the population intact—the people had simply taken shelter in caves in the hills, as they had been doing for hundreds of years. Their local knowledge and wisdom born of experience had paid off and saved them, just as it had when their environment was under pressure 1,500 years before.

Patrick Kirch offers Tikopia as an environmental as well as a social and cultural contrast to Mangaia. While this tiny dot occupies only about 4.6 square kilometers of Oceania, the survival of its people arguably offers hard lessons for the rest of the world.

The dominant feature of this volcanic island is the extinct single-cone volcano occupied by a beautiful crater lake. Tikopia was settled by the Lapita in about 2900 B.P. and initial human settlement essentially followed the same pattern as it did across most of the Pacific as they set out to exploit the island's advent abundance. The immigrants established a shifting cultivation system, using fire to clear the forest from the volcanic soil. As elsewhere, this degraded the forest, caused erosion, and had a heavy impact on indigenous fauna. Two species of land birds and four of seabirds became extinct, while fish and shellfish populations appear to have dropped. The deterioration and decline in numbers reached their worst point in about 500 A.D.

Unlike many other places, the people were then able to devise new regimes that slowed the potential ecological and population crashes. New agricultural practices were developed, notably the transition from shifting cultivation (accompanied by cessation of the associated destructive burning) to orchard gardening, which mimicked the multistorey diversity of a tropical rain forest. Most of the island came to be occupied by orchard stands of economic (fruit and nut) trees, under which low-growing tubers and other crops were planted. In a few places there were no trees and the land was used for field rotation of crops of yams and taro. For a period, pigs became the principal source of protein, but in about 1600 A.D., as in Mangaia, the islanders seemed to have consciously eradicated pigs because

of damage to gardens and competition for plant foods. Sea resources were once again turned to for protein, but now under controlled conservation practices to protect from overexploitation. Kirch describes Tikopia as "a model of a sustainable microcosm, its agronomic system perhaps unparalleled by other Pacific examples" (1997(b), p. 35).

This careful environmental management was accompanied by cultural practices that were designed to control population at sustainable levels. The islanders developed a culture that supported and practiced population control by celibacy, prevention of conception, abortion, infanticide, sea voyaging by young males, and some forced expulsions. To modern sensibilities, such customs appear harsh and ruthless—but they enabled stabilization of the population at sustainable levels.

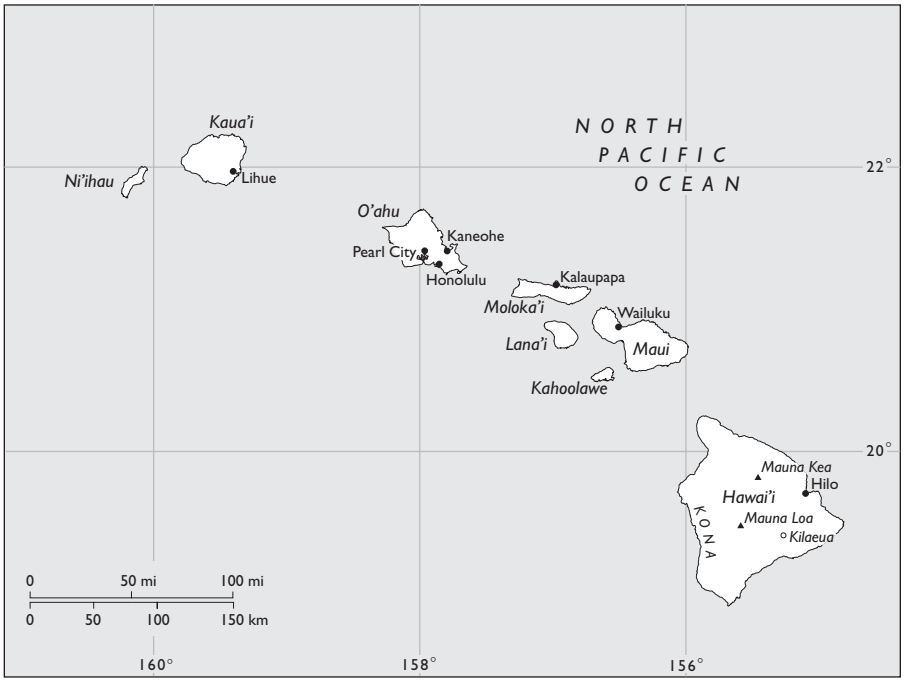
The Tikopians were also assisted in this achievement by the relative fertility and resilience of their volcanic island—an environment much more adaptable than that of Mangaia. Whether, beyond that, there were cultural beliefs or other elements that enabled the people of Tikopia to adjust their society to avoid permanent damage from a satiation slump is a question that so far remains unanswered.

HAWAI'I

(The following is informed by: Juvik and Juvik 1998; Kirch 2000, pp. 289ff; Kirch 1982; Kirch and Sahlins 1992; Kirch 1985; Kirch and Hunt 1997; Rapaport 1999; Carlquist 1980; Eyre 2000; Cuddihy and Stone 1990.)

The Hawaiian Islands offer something of a contrast to Mangaia and Tikopia because they do not seem to have experienced the same dramatic satiation slump and ecological crash, and a consequent threat to the human society, most likely because of the greater area, the more resilient environment, and the richer resource base provided by high volcanic islands. Nevertheless, there were profound environmental repercussions and extinctions as a result of human occupation, and there is evidence of a significant population and social change in the period prior to the arrival of Europeans.

The Hawaiian archipelago forms the most southeasterly point of a long chain of volcanoes that stretch from near Midway atoll in the northwest to the Big Island, the island of Hawai'i. The volcanoes have been formed over a period of 40 million years as the Pacific plate has drifted northwest over a stationary hot spot. Consequently, the Hawaiian Islands reduce in age from northwest to southeast, and Hawai'i itself, the Big Island, is still over the hot spot as the dramatic displays of the still-active Kilauea demonstrate. The Hawaiian archipelago



Hawai'i. The Hawaiian archipelago is still under construction by volcanoes, which have been created by magma being pushed through a hot spot or weak point in the earth's crust as the Pacific plate slowly rotates across it. Northwestern islands such as Kaua'i were created millions of years ago and the hot spot currently lies under Hawai'i, the Big Island, where Kilauea is still very active.

consists of 8 large islands and 124 small islands, reefs, and shoals, which together contain about 16,700 square kilometers, making it the largest archipelago in Polynesia after New Zealand. The older islands in the western half are more weathered and suited to agriculture and have more established reefs with richer marine life. Because of its relatively high latitude, mainly more than 20° north, the climate is generally mild rather than tropical. The prevailing winds are from the northeast and not only have a cooling effect but produce a distinct climatic difference between the moist windward sides of the islands and the much drier and warmer leeward sides.

Before humans arrived, an impressive range of species had managed to reach these distant island shores and, once there, evolved and adapted to local conditions. As a result, about 95 percent of flora and fauna in Hawai'i were endemic species, including 80 land birds (about 40 species of which were honeycreepers, which evolved from common ancestors), 24 species of seabirds, 29 species of waterbirds, 900 flowering plants, 100 ferns, 9,500 insects, and more

than 750 land and freshwater snails. There were two species of bat and one species of seal when the Polynesians appeared over the horizon in their ocean-going outriggers (Juvik and Juvik 1998; Carlquist 1980).

There is the usual and predictable debate over when that arrival occurred, and from where, but the reasonably well-accepted theory speculates it came from the Marquesas in about 400 A.D. In this case, it is generally believed that there was some return voyaging to central Polynesia over several hundred years until long voyaging by Polynesians gradually came to an end. The Hawaiians imported a substantial proportion of the Polynesian biotic baggage, including pigs, dogs, chickens, and rats, and twenty-three plants for food, fiber, and medicine including taro, sweet potatoes, breadfruit, bananas, yams, coconut, sugarcane, paper mulberry, and gourd. Unintentionally, their biota baggage probably also contained skinks, geckos, rats, flies and other insects, snails, and seeds (Juvik and Juvik 1998, p. 163; Eyre 2000).

The fertile volcanic soils of several of the Hawaiian islands, together with generally reliable rainfall on the windward side of the volcanic peaks, made

Pacific islanders developed sophisticated forms of agriculture to enable effective use of the limited resources of most islands. Taro, like rice in Asia, needs to be kept very moist while it is growing, and complex irrigation systems such as this one on Raratonga in the Cook Islands were constructed. (Photo courtesy of Lucinda Sargent)

these among the most potentially rich of the Pacific islands. Polynesian root, tuber, and tree crops grew readily, and intensive forms of agriculture were developed. The valley floors and lower hillsides of the western islands were converted to terraces and pondfields for growing taro, irrigated by diverting streams into canals. In the geologically younger eastern islands, irrigation was more limited but there was extensive shifting agriculture here and on leeward lowlands, mainly of kumara, yams, gourds, bananas, and paper mulberry. On shorelines, Hawaiians drew rich sources of protein from the sea with the unique Oceanic construction of large stone fishponds on reef flats in which they trapped and raised a number of species of fish. The islands produced sufficient surplus to support a strongly hierarchical chiefly society, probably the most hierarchical in Polynesia. Over a period of twelve or more centuries, a distinctive Hawaiian culture and linguistic elements developed (Kirch and Sahlins 1992).

The development of food sources stimulated population growth although, as with much of Oceania, the population size is the subject of ongoing dispute and investigation. It appears that the population grew steadily until about 1300 A.D., when it commenced a period of rapid expansion until about 1600, when it peaked and then declined. Estimates of the population when Captain James Cook landed in 1788 range from 200,000 upward, and around 250,000 seems a fairly safe conjecture. Once more, it appears likely the Hawaiian population had continued to expand to a point beyond sustainability, which then produced a slump. In this case, the repercussions were not as profound as they were on smaller islands because of the extent of fertile volcanic soil and the richness of ocean resources. A stabilized population might have been achieved by the adoption of more sustainable production practices and some degree of population limitation through abortion and infanticide, complemented by endemic intergroup warfare.

In 1982, Patrick Kirch was among the early scholars to argue that the traditional view of the Hawaiians as living in harmony with nature and having had little impact on the land was a myth. We now understand that the usual suite of factors contributed to massive intrusions in the landscape—the introduction of exotic plants and animals, which impacted heavily on vulnerable indigenous species; forest clearance particularly through the use of fire; and the manipulation of water systems for irrigation. The effects included considerable change to vegetation communities (creation of a hybrid landscape in many areas), erosion, and the extinction of scores of endemic species of flora and fauna including at least sixty species, or more than half the avifauna. These last included two types of flightless ibis, eight species of flightless geese, a bird-eating hawk, an eagle, three long-legged owls, seven flightless rails, and two species of crows (Eyre 2000, p. 54). The adoption of feathers for decoration and their role as symbols of status

in the cloaks of chiefs did nothing for Hawaiian avifaunal longevity. One chief is renowned for his cloak containing feathers of 80,000 birds (Belich 1996, p. 34). (There are two fine although disturbing examples of these cloaks in the Margaret Mead Pacific Peoples exhibition at the Natural History Museum in New York.)

NEW ZEALAND

(The following is informed by: Belich 1996; Anderson 1989; Anderson 1997; Anderson 2002; Kirch 2000; Howe 2003; King 2003.)

It is unsurprising that New Zealand was the last major archipelago in Oceania to be settled because it lies far to the south and to the west. Both cold latitudes and prevailing winds made voyaging in this region difficult, dangerous, and perhaps unattractive. Possibly it was that Polynesians were running short of new places into which to expand which forced them further and further afield in search of new territory. No one knows how many voyagers were lost before land was finally sighted. In some respects, it was one of the most difficult Oceanic environments for Polynesians to colonize except for one factor—it had lots of meat.

The archipelago is dominated by two large islands, originally joined Gondwana fragments that broke away 60 to 80 million years ago, but which have been significantly altered by subsequent geological activity. The islands were named very unimaginatively by Europeans—New Zealand, the North Island and the South Island. In the late nineteenth and early twentieth century, nationalist Maori decided they could improve the nomenclature and introduced the more poetical collective name "Aotearoa" (Land of the Long White Cloud), which is now sometimes incorrectly believed to be a pre-European traditional name (King 2003). The North Island contains 115,000 square kilometers and the South Island 151,000 square kilometers, while with outlying islands the country's total is 270,534 square kilometers. The two main islands are long and narrow, stretching 1,600 kilometers from 34°S to 47°S. The climate is therefore temperate (in fact cold in southern and alpine regions), windy (in the Roaring Forties), and is the only part of Polynesia that is not tropical or subtropical. The predominant winds, the Roaring Forties, come from the southwest, moist after crossing thousands of kilometers of ocean, and rise over the land to drop abundant rain, particularly on the western sides and most noticeably over the mountainous South Island. The Southern Alps contain eighteen peaks that rise above 3,000 meters, the highest being Aoraki Mt Cook at 3,754 meters. Some 360 glaciers carry away the snow and ice, the largest of which is the Tasman Glacier, but equally well known are the Fox and Franz Josef Glaciers. In fact,

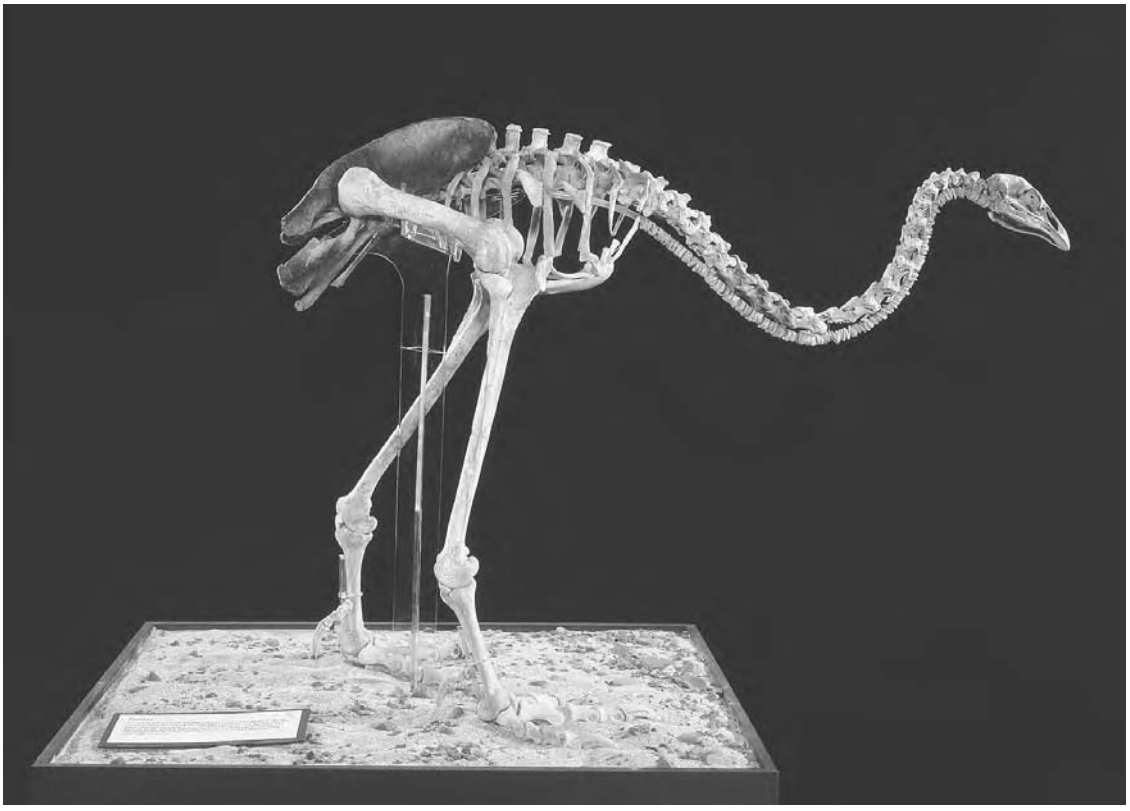
New Zealand. The two main islands of New Zealand form the largest land masses in the Pacific. Originally part of Gondwana, and carrying an inheritance of Gondwana vegetation, they have been substantially reshaped by subsequent uplift and volcanoes as they have drifted northward into the Pacific.

less than one quarter of the country is not more than than 200 meters above sea level (Taylor, et al. 1997; Hicks and Campbell 2003).

Over millions of years of isolation, the biota of New Zealand evolved to suit this landscape and climate. The Gondwana floral inheritance was complemented by later immigrants, and together these evolved to create a flora that was about 80

percent endemic, such as New Zealand's three great tree species, kauri (*Agathis australis*), kahikatea (*Dacrycarpus dacrydioides*), and totara *(Podocarpus totara).* Among the fauna, there were no mammals apart from very large populations of three species of seals on the coast and two species of bats, while there were a few lizards, three frog species, and about thirty species of freshwater fish. Like other Pacific islands, New Zealand possessed a substantial diversity of avifauna that had evolved free of most predatory threats apart from the now extinct New Zealand eagle. Many birds were flightless and ground nesting, such as the six species of kiwi, flightless parrots, and the aforementioned moa. There were about twelve species of moa ranging from 1.3 meters to over 3.5 meters in height, weighing up to more than 200 kilograms, and probably numbering in the millions.

When and where the Polynesians who came to be called Maori first arrived in New Zealand is the subject of considerable ongoing debate. Potential dates



Moas inhabited New Zealand in large numbers when humans arrived but were hunted to extinction within a few hundred years. Large numbers of bones, especially those gathered in the Maori butchery sites, have enabled the skeletons of the various species of moa to be reconstructed. (Museum of New Zealand Te Papa Tongarewa, Wellington, New Zealand)

have oscillated up and down the calendar, principally from the tenth to the fourteenth centuries, and there is disagreement about whether there was more than one founding party or if there were return voyages. However, as no New Zealand products have been found elsewhere in the Pacific and few Polynesian artifacts have been found in New Zealand, there is a strong argument for little or no continuing contact. An amusing although disputed estimate of the date of first arrival, based on calculations of available food and likely population growth, is from New Zealand historian James Belich. He concluded that "On these bases we get back to a founding population of a hundred in the year 1066. Isn't science wonderful?" (Belich 1996, p. 36; Discussion pp. 27ff). Needless to say, plenty of people disagree with him and there is strong support among modern scholarship for settlement in the twelfth or thirteenth centuries. Notably, prehistorian Atholl Anderson argues that recent redating of archaeological evidence and pollen records places settlement in the thirteenth or fourteenth centuries, and the most recent analysts, Kerry Howe and Michael King, support that view (Anderson 2002; Howe 2003; King 2003). The debate continues.

One thing upon which all scholars appear to agree, however, is that Maori had come upon a land, if not of milk and honey, at least of walking and swimming feasts. The advent abundance was greater in New Zealand than anywhere else in the Pacific. The coastlines were rich with seals and other aquatic life, while the land supported substantial populations of moa and other flightless birds. Maori experienced what Belich terms a "protein boom" because these easily hunted animals provided a diet rich in protein that promoted health, notably of mothers and children, which increased fertility and facilitated a rapidly expanding population.

Archaeological studies, especially those conducted by Anderson, have drawn a picture of a population that drew heavily on this richness of foodstuffs. Hunting parties, and sometimes even communities, moved from place to place along the coast, following the richest sources of game. Seals appear to have been pursued first and, once they were scarce, attention turned to the moa. Large camps and kitchens were set up to process and preserve moa meat. Estimates of the number of moa processed in one of the largest camps, at the mouth of the Waitaki River on the South Island, range up to 90,000 (Anderson 1989, p. 133). Maori seem also to have collected and eaten moa eggs and used fires extensively, probably as a hunting strategy, which further reduced moa habitat. Dogs and rats introduced by Maori also took their toll. Under such attacks, within perhaps 200 years, most of the moa (and other large game) were gone, although their final extinction in the last pockets might have taken another two centuries. In the words of Belich:

> Maori probably sliced through the most vulnerable game, such as the flightless goose, quite quickly. The northern seal breeding colonies may not have survived very long either, and it has been suggested that man and moa co-existed for no more than a century in any given region. (1996, p. 44)

Maori also transformed the environment by introducing dogs and the Pacific rat, and by burning and otherwise clearing the land. Anderson has described the impact on flightless avifauna and other vertebrate species, such as:

> (T)he New Zealand lizards and frogs, several species of which are known to have disappeared in the pre-European era, and others became greatly reduced in range, such as the tuatara. . . . Some species, such as the pelican and swan, were vulnerable to any form of human disturbance, especially at their nesting sites. Small ground-nesting birds generally, such as snipe, snipe-rail, and wrens, were most at risk of direct predation from a "grey tide" of rapidly expanding rat populations. Larger flightless or poorly flighted geese, *Aptornis,* and various ducks faced rat predation on eggs, competition with rats for some food sources, disturbance by dogs, habitat destruction, and direct human predation, while the moa were hunted into extinction and their natural predator, the great New Zealand eagle, lost its means of existence. (Anderson 2002, p. 28)

Unlike Australian flora, few species in New Zealand were adapted for fire, so when Maori burned the land, the result was a rapid and permanent transformation of floral distribution, essentially converting large areas of forest into tussock grasslands, notably on the eastern South Island where Maori fires are believed to have destroyed half of the forest. Grasslands are estimated to have increased from less than 2 million hectares to 8 million hectares as a result of Maori activities (McGlone 1983; Anderson 2002, pp. 30–32; Anderson 1997; Taylor, et al. 1997).

By the fifteenth century, big game was approaching extinction and, like the inhabitants of Mangaia and Tikopia, Maori faced an ecological crash, a major satiation slump potentially on a greater scale than elsewhere in the Pacific. What happened thereafter is open to different interpretations, with some authors seeing a Mangaia example and others something closer to Tikopia. Tim Flannery, in particular, has portrayed Maori society at the time of European arrival as in a state of social crash as a result of the extinction of their main source of protein. He argues that the crisis caused by the extinction of game resources transformed not only the Maori economy, but also their social and political organization. Population pressure and competition for the best agricultural land promoted tribal rivalries, as a result of which Maori built fortified hamlets known as pa and there was substantial territorial warfare, raiding, conquest, and enslavement. Also as a consequence of the satiation slump, according to Flannery,

Maori resorted to cannibalism at least partly as an alternative source of meat protein (Flannery 1994, chaps. 18 and 23). Not surprisingly, Flannery's views on this matter are not popular in New Zealand—he tends to be seen as yet another misguided Australian who does not know what he is talking about, especially when it comes to New Zealand matters. Nevertheless, as on Mangaia and in other Pacific communities, cannibalism developed as a ritual and as a symbol of power, although less clearly as a source of protein.

New Zealand scholars, including Anderson, Belich, and King, have drawn a milder portrait of a society that underwent a significant but relatively successful economic and social readjustment as seals and then moa declined and disappeared. Maori were forced by the satiation slump to adjust their economy from one based on hunting supplemented by gardening, to one based on gardening supplemented by some hunting. While the latter was more in accord with their Polynesian relatives, the Maori inhabited a temperate climate in which many of the traditional tropical plants had not arrived or had not survived. Those that had—taro, yam, bottle gourd, paper mulberry, and kumara—were generally confined to milder regions of the North Island. However, kumara was preadapted to a temperate climate, having come originally from South America. Once a technique had been developed to protect the tuber from frosts in underground storages over winter, kumara was extensively grown in the North Island and in warmer parts of the South Island. Other new techniques enabled the cultivation of taro and yams, although they were never as successful as kumara which became the agricultural basis for a developing sedentary Maori economy. Native plants and the hunting of smaller native fauna provided a small supplementary variety (Belich 1996; Anderson 2003; Bellwood 1975).

The transition to an agricultural economy brought further landscape changes as Maori cleared and burned the land, significantly reducing forests and changing vegetation communities; New Zealand had already acquired some of the characteristics of a hybrid landscape. The list of impacts on the flora and fauna with which Maori are now credited is very significant. Not only did they cause the extinction of the dozen species of moa, but also another twenty species of birds, while seals, particularly on the North Island, were reduced to small remnant populations. Their fires burned off a third of the native forest, and large areas of fernland were changed to tussock grassland. Rats and dogs wreaked havoc on ground-dwelling birds, flightless crickets, lizards, frogs (half became extinct), and land snails.

* * *

When a serious European presence began to be felt in the Pacific in most places after the 1760s, there had already been a human presence in Oceania ranging

from several hundred to more than 50,000 years. On the longer settled islands in the west, there had been substantial landscape and species modification, and the human societies were generally relatively settled into patterns of sustainable sedentary agriculture supported by some fishing and hunting. Across the scattering of islands known as Polynesia, settlement was much more recent and in many places the periods of satiation slump and adjustment following destruction of the advent abundance were still in a process of development. But Oceanic societies everywhere were dynamic and evolving. Political groupings ebbed and flowed, wars were fought, and islands were conquered. The Pacific was never really pacific. Into this fragile environment came the third wave of invasion, a tsunami that had traveled all the way from Europe. It engulfed Australia and the Pacific islands, and transformed them.

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3

"THE TRAGIC RINGBARKED FORESTS": AUSTRALIA 1788–1900

The tragic ringbarked forests
Stark white beneath the moon,
The sapphire misted mountains,
The hot gold hush of noon.
Green tangle of the brushes,
Where green lianas coil,
And orchids deck the treetops
And ferns the crimson soil.

Core of my heart, my country!
Land of the Rainbow Gold,
For flood and fire and famine
She pays us back threefold.
Over the thirsty paddocks,
Watch, after many days,
The filmy veil of greeness
That thickens as we gaze.

—Dorothea Mackellar, "My Country"

These further verses of Dorothea Mackellar's 1908 poem encapsulate some of the ambiguity, the contradictions, the love-hate relationship that mark the experiences and attitudes of British colonization of Australia. The building of a new society and the settlers' struggles to master the landscape was only a partial success in the face of an ecological struggle in which flood, fire, and famine were central. However, the bounty that was extracted from the land was so rich that it gave Australian colonists one of the highest standards of living on the planet. By the end of the nineteenth century, the white people of the new nation had increasingly come to accept and some even to love their adopted land, and to recognize the beauty in its forest and outback landscapes. But their achievements had been at the cost of the tragic decline of the indigenous peoples and severely depleted ecosystems, which were perhaps epitomized by stark landscapes of ringbarked trees. The icons or emblems that Australians were coming to revere included the kangaroo and the golden blossom of wattle trees (acacias): A cynic might point out that kangaroos had long been considered a pest and were killed by the millions, and that wattles and other indigenous vegetation had been cleared from millions of hectares of consequently degraded

land. Perhaps those icons that might equally represent European Australia's colonial relationship with the land would include the gun and the axe (and in the twentieth century one could add the chainsaw and the bulldozer).

* * *

In the fifteenth century, European sailors began to edge ever further from their shores. Led by the Portuguese and Spanish, but soon followed by the Dutch, British, and French, and motivated by a mixture of adventure, national glory, trade riches, and Christian evangelicalism, within two centuries they had reached the most distant oceans and had a colonial presence on most continents. From the eighteenth century, these earlier motivations were enhanced by the desire of Enlightenment science to discover, categorize, name, and collect the breadth of God's creation. In the nineteenth century, the desire to hunt, stuff, and exhibit God's fauna could be added (Thomas 1984; Barber 1980).

European arrival in Oceania commenced with Ferdinand Magellan's Spanish expedition, which rounded Cape Horn in 1520. Further Spanish exploration followed and there is some evidence of Portuguese presence on parts of the Australian coast. The focus of these Mediterranean nations, and later of the Dutch, was access to spices grown in the Moluccas in what is now Indonesia. The Portuguese won but were subsequently displaced by the Dutch, who also made the first significant recorded European sightings of Australia. Beginning in the seventeenth century, there were both accidental and deliberate contacts with the western and northern coasts of the continent. In 1642 to 1643, an expedition led by Abel Tasman passed along the south coast of Tasmania (naming it Van Diemen's Land) before sailing east into the Pacific where it touched upon New Zealand, Tonga, and Fiji before returning to Batavia via the northern coast of New Guinea.

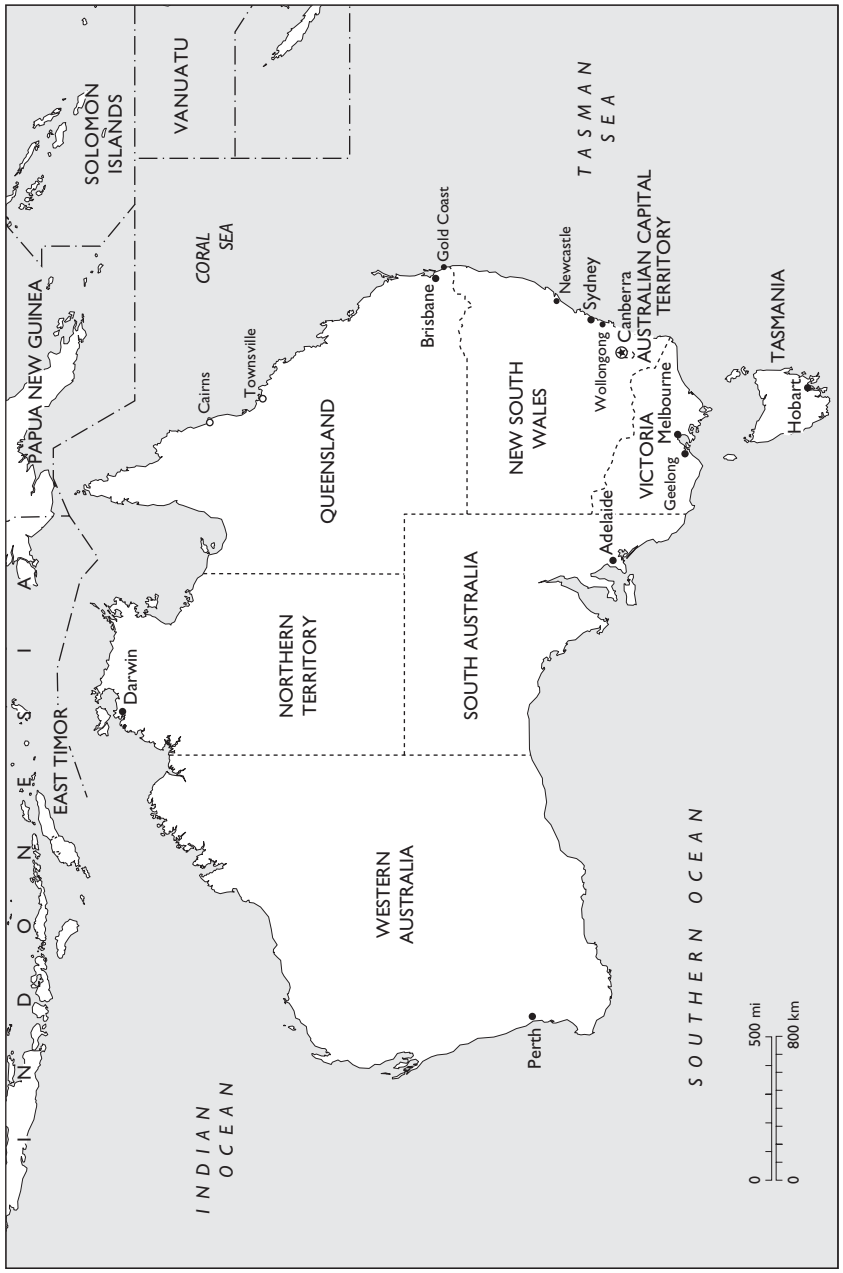
The most notable European explorer and discoverer of Australia and Oceania was a Briton, James Cook. His three expeditions from 1768 to 1779 crisscrossed much of Oceania. The first, in 1768 to 1771, was a major scientific expedition. Its overt purpose was to visit Tahiti in order to observe the transit of Venus across the sun, but Cook had secret instructions to proceed westward to determine the existence of the fabled great southern continent. To study the natural history of the lands that were found was another goal, and the *Endeavour* carried wealthy gentleman naturalist Joseph Banks and his eight-strong party who included Swedish naturalist Daniel Solander and artist Sydney Parkinson. After circumnavigating New Zealand, the expedition passed along much of the eastern coast of Australia, and everyone was fascinated and puzzled by the unusual biota they encountered. Banks's glowing report of land he had seen at Botany Bay, near the present site of Sydney, was influential in the

decision of the British government to found a convict settlement in New South Wales (Collingridge 2002).

The founding First Fleet of convicts and their guards, also carrying numerous plants and animals, arrived in January 1788 and established the settlement in Sydney Harbour (Frost 1996). Initial development was very slow, but beginning in the 1820s, the pace gathered, and in coming decades New South Wales grew into a major colony. Five other colonies were also established—Van Diemen's Land (later Tasmania) early in the century; Western Australia in the 1820s; and Victoria, Queensland, and South Australia in the 1830s. New Zealand was also settled largely as an offshoot of New South Wales. The British showed little imagination in naming the Australian colonies and their capitals. Five of the capitals were named after British politicians or administrators and one was named after a queen. By delicious chance, when another settlement was established in the Northern Territory, a subcolony on the north coast, its capital was named after a then insignificant scientist who subsequently transformed human society's understanding of the natural world—Charles Darwin.

During the nineteenth century, the colonies grew at an irregular and unequal pace. In the middle of the century, after the discovery of gold, Victoria raced ahead as the most prosperous and populous colony. By the end of the century, New South Wales had caught up. These were the most important of the colonies, but all offered their citizens the possibility of a higher standard of living than was available for most of their relatives at home in Britain. The colonies also boasted advanced democratic institutions as well as important social institutions such as universal free education. In 1901, when the colonies federated as a single nation, there were 3.8 million white Australians (the remnant Aboriginal population was so marginalized that they were not counted in the census). Most white Australians inhabited the relatively moist, cool, and fertile triangle on the southeastern coast of the continent, while there were small populations in Tasmania, around Adelaide, and in the southwestern corner of Western Australia. Vast areas of inland Australia were either populated sparsely by whites, or still occupied only by the indigenous peoples.

It is hard to think of two cultures, economies, and worldviews that were in greater contrast than those that, from 1788, confronted each other in the Australian landscape. The Aborigines, hunter-gatherers with an essentially communal orientation, were invaded by the most technologically sophisticated and economically and militarily powerful nation of the period, driven by individuated capitalism. Cultural and military clashes were inevitable, and just as inevitable was that the British colonists' numbers, power, and belief in their own racial superiority would overwhelm the Aborigines.



Political map of Australia

The British brought experiences, expectations, and assumptions about colonization. Like Austronesians and Polynesians in the Pacific, they assumed the right to occupy new lands, to exploit them for immediate benefit, and to acquire possession for their descendants. Generally unlike Pacific Islanders, the British and other Europeans found lands already occupied, but nevertheless assumed the right to displace the indigenous inhabitants. It can be argued that there were three particular factors in the British mind-set that gave rise to such assumptions, and shaped their response to and treatment of new environments and their inhabitants—the Three Cs: Christianity, Capitalism, and Contempt.

Lynn White argued that Christianity was the most environmentally harmful of the major religions because of the way it conceived the human relationship with nature (1967). Christianity, or the Judeo-Christian cultural philosophical stream, places man outside the natural world, on a higher plane, somewhere between God and the animals and other parts of the natural world. According to Genesis, God gave his creation to Adam and his descendants to enjoy and to use for their own benefit. In this view, British and other Europeans saw it as a Christian right or even duty to take up and make productive land that was empty or, in their terms, not being fully exploited by its indigenous inhabitants, and to bring Christian order and faith to such people (P. Marshall 1992; Glacken 1967).

The eighteenth and nineteenth centuries brought to Britain, and then to other Western countries, the industrial revolution, free enterprise capitalism, *laissez faire* economics and social policy, belief in progress and improvement, and the development of ever-greater technological capacity. Physically and emotionally, capitalism was part of a social as well as an economic revolution that resulted in increasing loss of human connectedness with nature. Industrial, urban societies were the negation of nature, dominated by the demands of commerce and production, and the need to exploit nature. Larger proportions of Western societies were becoming urban, and most urban people had little personal contact with nature, except perhaps in the tamed and idealized form of municipal parks or as depicted by Gilbert White and William Wordsworth. The wild nature of foreign lands was something to be discovered, tamed, and exploited.

Capitalism is a system driven by the imperative to compete, expand, develop, and exploit, and that is exactly what the British invaders did, with profound repercussions for the Australian land mass and its inhabitants of all species. The British came to Australia confident of their right to colonize, driven by their need to exploit new lands for wealth and raw materials, and in search of territory for their rapidly growing population. They saw the continent as a place waiting for development, essentially a collection of resources waiting

to be turned into wealth. The British were aggressive, acquisitive, greedy, and confident in their right to behave accordingly.

The British also brought to the Australian environment a level of contempt for all that was not British or Christian. The assumption of superiority of all things British and the pride in their great emerging empire reinforced the belief in their right to occupy new environments and displace indigenous people, but also spilled over into tangential issues such as aesthetics, judgments about indigenous species, and utilitarian landscape evaluation. Landscapes that did not suit their taste for order or beauty or were not judged of value for economic enterprise were dismissed. While the wide brown land of Australia was seen to possess some potential for economic exploitation, its harsh landscape with its ungainly or unusual floral and faunal inhabitants were often viewed as second rate. There was a common assumption that Australian flora and fauna, like the indigenous human inhabitants, were ancient and inferior to the more modern arrivals from the northern hemisphere, and were consequently destined to die off in the face of superior competitors.

None of the Three Cs promoted respect or care for the Australian environment. To develop and exploit the resources of a "pristine" and therefore wasted land, not only fulfilled God's purpose, it ennobled the landscape by imposing a redemptive order.

Nevertheless, it is difficult to generalize about the responses of British settlers to the Australian landscape, for these varied according to individuals and changed over time. It is apparent, especially in the early decades, that many colonists found the colors and shapes of the landscape alien; meadows, hedgerows, and the soft colors of England were more to their taste to represent beauty. There were some Australian places that were approved of and were spoken of with pleasure, but they were generally areas that reminded the colonists of England, notably Tasmania which was the closest colony climatically. From a scientific point of view, however, Australia was a source of fascination. The strange animals and the unusual vegetation piqued the curiosity of those who were interested in natural history—and there were many of these in the nineteenth century when botanizing and other forms of nature study were popular hobbies as well as scientific studies. There was so much in Australia that had to be studied, classified, and collected. The platypus in particular, a duck-billed mammal that lays eggs, intrigued the scientific community in Europe for decades until all its secrets were discovered—and hundreds of the animals died in the pursuit of that knowledge (Moyal 1986; Moyal 2002; Griffiths 1995; Finney 1993; Ritchie 1989).

Among others, the harder edge of contempt was more to the fore. Indigenous animals were intriguing but rarely seen to have commercial or environ-

mental value. Native grasses were of initial interest for pasture but were then replaced. While some trees were considered useful for timber they were often criticized as ugly and straggly in form (Frost 1975; Ryan, Ryan, and Starr 1997; Flannery 1998; Ritchie 1989; see Document section for responses).

As so few elements in the Australian landscape were given intrinsic value, it became part of the colonizing mission to transform the environment, to convert wasteland to production, to "improve" the landscape, and to create a more familiar culture and order. The insertion of British place-names and people's names on the landscape (Richmond, Dulwich, Hackney, Kew, Northam, York, Highgate), and the imposition of lines by building roads and fences were manifestations of the British sense of order and identity. But perhaps the most important means to create a more familiar and productive landscape was the introduction of more economically valuable and aesthetically pleasing species. (See Chapter 7, Hawaii, for a discussion of motives.)

In the 1980s, Alfred Crosby coined the term "ecological imperialism" to draw attention to the ecological aspect of European colonization across the globe. He emphasized that Europeans not only took with them their cultures and lifestyles, but also a whole panoply of other biota, both deliberately and accidentally—plants, animals, weeds, and microbiological forms (notably diseases). It was these that had much of the impact on the "Neo-Europes" that European colonizers established in North America, Australia, and elsewhere (Crosby 1986). They consciously and unconsciously undertook a blending of the world's biota, the creation of new and hybrid landscapes.

Even though the Aborigines had obtained a living from the continent for 50,000 years, the colonists saw few plants or animals that were suitable for food or economic exploitation. Indigenous animals and birds provided an early source of protein, but virtually no plants were considered edible. Indeed, almost no species of Australian flora were capable of intensive cultivation or food production comparable to those grown in the more heavily populated regions of the world, and the macadamia nut remains almost the only contribution made by Australia to the planet's epicurean delights. Besides meat and working animals such as cattle, sheep, pigs, and horses, imports of grains, vegetables, and fruit trees were essential for colonial survival and expansion. A great deal of early colonial endeavor was devoted to learning what could be grown in the challenging soil and climatic conditions.

The colonists also exhibited a desire to introduce favored garden plants. There were two main motives in establishing a garden: for food and for its aesthetic and nostalgic pleasure. A quite amazing volume and variety of exotic plants arrived very quickly, and scarcely a vessel seems to have docked without its collection of fruit trees, vegetable seeds, and potted garden plants (Frost

1996; see Documents, William Howitt). Gardening was an issue redolent of the class attitudes and social aspirations of British society, where the possession of land and a garden was largely limited to a propertied minority. In Australia, especially as the decades advanced, it became a realistic goal for a wide spectrum of the population to acquire a block of land and enjoy the creation, peace, and beauty of their own garden (Goodman 1988). Ideally, this was a quarter acre block, with a villa residence, the front garden essentially decorative and aesthetic, and the back yard for growing fruit trees and vegetables. This demand for land is one reason why Australian towns and cities came to sprawl widely across the landscape.

While a few Australian plants were judged sufficiently aesthetically pleasing for inclusion in gardens, most were considered untidy and scraggy, lacking the bright green of European foliage and inadequate in their flowers. Some acacias, calistemons, banksias, and other indigenous species have substantial and bright flowers, but many Australian species have small and subtle flowers that need to be carefully examined to be appreciated. They are very different from the English rose and its garden comrades, as well as from the great variety of vivid flowers that were discovered and redistributed around the planet in the eighteenth and nineteenth centuries. There was also legitimate concern about the presence of Australian species in gardens on safety grounds, for gum trees drop branches and most species are fire prone. These factors, as well as nostalgia for the gardens of Britain and a desire for large and colorful flowers, meant that aesthetic gardens were almost entirely exotic.

Perhaps inevitably, many species of the introduced plants naturalized and, free of their natural predators or climatic and other controls, escaped into the bush to become invasive weeds. They endowed the continent with a heritage of weed infestation from which it is ever more seriously suffering. It is notable that, in some parts of Australia such as the Hunter Valley in New South Wales, it is a challenge to spot any indigenous flora. Garden escapees have included cape clover, furze, gorse, briars, prickly pear, St. John's wort, nettle, horehound, groundsel, salvinia, and Patterson's Curse or Salvation Jane, all of which smothered indigenous species and covered grazing lands. Three examples of the worst of invaders were blackberries, Scotch thistles, and lantana. Blackberries seem to have been first introduced as a garden plant in Tasmania in the 1840s, but were also introduced on the mainland. They spread quickly by vigorous root growth and bird distribution of seeds and, free of Europe's cold winters, grew forcefully all year. Over time, hundreds of thousands of hectares of southern Australia came to be infested with blackberries that choked indigenous species and provided protection for another invader: the rabbit. Attempts to control black-

An Australian hybrid landscape—a horse stands ankle deep in a paddock overrun with the weed known as Pattersons Curse or Salvation Jane. In the background is a stand of indigenous eucalypts. Clare Valley, South Australia. (Photo courtesy Lucinda Sargent)

berries have had limited success (Kirkpatrick 1994; Parsons 1981(b); Parsons 2001; Michael 1994; Rolls 1969; Bolton 1992).

Scotch thistles were also introduced as a garden plant but, like other species of thistles and weeds, may also have arrived accidentally in the stuffing in mattresses or saddles, or in grain seeds. Before the middle of the century, they had become a major problem for landholders in many colonies, thriving in the warm climate and spreading quickly and easily by wind. Legislation was enacted in South Australia in 1851 and Victoria in 1856 to appoint inspectors in order to try to force landowners to control them. The Victorian Act nominated four species of thistle, including the Scotch thistle and the Bathurst burr (Parsons 1981(b)). However, such legislation was of little value, both because thistle spread was so vigorous and because of evasion and apathy on the part of many

property owners. Some owners even encouraged its growth in the belief that it could be a useful fallback source of pasture during dry seasons. This neatly encapsulates the major obstacles to control so many exotic species—ineffectual measures, apathy, and sabotage.

In large areas of the eastern side of New South Wales and Queensland one of the worst rampant species is the Latin American hybrid, *Lantana camara.* Lantana was introduced as a garden plant early in the nineteenth century and was spread rapidly by birds in warm and moist regions. It now covers 4 million hectares in which it smothers most other plants and poisons to death 1,500 cattle each year. However, like blackberry and some other invasive species, its dense tangles also offer protection for native birds and marsupials from predators, and provide food for a range of species (Low 2002, pp. 91–93; Queensland Department of Natural Resources and Mines, Fact Sheet).

The colonists appear to have seldom noticed the delightful calls of the Australian birds that came to sing in their gardens. Far better, it was believed, to introduce the familiar feathered friends of Britain, such as blackbirds, sparrows, and thrushes. This desire to introduce familiar and appealing species such as song birds was, together with a desire for animals for "sport" hunting, one of the major reasons for the foundation of acclimatization societies in each of the colonies in the second half of the nineteenth century. Already, many individuals had imported a diverse range of species, but the acclimatization societies brought a new era of organized effort to anglicize or hybridize the landscape. They collected funds for the importation of a large variety of species from across the world that were considered to be useful or pleasant. Many were carefully nurtured in captivity for some time in order to build up numbers and acclimatize before being released into the wild. Among species successfully introduced were deer, foxes, sparrows, finches, blackbirds, starlings, Indian minahs, pigeons, skylarks, and trout and other angling fish. The societies had less success with other species including llamas, racoons, and the mongoose. Of those that acclimatized, some were fairly harmless, but several, such as minahs, became feral pests that displaced native species or, like sparrows and blackbirds, attacked the colonists' gardens and crops (Lever 1992; Dunlap 1999; Jenkins 1977; Gillbank 1980).

It is ironic that the first attempts at so-called conservation legislation in Tasmania (1860) and Victoria (1862) were intended to protect acclimatized species and hunters' game. The Game Preservation Act in Victoria outlawed the killing of imported game species except by landowners and Aborigines. Its provisions included:

> Whereas certain persons have imported and may import from parts beyond the seas at considerable expense for the benefit of the colony game not previously

existing therein and it is expedient that encouraging should be given to such importations of game by protecting it and its progeny. . . .

(Penalties):

Pheasants £5	Deer £15	Nonindigenous birds £1
Partridges £5	Swans £15	
Grouse £5	Antelope £15	
Hares £5		

(Victoria, Statutes 1862)

There were also penalties for killing indigenous game birds in their breeding season. The legislation passed with little comment, the only serious opposition coming from C. J. Don, the first working men's representative in the Victorian parliament, and his objections were on the grounds that the legislation was attempting to introduce British game laws into Victoria (Victoria, Parliamentary Debates 1862). Such objections prevented similar legislation being passed in New South Wales.

Apart from humans and the dingo, Australia had no terrestrial placental mammals prior to colonization. The colonists introduced many, several of which escaped into the bush and spawned wild populations that thrived at the cost of indigenous species. These included production and working animals such as cattle, horses, pigs, goats, donkeys, buffalo, and camels. It is rather subjective to nominate the most environmentally destructive animals, but most lists would include three: domestic cats, foxes, and rabbits. Cats were introduced to control vermin and as companion animals, and foxes as hunting quarry, but both quickly established feral populations which took a terrible toll on the relatively defenseless small native marsupials and avifauna.

Wreaking destruction through their impact on habitat were rabbits. The introduction of the wild rabbit to Australia is generally attributed to Thomas Austin near Geelong in Victoria in 1859. He was by no means the first to attempt introduction, for they were a popular food source and hunting and trapping animal, and there was a community desire for the familiar sight of furry little bunnies hopping across the fields as they did in England. Austin arranged for a special shipment of wild English rabbits, which apparently arrived in company with some hutch rabbits, and the resulting offspring, when released, immediately thrived and formed the basis for the Australian wild rabbits that have bred in billions and spread across most of the continent.

The newcomers multiplied rapidly (as rabbits do) and soon swarmed toward the open lands of Victoria's Western District. Within a decade, they had become a great plague, a gray carpet of destruction whose frontier spread into South

"The rabbit pest. Two sides of a netting fence." Cobar, New South Wales, 1905. This image was intended to demonstrate the effectiveness of rabbit-proof netting fences by showing the contrast between a paddock eaten bare by rabbits and adjacent area protected from them. However, the picture may not be so clear. Desperate rabbits might well be able to cross such a low fence, so one suspects that overgrazing by sheep was part of the reason for the loss of vegetation. (State Library of New South Wales, At Work and Play, 02766)

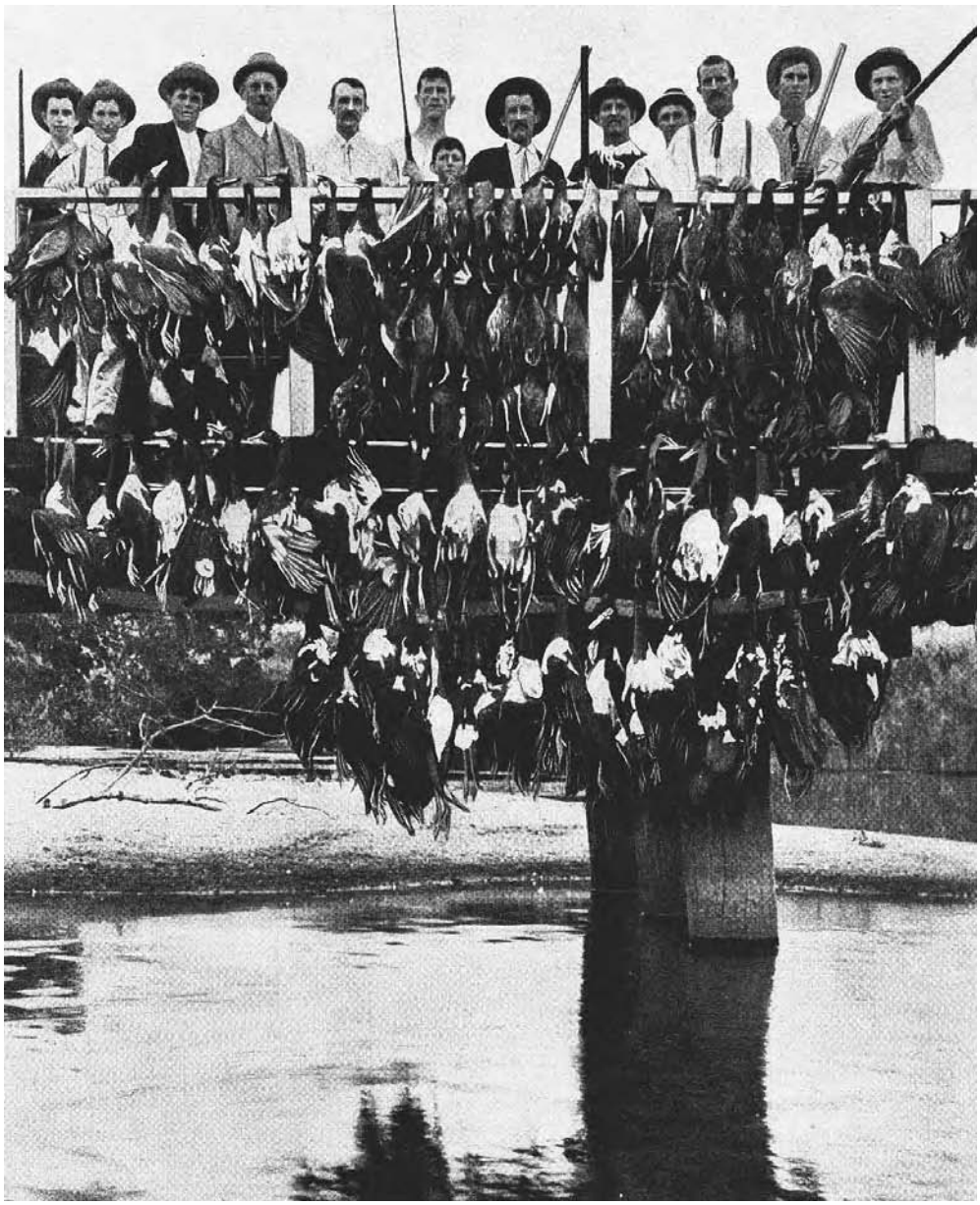
Australia in the 1870s, into New South Wales and Queensland in the 1880s, and into Western Australia early in the twentieth century. Long rabbit-proof fences across Queensland and Western Australia had limited success. Rabbits competed with native fauna for food and burrows, and with grazing animals for grass. They inhibited the regrowth of many native plants (and thereby influenced floral distribution) and caused decline in tree and bush cover. By exposing the soil and by digging burrows, rabbits encouraged erosion and soil degradation. The only native predators that might have helped control them, raptors and dingoes, were being ruthlessly exterminated by farmers as pests. The campaign to defeat the rabbit became one of the great stories of Australian history, but there were no victories until the 1950s, and the war has not been won (Rolls 1969; Stodart and Parer 1988; Coman 1999).

Such destruction caused great concern among colonists, but generally it was concern for the economic implications rather than environmental loss.

There was little overt concern that the spread of settlement and the introduction of alien species of flora and fauna had displaced indigenous species, sometimes to the point of extinction. The bush, which had previously thrived with life—especially at night—was, in settled areas, becoming ever quieter. However, the impacts and ecological ripples were uneven between species. Initial settlement reduced many species and, in the long run, the vast majority of species were on a descent to a fraction of their populations, or to extinction. However, the environmental disruptions of colonization enabled a few, such as galahs, cockatoos, and kangaroos, to benefit from the removal of predators and the provision of new water and food sources on the colonists' farms. Such "pest" species became the object of slaughter.

The killing of birds and animals was a traditional part of British culture—for food, because they were "pests," or for pleasure. It was simply accepted that animals and birds were lesser creatures, or had been created by God for human use. In Australia, the colonists continued existing customs of slaughter, though at an increased rate because of different conditions. Indigenous fauna was categorized as useful, harmful, or attractive, and treated accordingly. To be useful or harmful was dangerous—for the animals. Not many fell into the category of useful, although on the frontier there was an initial heavy dependence on native species for food. Just about anything that moved was boiled, baked, fried, or roasted to see if it would suit European tastes. In the long run, few did, though kangaroos were a source of meat for many decades, and water birds, particularly ducks, also maintained popularity. As beef, pork, and mutton became readily available, eating native species largely disappeared. So did the species, although not essentially because of the numbers hunted and eaten.

Nevertheless, hunting remained a significant recreational activity. Unlike Britain, where hunting was legally limited to the tiny landowning minority with estates, Australia had no game laws. Until after the middle of the nineteenth century, there was a permanent open season for everyone, resulting in great loss of indigenous fauna. A great deal of the killing was casual or opportunistic—simply shooting anything that moved. More purposefully, kangaroo hunting was the great favorite in the early decades, both because it was closest to fox and deer hunting, and as a source of protein. The dingo offered some substitute as a quarry for those who wished to ride, but it lacked the social cache of the fox or deer. Apart from these and shooting water birds, Australia was considered to offer little in the way of worthwhile "sport," and in the second half of the century, deer, foxes, rabbits, hares, and other species were introduced, each with their own impact on the environment. This was part of a conscious emulation of the British elite tradition of hunting as a "sport" for its masculine camaraderie, its excitement, and for trophies on the walls and skins on the floor.



A big shoot on the Burdekin River, Queensland. Hunting indigenous game was a popular "sport" in the Australian settler community. There was no equivalent of the British game laws and until well into the nineteenth century there were few effective attempts to control hunting. As a result vast numbers of indigenous birds and animals were slaughtered. (E. J. Brady, Australia Unlimited, Melbourne, 1918, p. 135)

However, "sportsmen" would shoot almost anything and it was reported in 1867 that the kills on one Victorian property included (besides 14,253 rabbits) 448 hawks, 23 eaglehawks, 622 native cats, and 32 tame cats (Rolls 1969, p. 26).

Another culturally based response to the landscape that profoundly impacted the Australian environment was the colonists' ambiguous and sometimes contradictory attitude to the use and prevention of fire. The abolition of Aboriginal fire regimes across most of the country in itself changed floral and faunal distributions, but the colonists went further and in many cases introduced new fire conditions. Pastoralists, farmers, and gold prospectors extensively used fire as a tool to clear the land. However, this ran counter to an increasing determination among foresters and members of the general community to prevent fires as much as possible. The colonial experience was punctuated by innumerable small to medium bushfires, as well as several large and catastrophic fire events. The worst of these occurred on Black Thursday, 6 February 1851, when, probably as a result of pastoralists burning off in hot and windy conditions, stock and landscape across a quarter of Victoria and parts of South Australia were devastated. Similarly devastating fires blazed on Red Tuesday, 1 February 1898 (Pyne 1991; Kirkpatrick 1994; Griffiths 2001). As the colonists experienced and learned to fear bushfires, the prevention of all fires seemed the most logical solution. However, this made the situation in the bush potentially more dangerous; it was not appreciated until the twentieth century that the periodic "cool" burning by Aborigines had inhibited the accumulation on the ground of combustible material. In the later nineteenth century, an increasing belief in the need to prevent all fires resulted in a buildup of combustible litter on the forest floor that, when bushfires did break out, made them far fiercer and more destructive. The seriousness of the conflagrations of 1851 and 1898 can be seen at least partly as a result of changed burning practices—in a sense a cultural creation (J. Smith 1992). In this as in most matters, the knowledge of the Aborigines was ignored, and the response to such catastrophes was a greater determination to inhibit fires, clear the bush—especially near habitations—and plant exotic species. White Australia had just commenced to climb the learning curve of living in a combustible environment—they have still not reached the top of the curve.

* * *

All species, and all human societies, depend upon successful exploitation of the environment for their survival and for the transmission of their genetic inheritance to future generations. Like Aborigines and the Pacific peoples, the Australian colonists developed economic enterprises within the parameters of their technology and the environment. There were, however, two main differences.

First, the British colonists brought a sophistication of knowledge and technology that enabled them to discover and exploit a very large advent abundance even in a land that had been occupied for more than 50,000 years. Second, these attributes also gave them a capacity for a far higher degree of exploitation, and consequently to cause more extreme repercussions for the environment—they rapidly qualified to be among Flannery's "future eaters." Even though the evidence of environmental decline was apparent from the early years, the limited nature of ecological understanding meant that only a few people expressed concern, while the size of the continent and the surrounding ocean made their resources seem inexhaustible—and indeed it was sufficient to avoid a full satiation slump. Convicts, their guards, and later colonists intent on making their fortune and returning to Britain or simply struggling to extract a living from the land, seldom had the interest or the luxury of environmental care.

Commercial exploitation of "useful" species was limited, but commenced in the dying years of the eighteenth century with the immense wealth of coastal marine life. Large numbers of sperm and right whales migrated each winter from Antarctica into warmer waters around the Australian and New Zealand coastlines and into the Pacific. Their bodies produced oil, bone, and other products that were worth immense amounts in Europe and North America, and from the 1790s small numbers of American whalers arrived in South Pacific and Australian waters. Whaling off the southern coasts grew into a major industry in the first four decades of the nineteenth century as local vessels joined the dozens now coming from Europe and North America. By the 1840s, the wholesale slaughter of unknown hundreds of thousands of whales had caused a population crash, and the industry died away to a small remnant, which thereafter operated episodically throughout the century.

Following a parallel path was the killing of fur and elephant seals, which occupied rocky outcrops in huge numbers along southern shores of Australia and the islands of Bass Strait, Tasmania, and New Zealand. Their fur and body oils were highly valuable, and the seals were docile and unaccustomed to predation. The parties of sealers who were put ashore near rookeries were able easily and systematically to club their way through the semitame animals whose bodies were then skinned, cut up, and boiled down. The slaughter continued in and out of breeding season, countless numbers killed within a few years. One estimate is that 250,000 were taken in the Antipodes between 1806 and 1810 (King 2003, p.120). Some minor species were driven to extinction and others reduced to an insecure remnant, and the industry was dead by the 1830s. These two cruel and bloody industries played a major role in the development of Hobart in Van Diemen's Land and Albany in Western Australia, as well as New South Wales and Sydney, and were the principal source of foreign exchange in the Aus-

tralian colonies until the 1830s (Hainsworth 1968; Colwell 1969; Lines 1991; Garden 1977).

The fur and skin trade in indigenous marsupials was never such a major industry, but several animals had commercial value and, beginning in the early years, there was a small but significant slaughter. Kangaroos were sought for their skins, and platypus were hunted to low numbers largely for rare and valued platypus rugs. Possum rugs were more common because the animals proved more resilient to hunting even though, for example, in 1906, 4 million possum skins were sold in London and New York. Koalas were also hunted for their skins, but this did not become an extinction-threatening craze until early in the twentieth century. In southeastern Australia, lyre birds were killed for their superb tail feathers to grace ladies' hats, a major reason for their decline in the nineteenth century (Marshall 1966).

Another reason for hunting, or for more generalized slaughter, was that many Australian species came to be seen simply as pests or vermin because they did not fit into the settlers' plan for the continent, and were therefore designated a nuisance or destructive. Strychnine, hunting dogs, and the gun were the main weapons in the war on native fauna. Perhaps the greatest battle was against dingoes, which preyed on the lambs and sheep that were introduced into their territory. Dingoes were hunted and poisoned to small numbers across vast areas of southern Australia. In more remote northern areas, they were more difficult to exterminate, so late in the nineteenth century, thousands of kilometers of fences were built across the continent to confine them to the north. Because kangaroos were wrongly believed to eat as much as several sheep, they were slaughtered as pests, while because raptors (eagles, hawks, kestrels, etc.) sometimes preyed on lambs and young domestic animals, there was an open war on them. Emus became a target because they trampled crops, as well as for their oil and feathers (Marshall 1966). In Tasmania, the thylacine was hunted throughout the nineteenth century and pushed to extinction in the 1930s by farmers who feared it as a predator. The reality is that the thylacine was a rare animal even when Europeans arrived, and its depredations were minimal. It suffered an image problem from having stripes like a tiger and a slightly wolfish appearance, and therefore became exaggerated into a major threat to farm animals in the public mind (Paddle 2000; Owen 2003).

The death toll from the pursuit of "pests" was immense. Keith Hancock examined the annual reports of the chief inspector of stock in the Monaro region of New South Wales and found that, from the 1880s to 1900, they contained astonishing tallies of slaughter. In most years, wallabies and kangaroos were killed by the millions; kangaroo rats in hundreds of thousands; possums, bandicoots, paddymelons, and crows in scores of thousands; and wombats in

hundreds. The killing was sustained and indiscriminate, and all aimed at saving crops and pasture (Hancock 1972, pp. 113–114).

* * *

In the 1960s, there was a flurry of debate among historians about the reasons for the foundation of the British colony in New South Wales in 1788 (Martin 1978). Until then, it had generally been accepted that the need to send excess convicts somewhere was the main factor. It was now argued that there were also commercial reasons, notably to establish a British trading port and whaling base in the region, and to exploit for naval purposes the flax and timber that had been reported by Cook on Norfolk Island, some 1,500 kilometers off the Pacific coast. While the evidence is inconclusive, such commercial goals are logically to be expected, and the economic viability of the colony soon became a major goal.

To survive and to achieve viability, attention turned to assessing ways to exploit the Australian environment, and in their evaluations many explorers and observers effectively reduced the landscape to a collection of potential resources and commodities (See Documents). Agriculture was of vital importance in each of the colonies as it was essential that the settlers were able to eke from the land sufficient food to feed new and rising populations. This was not an easy challenge given that Australian soils and climate often baffled incipient farmers whose knowledge and crops were shaped by a European temporal rhythm and seasonal and climatic template. Over time, the colonists were able to clear land, sow crops, build their herds and flocks, and establish self-sufficiency in food production. In due course, they expanded inland in each of the colonies to the extent of viable land or to the edges of the unviable arid regions, establishing a range of economic enterprises and many small cities and towns. While at times and in places there was profound poverty, for many immigrants, Australian colonial societies offered greater affluence and opportunity than in Britain.

Until recent years, Australian history has largely been written in terms of these successes of colonial society—of the pioneering spirit that mastered a difficult and alien landscape, of the egalitarian ethos that built a better New Britannia, of colonial enterprise that created wealth and opportunity. In the last three decades, there have been great changes in historiography in Australia as elsewhere, with far more discriminating examination of national history through new themes such as race and gender. These have been given the term "black armband history" because they draw attention to the negative aspects of the history as well as the positive (Macintyre and Clark 2003). Environmental history is also a form of "black armband" because much of its emphasis inevitably focuses on the fact that European occupation of Australia, while boasting many achievements, has been done at a dreadful cost to the environment.

An examination of Australian industry and commercial enterprises uncovers a very uncomfortable history.

The first export industries, as mentioned above, essentially extracted animal bodies from the environment and provided valuable income until the 1830s when there were few seals and whales left and the export of wool took over. Through their fires, Aborigines had contributed to the creation of a landscape ideal for grazing animals—vast areas of open grasslands interspersed with occasional trees were well suited to sheep, which could supply wool to the ever-hungry British textile factories. Wool growing gathered pace in the 1820s, first across large areas of New South Wales and then was largely responsible for an enormous spread of settlement in the 1830s and 1840s that contributed to the foundation of the four new colonies. Wool growing had brought low-density settlement to most of the readily suitable regions by the 1850s and had established the permanence of the colonies. An aphorism often used was that Australia "rode on the sheep's back." Wool was Australia's principal export and source of foreign exchange from the 1830s until the mining boom of the 1960s, although challenged in the 1850s and 1860s by gold, and rivaled in the twentieth century by other land-based primary products.

The pastoral industry also helped to feed the expanding colonial population. While sheep were an important source of meat, beef cattle had been present from earliest settlement and dominated the pastoral spread into more marginal northern and western parts of the continent in the second half of the nineteenth century. Cattle were more suited to the harsher arid areas and were not as vulnerable to dingoes. The development of refrigeration in the last two decades in the nineteenth century opened a vast new meat market in Europe. The droving of cattle over long distances to the rail heads for transport to domestic and foreign meat markets became part of the industry and of Australian folklore.

The success of the pastoral industry was, however, at considerable ecological cost. Environmental writer Eric Rolls has captured the early transformation of the land:

> When Europeans came to Australia, the soil had a mulch of thousands of years. The surface was so loose you could rake it through the fingers. No wheel had marked it, no leather heel, no cloven hoof. Digging sticks had prodded it, but no steel shovel had ever turned a full sod. Our big animals did not make trails. Hopping kangaroos moved in scattered company, not in single file like sheep and cattle. The plentiful wombats each maintained several burrows so there were no well-used runs radiating from one centre as from a rabbit warren. Every grass-eating mammal had two sets of sharp teeth to make a clean bite. No other land had been treated so gently. . . .

The pastoral idyll, Riverina, New South Wales. The open, parklike appearance of large areas of Australia's southern hinterland, largely a creation of Aboriginal burning, made it ideal for the grazing of sheep and cattle. Wool became the main Australian export for well over a century, and Australia portrayed itself to the rest of the world with images such as this. (E. J. Brady, Australia Unlimited, Melbourne, 1918, p. 158)

Among the grasses grew tap-rooted herbs and many other plants. But always there were spaces. Birds and small mammals had plenty of room to walk about while they fed on roots and shoots or stretched upwards for the oat-like and millet-like seeds of the grasses. This lovely pasture lasted about six years in most districts. The method of stock management hastened the destruction. Stockmen mustered their cattle each late afternoon and camped them down on water, shepherds yarded their sheep and drove them out each early morning. The ground powdered under the cutting hooves, then hardened when it rained. The plants had never had to push their roots through hard ground, they had never had their leaves bruised by cloven hooves, they had never had whole bunches of leaves torn off between a set of bottom teeth and a top jaw pad. They died. . . .

> Ground never stays bare for long. Inferior Australian grasses . . . found the new conditions ideal, so did imported weeds with thousands of years' experience of hard soil. (Rolls 1993, pp. 161 and 165)

Besides these impacts, streams became churned, muddied, and polluted by runoff containing animal waste and increasing volumes of silt. In many areas, pastoralists used fire to clear land and to stimulate fresh green growth. This alteration of fire regimes, notably in the Australian Alps, did much to alter floral distributions and faunal habitats (See Documents).

An even more dramatic, although somewhat localized, economically based transformation of the landscape followed the discovery of copper in South Australia in the 1840s, and of gold in Victoria and New South Wales in the 1850s, as well as in Queensland and the Northern Territory in the 1870s and in Western Australia in the 1890s. In all cases, the mining of minerals brought a great stimulus to local populations, to prosperity, and to development, all of which have been lauded in Australian history. By contrast, the profound negative impact of mining on local ecosystems and the rapidly increased pressure upon flora and fauna entailed an environmental cataclysm that was arguably without human-caused equal in the history of the continent to that time. There were four particular environmental impacts from mining: Population influx and the establishment of numerous urban centers; localized damage from digging and the spread of subsoils as mullock or tailings; the clearing and consumption of timber; and the degradation of water systems (Garden 2001).

As humans swarmed across the landscape during the gold rushes in numbers never previously experienced, they transformed it. The ecological footprints of their towns, habitations, and industries were heavy, as were their water demands, waste disposal, and consumption of local resources. The sites of gold mines were soon turned into wastelands as vegetation was removed, the soil turned over, and shafts dug. Great volumes of clay and rock were brought to the surface and spread around in mullock heaps. Once beautiful areas were turned into moonscapes. Disturbed land eroded easily and was invaded by weed species, and over time the mullock was eroded and washed by rain and wind into streams and rivers. Water was needed in huge volumes for washing processes, for steam engines, and in some places, waterwheels were used as a source of power. Streams were diverted and dammed for mining and domestic purposes, and water systems were degraded by waste and silt, which stifled aquatic life. Timber was consumed by gold mines for pit props, as fuel for steam engines, and for a myriad of other uses. To supply such a demand, teams of timber cutters and their drays spread across ever-lengthening distances around the

Gold mining transformed the economies of the Australian colonies and resulted in a major stimulus to immigration and the intensity of settlement. Mines caused profound localized environmental damage, but their ecological footprint also spread much further as they drew in supplies of timber and water and spread their waste into water systems. Bendigo, Victoria, 1875. (Nicholas Caire photograph, Royal Historical Society of Victoria, AL59-0010)

goldfields, stripping the landscape bare of much of its tree cover. Mines also became big polluters with the dispersal into the environment of chemicals such as arsenic, which were increasingly used in extraction processes. Once destroyed, ecosystems take a very long time to repair in the harsh but fragile Australian landscape, and the sites of gold mines are still marked by ecological degradation as well as tourist-attracting cultural heritage.

In the aftermath of the gold rushes of the 1850s, most of the eastern colonies faced significantly changed circumstances. Populations had increased, some dramatically, and these people needed food and employment. One of the neat solutions to this dilemma was to withdraw areas of land from pastoralists and redistribute it in small holdings on easy terms to aspiring yeoman farmers. To this purpose, in the 1860s and 1870s, most colonial governments introduced what were known as Selection Acts. Selection had mixed success, and while it

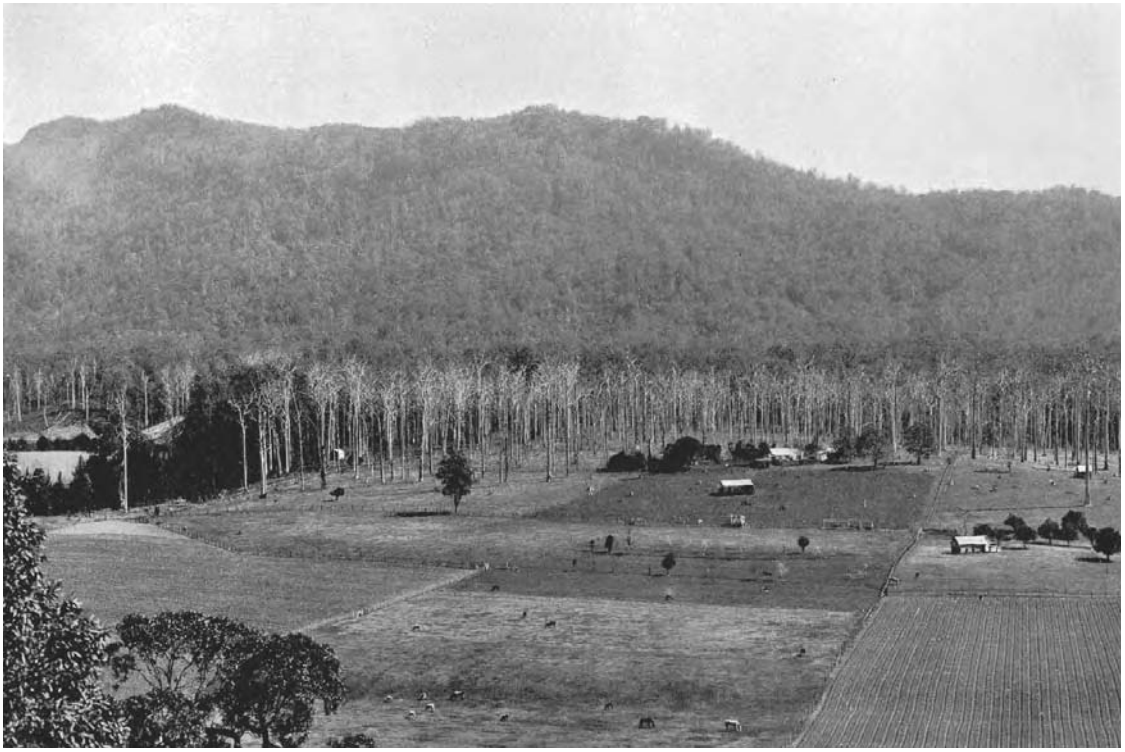
The yeoman farmer dream. Whilst this image of an oat harvest was taken in the Blenheim region of the South Island of New Zealand in about 1912, it encapsulates the ideal of recreating British agriculture in Australia and New Zealand, a dream that drove rural settlement in both societies from first settlement until well into the twentieth century. Unfortunately, environmental conditions inhibited full realization for many settlers, and the impact on the environment was always damaging and often devastating. (Agriculture Department Collection, Alexander Turnbull Library)

contributed to significant increases in agricultural outputs, there were many failures. Political and administrative factors were important in this, but often it was the nature of the environment, particularly poor soils and the irregular climate (droughts and flooding rains) which challenged and overwhelmed the industry and the spirit of the farmers. Not much Australian land is suited to intensive agriculture on small holdings and, even though the units were often very large by European standards—320 to 640 acres (130 to 260 hectares)—often they were not viable or manageable. In some colonies, Selection farmers became known somewhat derisively as "cockies" because, like the cockatoos they were named after, much of their backbreaking labor involved bobbing up and down as they tilled the ground. Many people probably also thought they were

galahs—another interesting example of the name of an indigenous bird being used as a term of derision and abuse.

One of the most dramatic examples of agricultural failure took place in South Australia. While Victoria and New South Wales were boosted by gold rushes in the 1850s, South Australia endeavored to become the colonial breadbasket. In the 1860s and 1870s, the government facilitated rapid land subdivision and settlement north of Adelaide. In 1865, the South Australian Surveyor-General, G. W. Goyder, warned that agriculture would not be sustainable beyond a line of reliable rainfall that he calculated to be drawn across the landscape generally a little more than 150 kilometers east and north of Adelaide. Beyond it, Goyder argued, the climate was too arid for agriculture. However, a series of above-average rainfall seasons in the early 1870s led to a dismissal of his caution, and an apparent confirmation of the contemporary belief that "rain follows the plough." Settlement expanded rapidly beyond Goyder's Line, and Goyder was ridiculed. Inevitably, the good seasons ended and when an El Niño drought occurred at the start of the 1880s, the results were devastating. Drought dried the land, killing crops and animals and destroying the dreams of the families who abandoned their farms in a mass retreat back behind Goyder's Line (Meinig 1962; Sheldrick 2005). These days, if one travels north of the Clare Valley or through Quorn and Hawker toward the Flinders Ranges, along the line of the old Ghan railway, one sees many signs of the human and environmental tragedy that forced the agricultural retreat—broken-down farmhouses, abandoned settlements, and even the occasional ghost town.

Everywhere, agrarian pursuits led to the clearing of indigenous vegetation: along the Queensland coastal plain for sugar cane from the 1860s; in New South Wales, South Australia, and Western Australia for grain cropping and grazing; in Victoria for crops and dairying; and in Tasmania for orchards and dairy herds. Often the terms of purchase required Selectors to clear the land as an "improvement" and as an affirmation that they were legitimate farmers. Consequently, small selections or farms could not afford to leave land unproductive, so it was methodically cleared, leaving little if any bush, shade, or habitat. Such clearing was at the heart of many environmental problems. Australian soils are ancient, weathered, often infertile, and easily eroded. The more they were cleared, dug over, and cropped, the more they deteriorated. In an endeavor to eke a living from the land, in many places the soil was effectively mined—worked until its goodness was extracted and left bare. In some arid regions, the soil's structure was turned to fine powder, which was easily dispersed by wind and water. Disastrous sand drifts and dust storms resulted, and the process of dryland salination, later worsened by irrigation in some regions, had commenced (See Chapter 4). There was little knowledge or concern about this in the 1860s and 1870s,



"Won from the Jungle." Vast areas of vegetation were cleared in each of the Australian colonies in order to carve out land for agriculture. The battle against the bush was often described in military terms like the original caption on this image of cleared forest on the plateau at Dorrigo on the north-central coastal region of New South Wales. (E. J. Brady, Australia Unlimited, Melbourne, 1918, p. 205)

even though the effect of plundering the soil by repeated cultivation was becoming apparent. Formerly fertile land became exhausted, but until late in the century, farmers knew that when land was exhausted, it was often cheaper and easier to move further afield and take up new land on the frontier than to care for the old.

Another repercussion of land clearing was the loss of tree cover across the continent. At first, the vastness of woodlands and forests was such that little thought was given to conservation, and often trees were seen not as a potential resource but as a barrier to production. There was extensive destruction of trees simply to get them out of the way, notably by ringbarking or girdling as it is termed in North America—the cutting of the cambium layer in a ring around the trunk to kill the tree. This produced Dorothea Mackellar's "tragic ringbarked forests." The worst example of this was in Gippsland, in the eastern part of Victoria. It was one of the most densely forested regions in Australia, where large areas were cleared for farming in the late decades of the century. Much of

In Gippsland in Victoria the war against the forest involved the clearing of some of the largest trees in the world, notably mountain ash. A mixture of ring-barking (girdling) and felling was used. Many of the oldest trees were hollow inside and this one was large enough to be adopted as a church. Judging by the cuts in the tree and the plank jutting out of it, this "Lord of the Forest" has been felled by axemen, but those in the background form a "tragic ringbarked forest." (E. J. Brady, Australia Unlimited, Melbourne, 1918, p. 20)

the forest was ringbarked and left to die. It was an ecological crime as well as a stupendous waste of valuable timber (Lines 1991, pp. 122–124; Ritchie 1989).

This waste seems somewhat surprising given that the commercial exploitation of timber was a significant part of the colonial economies, but such ambiguities are indicative of the unusual relationship that white Australians have had with the trees and forests that used to ring the eastern and southwestern coasts and which occupied much of Tasmania. Timber was an invaluable resource in a society in which metals had not yet become fully prevalent. It was a universal building, construction, and utilitarian material, as well as the principal source of energy for heating and cooking. From the earliest settlement, trees were felled for commercial purposes, and timber cutting was one of the early major industries and exports. In forested areas, timber getters were in the van-

guard of settlement and, by late in the century, timber towns were scattered across the forested lands of each of the colonies. Some Australian species were also valued for the beauty of their timber, notably red cedar (*Toona australis*), which was so popular for building and furniture that by the end of the century, it had all but disappeared across its range in New South Wales and Queensland (Webb 1966). Western Australian sandalwood experienced a similar fate; prized in Asia for its scent, sandalwood was cut from the bush to provide cash income, which saved many a struggling farmer. Among the most important export timbers were Western Australian jarrah and karri, two very beautiful timbers but prized mainly in the period for their hardness. Many piers and jetties in the colonies were built with Western Australian timbers and some cities, including London, had streets paved with jarrah.

While trees and forests had utilitarian value and were a source of wealth, many negative voices were raised against them. Farmers and pastoralists often saw them as a barrier to progress and development, and were faced with the huge task of clearing them so that the land could be made productive. Removing trees also had cultural connotations, representing mastery, the establishment of order, and the opening of the country for productivity and improvement, as well as making it more aesthetically appealing to the immigrant eye. The monotony of dull-colored evergreens and the vastness and ruggedness of the forests could be overwhelming, and Keith Hancock (1930), perhaps with some hyperbole, coined the term "they hated trees" to capture the colonial response. The axe was both a practical tool and a symbolic way to master and "improve" the landscape.

Even as colonial enterprise stretched across the wide brown land, a disproportionate number of colonists clustered into urban areas. In the nineteenth century, Australia changed from a continent with only one significant but small town (Sydney) to one of the most highly urbanized countries in the world—with two thirds of the population living in urban areas. A high proportion of these were in the six colonial capitals, two of which (Melbourne and Sydney) had a population of nearly half a million (Glynn 1975). The reasons for such an urban concentration are complex, but relate essentially to a mixture of economic and environmental factors. Australia developed after the start of the industrial revolution, bypassing earlier stages of development that had promoted high rural populations—subsistence agriculture and small-scale surplus agriculture. Besides, most of the Australian environment was not suited to such intensive agrarian activity and the pastoral industry that came to dominate most of the landscape required only a small and partly seasonal workforce. Those urban centers that developed outside the capitals had only limited roles, essentially to provide transport, commercial, service, and administrative functions for the rural

The Western Australian Group Settlement schemes in the interwar years enlisted inexperienced British migrants into the heartbreaking task of clearing large areas of bushland and forest to make way for their farms. While the felling of a marvelous karri tree was portrayed here as a heroic venture, in reality settlement of such a land was a task that broke many men and their families. (E. J. Brady, Australia Unlimited, Melbourne, 1918, p. 739)

industries. Only gold towns tended to be more densely populated and economically complex.

Environmental factors played a major part in the selection of townsites and their development. Mining towns aside, most urban sites in Australia were deliberately chosen for four reasons: the availability of water; the availability of timber; access to a means of transport; and aesthetic appeal. In most cases, this meant that they were cited adjacent to a river or creek. The irony, of course, is that towns and especially cities soon destroyed the very factors that were responsible for their siting—the land was built on, the trees cut down, the water polluted, human and industrial waste poured into the environment, and the beauty destroyed. Australian cities and towns were no different in this aspect from those in Europe and North America.

Similarly, the environmental impacts of urban centers spread far beyond the last houses—the ecological footprint as it is termed. Towns and cities, especially the capitols, drew their food and raw materials across ever-increasing distances as their populations expanded and with the establishment of better transport, notably railways. However, it was in their water supplies that Australian cities were eventually to have one of their greatest ecological impacts. Although inhabiting the driest continent, the standard of living and expectations of the colonists, perhaps epitomized by their exotic botanical gardens, public parks, and private gardens, resulted in very high patterns of water consumption. To slake their thirsts, the Australian capitols began a long project which continued throughout the twentieth century to tap or dam the available rivers in their hinterlands. The impacts on Australian water systems and the ecosystems dependent upon them has been immense (Powell 1988; Powell 1989; Powell 1991).

* * *

It has become something of a trend for environmental historians to argue that from the early years of settlement, there were colonists who were alarmed about environmental degradation and who endeavored to introduce conservation measures (Bonyhady 2000; Hutton and Connors 1999; Mulligan and Hill 2001). While it is true that in almost any period it is possible to find expressions of concern about such matters as the loss of indigenous species, clearly those who expressed these views were a tiny minority—and generally they were like voices crying in the wilderness. The colonial project—to master, develop, and prosper—overwhelmed the faint cry of such sentiments.

Nevertheless, conservation issues did emerge in the second half of the nineteenth century. Most interestingly, whereas in most respects Australian society was derivative of British trends, in the area of nature conservation, the

United States was the source of much inspiration and conceptualization. This can presumably be explained by the shared experiences of the two frontier societies. The romanticized view of American nature depicted in *Walden* by Henry David Thoreau (1854) was widely read in the colonies, and *Man and Nature or Physical Geography as Modified by Human Action* by George Perkins Marsh (1864) imposed itself on the consciousness of at least some newspaper and administrative figures. The latter was a seminal work that examined the impact of humans on the natural world. Marsh was particularly interested in the relationships between forests and water quantity and quality, and described how forests filter and even out the flow of rainwater into catchments. Marsh also believed that the presence of trees brought rain and that clearing them would lessen rain, a theory with obvious significance for a dry continent like Australia. The book stimulated discussion in the United States, Europe, and Australia (Marsh 1864; Tyrrell 1999; Lowenthal 2000). In Victoria, at least, his warnings about the importance of forests for environmental health and water purity rang a chord, for they coincided with two important developments. The first was the rapid disappearance of tree cover across central Victoria because of the timber demands of the goldfields. The second was the dependence of Melbourne on the hills to its north and east for its water supply. While not directly attributable to Marsh, the concerns he expressed seem to have contributed to early moves to set aside timber reserves and to protect Melbourne's water catchment from timber cutting and clearing (Powell 1988; Powell 1989; Wright 1989; Dingle and Rasmussen 1991).

These actions nicely encapsulate the anthropocentric and utilitarian motives that lay behind most early conservation. Rather than responding to concerns about the loss of ecosystems or the degradation of the landscape, anthropocentric utilitarian conservation was essentially intended to preserve and protect "resources" and landscapes for human benefit.

Conservation sentiment and action was also stimulated by a subtle transformation in the relationship between white Australians and the bush in the late decades of the nineteenth century. By then, most colonists were Australia-born and, although raised to consider Britain to be "Home," they lacked a personal sense of identification with the British landscape. To many colonists, perhaps especially those safely ensconced in the cities, the landscape no longer seemed so daunting, alien, and challenging. The tyranny of distance had been somewhat overcome by technology, and the land had been partly tamed by the plough, the axe, and the gun. The bush could now be seen as potentially friendly and enjoyable, and could be taken to heart as part of the emerging national culture. It became an object of new emotional, aesthetic, recreational, and scientific interest, and was a major focus of the emerging sense of intercolo-

nial Australian identity and nationalism that resulted in the federation of the colonies in 1901. Two cultural expressions of this identity were a flourishing of literature and art that depicted and promoted what was seen as distinctively Australian—the Australian bush and the people who inhabited it. This was captured in the poetry of Banjo Patterson, the stories of Henry Lawson, and the art of Arthur Streeton, Tom Roberts, and Frederick McCubbin, among others. Their words and paint depicted what was accepted as "typically" Australian, despite the reality that the "ordinary" Australian was an urban wage earner (Mulligan and Hill 2001; Dunlap 1999).

Such sentimental identity with the bush was accompanied by a growing popularity of outdoor recreation, notably among urban residents who strayed beyond the suburban fringe to beach or bush for health, aesthetic, and scientific pursuits. This was partly a pursuit of health and beauty, a cultural reaction to the bleakness of urban life that had its roots in Romanticism and its idealization of rural life and landscape. Victorian-era health beliefs also emphasized the value of fresh air and of escaping from the smells and miasmatic gases of the city. Such attitudes manifested themselves in increasing popularity of holidays at the seaside or in the mountains, in family picnics, in bushwalking or rambling, or in the pursuit of amateur scientific investigations of natural history. Walking and scientific activities might involve small groups of friends, or newly organized clubs of walkers or field naturalists. There were also early examples of appreciative Australian nature writing (Mulligan and Hill 2001; Griffiths 1990; Griffiths 1995; Inglis 1999).

It was only a small step from enjoying and admiring the bush and beach to believing that parts of the indigenous landscape were worth preserving. In this, Australian conservationists again appear to have been aware of the example of their American cousins who had focused considerable effort on the creation of national parks. These were not established in the way modern national parks are expected to be—areas protected for their high ecological value—but rather areas of outstanding natural beauty or tourist interest that were protected essentially for their anthropocentric value. Australia produced no major conservation activists like American John Muir, but his nature writings and agitation for the establishment of the Yosemite National Park were known and emulated by some of the Australian urban elite (Mulligan and Hill 2001; Hutton and Connors 1999).

A combination of sympathetic public servants, nature leagues, and bushwalking clubs lobbied governments to preserve "wilderness" areas for recreational, aesthetic, nature-loving, and scientific purposes. The first of this type of landscape preservation reservation was established around the Jenolan caves in the Blue Mountains in New South Wales in 1866, and Australia's first specifically named national park was the Royal National Park south of Sydney in

1879. The next was the Belair National Park near Adelaide in 1891. Most of the first generation of national parks were, in reality, essentially large and glorified picnic parks, complete with areas of green lawns and introduced trees.

However, for all their good intentions and efforts, the early conservationists did little to stem the tide of land clearing, ringbarking, and eradication of indigenous fauna across the wide brown land. Colonial community attitudes were still essentially devoted to concepts of developing the land and improving on nature. By the end of the nineteenth century, the Australian environment and its original inhabitants had been changed irrevocably.

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4

"BROAD, BUSY BULLDOZED ACRES": AUSTRALIA 1901–2001

I love a sunburnt country,
A land of open drains
Mid-urban sprawl expanded

For cost accounting gains;
Broad, busy bulldozed acres
Once wastes of ferns and trees
Now rapidly enriching
Investors overseas.

A nature-loving country
Beneath whose golden wattles
The creek is fringed with newspapers
And lined with broken bottles.
Far in her distant outback
Still in whose cities chafe
Find hidden pools where bathing
Is relatively safe.

—Oscar Krahnvohl, "My Country," c. 1980

There have been a number of parodies of Dorothea McKellar's poem, "My Country," which have picked up and satirized its sentiments, which, in the more cynical and ecologically degraded late twentieth century, came to seem excessively sentimental. The above parody is indicative of both a more environmentally concerned reading of the landscape and recognition of the extent to which the Australian environment had been abused in the twentieth century.

It was a century that, judged by traditional "development" criteria, was successful for most Australian people. It was a century whose history and environmental history divide into two halves separated by World War II. Until 1945, the patterns of expansion, settlement, and environmental impact were essentially a technologically advanced extension of those from the previous century. While there were profound problems brought by two world wars, the trough of the 1930s depression, harsh droughts, and raging bushfires, the period also saw population growth, increased industrial and agricultural production, more irrigation, better transport, and, for some people, prosperity. The post–World War II years brought even better news—a few years of record prices for wool and substantial

exports of grains and other primary products, a mining boom that saw massive exports of iron ore, coal, and uranium, the growth for a few years of manufacturing, high–volume exports of wood chips, large engineering projects to dam and harness Australian waters, rapid population increase, and a rise in disposable income and standard of living, and in the acquisition of personal possessions to a level that would have been unbelievable to earlier generations. Much of this was a reflection of and response to global developments.

However, the environmental historian must wear the black armband of mourning, because the reverse side of this history is one of unsustainable environmental exploitation and ecological loss, especially in the second half of the century. Inevitably, as globalization homogenized the planet, Australia's environmental history was essentially a variation on the worldwide themes. The human population explosion was reflected in a virtual tripling of Australia's population between 1945 and the end of the century to nearly 20 million people. Similarly, Australia shared the experience and repercussions of increased postwar affluence and consumption: the demand for energy, especially fossil fuels, and the consequent threat of greenhouse effect and climate changes; the massive use of chemicals with their unpredicted repercussions, such as chlorofluorocarbons, which severely depleted the ozone layer, notably over the Antarctic and parts of the southern hemisphere; and the rise of the mass consumer society with its explosion of personal possessions—cars, houses, and electrical goods, to name a few. Australia was also suffering from a series of profound environmental problems associated with the degradation of land, water, and ecosystems. The advent abundance of the continent was arguably nearing exhaustion. Technological and scientific innovations had postponed a full satiation slump, but unless there was new political will and a change of mentality, it was not certain that it could be delayed for many more decades.

A useful way to examine the history of such large and complex issues across the century is through five aspects that broadly capture the main themes of twentieth-century white Australia's relationship with the environment: people, land, water, fire, and environmentalism. The issue of introduced species will be discussed further in Chapter 6.

PEOPLE

In the pastoral industry, one of the evaluations of land is its carrying capacity, or how many beasts it can support in some sustainable way. To estimate this was not always easy for the early pastoralists who came from a country where the calculation involved a number of sheep to the acre. It took some time to appreci-

ate that, in most of Australia, the ratio was reversed—a significant number of acres to each animal. The soil, the climate, and the vegetation set limits on the land's grazing capacity, and over the years this reality shaped the pastoral industry. Although overstocking still regularly occurs and there are constant scientific attempts to increase carrying capacity, the reality is generally accepted that environmental limitations mean that stock has to be kept fairly sparse.

The same reason and logic have not generally impinged upon ideas about the carrying capacity of the human population. When the British arrived, there were probably about a half million humans in Australia. Early in the twenty-first century, there are about 20 million. This is tiny by world standards, with some of the planet's most densely populated nations crowding a similar population into a minute fraction of the area. It is also an issue of ongoing debate. It is argued on the one hand that, given environmental realities, Australia is already overpopulated (Flannery 1991; Flannery 2003; O'Connor 1998; Birrell, et al. 1984). On the other hand, a majority of Australians and their politicians are likely to assert, as they have from the earliest days of colonization, that the Australian population can and should increase by many more millions. This argument depends mainly upon an unsubstantiated equation of space with resources and carrying capacity—that because Australia occupies such a large area it must have the resources and development potential to support a much larger population. It is therefore argued that it is responsible, necessary, and desirable to fill the space with people and industry.

The desire for more people has also had national security and racial significance. White Australians have been profoundly conscious of themselves as a small, affluent European outpost, south of Asia, only sparsely occupying what must, to others, seem a very attractive conquest. This deep sense of geographical isolation and military vulnerability—this invasion mentality—has shaped the Australian psyche and relations with the rest of the world. In the nineteenth century, the Australian colonies clung to the skirts of Mother Britain, fearful that one of the other European powers might invade and colonize. Late in the century, there was a new element in the fear: Perhaps the invading Europeans might join with the Japanese or Chinese to invade and overwhelm this desirable land. There was a strong racial element in this fear, grounded in the British sense of superiority and exclusivity, and reinforced by the pseudoscientific justification of Social Darwinism. The White Australia Policy, which prevented entry of nonwhites, was the first piece of legislation passed by the new federal parliament in 1901 and remained in effect until well into the 1960s.

Fear of invasion became even more pronounced in the twentieth century, especially when Britain was at war in Europe and Asia, as Japan grew in strength, and as the threat of Asian Communism was seen to hover over Australia in the

post-World War II decades. Concern about the "empty" northern third of the continent was a national preoccupation. The millions of Asians to the north were increasingly seen as a potential threat because their covetous eyes were feared to be focused upon Australia's empty spaces.

Historically, two forms of protection have been mounted against these threats. The first was to ensure that Australia had a great and powerful friend to come to its defense. In the nineteenth and first half of the twentieth centuries, Australians looked to Britain for security, fighting with the British in the Boer War and the two world wars. Changes in the balance of world power after World War II saw a transition of alliance and dependence, and Australia sent troops to join the Americans in Korea, Vietnam, Afghanistan, and Iraq.

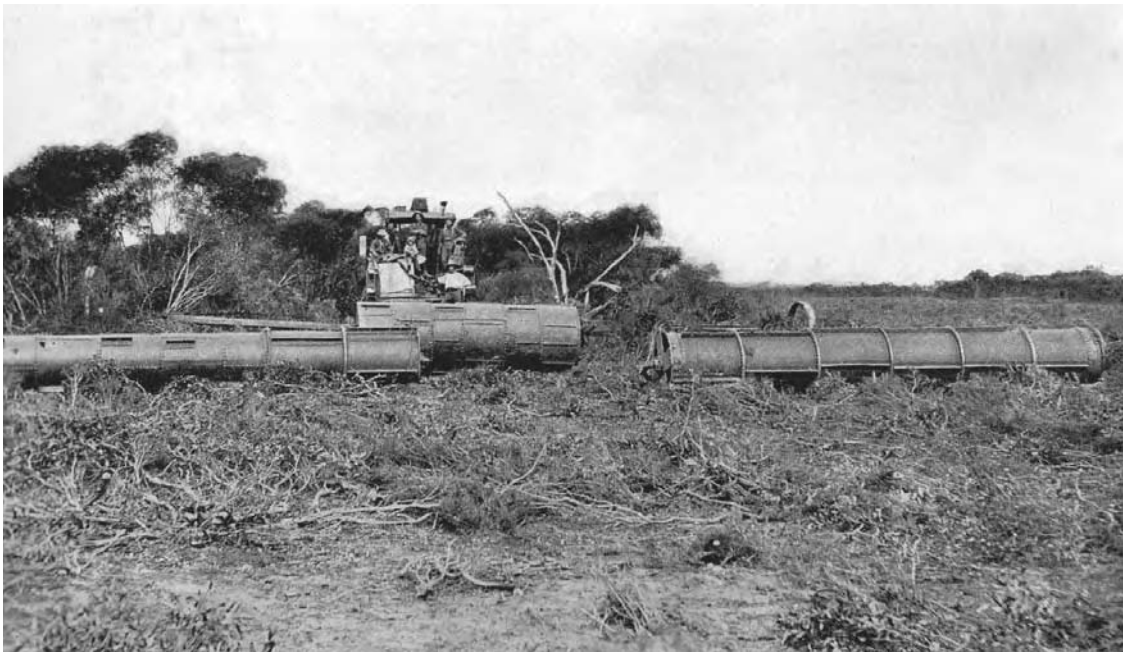
The second form of protection was to try to fill the land with more people and more industry. More people meant more defenders. More industry meant economic and military strength and a greater moral claim to be effectively occupying the land. This attitude has had one historical expression in the reoccurring rural dream of converting the bush into a sort of utopian reproduction of old England—a land divided into small farms with smiling green fields under the Australian sun. It was a major motivation behind the Selection Acts of the 1860s and 1870s, and continued into the twentieth century in the shape of various closer settlement and soldier settlement schemes. From the 1830s, there was also a multitude of immigration programs intended to entice immigrants to Australia, and often to place them on the land as farmers. Prior to World War II, these schemes were aimed almost exclusively at British immigrants, partly because of a sense of duty to relieve Britain of some of her population pressure.

With the help of immigration, the Australian population rose from 3.7 million in 1901 to about 7 million in 1945. After World War II, stirred by insecurity attributable to Japanese wartime expansion and to postwar rumblings in Asia, Australia initiated its largest immigration program. The cry was to "populate or perish." At first, large numbers of British were recruited together with "Displaced Persons" from war-ravaged countries; the net subsequently spread to cover all of Europe, and then gradually widened further to include people whose skin was less white. More than 2 million immigrants arrived between 1947 and 1969, helping to lift the population to 12.6 million in 1971. Following the abandonment of the White Australia Policy and the ending of the Vietnam War, from the 1970s, there was a stream of immigrants of all colors and from most parts of the world. In 1996, the population reached 18.3 million (Sherington 1990).

By then, the traditionally accepted argument about the need or desirability of continuing immigration was being questioned, and there were calls being made for a population policy. While a racist reaction to the changing Australian demography was one factor, much of the debate revolved around the question of

carrying capacity. Had Australia already passed beyond what was a reasonable sustainable population size, given the nature of the continent and signs that the environment was under great stress? What is a sustainable carrying capacity? The debate continues.

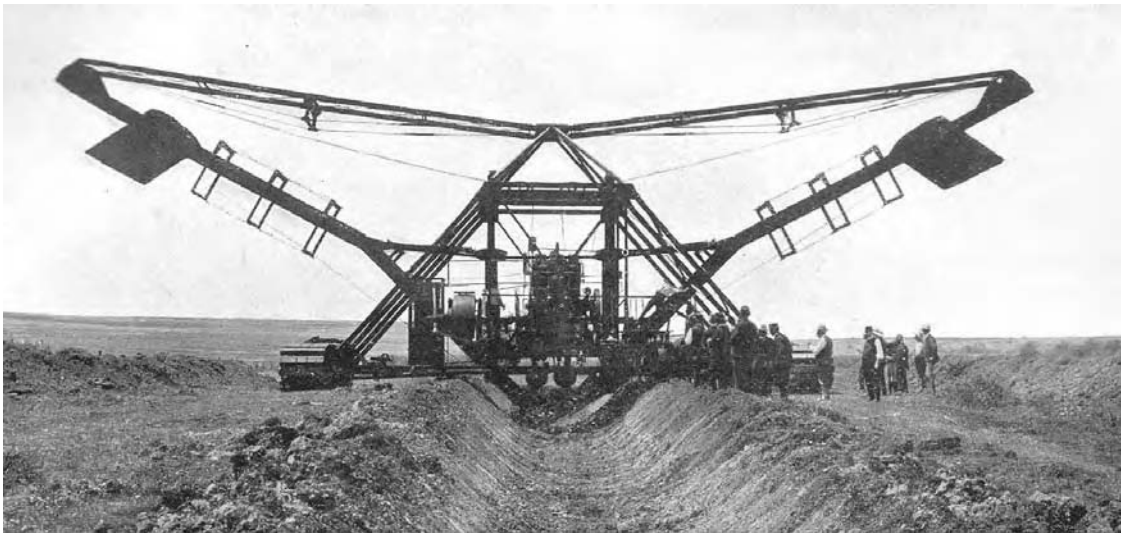
Geographer J. M. Powell has drawn attention to the period after World War I as providing a fascinating case study of the divergent opinions on the issue of carrying capacity and environment (Powell 1988; Powell 1993(b); Macintyre 1986, chap. 9). Although there was no military attack upon Australia, the psychological impact of the war and continuing concern about Japan reaffirmed to Australians that they lived in an insecure world and that membership of the British Empire was one of the keys to their security. A popular expression of these sentiments is to be found in the 1918 publication of *Australia Unlimited* by journalist, writer, and adventurer E. J. Brady. This was a large, glossy book whose title provides a clear indication of its intent. To Brady (1918), the term "dead heart," which was often used to describe central Australia, was a misnomer. The heart was red, but not dead. Brady argued that, in reality, there was immense potential locked in the so-called deserts, simply waiting for the ingenuity of man to unlock it and make the deserts pulsate with life. Brady even described the term desert as a myth.



Mallee lands were easier to clear than forests and various methods were developed, such as dragging huge rollers through the bush. The broken trees could then be gathered and burned. (E. J. Brady, Australia Unlimited, Melbourne, 1918, p. 337)

The keys to Brady's argument were two-fold. First, he argued that the fine red sands and dust that cover so much of Australia were, in fact, highly fertile. All they needed, as had been shown in the mallee lands of South Australia, was hard work and water to turn them into bountiful production. He also argued that in many areas, this water was at hand. It had often been bemoaned that some Australian rivers flowed inland where the water disappeared into the arid landscape, apparently lost and wasted. Brady believed, on the contrary, that this was part of an ingenious design by the "providences of Nature" (God?). The water actually drained into underground aquifers that lay beneath vast areas of central Australia, known as the Great Artesian Basin, and was waiting there for exploitation. It had already been shown that this water could be tapped by bores to water stock and gardens (See A to Z). Brady had faith that Australian ingenuity and effort, assisted by the right sort of young British farmer immigrant, in the future would make it possible to bring together the fertility of the desert sands and artesian water. The deserts would bloom as rich agricultural land. Australia's potential was unlimited.

There were many others who accepted such views of the potential of the land, with predictions that in the future, Australia would accommodate 200 million people and more (Gregory 1928). One aspect of this argument was the practice in the 1920s and 1930s of comparing the size of Australia with that of Europe and arguing that, as Australia was larger than the main western European countries combined, it should hold a similar population. Even if one allowed for



The "reclamation" of "swamps" in order to convert "wasteland" to production was another of the important concepts and projects in mastering the environment. (E. J. Brady, Australia Unlimited, Melbourne, 1918, p. 651)

E. J. Brady promoted the groundwater in the Great Artesian basin as the solution to the aridity of outback Australia. The Florida Bore in northern New South Wales was pictured as an example of the miraculous transition of the landscape. However, in reality much of the water was allowed to run uncapped into the landscape, where it evaporated or was otherwise wasted. (E. J. Brady, Australia Unlimited, Melbourne, 1918, p. 487)

the unsuitability of central Australia for intensive occupation, so the argument went, the fertile fringe was large enough to encompass the space and the population of the main European nations. The "great empty land," according to Sir John Kirwan (1934, p. 312), was "one of the last of the world's fertile spaces that remain to be filled."

A few skeptics questioned such judgments, pointing to the reality of Australia's infertile soils and the arid and unreliable climate, and that while artesian water was useful, it was not sufficient for the unlimited dreams of Brady and his ilk. The most prominent critic of *Australia Unlimited* was Australia's first professional geographer, Thomas Griffith Taylor. A meteorologist by training, he

was appointed to the first chair of Geography at Sydney University in 1920. An environmental determinist, Taylor wrote extensively about the climatic and agricultural realities of Australia—that the dryness of the continent limited the productivity of vast areas, and that the climatic conditions of northern Australia made the region unsuitable for intensive European settlement. He used the term "homoclime" (wandering into some rather suspect Social Darwinist climate and race determinism) to explain that the different human "races" were physically predisposed to survive and work better in different climates and conditions. He believed that white Australian settlement had already extended about as far as the environment and racial disposition of Europeans would allow. He predicted a possible population of 19 or 20 million by the end of the century (he was correct) and 60 million as saturation. Such assertions outraged many people, and Taylor's cause was not helped by the fact that he tended to be assertive and even aggressive. He went too far for mainstream Australia when he argued that if Europeans could not settle in northern Australia, the government should bring in Chinese or colored people who could. After a few years of controversy, he emigrated to the United States (Taylor 1923; Powell 1988; Powell 1993(b)).

A political expression of Brady's sort of optimism was manifest in the policies of the conservative Bruce-Page federal government which was in power for most of the 1920s. The motto of the government was "men, money, markets." The phrase encapsulated a neat plan to bring immigrants from within the Empire (essentially Britain), to borrow capital from British sources to undertake immigration schemes and settle the newcomers on the land, and to export the resulting bountiful harvests to markets within the empire. During the decade, British immigrant and settlement schemes were operated by each of the state governments with British government support, using large sums of borrowed money. Many immigrants went straight onto new blocks and farms—a temptation that was resisted by Australian urban dwellers who generally knew better than to accept such a challenge. In the long run, a very high proportion of the settlers suffered predictable, disastrous consequences.

One of the most heart-rending stories of this human and environmental disaster was the Group Settlement Scheme, which was introduced by the Western Australian government in the 1920s. About 18,000 people arrived from Britain, enticed by promises of bountiful and fertile lands. The reality was a harsh and uncleared country that took months or years of struggle to prepare, a situation made worse by bad administration of the scheme. Poor soils and the difficult climate meant that most settlers were unable to make the land productive, and with the onset of the depression at the end of the decade, large numbers walked off their blocks or sank into desperate poverty. Of the 239 blocks established around the town of Denmark in the 1920s, for example, only 98 were still occu-

pied in June 1936, and in some of the areas around Northcliffe, the attrition was even worse (Gabbedy 1998, vol. 2, p. 529; Crawford and Crawford 2003; Bolton 1994).

The land had spoken, but many people, then and since, preferred not to hear the message.

LAND

Like Group Settlement, many of the twentieth-century settlement schemes involved the occupation of increasingly marginal new land, much of it former grazing land. All the schemes, and the growth of agriculture in general, had in common the need for further clearance of land. The ecological results included further loss of indigenous flora and fauna and further impetus to the ongoing degradation of soils and water systems. While the evidence of such degradation was available before the middle of the century, the process of settlement and clearing actually gathered pace in the decades after World War II. In marginal areas, settlement was facilitated by the development of heavy bulldozers (a civilian application of army tank technology) which could clear the land at much faster rates, and stimulated by scientific advances in areas such as plant breeding and soil science. It was discovered in the 1930s, for example, that many Australian soils were lacking in natural minerals necessary for fertility and that the application of minute doses of trace elements and the planting of subterranean clover to fix nitrogen in the soil, could transform mallee and sandy regions previously incapable of growing crops (Barr and Cary 1992).

In the post-World War II era, the availability of this new technology and science reinvigorated the desire to convert the vastness of Western Australia's outback to agrarian production. One area that attracted attention was the sand plain region of mallee and low scrublands that lay in the hinterland of Esperance on the south coast. The area had resisted attempts to establish farmlands earlier in the century, but in the changed conditions of the 1950s and amid great hype, there was fresh optimism. As well as many smaller blocks, the government arranged in 1956 to sell 1.5 million acres (607,000 hectares) to an American syndicate (including prominent entertainment personality Art Linkletter) for development and subdivision. There was a good deal of head-shaking among experienced local farmers as the syndicate rushed into clearing 16,000 acres (6,500 hectacres) in 1957 and sowed their first crop, only to see it fail because of inappropriate techniques and poor rainfall. The syndicate then quietly withdrew from further cropping, although over time it subdivided some of the land and returned some to the government.

Despite the initial failure, during the 1960s and 1970s, large areas in the Esperance region were sold to American interests and Australian farmers, cleared, and converted to crop and pasture. Although the initial results were generally good, the range of human and natural forces that battle Australian farmers gradually lined up against them—fluctuating economic and marketing conditions, crop and pasture diseases, worms, insects and other pests, wind damage to crops, soil erosion, weeds, and inconsistent rainfall that dried the land at times and waterlogged it at others. The farmers fought back with a new arsenal of chemical herbicides and pesticides and with reformed agricultural techniques, but the returns were seldom bountiful. The most severe problems were ones that their very clearing and occupation of the land had created.

> The crops and pastures do not intercept or use as much of the rain as did the native vegetation, and along with increased run-off due to increased compaction of the soil and loss of soil structure due to tillage, the soil profile and the local wetlands have slowly been "filling" with water, bringing the problems of waterlogging and salinity. (Blumann 1995, p. 179)

Large areas of the region, which had been bulldozed and stripped with such ingenuity and expenditure, and with such cost to the flora and fauna, are now suffering soil salinity and sodicity (see Chapter 6) and are incapable of supporting most forms of life. Fittingly, one of the local histories is named *Faith, Hope and Reality* (Blumann 1995; see also Rintoul 1964; *Economics of Land Development* 1970; Powell 1988).

The Esperance experience encapsulates the environmental as well as the human costs that have accompanied a great deal of Australian agricultural development, and also illustrates the failings of agricultural science. All too frequently, agricultural scientists and those involved in the promotion of the agricultural industry have seen the soil and other elements of the environment simply as resources to be exploited. A great deal of expenditure, research, and discovery has focused on better ways to extract from the land; relatively little has been devoted to the long-term cost and environmental impacts. Soil and water systems have been mined for short-term gain, often with the misguided advice of so-called experts.

A classic example of bad agricultural practices, one that farmers were encouraged to adopt, was dry fallowing in arid grain-growing areas. This technique was developed in the late nineteenth century and was widely used until the 1930s. It involved the repeated ploughing and tilling of the land in between crops in the belief that it would improve the soil by making it finer and increase moisture content by enabling rainwater to soak in. At the same time, ploughing would destroy the capillary tubes that facilitated evaporation of subsurface

moisture. Some spectacular results were achieved in the early use of the technique, principally because the removal of weeds reduced moisture loss. In the long run, however, the constant ploughing and tilling broke down and destroyed the soil's structure, reducing it to a fine powder that was easily eroded by wind and water. Areas of Victorian and South Australian mallee country suffered heavily from the process, and from early in the century, the land began to experience sand drift and periodic dust storms. As Beale and Fray describe it, much of the topsoil has "gone with the wind," some blowing as far as New Zealand where it has turned the snowfields pink (Beale and Fray 1990; see also Barr and Cary 1992; Dingle 1984; Keating 1992).

Sand and dust storms have occurred naturally over millions of years as the friable, ancient soils have been broken down and torn at by natural forces. Where the deep soils of Britain and Europe can remain stable after disturbance, as well as quickly repair, in Australia, disturbed soils are likely to degrade. In Victorian mallee country, I have seen vehicle tracks twenty years after they were made, still clearly visible in their original form, although in places they have become eroded scars across the landscape. Erosion by wind and water has become a major problem because of the exposure of soils through clearing, agricultural practices, overstocking pasture, and the depredations of rabbits, especially during El Niño episodes (White 1997). Dust storms were particularly bad in the first half of the century. Day was turned into dark as searing, northwesterlies howled out of the center of the continent, picked up mallee dust from the degraded farm and pastoral land, and carried it over Melbourne and other places to the south and east. There have also been periodic storms since then, one of the most dramatic preceding the dreadful bushfires of February 1983. Exposed and degraded land was open to wind and water erosion, and deep gullies scar the land in many agricultural and pastoral areas (Young 2000; Barr and Cary 1992; Woods 1984).

Despite these warning signs, in the second half of the twentieth century, land clearing accelerated and as much land was made bare as had occurred in the previous 150 years. In 1999, only four countries had a higher rate of clearance than Australia (Australian State 2001, p. 7). As the Esperance experience illustrated, a repercussion of such clearing over large areas of Western Australia and the Murray-Darling Basin was dryland salinity. Two other forms of soil poisoning also appeared in the late decades of the twentieth century—soil acidity and soil sodicity. These will be discussed in Chapter 6.

Land clearing was the principal initial cause of dryland salinity, but in some areas, notably in the Murray-Darling Basin, salinity was substantially aggravated by irrigation. In the second half of the nineteenth century in Victoria, South Australia, and New South Wales, irrigation had been presented as the

Irrigation was increasingly turned to as the solution to Australia's aridity. If rivers were dammed and the water conserved, so it was believed, it would be possible to ensure that the life-giving fluid was available when and where it was wanted and would "make the deserts bloom." (E. J. Brady, Australia Unlimited, Melbourne, 1918, p. 389)

panacea for the irregularity of Australian seasons. It was argued that the colonies did not have a shortage of water but rather a maldistribution. If water could be stored when it was abundant and distributed as needed, it would even out the seasons and also make it possible to convert arid land into productive farms and orchards—to make the deserts bloom. It seemed an eminently sensible idea that offered an imagined future of highly productive land.

Irrigation schemes commenced in New South Wales, Victoria, and South Australia in the 1860s and 1870s, but they were plagued, like their successors, by insufficient capital and expertise, and substantial losses of water through evaporation and leakage. Nevertheless, Victoria adopted the gospel of irrigation with great fervor. After a major inquiry in the 1880s, a much more ambitious irrigation network was provided for. One of the principal results was the arrival of two Canadian-Americans, George and William Chaffey. They negotiated the

acquisition of a large area on the Murray at Mildura for an irrigation scheme, and also arranged with the South Australian government to establish a similar scheme at Renmark. After many initial difficulties, early in the twentieth century both regions began to fulfill the promise by supplying urban markets with citrus, grapes, and dried fruits (Wells 1986; Voullaire 1985; Powell 1988; Powell 1989; Davidson 1969).

Irrigation schemes gathered pace in the early twentieth century, spurred by droughts and fed by faith in human capacity to bend nature to its needs. Some of the post-World War I soldier settler and other closer settlement schemes in the eastern states entailed irrigation settlements devoted to a mixture of orchards, vineyards, and irrigated pasture for dairying and other grazing. Increasingly, the Murray River and its tributaries were dammed and pumped, and the waters were distributed to distant farms. Between 1914 and 1940, the area under irrigation in Victoria increased from 100,000 to nearly 600,000 acres (40,500 hectacres to 243,000 hectacres), and in New South Wales between 1920 and 1940 from about 60,000 to 380,000 acres (24,000 hectacres to 154,000 hectacres). Queensland and South Australia had smaller but still significant areas under irrigation (Davidson 1969, p. 78; Powell 1989; Powell 1991; Anderson 1978). While initial returns were sometimes good, by World War II, there was increasing evidence that irrigation was causing waterlogging and salination. As early as 1927, the Division of Soils in the Commonwealth Scientific and Industrial Research Organisation was established to research "the problems of waterlogging and salinity in the Murray Valley" (Heathcote 1988, p. 135; Beresford et al. 2004). Nothing resulted, but faith in science remained apparently undented.

After World War II, governments developed irrigation with even greater enthusiasm. The sentiment was nowhere better captured than in a glossy promotional book published in about 1960 by the Australian Publicity Council, entitled *Liquid Gold Australia.* While devoted essentially to Victoria, in many ways it was a latter-day version of Brady's *Australia Unlimited* and even used that phrase as the title for its introduction. The book propounded the message that "parts of the continent are exceedingly fertile and others are potentially fertile but lack adequate rainfall" (Turnbull 1960, p. 3). The solution, of course, was irrigation which, one would gather from the colored photographs, was already performing agricultural miracles, especially in the Goulburn Valley.

Spurred by such visions, by the mid-1960s, the area under irrigation had risen in both Victoria and New South Wales to nearly 1.3 million acres (526,000 hectacres), in Queensland to 300,000 acres (121,000 hectacres), in South Australia to 100,000 acres (40,000 hectacres), and in Western Australia to about 60,000 acres (27,000 hectacres) (Davidson 1969, p. 78). The industry gathered even greater pace and the volume of water extracted for irrigation increased by

76 percent between 1985 and 1996/97. By the end of the century, irrigation consumed 75 percent of the water used in Australia (Australian State 2001). Large areas of northern and central Victoria were irrigated by the Murray and its tributaries, but it was New South Wales that saw the largest growth as the Murray, Darling, Murrumbidgee, and other rivers had their waters diverted. Large areas of central New South Wales came under cropping, including new crops such as cotton and (almost beyond belief in the middle of the world's driest continent!) rice.

In 1969, the economics of irrigation were profoundly questioned by agricultural economist B. R. Davidson. He revealed that while only 10 percent of agricultural commodities were produced on irrigated land, over 90 percent of the water conserved in Australia was used for irrigation. He questioned the economics of this vast national expenditure and argued that Australia could produce all the food and fiber it needed without irrigation. Besides, the economics did not hold water:

> . . . farmers on all Australia's major irrigation schemes are supplied with water at a price which is only sufficient to pay the operating expenses of the schemes and not the interest on the capital invested in them. In these circumstances, how can irrigation be termed a profitable investment? . . .
>
> Few Australians realise that the total cost of settling farmers on irrigated farms, including the cost of constructing water storage and distributory works, is far higher than the cost of settling the same number of people on dry land farms. . . .
>
> The conflict between what the Australian people think irrigation achieves and what even a cursory glance at the evidence available suggests it does achieve presents a striking contrast. (Davidson 1969, pp. 3–5)

The accumulating consequences of irrigation for the environment were profound. In the haste to irrigate, until late in the century there was relatively little effort to provide drainage of excess water. Pouring irrigation water onto land can cause a rise in the water table and eventually a waterlogging of the surface. Even more catastrophically, the rising water can bring into the root zone of plants or to the surface the accumulation of salt that lies beneath the soil across large areas of Australia. In the last four decades of the century, the area of irrigated land that was salt-affected rose alarmingly. Many solutions were attempted, but too little and too late. The easiest early "solution" in the eastern states was to pump the salty water into the water systems, from where it generally entered the Murray, further degrading the river which was already under stress from the increasing range of human activities within its catchment. Late in the twentieth century, more sophisticated and successful techniques were introduced to deal with the salt but, by then, decline of the Murray had become an ecological catastrophe (Barr and Cary 1992; Young 2000; Dingle 1984).

WATER

The Murray River is Australia's only reasonably large river. It stretches 2,570 kilometers from its source in the Alps to its mouth at Lake Alexandrina in South Australia. Its largest tributary, the Darling River, is even longer at 2,740 kilometers, although it carries far less water. The Murray-Darling catchment area sprawls across more than 1 million square kilometers, about a seventh of the continent, occupying more than half of Victoria and New South Wales, much of southern Queensland, and a significant part of eastern South Australia. The Basin is the source of 45 percent of Australia's gross food production as well as other significant economic activity. Nearly 2 million people live in the catchment, while another 1 million are heavily dependent upon its water (Sinclair 2001, p. 16; Young 2000, p. 47; Australian State 2001, p. 58; White 1997).

By the end of the twentieth century, the Murray River and the Murray-Darling Basin were in a state of ecological disaster.

To foreign eyes, Australian rivers in their natural state behave in very strange ways. Apart from those in the moistest corners of the continent with the most regular rainfall, the rivers tend to be intermittent. They flow wide during wet months, flooding large areas and forming wetlands. During the dry season, many are reduced to a low and sluggish flow or just a chain of billabongs and pools, like Cooper Creek in western New South Wales and the Avon River in Western Australia. Other rivers become lost in the inland deserts or, near the coast where they are only intermittently able to force their way through the coastal dunes, the water is retained in coastal wetlands. Over hundreds of thousands of years, Australian ecosystems evolved to suit this feast or famine of water. Large areas of inland Australia, notably the Murray-Darling Basin, were dependent upon such periodic flows.

By late in the twentieth century, the majority of the waters of the former "Mighty Murray" had been dammed and diverted for irrigation, domestic, and other uses, and many of its former wetlands had been drained for grazing and cultivation. The seasonal cycle had been reversed and the river ran nearly full in summer when irrigation water was needed, and ran low in winter when dams were refilling. The river was also suffering from declining quality because of salt and silt, fertilizers and pesticides that seeped into it principally from agricultural and pastoral properties. At times, fish were killed in large numbers by these chemicals, or parts of the river and its tributaries turned green with algal blooms. The aquatic life that occupied the river, such as the Murray cod, was fast disappearing. The large floodplains and wetlands with their stands of majestic river redgums (*Eucalyptus camaldulensis*) depended upon its periodic overflow of water for regeneration and ecological health. They were now denied

these vital rejuvenating flows and were dying. At times there was even insufficient water in the Murray to keep its ocean mouth open and it silted over. The people who depended upon the Murray for domestic water, including a large part of the city of Adelaide, were facing a crisis. Adelaide's drinking water is predicted to exceed salinity guidelines on two days out of every five by the year 2020 unless there is effective action.

One of the major obstacles to overcoming these problems is that the Murray-Darling Basin covers parts of four states, and any agreement must overcome the parochial and political interests of the states and gain cooperation from the federal government, which holds the purse strings. To obtain agreement whether to allow the Murray the 1,500 gigalitres it needs for environmental health and to decide which consumers will have to give up part of their rights to enable it to happen, has taken years of negotiations. It is already too late for

Clearing land and streamsides of indigenous vegetation contributed to problems for both soils and water systems, including erosion and siltation. The contrast is very apparent between this area of indigenous bush beside the Margaret River in Western Australia and the bare and eroded banks of the adjacent paddock. (Photo courtesy of Don Garden)

the ecological health of many areas dependent on Murray water, but a begrudging intergovernmental agreement in mid-2004 paved the way for some initial environmental flows (Sinclair 2001; Melbourne *Age,* 27 Dec 1999, 28 July 2003; Powell 1993(a); Australian State 2001; White 1997; White 2000).

The fate of the waters of the Murray encapsulates one of the core themes in Australia's environmental history—how the nation's limited water systems have been perceived, utilized, and profoundly damaged. In essence, water has been conceptualized as a "resource" for human benefit; rivers and water systems were merely channels carrying the resource and could be manipulated as required. Because of such attitudes, an enormous engineering and financial commitment has been made to maximize the utility of the continent's water, principally by building dams and truncating water systems. Government funding of new dams slowed in the last twenty years of the century, largely because there were so few untapped rivers left to dam but also partly because of emerging environmental awareness. By contrast, there was a largely uncontrolled increase in the number of water storages on farms and other private land, which prevented water from flowing through the natural systems. This is immediately apparent when flying into any Australian capitol; one sees a landscape pockmarked with the dams that occupy almost every small property and paddock. Over the suburban areas, a predominant color is the green of lawns and exotic gardens which are regularly watered, while the sun glistens off the swimming pools that are found in the backyards of many homes. Dams, gardens, and swimming pools represent a tiny sample of the hydraulic manipulation and unwise water usage that has been an integral part of Australia's European history.

The fact that much of the continent is dry and the rainfall irregular has increased the challenge but not the caution about the ecologically damaging repercussions of such utilization.

Sometimes in Australia there is an "excess" of water as a result of winter and La Niña "flooding rains" and tropical downpours, or because of accumulation in wetlands. These have also presented challenges and have been the subject of great national enterprise. Rivers such as the Avon River in Western Australia and the Brisbane River in the Queensland capitol have been straightened, widened, and embanked to reduce the likelihood of floods. Many Australian wetlands are no longer very wet. The terminology is instructive, for in Western cultures "swamps," "bogs," and "marshes" have historically been depicted as dark and threatening, often represented as places of the alien, reptilian other (Giblett 1996). They were also associated with disease and miasmatic gases. To drain them was to "reclaim" the land for some utilitarian purpose. Since the late nineteenth century, many of these undesirably wet areas, such as the vast Koo Wee Rup Swamp in southern Victoria, have been "improved" by drainage

to make the land available for cultivation and grazing (Roberts 1985). In Victoria and New South Wales, 35 percent of wetlands have been lost, mostly in the twentieth century (Beale and Fray 1990, p. 77). Only in recent decades has it come to be appreciated that wetlands are among the most dynamic and complex of ecosystems. They are biologically rich and make a broad environmental contribution by filtering water and regulating its flow and its content of nutrients and minerals. This recognition resulted in attempts from late in the century to recreate wetlands in some places and to protect those that remain.

One of the largest Australian hydraulic engineering projects was undertaken in Western Australia at the start of the twentieth century. The western colony had grown slowly in the nineteenth century, held back by the harshness of its land and climate. When gold was discovered in the 1890s, it stimulated population and economic growth, but full progress was retarded by the remoteness of the goldfields, which lay several hundred kilometers east of Perth in a harsh and arid region. The shortage of water inhibited the development of mining and of the region in general. In 1898, the colonial government legislated for a grand scheme. The Helena River in the Darling Range near Perth was to be dammed by a weir at Mundaring. From there, the water was to be piped 600 kilometers to Kalgoorlie. The work was dogged by technical difficulties, delays, and criticism. It was all too much for the brilliant designer and chief engineer, C. Y. O'Connor, who committed suicide nine months before the scheme opened in January 1903. From most points of view the Mundaring scheme was a great success as it brought a reliable supply of water which enabled the eastern goldfields to expand and prosper (Tauman 1978; Powell 1998). However, there is no indication that any consideration was given to the environmental repercussions in the Darling Range. The truncation of a river's water greatly reduces the flow upon which downstream life depends. It destroys ecosystems and generally reduces a stream to a chain of muddy ponds except in the height of the wet season.

Such truncation and degradation of water systems in the interest of domestic supplies had begun in the hills near the capitol cities and major towns in the second half of the nineteenth century and was to continue throughout the twentieth century as urban centers grew (especially after World War II) and stamped their ecological footprints firmly across their hinterlands. By late in the twentieth century, all readily available water systems near the capitols had been diverted to urban purposes and the cities were facing a dilemma about how to secure adequate future supplies. In Perth, there was a major drop in average rainfall in the last two decades of the century (perhaps because of global warming), and groundwater had been extensively used for garden watering, causing a steep decline in underground reserves. Adelaide was in an equally parlous situation as its low rainfall and small water catchment areas had resulted in increasing depen-

dence upon piping water from the Murray River. As the quality of Murray water plummeted, Adelaide's potable water became an urgent issue. In all states, domestic water shortages loomed, especially in the increasingly frequent periods of El Niño droughts in the 1990s and early twenty-first century. Whereas until the 1990s, the usual government reaction to droughts and water crises had been to build more dams, at the start of the new century governments were tending more to educate people about water conservation and to try to find other ways to reduce consumption. It is notable that a frenzy of privatization of public utilities late in the twentieth century did not include water authorities—a recognition that water was more than a commercial "resource."

While struggling domestic supplies impinged most overtly on urban Australians, the vast majority of conserved water in the country, as already discussed, was for agricultural purposes. The scale of water system manipulation was such that, by late in the twentieth century, there were scarcely any significant river systems on the continent and very few in Tasmania, which had not been dammed or diverted for agricultural, domestic, or power generation purposes. Three of the largest projects serve as exemplars—the Snowy Mountains Scheme, and the Burdekin Catchment and Ord River projects.

The Snowy Mountains hydroelectric and irrigation scheme was Australia's largest and most expensive civil engineering project when it was undertaken in the 1950s. It involved the diversion of waters from a number of streams in the Snowy Mountain region of New South Wales. Seven large dams, 145 kilometers of tunnels, 16 power stations, and hundreds of kilometers of race lines tell the engineering story of a project that was progressively opened over a period of twenty years beginning in 1955. The scheme greatly increased electricity generation for the eastern coast and stored huge volumes of water for release into irrigation systems, principally in New South Wales. It was a great technical achievement, a tale of development and mastery. However, in the 1990s, the environmental story increasingly came to be told. The scheme had had a considerable impact on controlling and regulating the flow of water in the Murray River, and was one of the principal causes of the decline of natural environmental flows, which were critical to flush the river and regenerate the river redgum floodplains. Other truncated systems were also shown to be under stress, notably the Snowy River, which had formerly flowed southeast into Victoria but now trickled with only 1 percent of the water it had previously received in its headwaters. The river was reduced to a chain of ponds for much of the year, and the farms and towns through which it passed on its way to the sea were profoundly affected. Environmentalist George Seddon wrote movingly about the changes in the river in his innovative 1994 work, *Searching for the Snowy: An Environmental History.* In the 1990s, the decline of the Snowy became a political issue, especially in Victoria. The electorate

through which it ran elected an independent member to the state parliament who was committed to having the flow restored. His pressure was instrumental in an agreement in the year 2000 to divert a small amount back to the Snowy, intended to rise eventually to 28 percent of former flow, which was considered the bare minimum to restore its ecological health (McHugh 1989; Seddon 1994; Melbourne *Age,* 19 Jan 2000, 7 Oct 2000; Australian State 2001; Miller 2005).

In the years after World War II, attention also turned to Australia's northern third. A largely "empty" land because of its difficult environment, its vulnerability emphasized by wartime Japanese attacks upon Darwin and Broome, development now seemed even more urgent. An enticing element in the north, especially in the tropical regions, was its extensive rainfall in the wet season. If the water were dammed, so it was argued, rather than allowed to run to waste inland or out to sea, it could create an irrigation-based agricultural industry—again the dream to make the deserts bloom. A number of schemes commenced in the 1950s, notably at Humpty Doo in the Northern Territory (a short-lived research project aimed at evaluating the potential of rice growing, but had little success largely because of difficult soils), the Burdekin Catchment in Queensland, and the Ord River in Western Australia.

The Burdekin Catchment encompasses an area of 130,000 square kilometers inland between Townsville and Mackay in north-central Queensland. The region was subject to periodic severe flooding and was therefore a prime target for a scheme that would combine flood mitigation, prevention of water being allowed to "run to waste," the provision of irrigation water for hundreds of new farms, and hydroelectricity generation. Work began in the 1950s, with large areas cleared for agriculture, notably sugar cane and tobacco. There were also extensive projects to tap groundwater and to conserve rainwater by damming the Burdekin and Broken Rivers. Despite the huge capital investment, the manipulation of large quantities of water, and the creation of many new farms, under virtually no circumstances could the scheme be judged a substantial success. In 1965, B. R. Davidson pointed out that financial returns fell far short of viability. Farmers struggled and many failed, and the environment suffered from loss of habitat, erosion, siltation, and other damage (Davidson 1965; Powell 1991; Powell 1998; White 2000).

The Ord River in northern Western Australia was dry for much of the year, but in the tropical wet season an average 5.4 million megaliters passed through the system. This was seen as a classic case of water being allowed to run to waste, and moves began after World War II to rectify this "fault." Dams were built and irrigation crops of rice, cotton, peanuts, sunflowers, sugar, and others were planted. However, as with Esperance, there were problems with pests, soil quality, and economics, and cotton had to be abandoned. Nevertheless, the area

survived as an agricultural region and, after years of struggle, began to expand again in the 1990s (Davidson 1972; Powell 1988; White 1997).

These northern schemes all had a number of elements in common, including the environmental repercussions of cutting off downstream riparian flows. The Burdekin system also had an impact through its plume, which flowed into the Pacific Ocean, polluted with chemicals and silt from the sugar farms, and which degraded the Great Barrier Reef. One of the main criticisms of these attempts to irrigate the north was again directed at their economics, and came again from B. R. Davidson in his 1972 edition of *The Northern Myth: Limits to Agricultural and Pastoral Development in Tropical Australia.* He concluded, as he had with irrigation in the south of the continent, that the returns would not justify the capital outlay.

On a more positive note, it should be recognized that the dams have created large bodies of water in which aquatic and avian life have thrived, especially in the case of the Ord scheme. The species of flora and fauna that have benefited from the opportunities offered by the multitude of new water sources include ducks and other water birds, rushes, frogs, and yabbies (small freshwater crayfish) (Low 2002).

FIRE

In January 2003, a series of enormous bushfires and firestorms raged across large areas of eastern Victoria and southern New South Wales. At their peak, the fires broke out of public reserves and private farmlands around the Australian Capitol Territory and the nation watched with horror as they crossed into the Territory and attacked Canberra's domestic fringe. Four people died, and more than 400 homes were lost, as well as public institutions such as the Mount Stromlo astronomical observatory. There were major losses of flora and fauna, with some threatened species pushed even further toward extinction. When rains followed the fires some weeks later, there was serious erosion of exposed soils, and large volumes of silt and ash were washed into the already damaged water systems (Clack 2003).

The last embers of the fires had not been extinguished before recriminations commenced. Some were spitefully political cheap shots, principally taken by a minister in the conservative federal government at the state and territory Labor governments. Some people directed their frustration at the failure of the fire services to cope better with the fires. Forest industry representatives (the timber cutters) suggested that they could prevent future bushfires if they were given control of the forests! A significant amount of media and community

anger, however, was aimed at the "greenies" who were seen to have contributed to the extent of the fires by opposing the clearing of native bushlands, especially in national parks. In country Victoria, a man whose property and residence were burned vented his anger at the "raving looney greenies" by cutting down 1,000 trees in a national park adjoining his property. The court indicated its level of concern at such environmental vandalism by making him pay a paltry $500 (US$300) into the court fund and not recording a conviction (Melbourne *Age,* 5 Nov 2003). (In case I am accused of being unsympathetic to a bushfire victim, I should point out that I have twice lost my residence in bushfires.) Such arguments, debates, and emotions are indicative of the ongoing misunderstandings and difficulties associated with living in the fire-prone continent.

Bushfires have been part of European occupation of the continent and, as discussed in Chapter 3, were often made worse by changes in the landscape that followed the discontinuation of Aboriginal burning regimes. The twentieth century was peppered with often creatively named conflagrations, among the most intense of which were: Black Friday 1939 (principally Victoria); Black Tuesday 1967 (Hobart); Ash Wednesday 1983 (South Australia and Victoria); and in 1994, fires that penetrated the Sydney suburban fringe. Not surprisingly, fire has attracted the attention of environmental historians. American Stephen J. Pyne wrote one of his many fire histories on the combustible continent, *Burning Bush: A fire history of Australia,* and Tom Griffiths has written about the 1939 fire in a number of places, depicting it largely as a cultural creation resulting from changed burning practices. He has also paid high praise to Judge Leonard Stretton who inquired into the 1939 fires and whose recommendation led to a reorganization of the Victorian fire services (Pyne 1991; Griffiths 1993; Griffiths 2001).

In the late decades of the century, significant conceptual changes in relationship to fire emerged in the scientific and then the wider communities. One of these was a developing understanding of El Niño episodes and a growing appreciation that dry periods or droughts were not an aberration in the Australian climate but rather a periodically occurring natural phenomenon, which should be planned for in agrarian industries and fire control. Another new understanding was of traditional uses of fire by Aborigines and their role in creating the landscape. It was realized that periodic cool fires, such as those lit by the Aborigines in open forested areas, alleviate the threat of major bushfires and more closely replicate the fire regimes around which ecosystems had evolved. Further, it was realized that fires in densely forested areas, where Aborigines did not burn, are a necessary occasional and natural occurrence and the health of some forests is dependent upon periodic though not too frequent fires. A distinction and a debate emerged among fire, forestry, and environmental experts between "cool burns," aimed at reducing loads of combustible material, and "ecological burns," de-

signed to replicate Aboriginal burning or to provide fires that were appropriate in period and intensity to promote regeneration and ecological health.

There have been major problems in applying and intermeshing this hodgepodge of understandings. The timber industry and some forestry administrators have tended to grasp the concept of frequently cool burning forests as a way of reducing the threat of major bushfires. They have even argued on the basis of very suspect and self-serving "evidence" that clear felling forests is the ecological equivalent to a bushfire! Such practices place the ecology of forests at risk, and have met environmental and some scientific opposition. By contrast, more ecologically oriented scientists and environmentalists have become exponents of periodic ecological burning of open forest lands. However, the problem with introducing such a practice is that there is insufficient understanding of Aboriginal burning patterns, especially in the south where so much of the culture has been lost, and the danger that inappropriate burning frequencies and intensities could kill off the species they are endeavoring to protect. Even if such knowledge existed, Australian national parks services, forestry, and environmental departments are so underfunded that they lack the expertise and staff to undertake such a burning regime. The lack of political will to deal with these matters was one of the most significant factors contributing to the extent and ferocity of the 2003 fires.

Another element in the fire dilemma is the increasing number of people who live on the urban-bush interface around Australia's expanding cities. Many fringe dwellers, attracted to the cheaper and larger blocks of land or the chance to live near gum trees and native birds, surround themselves with (fire-prone) bushland. Others, driven by a fear of fire and infected by the tidiness virus, clear, chop, and mow until they have destroyed the bush and replaced it with a new suburbia of lawns, birch trees, and rose beds. Neither approach is particularly good in the Australian environment. The former properties are vulnerable to devastating fires while the latter properties waste water and act as an avenue for invasion of the bush by garden species which become environmental weeds.

While the debates about how to live with the Australian bush continue, uncontrolled bushfires will be part of the Australian way of life. And the "greenies" will be an easy target to blame—rather than the politicians who are essentially responsible.

ENVIRONMENTALISM

The emerging understanding of the role of fire in the Australian environment was indicative of the transformation of environmental knowledge across the

planet in the twentieth century. Until Darwinism opened human eyes to evolution, the study of natural history in Western science had been largely reductionist—to break down and study nature through its individual components. Following Darwin, there was a trend toward a more holistic understanding of the broader environment, of the communities within which species live, and the interdependences between them. From this came the study of ecology, which revolutionized not only human knowledge of nature but also, in recent decades, has informed understandings of how humans should interact with the nonhuman world. It forms the basis for green environmentalism, a belief that humans need to see themselves as part of nature, not apart from it.

At the end of the twentieth century, concern about the environment was infiltrating the general population, although for most people it probably resulted in little more than putting out their recycling each week for collection. However, in both the scientific and broader communities, there had been a growing interest in nature conservation, and in the late decades of the century an increasing diversification and sophistication of conservation and environmental attitudes and philosophies. The principal stimulant for such concerns, in Australia as elsewhere, was mounting awareness of the loss of the natural world and talk of global climate change and other impending threats to life on the planet. In the first half of the century, environmental concern was still essentially anthropocentric and utilitarian, focused on the establishment of areas of conservation protection and the creation of new national parks. After World War II, the increased pace of environmental change and knowledge stimulated a broad range of professional, government, and non-government bodies concerned with environmental study and protection, and put the environment onto the political agenda.

Interest in nature in Australia, and concern about its preservation prior to the 1950s, can be summed up in the work of five men—Donald Macdonald, Charles Barrett, Crosbie Morrison, Francis Ratcliffe, and Myles Dunphy. Macdonald and Barrett were Melbourne amateur naturalists and nature writers who consciously placed themselves in the literary tradition of Gilbert White and Henry David Thoreau. In the early decades of the century, in newspaper articles and books, they sought to share with and educate the general public in their love and understanding of nature. Crosbie Morrison continued this work from the 1930s, at first in print, but then through a long-running and highly popular radio program, and finally for a period on television. Francis Ratcliffe was an English biologist and ecologist who fell in love with Australia. His principal work, *Flying Fox and Drifting Sand,* drew attention to the plight of the flying fox and expressed profound concern at the extent of land degradation (See A to Z). In some of the Australian states, bushwalkers were among the most promi-

nent advocates of conservation, their epitome being Myles Dunphy who campaigned mainly in New South Wales for the creation of national parks. Unlike most of his predecessors, his motives and philosophy were not essentially anthropocentric, and he sought equally to preserve areas of wilderness for their perceived intrinsic significance. He has become one of the few widely recognized, historically significant Australian environmental campaigners (Meredith 1999; Griffiths 1996; Pizzey 1992; Mulligan and Hill 2001).

Such conservation and nature-promoting trends in Australia continued largely to follow the patterns that were being set in North America. In the 1960s and 1970s, American environmental writers like Vance Packard, Rachel Carson, Paul and Ann Ehrlich, and David Suzuki were probably better known than their Australian counterparts such as Jock Marshall, Vincent Serventy (who also had a television program), Eric Rolls, Len Webb, Geoff Mosley, and Charles Birch (See Bibliographical Essay). The concern that these writers collectively expressed and the attention they received, perhaps especially Rachel Carson who wrote *Silent Spring* (1962), is attributed by some with having given rise to the increasingly complex environmental philosophies and the modern environmental movement.

The most significant new element in environmental understandings was ecocentrism or biocentrism, an environmental philosophy that sees ecosystems as the center of the natural world and, on that basis, values all life equally and sees all life forms as equally worthy of preservation. Such concepts developed most strongly in the decades after World War II, underpinned by emerging scientific understandings of the interconnectedness of life (ecology) and stimulated by environmentalists such as Carson who promoted public awareness of the repercussions of human actions on the natural world. It is a philosophy that argues that humans must be viewed as a part of nature, rather than apart from and superior to nature. It therefore stands in direct contradiction to the anthropocentric views that previously dominated Western attitudes to nature. It is also significantly at variance with the early form of conservation thought that developed in the second half of the nineteenth century—anthropocentric utilitarian conservation, which sought to conserve parts of nature for future human benefit. By the late twentieth century, these two environmental belief systems (utilitarian anthropocentricism and ecocentrism) lay at the opposite poles of a gradation or continuum of attitudes toward the environment.

From the 1960s, as awareness of environmental matters penetrated society and as the increasingly diverse range of environmental philosophies gained public attention and adherents, the environment became a source of public concern. Initially, the main focus was upon the impact of environmental degradation upon the quality of human life—the anthropocentric concerns were largely

dominant. Nevertheless, public pressure and government sensitivities resulted in the environmental issues becoming public and political causes. Environmental groups were established to lobby and to work at the three levels of society: Federal, notably Australian Conservation Foundation in 1965; state, including the Wildlife Preservation Society of Queensland in 1962, Nature Conservation Council in Western Australia in 1967, Tasmanian Conservation Trust in 1968, Conservation Council of Victoria in 1969, Conservation Council of South Australia in 1971, and the Total Environment Centre in Sydney in 1972; and a diversity of local groups concerned with particular issues and places (Hutton and Connors 1999). Governments responded to mounting environmental problems and debates by gradually introducing a raft of environmental legislation and authorities, often (initially at least) with few teeth or little power. The first Environmental Protection Authority was established in Victoria in 1970 to oversee such matters as air and water quality control (Unglik 1996). Other states followed, but the authorities generally suffered from inadequate funding and political and industrial pressures that inhibited their effectiveness. Governments also introduced requirements for Environmental Impact Statements for major projects and developments, with mixed success. Increasingly, environmental issues were drifting into the courts as competing interests set out to test the strength of the new laws and authorities (Hutton and Connors 1999).

In turn, these new authorities and legislation were a reflection not only of mounting community awareness and concern, but also of the environment as a potential political issue. Environmental matters first emerged as political issues capable of influencing voter preference in the late 1960s, and have continued to do so although significantly ebbing and flowing according to economic and other circumstances. Among the early controversies in the 1960s were an attempt by the Victorian government to hand over much of the uncleared land in the Little Desert for agriculture, and the Queensland government's encouragement of oil drilling on the Great Barrier Reef (Robin 1998; Hutton and Connors 1999). However, the most critical campaign in making the environment a consciously public and political issue was Lake Pedder. Perched high in the mountains in southern Tasmania, Pedder was a lovely small lake, noted for its pure sandy beaches and evocatively surrounded by mountain peaks. In 1967, it was proposed to dam the lake's outlet to create a large body of water several times the original size. The reasons lay in Tasmania's economic dilemma. It is the smallest of the Australian states, with a resource base limited essentially to its forests and plentiful rainfall. Exploitation of these has been central to Tasmania becoming the focus of several of Australia's most important environmental campaigns. It has been widely believed in Tasmania that the way to a better future for the State was to use its rainfall and rivers to generate cheap hydroelectricity which would attract

industry. Tasmania's Hydro-Electric Commission (HEC) vigorously pursued this goal after World War II, developing great economic and political power as it steadily dammed Tasmania's rivers. However, its proposal to dam Lake Pedder produced an unexpectedly strong reaction from those who appreciated its beauty and significance. A campaign was begun that steadily won support both in Tasmania and on the mainland. Devious state governments of both major political parties, in league with the HEC, pushed ahead with the scheme, steamrolling any opposition. Flooding began in 1972, and the lake was lost (Hutton and Connors 1999; Pybus and Flanagan 1990; Lohrey 2003).

The memory and the experiences of the campaign re-emerged late in the 1970s when the HEC proposed to destroy yet another area of wilderness around the lower Franklin and Gordon Rivers on the west coast. This was an area of great beauty and biodiversity, one of the few remaining unspoiled wet temperate wilderness regions in the world. An even greater protest was organized than for Pedder, headed by Dr. Bob Brown and the Tasmanian Wilderness Society, which had been formed in 1976. A sophisticated campaign simply caused the Tasmanian authorities to speed the work, but a sudden change of government at the federal level brought in Bob Hawke as prime minister, elected on a promise to stop the dam. Hawke acted and while the Tasmanian government fought the decision in the courts, it finally had to admit defeat, although it continued to approve the damming of other areas and the clear felling of native forests (see A to Z) (Hutton and Connors 1999; Green 1981; Wilderness Society 1983; Lowe 1984; Pybus and Flanagan 1990; Doyle 2000; Lohrey 2003).

The 1970s and 1980s saw several other major campaigns—against uranium mining, against sand mining on Fraser Island, and in particular, to stop the loss of Australia's remaining forests. Trees and forests became a focus of the environmental movement, especially the remaining "old-growth forests" (had never previously been cut). It has been argued that the concentration on forests was something of a distortion or misdirection of effort, similar to the emphasis on a few icon animals such as koalas and bilbies. It meant that many less "sexy" elements in the environment, such as arid lands and frogs, were neglected. By contrast, it has been argued that forests are such an obvious and attractive part of the environment that they can be used to stimulate environmental awareness and involve people in environmental issues. Besides, there are few elements in the landscape that are as important as trees, and their excessive exploitation can be devastating to the environment and to the societies dependent upon them.

The main reason for the higher intensity of debate over old-growth forests was an increased pace of logging after World War II. Initially, this was in response to a higher demand for timber for housing and other domestic purposes. That caused minor controversy as beautiful stands of forest were destroyed, but

Environmental protests and expressions take many forms, and the arts community has contributed in many ways. Concern about the degradation of water systems in modern consumer throwaway society is expressed by artist Tony Flint in "Confluence" (Acrylic on canvas, reproduced with permission of the artist)

the issue opened a long period of dispute between those who sought to exploit Australia's old-growth forests and those who sought to protect them. It is a complex issue because there are workers, families, and communities who depend on the timber industry for their livelihood, and environmentalists threaten the livelihood of the timber communities by opposing the short- and long-term environmental repercussions of the industry (Watson 1990; Crawford and Crawford 2003). Logging of old-growth forests became particularly explosive after the decision in the late 1960s to export wood chips to Japan for paper making. Part of the original justification for the industry was that only waste from timber felling would be chipped. However, it became increasingly apparent that enormous swathes of forest in areas such as Eden on the south coast of New South Wales and in Western Australia were being cut for the chipper. Protests developed in the 1970s, but the industry flourished under the protec-

tion of governments more preoccupied with income and "development" than the environment. By 1990, about half a million hectares of old-growth forest had been clear cut (Dargavel 1995, pp. 162–163; Routley 1974).

One of the major flashpoints in the fight for the forests was in northern Tasmania in 1988 to 1989 when the government agreed to a proposal to establish a huge new paper pulp mill at Wesley Vale, which would produce 440,000 tons of pulp per annum. This monstrous mill would consume vast areas of forest while also threatening environmental damage from its processing and waste. The 1989 Tasmanian elections were fought to a substantial degree over the issue of Wesley Vale, and the Tasmanian Greens won sufficient seats to hold the balance of power in the state parliament. The Greens chose to support the Labor Party, who then formed a government. The Wesley Vale scheme was dropped, but the experiment in cooperation between Greens and Labor was unsuccessful and fell apart, embittering both sides (Hutton and Connors 1999; Dargavel 1995; Pybus and Flanagan 1990; Lohrey 2003).

While the cutting of forests was a state government responsibility, timber companies needed licences issued by the Commonwealth government to export timber and chips. During the early years of the Hawke government, in the mid-1980s, there was a heightened level of concern about loss of forests, which resulted in the imposition of slightly greater control over the industry. However, later in the 1980s, woodchipping volumes were allowed to increase, causing anger and protests among environmentalists. An attempt to devise a national forest policy to take the heat out of the issue was finalized in 1992 but was rejected by the environmental lobby because it did not provide for phasing out of the logging of old-growth native forests. So the controversies continued, and by the mid-1990s, the woodchip exporting system, especially under the Keating government (1992 to 1996), was degenerating into farce. Decisions on the volumes of woodchips to be exported were made on an annual basis by the Minister, and generally both the industry and environmentalists were left dissatisfied. In January 1995, timber workers blockaded Canberra with their trucks to try to pressure the Labor government to be generous with woodchip licences. Such actions underlined the problem for the Labor Party, which encompassed within it both people of green conscience and union members who were principally interested in maintaining jobs.

The Keating government then set out to establish a series of scientifically based and sustainable Regional Forest Agreements (RFA) across the nation which would provide longer-term, balanced regional arrangements with agreed volumes of timber to be cut, chips to be exported, and areas to be protected. Their intention was to give greater certainty to the industry while building in long-term environmental preservation. When elected in 1996, the conservative

The timber industry cut out large areas of Australia's limited forests in the nineteenth century, but only a tiny proportion of the great onslaught in the twentieth century, especially after World War II. Tasmania was, and still is, particularly dependent on the export of timber and woodchip exports for employment and income. This image was taken in the Geeveston Forest, Tasmania, early in the twentieth century. (E. J. Brady, Australia Unlimited, Melbourne, 1918, p. xxxvi)

Howard government continued the process and the agreements were finalized over the next few years. Predictably, they did not satisfy anyone. An increase in both the area of old-growth forest that was to be protected and in the total native forest held in conservation reserves, produced further complaints from the timber industry that it would have insufficient future access to timber. However, the environmentalists protested louder. They were outraged at the inadequacy of the area of forest that was to be protected and at the continued cutting of ecologically significant areas. These included the Errinundra Plateau in Victoria, the southwest jarrah and karri forests in Western Australia, and the Tarkine region of Tasmania (Hutton and Connors 1999; Lohrey 2003; Australian State 2001; Crawford and Crawford 2003). Public protests in several states

caused governments to refine the boundaries and to reduce the cutting of old-growth forests. Meanwhile, controversy surrounding this matter also continued to plague the Labor Party and its union members. In the October 2004 federal election, the timber workers' union in Tasmania campaigned against Labor because the party proposed to review the RFA and offered a package to curtail the logging and restructure the industry. The pro-logging Tasmanian Labor government also attacked its own federal party. This division in Labor as well as the low priority given by the electorate to the environment are seen as major reasons why the Labor vote actually declined in the election.

Forestry and loss of "wilderness" had, since the 1980s, been a key issue for the small and fluctuating "green" vote and for the small green parties. At the federal level, there was a green presence in the Australian Senate beginning from the 1980s when the Australian Democrats was established—a party with a strong green leaning. There was also a series of environmentally motivated Senators who were elected on anti-uranium mining or other specific environmental issues, or who represented the emerging specifically green parties. The 1990s was a bleak period politically as environmental issues were largely swamped by an economic downturn, but from the end of the decade, a more united Australian Greens Party began to lift its support under the impressively dignified and principled leadership of Dr. Bob Brown (Lohrey 2003; Hutton and Connors 1999). Early in the twenty-first century, at both federal and state levels, the Greens and environmental issues came increasingly to the fore and the Greens recorded higher voter support in a number of elections. Because of Australia's preferential voting system, this placed them in a position to influence elections and occasionally to win places in parliament.

Such support for the Greens forced the main political parties (Labor, Liberal, and National) to take the environmental vote more seriously, but there were few signs that they had the knowledge, understanding, or will to make hard decisions and to tackle the profound environmental issues that were confronting the nation. Labor exhibited greater environmental credentials, but the Liberal-National coalition that was in power at the federal level provided little more than token expressions of concern and dribbles of inadequate funding.

At the start of the twenty-first century, the Australian community was divided over environmental issues—there were those who strongly supported the environmental cause and those who believed that the only good greenies were those found underneath the tread of their 4-wheel-drive tires (sport utility vehicles in American terms). The large and generally silent majority was slowly becoming environmentally aware, although the environment still did not rate as highly as many immediate issues such as economic growth. Dated and dangerous outright opposition to environmentalism was in steady decline, and public

awareness and ecological and sustainable sensitivities were increasing, but there were still major economic interests, anthropocentric attitudes, and pockets of ignorance that denied the value of ecosystems, biodiversity, and a healthy environment.

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5

"AND MAR THE LOVELINESS OF AGES": NEW ZEALAND AND THE PACIFIC TO 2001

Gone are those gentle forest-haunting things,
Eaters of honey, honey-sweet in song,
The tui and the bell-bird—he who rings
That brief, rich music we would fain prolong,
Gone the wood pigeon's sudden whirr of wings,
The daring robin all unused to wrong,
Ay, all the friendly friendless creatures. They
Lived with their trees and died and passed away.

The axe bites deep. The rushing fire streams bright;
Swift, beautiful and fierce it speeds for man,
Nature's rough-handed foeman, keen to smite
And mar the loveliness of ages. Scan
The blackened forest ruined in a night,
A sylvan Parthenon that God will plan
But builds not twice. Ah, bitter price to pay
For Man's dominion—beauty swept away!

—W. P. Reeves,
"The Passing of the Forest," c 1898

These two stanzas are part of a poem that was inserted at the end of William Pember Reeves's 1898 history of New Zealand, *The Long White Cloud*. Reeves was an energetic young politician, writer, and historian whose history, while largely conventional in its acceptance or praise of European pioneering achievements in New Zealand, was unusual for its insertion of descriptive passages, at times delightful lilting appreciations, of New Zealand landscapes, particularly its forests. Even more unconventional was the

inclusion of a poem to fill the last pages of a history, especially a poem that contained such expressions of loss and regret at the passing of the forests and its inhabitants under the bite of the axe of "Nature's rough-handed foeman." It was a bitter price to pay for man's dominion—the loss of such beauty.

Such sentiments were becoming increasingly common in the New Zealand community in the late nineteenth century where the devastation of forests and resulting soil erosion had been immense. Expressions of regret at the loss of environment were also to be found elsewhere in Oceania and in Australia, although the level of degradation varied considerably across this vast region. Australia had proved large enough and had sufficient available resources to postpone the full impact of the damage that followed European arrival. Many parts of Oceania, especially in small, fragile, and vulnerable environments, were not as complex or resilient, and the damage was more rapid and extensive. By the end of the nineteenth century, ecosystems and human societies across much of the Pacific had been profoundly changed. The age-old loveliness of nature's paradise had been marred, and worse was to come in the twentieth century.

The sad fate of Guam in the Marianas in the northwestern corner of the Pacific encapsulates much of the human and environmental history of the European period in Oceania, although it also offers some informative contrasts. Guam was the first Pacific island to be landed upon by Europeans, the first to be colonized, and the subsequent course of events is representative of much of the colonial and postcolonial periods.

When Magellan emerged into the calm ocean west of Cape Horn in November 1520, his goal was the spices of the Moluccas in present Indonesia. Crossing thousands of kilometers of ocean, he saw only two small uninhabited islands before landing at Guam in March 1521. Guam, an elongated, coral-fringed, curving island, 50 kilometers long and up to 13 kilometers wide, is the largest island in "Micronesia." The northern half consists of an uplifted limestone plateau while the south is made up largely of volcanic hills and valleys. Prior to human occupation, it was substantially forested with a rich diversity of plant and bird life including the endemic Guam flycatcher and the flightless Guam rail, some small reptiles, and three mammals (bats). The first human occupants were the Chamorros who are believed to have migrated from Southeast Asia in about 3500 B.P. They retained many Asian cultural elements, including rice cultivation—the only Pacific peoples to do so. They introduced the usual suite of Pacific plants and also ate local species, fished, and through clearing, hunting, and introduction of alien species contributed to some loss of indigenous biota. The population has been variously estimated at generally from 30,000 to 50,000 people when Magellan arrived, and there was a highly developed local culture that, like Rapa Nui, boasted some impressive archaeological remains. In this case, there are rows of tall mush-

Latte Stones: This combination of upright column and rounded cap-stone (often made from a single large coral head) were used by the ancient Chamorro people, in sets of four, six, or eight, as foundation stones for elevated A-frame–style houses. Most latte sites are found in the jungle, along rivers, or on the beach. (Nik Wheeler/CORBIS)

room-shaped stone pillars or *latte,* which were probably stilts upon which the houses of the elite were built (this account of Guam based on: Rogers 1995; Thompson 1941; Carano and Sanchez 1969; see also Godard 1995).

As often occurred, there was initial friendliness between the local people and the European visitors as the Chamorros supplied the scurvy-ridden Spaniards with water and food. But misunderstandings followed, and Magellan sailed away leaving seven Chamorros dead and several houses burned. The Spanish did not succeed in wresting the Moluccas from the Portuguese but instead claimed the Philippines and in the sixteenth century began to colonize them. Over the next two centuries, the number of Spanish vessels plying the waters around Cape Horn and across the Pacific, mainly to the Philippines, was substantial, leading Oskar Spate to entitle his history of this period *The Spanish Lake.* The voyaging Spanish encountered other islands in the Solomons, Vanuatu, and the Marquesas, and there were regular visits to Guam to replenish stores in exchange for metal and other European goods. In all likelihood, diseases were introduced that commenced a slide in the population.

In 1668, Spanish Jesuit missionaries and their military protectors arrived to convert the Chamorros to Christianity. Their impact set patterns for what was to happen across the Pacific in the nineteenth century. There were some conversions, which caused division among the Chamorros, and the missionaries deliberately set out to undermine and destroy the traditional "heathen" culture. The consequent breakdown of traditional society, and resistance by some of the Chamorros against Spanish interference and influence, resulted in intermittent warfare until the end of the seventeenth century and the death of many Chamor-

Modern tourism in Guam. A large resort complex and hotel overlook the shore at Guam's Pacific Island Club. (Michael S. Yamashita/Corbis)

ros. While fighting continued, epidemics of European diseases (probably smallpox and influenza) further devastated the Chamorros. Robert Rogers has observed:

> The near-decimation of the Chamorros thus came from a number of causes—war, deprivation, diseases, disease-induced infertility, societal demoralization, and, finally, epidemics, all caused by the Spanish invasion . . . for each Christian killed, 100 or more Chamorros died in the Spanish conquest of the Marianas. (Rogers 1995, p. 71)

When the first census of the Marianas was held in 1710, it found only two islands still populated (Guam and Rota), with a combined population of a mere 3,539 people, but this is likely to have been an underestimate (Thompson 1941, p. 30). In the next two centuries, Guam remained a quiet backwater. The Spanish encouraged immigrants, many of whom interbred with the locals and brought a slow revival of the population, but the Chamorros and their culture were increasingly diluted.

The ecological effects of such depopulation are not well understood, but there would most likely have been some revival of aquatic and terrestrial species

and regeneration of cleared land. Countering these, however, the Spanish brought their own cultural influences and species from Spain, South America, and the Philippines. These included corn (which replaced rice as the staple), cacao, coffee, tobacco, horses, pigs, poultry, water buffalo, cattle and deer, and dogs, which formed packs and roamed the island. Here as elsewhere, burning the forest and grass to create cattle pasture and cultivable areas contributed to a decline in forests and facilitated erosion and weed dispersal. However, the level of economic activity was not high, and the locals adopted a casual and essentially subsistence existence, resisting attempts to develop a money-oriented export economy, for which they were often condemned by Europeans as lazy. One of the few sources of external income arrived in the second quarter of the nineteenth century when substantial numbers of visiting whalers spent periods in Guam resting; trading for food, water, and timber; and spreading venereal diseases.

Following the 1898 United States victory in the Spanish-American War, Guam was ceded to the Americans who then established a naval base there. This contributed to an increase in population, from about 10,000 in 1901 to 23,000 in 1941. The Americans also brought economic development as they endeavored to stimulate industry and increase exports. Coconut plantations for the export of copra to Japan expanded in the first quarter of the century. While the northern half of Guam retained areas of forest on its shallow limestone soils, the accessible areas of volcanic soils in the southern half were widely cleared and used for grazing and cropping. The island's capital, Agana, grew significantly, becoming the island's first urban center—with all the usual environmental, social, and cultural repercussions.

On 10 December 1941, two days after their attack on Pearl Harbor, the Japanese captured Guam. In the next two and a half years, the local people suffered the brutality and executions associated with Japanese occupation; several thousand troops with horses, military equipment, defense works, and waste also placed great pressure on the island's ecosystems. On 21 July 1944, following intense bombing, American forces commenced the campaign to retake the island. Nearly three weeks later, following one of the most bloody and intense battles in the Pacific, most of the Japanese forces had been defeated or captured. Agana had been completely destroyed and much of the island lay devastated. Ferocious fighting took place in the jungles, and even after the American victory, some Japanese managed to remain hidden until the end of the war and even for many years beyond. The last Japanese soldier did not surrender until 1972 (Crowl 1995; Masashi 1967; Carano and Sanchez 1969).

The war destroyed large areas of jungle, reefs, beaches, and other habitat on Guam, and left tons of wrecked military equipment and garbage, which were bulldozed over cliffs into the ocean. Much of this ecological damage was capable

of recovery, but another legacy of the war and the military activity was more insidious. In the three decades after the war, the forests of Guam gradually became quieter and eventually were blanketed by an eerie silence described in the title of Mark Jaffe's book, *And No Birds Sing.* Suspecting the chemical dichlorodiphenyl-trichloroethane (DDT) and other causes, in the 1980s, a number of scientists studied this phenomenon. They eventually discovered that the culprit was the brown tree snake (*Boiga irregularis),* a native of northwestern Melanesia and Indonesia. It had arrived during or soon after World War II, possibly brought by American soldiers to catch rats or accidentally carried in returning war material. Its presence on Guam was known, but because it is mainly nocturnal its impact on birds, lizards, rats, bats, and poultry was not recognized until it was too late. It is estimated that the snake destroyed the avian population of perhaps 300,000 birds, causing the disappearance of six of eleven forest species including the extinction of the Guam flycatcher. The Guam rail plunged from 80,000 birds in the late 1960s to only 1 known in the wild and 50 in captivity in 1985. The disappearance of birds and lizards had a flow-on effect for floral species, which were dependent on birds for reproduction, and also in an increase of populations of spiders and insects, which had been prey for the birds and lizards. In some of this carnage, the snake had been assisted by the cane toad (*Bufo marinus*), which had also arrived in Guam. The ecological balance was upset and the forests became silent. Efforts to control the snake have had limited success, and it has also infiltrated other parts of Oceania. In the 1990s, it was seen as a significant ecological threat to Oceania (Jaffe 1994; Quammen 1996; Quammen 2000; Lobban and Schefter 1997; *Honolulu Advertiser,* 11 Dec 2002; McNeill 2001).

In the 1950s and 1960s, most places in the Pacific apart from the French colonies and American dependencies became self-governing independent states. The people of Guam were given nominal semi-independent self-government in 1950, but the strategic significance of Guam for American foreign policy had increased—it had become "the Gibraltar of the American lake" (Rogers 1995). The United States hung onto significant control and military bases grew as Guam became a major staging post between the United States and Asia and the Middle East. By the 1990s, significant parts of Guam were highly urbanized and the northern half largely militarized, while the beautiful beaches and excellent diving (partly over World War II wreckage) attracted about a million Japanese and other tourists per year. Guam was overpopulated (approaching 150,000), and the destruction of its flora and fauna and other environmental stresses were causing considerable concern. Robert Rogers neatly summarized the depressing situation in 1995:

> Evergrowing garbage dumps and the use of pesticides on golf courses began to contaminate the water lens and wells. Many of Guam's reefs were dying from

> silt runoffs from construction sites. The progeny of brown tree snakes . . . now crawled everywhere, killing off native birds and even attacking small children. Only about 500 *fanihi,* the Marianas fruit bat, survived on Guam by 1990. *Koko,* Guam's unique flightless rail, numbered a mere fifty birds, and overfishing was reducing offshore fish populations. . . . The high-rise hotels along the beach disrupted the flows of fresh water from the plateau above. (Rogers 1995, p. 288; see also Lobban and Schefter 1997)

* * *

While the chronology and details vary, and leaving aside New Zealand for the present, Guam is indicative of the broad patterns of the environmental history of Oceania in the period since European arrival. This can be seen as occurring in three stages. The first was an initial period that, in human terms, involved cultural disruption accompanied in many places by significant depopulation. (There is continuing debate about pre-European islander populations and the extent of decline after contact—was it a "fatal impact" or something considerably less? Whatever the arguments, no one seems to have ventured that islander longevity or mortality were improved by the arrival of explorers, sealers, whalers, and missionaries [Denoon, Mein-Smith, and Wyndham 2000; See A to Z].) Environmentally, this first phase saw rapid exploitation of those Oceanic resources that were of value to European economies. Given that except on the largest of islands, the "natural resources" were limited, these early "extractive" industries were short-lived, reaching the satiation slump fairly rapidly.

The second stage was a period of colonization, gradual repopulation in some places, adoption of European ways and technology by Pacific peoples, and attempts to develop export commodities that would give the islands an economic base. One of the principal manifestations of this phase was the establishment of monocultural plantations. This period also saw the introduction of innumerable alien species of flora and fauna. All of this combined to cause broad environmental degradation of the fragile island ecosystems. The third period began with World War II when the Pacific was drawn further into the great geopolitical, economic, and cultural developments of the twentieth century. War, political instability, and the nuclear age sat uncomfortably beside the Pacific paradise myth and an explosion of sun-seeking tourists.

Unlike Guam, most of the Pacific did not enter the first of these three stages until well after the middle of the eighteenth century. While between 1520 to 1760, about 450 European ships, mainly Spanish and Dutch, had crossed the Pacific, only a tiny proportion of the thousands of Pacific islands had been sighted, and in most cases the contacts with islands and peoples had been light (McNeill 2001, p. 83; Spate 1983). The transformation commenced in

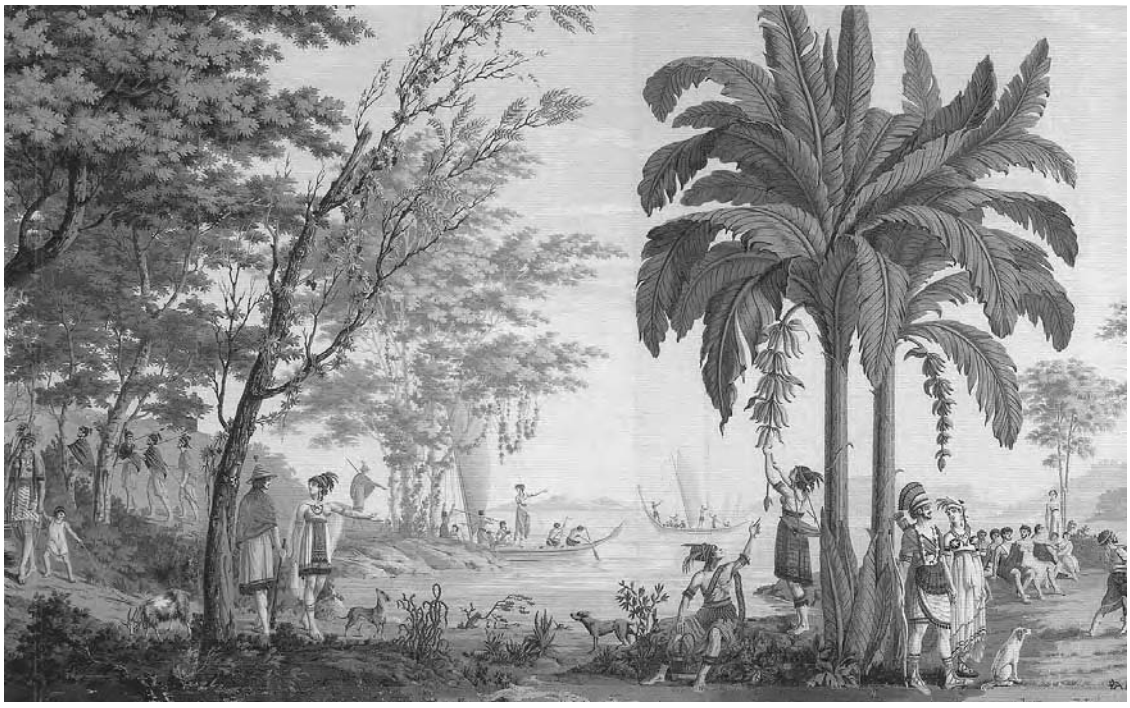
The Pacific paradise image—sunset at Kona, Hawai'i. (Photo courtesy of Don Garden)

the 1760s with a sudden increase of new European arrivals, now principally British and French. Many of their expeditions had a significant scientific motivation: Taxonomy, the desire to discover, understand, and categorize the entirety of God's creation, was a driving force in Enlightenment science (Storey 1996). Tahiti became a focus of European contact after expeditions led by Briton Samuel Wallis and Frenchman Louis de Bougainville visited the island respectively in 1767 and 1768. They found a place where the people apparently lived in a state of idyllic warmth and comfort, were well fed, and were free of sexual and other inhibitions. The way in which the explorers, particularly Bougainville, described this discovery did much to establish and reinforce the paradise mythology that thereafter surrounded not only Tahiti, but the Pacific or South Seas as it was often termed. Bougainville announced:

> I felt as though I had been transported to the Garden of Eden. Everywhere we found hospitality, peace, innocent joy and every appearance of happiness. What a country! What a people! (Cameron 1987, p. 13)

Such responses to Tahiti and other islands touched an existing tradition in European conceptualization and literature about island utopias, Arcadias, and noble savages. The theme was taken up by the French philosopher Diderot and other writers for whom the South Seas offered a contrast with the decadent regimes and industrial exploitation of Europe. In these early stages, European explorers were almost unanimously enraptured by the charms of the islands and of the people—or at least of the women (Nicole 2001; Smith 1960; Grove 1995; Howe 2000; Howarth 1983).

In due course, such responses were challenged as some of the veils were drawn aside, revealing that island life was not always idyllic, but included less admirable activities including wars, cannibalism, human sacrifice, and infanticide. An equally extreme and distorted depiction then arose of islanders as heathen cannibals. Shocked at this perceived depravity, a great evangelical missionary movement was mounted in the nineteenth century by European Christians



Noble savages or heathen savages? Early representations of Pacific people often portrayed them as leading an idyllic life in which to obtain food little more was needed than to pick fruit from a tree or drop a net or line into the ocean. This detail from an early nineteenth-century French panoramic wallpaper encapsulates that image. Elsewhere, however, the panorama captured the emergent view of Pacific peoples as heathen savages, depicting the death of Captain Cook and other warlike behavior. (Jean-Gabriel Charvet & Joseph Dufour, "Les Sauvages de la Mer Pacifique," c. 1804–1805, National Gallery of Australia)

who set out to convert the savages and to modify their behavior. Puritanical missionaries forced the people to clothe themselves and to live in new settlements around mission churches, and often forbade them to sing, dance, and play music. The resulting loss or corruption of traditional cultures was reinforced by the spread of European diseases, alcohol, and other debilitating forces, all contributing to steep depopulation in many oceanic communities. Western societies were left with an ambiguous view of the Pacific that combined contradictory perceptions of paradise and degradation.

In the 1760s, Wallis's report of Tahiti had led to it being chosen as the site for an exploratory and scientific expedition under James Cook to view the transit of Venus in 1769. From there Cook sailed west, around New Zealand and along the eastern coast of Australia. He returned with expeditions in 1772 to 1775 and 1776 to 1779 that crisscrossed large areas of the Pacific, "discovering" and studying many islands and peoples (Beaglehole 1974; Hough 1994; Cameron 1987). Other expeditions from European countries sought to fill in Cook's blanks. Close behind them came the other vanguards of European "civilization"—sealers, whalers, traders, and missionaries. By the early nineteenth century, the invasion was under way.

The first half of the century brought exploitation of the five principal Oceanic resources that had value for European economic activity—seals, whales, bêche-de-mer, sandalwood, and, on a smaller scale, food. The first four were purely extractive industries, which involved taking species from the environment as quickly as possible, without regard for conservation or sustainability. Within a few years, most of the species had been reduced to a tiny remnant—a satiation slump. As Dorothy Shineberg and others have pointed out, apart from whaling and food, the key to much of this early trade was China. The British and the Australian colonists were eager to obtain Chinese tea, while Chinese silks were sought in Europe. However, Europeans had little that the Chinese wanted in return, except for cotton and opium from India. Fortuitously, in the Pacific the Europeans found sandalwood, sealskins, and bêche-de-mer, all of which were valued by the Chinese and became significant elements in a complex trading web that involved Chinese and Western products (Shineberg 1967).

Sealing, the first of the extractive industries, generally had a greater impact upon the environment than on human societies. Seals were mainly found on largely uninhabited coastlines around the South Island of New Zealand (the Maori having killed off the North Island populations) and on more southern islands toward the Antarctic as well as along southern shores in Australia. However, sealers visited inhabited places for food and other supplies and interacted with island people. Shineberg drolly remarked about such ship-based adventur-

ers that "there were few better representatives of human imperfection than merchant seamen" (Shineberg 1967, p. 163). Sealing in the Pacific commenced in the late eighteenth century, but became a major activity in about 1810, partly as an extension of the industry that had been operating along the Australian coast. American and Australian sealers methodically bashed their way through the seal populations, killing millions for their skins, which were sent principally to China. By the 1830s, the seals were gone and the trade was dead (McNeill 2001; Tong and Cox 2000).

The next extractive industry was whaling. Whales were prolifically distributed across Oceania, with right whales in southern waters and sperm and humpback whales in tropical waters becoming the principal quarry. Whaling commenced late in the eighteenth century, but it was essentially once stocks around the Australian coast were becoming scarce in the 1830s that attention turned fully to the Pacific. American, French, and British vessels from Australia and New Zealand prowled the oceans, the American fleet alone numbering almost 700 vessels crewed by 16,000 hands in the 1840s (Howe 1984, p. 93; Tong and Cox 2000). How many whales were harpooned and butchered will never be known, but it must have been at least hundreds of thousands, and by the 1850s, their numbers had been vastly reduced. The environmental impacts of whaling were more widespread than this bloodshed, for whalers were frequently in the vanguard of European contact with islands and peoples. They, like other ship-based exploiters, were frequently involved in violence, and introduced diseases, weed species, and animals that became feral pests such as rats, goats, and mosquitoes. Whaling parties also consumed large numbers of trees for firewood. American whalers established the Hawaiian islands as their base in the northern Pacific, thereby acting as a vanguard of American interests and influence (Clark 1949; Starbuck 1964; McNab 1913; Morton 1982; McNeill 2001; Moorehead 1966; Bennett 1987; Kirch and Sahlins 1992).

Bêche-de-mer, or sea slugs, were a culinary delight in China and elsewhere in Asia, and as the Pacific was explored it was found that the creatures were widely distributed. They were intermittently harvested from the 1820s, principally in Fiji but also in the Carolines, New Caledonia, and the Solomons. Once again, the trade disappeared within two or three decades because of overexploitation, although it appears that in the long-term, after localized overfishing, the slugs were able to replenish themselves. Of greater environmental impact was the drying of the bêche-de-mer before exporting, a task that caused deforestation through consumption of large volumes of wood for the construction of drying houses, other buildings, and for fires. It has been estimated that in the period of 1827 to 1835, in Fiji alone, over 500,000 cubic feet of stacked firewood was burned by the traders (Ward 1972, p. 118; McNeill 2001; Howe 1984).

The discovery that sandalwood grew naturally on many of the larger and more fertile Pacific islands led to a series of "sandalwood rushes" in the first half of the nineteenth century. When burned, the wood gives off a pleasant perfume, an attribute that made it highly valued in China. European traders who sought the wood in the Pacific usually found it necessary to trade with island chiefs upon whose land the trees were found, and were also generally dependent upon island labor to cut the wood and carry it to the ships. This placed local people in a powerful position to trade for an extensive range of European goods and brought substantial wealth to a few island leaders. However, as the tree is slow growing and as it was cut without consideration for conservation or replanting, sandalwood rapidly became scarce. This also made it more expensive and more highly sought-after. These were ingredients in what at times was a violent trade as island after island was stripped of its forests, at times with forced labor and amid interracial conflict. The first major rush was to Fiji early in the nineteenth century, but commercial quantities had been cut out by 1816. The Marquesas were stripped between 1814 and 1817. Meanwhile, a sandalwood boom had commenced in Hawai'i in 1811, which, over the next two decades, brought immense wealth to the Hawaiian aristocracy who used the forced labor of their own people to cut and carry. The last surge of the industry was in the 1840s and 1850s in the western Pacific, where sandalwood grew prolifically on some of the islands in Vanuatu, New Caledonia, and the Solomons (Shineberg 1967; Kirch and Sahlins 1992; McNeill 2001; Howe 1984).

From the time Magellan arrived in Guam, one of the principal needs of European visitors and traders was to replenish their supplies of water and fresh food. Water was generally readily available, but food required trade and barter with the local people, a situation that gave them agency or power. Indigenous people were not simply passive victims of an imposed economic order and biota, but often chose to adopt, conform, and cooperate as it suited them. In many cases, this involved the adoption and adaptation of culture and biota that were harmful to them and to their environment. Where a surplus of foodstuffs was available, trade brought highly prized European implements and goods, which had the potential to transform traditional island life. On those islands that were visited frequently, islanders sometimes abandoned traditional agricultural sequences and practices to concentrate on production for trade, especially vegetables and pigs. They not only traded traditional foods but adopted introduced plants; as early as 1809, Fijians on Mathuata were growing pineapples and pumpkins, which had been brought by sandalwood traders (Ward 1972).

In a small number of cases, food production developed into an export trade, of which two examples stand out. The first was the supply of pigs from Tahiti to Sydney in the early years of the Australian convict settlement, commencing

with a shipment of eighty pigs in 1793. It is estimated that from then until the 1820s, some 3 million pounds of salt pork was traded, often for guns for use in local power struggles (Howe 1984, p. 92). Pigs and potatoes were quickly adopted by Maori who were able to adapt their kumara-growing skills to the new tuber. Potatoes spread rapidly through New Zealand and also formed a significant export commodity to Sydney (Clark 1949). Timber and, to a lesser extent, flax were also sought in New Zealand and exported from as early as the 1790s.

By the end of the first phase of European contact, island life and environments in many of those places that had been exposed to European influence were markedly changed. Already, a number of species of birds had been made extinct by European introduction of alien species and other disruptions to the environment (Flannery and Schouten 2001). Pacific peoples had also contributed to the ecological decline by grasping at chances to participate in economic activities that changed their fragile insular environments. They deforested large areas by selling their sandalwood trees and cutting firewood for sealers, whalers, and bêche-de-mer merchants, and they cleared more land for agriculture and intensified harvests from the sea to sell food to the newcomers. Islander enthusiasm came from a desire to acquire the many utilitarian goods carried by Europeans, particularly metal items and implements, but glass, pottery, and cloth were also highly prized. Acquisition of these had considerable impact on traditional patterns of work and land use. Nails, axes, knives, and other tools altered the balance of power between nature and islanders by revolutionizing labor. Cutting and scraping tasks, or work such as clearing and fencing, chopping down trees, building houses, and making fish hooks could be completed in perhaps a quarter to a third of the time previously taken using fire and stone (Shineberg 1967, pp. 160–161; Howe 1984, pp. 324–326; Bennett 1987, pp. 33ff). The environmental impact of these more efficient practices is not clear, and any increase in the capacity to chop and clear is likely to have been counterbalanced by the decline in population that often followed contact with Europeans. However, culturally the new goods contributed to transitions in social, gender, and spiritual relationships, as well as in demographics.

The second phase of the European period ran for nearly a century, from about the middle of the nineteenth century until World War II. It was marked by the assertion of stronger colonial hold on most islands, one of whose manifestations was an attempt to make the new territories profitable, often through plantation agriculture, a form of industry that had widespread environmental and demographic effects. An equally powerful onslaught on fragile Oceanic environments resulted from a bewildering increase in the number of introduced species.

Until the 1840s, it was trade and the cross rather than the flag that acted as the vanguards of European influence in the Pacific. France carved out its areas of interest and claimed them early. By contrast, Britain moved much more slowly in most places, and it was principally from the 1870s that the British formalized their territorial claims when rivalry from Germany precipitated a scramble among the Western powers to claim possessions in the Pacific, as it did in Africa and Asia. In essence, the British signed the Treaty of Waitangi to establish ownership in New Zealand in 1840 but made no other formal claims until Fiji (1873), Papua (1884), the Cook Islands (1888), Kiribati and Tuvalu (then the Gilbert and Ellice Islands, 1880s), Tokelau (1889), the Solomon Islands (1890s), Tonga (1900), and Niue (1900). The French claimed Tahiti and the rest of French Polynesia in the 1840s, New Caledonia in 1853, and Wallis and Futuna in the mid-1880s. Germany gobbled up much of what was left, particularly in Micronesia—northeastern New Guinea (1884), the Marshall Islands (1885), Nauru (1886), northern Solomons (briefly before handing over to Britain in the 1890s), northern Marianas (1899), Palau (1899), the Carolines (1899), and Western Samoa (1899). The United States came increasingly to people and control Hawai'i before annexing it in 1898—at the same time as it wrested Guam and the Philippines from Spain and claimed eastern, or American, Samoa. In 1906, the British and French agreed to share administration of Vanuatu (then New Hebrides).

There were some adjustments after World War I when Germany forfeited her colonies, the most significant aspect of which was the arrival of Japan as a colonial power when it took Germany's Micronesian possessions as League of Nations Mandates. Australia was given a Mandate to govern former German New Guinea. Meanwhile, Britain reduced its responsibilities by handing the governing of Papua to Australia (1902), and to New Zealand the Cook Islands (1901), Niue (1910), and Tokelau (1925) (Howe et al. 1994).

This increasing intrusion of the outside world and the incorporation of Oceania into broader political and economic movements had profound implications for people and environments. The first generation of extractive industries had plundered themselves into oblivion, frequently leaving a legacy of European diseases and cultural destabilization that were further aggravated by Christian missions and other European intrusions. These disruptions to traditional economies raised the need for reassessment and adjustment on many islands. Most were too small to sustain economic activity that went far beyond traditional subsistence agriculture. However, the generally mild or tropical climates and volcanic soils on many of the larger and more fertile islands stimulated a search for ways to exploit their "natural resources," particularly to find export crops. Local people everywhere produced what commodities they could to trade

European colonization in the nineteenth century brought plantation agriculture to many Pacific islands, such as this sugar plantation in Fiji in about the 1890s. (Burton Bros Collection, Alexander Turnbull Library)

for manufactured goods. However, large-scale production was generally controlled by European planters and companies who used islanders as wage or semi-slave labor. Many crops were tried—coconuts were harvested for copra and coconut oil throughout Oceania (Bennett 2000); cotton was introduced in Fiji, Samoa, French Polynesia, and Queensland, encouraged by the disruption to supplies by the American Civil War; Fiji, Hawai'i, Queensland, and parts of Micronesia grew sugar; pineapples largely took over the Hawaiian island of Lana'i in the twentieth century; and coffee, cacao, citrus, spices, tobacco, and rubber were grown in various places. All this took place with generally mixed or limited success because the marginal economics of producing commodities far from their markets were compounded by problems of pests and diseases (Ward 1972; Moynagh 1981). Cattle and sheep were grazed on some islands to produce meat for regional and export markets, and wool was grown for export particularly in Hawai'i and New Zealand. On Rapa Nui, grazing animals were introduced to the grasslands in the nineteenth century and became the economic mainstay.

Rubber plantations were much less common than cotton or sugar, but were established in some places, including this one in Samoa early in the twentieth century. (Tattersall Collection, Alexander Turnbull Library)

The environmental implications of monocultural plantation crops and grazing were often severe. Common repercussions were loss of indigenous species, the degradation and siltation of water systems, the siltation of coastlines, weed infestations, and crop pests. Attempts to control crop pests often created a second generation of environmental problems. As is discussed below and in Chapter 7, when species such as the Indian mongoose, Indian mynah, and cane toads were imported, they tended to ignore their intended targets and become environmental pests themselves. In Hawai'i in the early twenty-first century, the grazing lands of Moloka'i provided a sample of what is often found across the Pacific—a depressing encounter with erosion and weed infestation.

A historian of guano mining in the Pacific noted, with some understatement, that, "One of the cruder ways of changing the landscape of a South Sea island is

Guano, or phosphate, mining was one of the most invasive and destructive forms of European economic activity. After the guano was removed, little was left other than the harsh base of rock and limestone on which little could grow. This is Makatea Island in French Polynesia, photographed in about 1926, where mining commenced in 1908 and was exhausted in the 1960s. (Alexander Turnbull Library, Wellington, New Zealand)

to dig it up" (Newbury 1972). That is what mining has done on a number of islands, with severe localized damage. Fiji and New Zealand had gold mining beginning from the second half of the nineteenth century, and nickel mining commenced in New Caledonia early in the twentieth century. However, the most significant mining export from the Pacific has been guano (accumulated bird excreta), which was dug from several islands but principally from Makatea in French Polynesia, Nauru in northern Melanesia, and Banaba (then Ocean Island) in Kiribati. In the late nineteenth century, it was recognized that these islands were covered in many meters of accumulated guano, which could be used as an invaluable form of phosphate fertilizer, notably on the depleted soils of Australia and New Zealand. Mining of guano, usually with imported labor, began early in the twentieth century and brought substantial wealth to the mining companies. However, it was a nonsustainable industry that stripped the islands, eventually leaving them

as potholed rocks, effectively uninhabitable. The people of Banaba, after years of exploitation by the British Phosphate Company and then the brutality of Japanese occupation, were relocated after World War II to Rambi in the Fiji group. The people of Nauru have similarly seen most of their island dug out from underneath them, leaving a desert of coral. At the start of the twenty-first century, their future was unclear (McNeill 2001; Binder 1978; Weeramantry 1992; Denoon, Mein-Smith, and Wyndham 2000).

Another "resource" that was exported on a small scale and consumed locally on a much larger scale was wood. In the colonial era, forest clearance increased as timber was cut for a range of urban and industrial construction uses that had not existed prior to European arrival. However, an increasingly important use of wood was for fuel. Wood fires were a principal source of energy, particularly for steam engines that became the main force in the second half of the nineteenth century for plantation machinery and for a diverse range of industrial and transport purposes (Bennett 2000).

While essentially a cultural and human phenomenon, one of the most influential impacts on the environment was demographic change. In some regions there was a slow recovery of population numbers from the middle of the nineteenth century while others, notably parts of Melanesia, continued to decline into the new century. There were also significant redistributions of people that brought different and new environmental stresses. From early contacts, drawn by a combination of need and adventure, significant numbers of islanders, especially young men, left their villages and began to travel the world as crew on trading ships, often in whaling or sealing parties or, strangely, some Hawaiians became fur trappers in North America. Sometimes young men were recruited to work on other islands in new industries. Such mobility was socially and culturally intrusive and emigration became a major issue in the second half of the nineteenth century when islanders from a number of regions, but notably Melanesian islands of Vanuatu, New Caledonia, and the Solomons, were recruited to work in such places as the Queensland sugar and Fiji cotton plantations. Generally they worked under reasonable contracts, but at times they were the victims of bad practices and there were incidents of blackbirding—kidnapping and forced labor, effectively slavery. The negative aspects of the labor system have attracted a great deal of attention and have given the labor trade a worse reputation than it deserved. For many islanders, a period of working overseas provided both valuable experience and income. The largest emigration of island laborers came from the Solomon Islands after 1870. Peter Corris estimated that "between 1870 and 1914, more than 30 000 Solomon Islanders were recruited for indentured labour in Queensland and the Pacific Island colonies." Of these, the largest destinations were about 19,000 recruited to Queensland and

9,400 to Fiji (Corris 1973, pp. 149–150). More broadly, Kerry Howe estimated that well over 100,000 Melanesians were recruited to Queensland and Fiji between the 1860s and the early twentieth century (Howe 1984; Ward 1972).

The worst slavers were Peruvians who kidnapped slaves and recruited laborers (who often were treated little better than slaves) from several Oceanic islands in the early 1860s. Most died from overwork and disease. One of the worst cases involved Rapa Nui, whose population was already in a steep decline prior to the nineteenth century. Peruvian recruiters and raiders carried away about 1,400 people, or about 34 percent of the estimated population. These included all the leaders and the strongest islanders. Many were taken to dig guano on islands off the coast of Peru. Few survived the mistreatment, poor diet, and diseases, but protests about the trade forced the Peruvian government to attempt to repatriate Pacific Islanders in 1863, about 100 of whom were Easter Islanders. The death toll on the disease-ridden vessel was so great that only fifteen of those originally taken from Rapa Nui survived the return voyage and were put ashore. The tragedy continued as the survivors carried smallpox and tuberculosis, which swept through the remaining population (Maude 1981; Young 1999).

The environmental repercussions of such interventions in island life and the breakdown of traditional cultures and environmental relationships are not fully understood, although they clearly were complex. Depopulation of indigenous peoples was uneven in its impact, very severe on some islands but much less so on others, and historians are somewhat divided about the details. At the same time, the migration and importation of labor from outside the Pacific to island communities also challenged traditional Pacific societies and their use of resources. The largest group of immigrants were the thousands of Indians brought to work the plantations of Fiji from the 1870s (McArthur 1967; Moynagh 1981; Howe 1984; Denoon et al. 2000). In the twentieth century, people from a variety of fringing countries migrated into Oceanic societies, most notably to Hawai'i where the four largest "ethnic" groups in 1940 were Japanese (157,905), Caucasian (103,791), Hawaiian (64,310), and Filipino (52,569), with lesser numbers of Chinese, Puerto Ricans, Koreans, and others (Price 1963, p.128). New arrivals, lacking a history of understanding of Oceanic environments, brought new crops, new needs, and new ways of interacting with the environment. Japanese immigration in the interwar years, for example, is associated with the spread of the edible Giant African snail, which became a major pest.

The introduction of a bewildering array of species of alien flora and fauna profoundly damaged many fragile Oceanic environments. The reasons and motivations for the introductions are complex, involving the deliberate introduction of utilitarian and culturally desirable species as well as the accidental arrival of numerous undesirable and harmful ones. Many of both types, intended

Europeans brought innumerable new species of plants to the Pacific islands, many of which became weeds, such as this creeper, which has taken over and is choking the indigenous forest on Atiu, Cook Islands. (Photo courtesy of Don Garden)

and accidental, thrived, went wild, and had dramatic effects on local species and ecosystems (See Hawai'i, Chapter 7). It is difficult to estimate the most damaging, but for much of the Pacific the claim could be made for pigs, goats, and rats. Polynesian pigs had previously been present on many islands and had caused considerable environmental harm, but Europeans brought their own larger breeds, which became more numerous, more geographically spread, and more environmentally destructive. Pigs and goats were introduced as sources of food, but many escaped into the wild where they had a devastating impact on the natural vegetation that they ate, rooted out, and otherwise damaged. In doing so, they also degraded soils, water systems, and the habitat of vulnerable indigenous avian and other fauna. The Norway rat (*Rattus norvegicus*) and the black rat or roof rat (*Rattus rattus*) were unwelcome passengers on European ships and spread rapidly across the islands, having a devastating effect on birds, reptiles, insects, and other species. Many garden plants rapidly became environ-

mental weeds and, as mentioned previously, primitive forms of biological control saw the Indian mynah (that ubiquitous "flying rat" of the Pacific), the cane toad in Fiji, and the mongoose in Hawai'i fail in their purpose and attack other species (Lal and Fortune 2000).

A factor in the arrival of such a diversity of species was the increasing volume and regularity of contacts with the outside world through the growth of shipping in the Pacific. Scheduled shipping services became possible in the age of steam, greatly increasing the deliberate and accidental transport of flora and fauna. For example, services connecting Sydney, New Zealand, Fiji, Hawai'i, and San Francisco established a link of biota across the Pacific. In the years leading up to World War II, the early airlines also began to ply across Oceania. The world was shrinking and hybrid landscapes were becoming more common.

The third phase of the European period brought the largest-ever invasion of humans and alien species into Oceania as the region was increasingly engulfed by the wider world of political, economic, cultural, and environmental developments

Goats, kept for both meat and milk, were one of the earliest animals introduced by Europeans into the Pacific islands. They also became one of the most destructive. Goats in Fiji in about the 1920s. (W. H. Raine Collection, Alexander Turnbull Library)

of the second half of the twentieth century. Four aspects illustrate the main environmental themes—World War II, nuclear testing, a return to extractive industries, and more people—both population increases and tourism. Other profound environmental problems facing Oceania, notably global warming, will be discussed in Chapter 6.

Oceania was first dragged into World War II in 1940 when German warships launched actions against British targets, including a bombardment of Nauru and laying mines in New Zealand waters. It was following the Japanese attack on Pearl Harbor in December 1941 that the Pacific became a significant theater of war. The Japanese swept out of Southeast Asia, taking much of New Guinea and the Philippines, and advancing toward Australia and into the Pacific where they occupied many islands in Melanesia and Micronesia, including the Solomon and Gilbert Islands. At times, their ships and aircraft penetrated far beyond, as well as making attacks upon the Australian mainland. Their intention was to establish a Greater East Asia Co-Prosperity Sphere, which would include large areas of the northern Pacific. The Japanese advance was effectively

New Zealand troops, Guadalcanal, 1943. Never before had there been so many humans in the Pacific as during World War II, and many islands were highly modified by the presence of the military, particularly those that were devastated by fighting. (War History Collection, Alexander Turnbull Library)

halted with the battles of the Coral Sea and Midway in May and June of 1942. Thereafter, a period of regrouping occurred until 1943 when the Americans, together with Australians and others, slowly and methodically moved from island to island, removing these most recent invaders (Laracy 1994; Bergerud 1996 and 2000; Denoon, Mein-Smith, and Wyndham 2000).

The war in the Pacific provides graphic demonstration of the ways in which environment shapes war. Japanese expansion had both political and economic motivations, the latter being a desire to possess lands that would supplement Japan's limited resource base. Although the resources on the Pacific islands were also limited, where it was possible, the Japanese set out to extract and redirect as much produce as they could back to Japan. Land was cleared to establish new plantations, mainly using forced local labor, and some timber and other resources were extensively exploited. Among the worst cases were the guano-rich islands of Nauru and Banaba, which the Japanese occupied, enslaving the people. About a third of the Banabans, some 463 people, are believed to have been shot, flogged, or starved to death; sunk (in the case of a number of lepers); or died of disease. By the end of the war, all the Banabans were either dead or had been transported to other islands—apart from one man found hiding in a hole when the liberators arrived (Binder 1978). Faced with defeat and withdrawal, the Japanese were often brutal to the occupied people but, strangely, do not appear to have pursued environmental damage as a war strategy—a scorched earth policy—to the extent that Germany and Russia did in Europe. However, the islands from which the invaders were removed, as well as the local inhabitants, were profoundly damaged by the occupation and liberation (Westing 1980, 1988, and 1990).

The Pacific islands produced no oil or petroleum, they had no manufacturing industries capable of turning out tanks or planes or warships, and they produced food and other products in insufficient volumes to support the large military forces that had descended upon them. To a substantial degree, therefore, it was the logistics of accumulating men, machinery, armaments, and supplies across the ocean distances and on a multitude of islands that would be the key to victory in the Pacific. The endeavor to achieve these imperatives imposed an immense drain on both sides, but in the long run, it was the Americans and their allies who had access to the greater resource and industrial base, and were eventually victorious.

Armed forces and military operations placed immense pressure on insular Oceanic environments. Many islands had never before been occupied by so many humans and, even when there were no battles or bombs, the pressure upon them from so much human activity, including the volumes of rubbish and waste, was considerable. Military activity was very destructive—habitat loss

from the clearing of land for aerodromes and other purposes, the building of fortifications and diverse structures, spills of oil and other substances on land and sea, blowing up coral reefs to create passages for ships or to use as the surface of aircraft runways, and the various alien species that traveled with military forces into new environments.

Climate and terrain are major factors in determining the nature of war within a theater—how battles are fought, who wins and why. The jungles of Southeast Asia with their heat, humidity, disease, and tropical vegetation, for example, presented very different strategic issues from the snow-covered Russian steppes. The conditions on Pacific islands tended to be more like those in Southeast Asia, and a good deal of fighting took place in dense undergrowth and jungle in rough terrain. However, there were distinctive aspects to the Pacific theaters, such as fighting in the limestone formations of makatea islands, which ripped at men and equipment and provided innumerable places for an armed and entrenched enemy to hide. Coral-fringed islands were difficult to attack from the sea, as American forces found on island after island. The coral was often too shallow for landing crafts to pass over except at high tide. On the tiny island of Tarawa in the Gilbert Islands, marines were forced to get out of their landing vessels and to scramble for hundreds of meters over reef and rough ocean floor while under heavy fire. Many of those attempting the landing at Tarawa were drowned or were shot while exposed. Once the survivors struggled ashore, they were faced with rugged terrain and deeply entrenched forces, but eventually were victorious at the cost of 1,009 Americans dead and 2,101 wounded. More than 4,700 Japanese died. All this occurred in an area of 2.5 square kilometers. No one bothered to record what happened to the island's ecosystems, but photographs give a give a graphic insight (Winters 1998; Russell 2001; Bennett 2000).

After American forces captured the island of Tinian in the Marianas in 1944, a large area was cleared for military purposes, including several kilometers of runways. It was from here that the first atomic bombs left for Hiroshima and Nagasaki. From paradise to purgatory!

This early involvement with nuclear issues was a harbinger of Oceania's place in one of the most serious "environmental" issues of the second half of the twentieth century—nuclear testing. The full effects of nuclear tests and the potential damage from nuclear fallout were not initially recognized in the late 1940s and perhaps even during the early 1950s. However, even after the repercussions of radiation and nuclear fallout were known, Pacific islands continued to be used for testing. A big, open ocean; a small and sparse population; thousands of tiny remote islands and atolls that might be considered expendable—these were the ingredients that made the Pacific the test site of choice for the United States, Britain, and France. The Americans began the process in 1946, re-

moving the inhabitants of Bikini Atoll in the Marshall Islands to explode a bomb over it. Inside its lagoon was a fleet of about 100 old warships, aboard which had been placed for experimental purposes 5,000 rats, 204 goats, 200 mice, and 60 guinea pigs (Delgado 1996, p. 29). Between 1946 and 1958, the Americans tested at least sixty-six bombs at Bikini, at nearby Eniwetok atoll, and at Christmas Island in Kiribati. These included the massive and extremely "dirty" "Bravo" hydrogen bomb in 1954 (See A to Z, Bravo). Despite many promises, by the end of the twentieth century, Bikini had not become habitable and the islanders were still essentially displaced persons (Dibblin 1988; Woodard 2000).

The British began their tests at Maralinga in South Australia in 1956 to 1958, leaving a large area too contaminated for the indigenous inhabitants to return, and a legacy of disease among the Aborigines, which is blamed on the fallout. The British also used Christmas Island in Kiribati as well as the Gilbert Islands for tests.

In 1963, the United States, Britain, and the Soviet Union, in the face of growing protests and of deeper understanding of the repercussions of atmospheric testing, signed the Partial Test Ban Treaty in which they agreed to stop atmospheric and underwater testing. France and China refused to sign. Indeed, the French chose to swim against this tide of opinion and practice and, from 1966 to 1974, conducted forty-one above-ground tests at Mururoa and Fangataufa atolls in French Polynesia, causing a rise in radiation on many islands in the region. In the face of mounting outrage in the Pacific nations and elsewhere, the tests were finally moved underground beginning in 1975.

Nuclear activity was one of the major global environmental concerns from the late 1950s. Both the direct repercussions of localized destruction and radiation and the military capacity it promoted threatened the future of life on the planet. Within Australia and the Pacific, there was grassroots concern on both issues and, while the Australian government generally acquiesced, New Zealand and many Pacific states were moving toward opposition to all nuclear testing and use. They did so despite considerable diplomatic and sometimes economic pressures from the United States and France. New Zealand took the most daring stance and, from the mid-1980s, refused entry to American warships because the United States government refused to confirm or deny whether its vessels were nuclear powered or were equipped with nuclear weapons. As a result, New Zealand was denied access to American intelligence and was effectively excluded from the ANZUS Treaty that had been concluded between Australia, New Zealand, and the United States in 1952 and had been of considerable defense significance for the southern nations.

Meanwhile, in the 1980s, there were mounting fears about the geological instability caused by French explosions in the region around Muraroa Atoll. The

international environmental organization Greenpeace had emerged as one of the chief antinuclear campaigners. Its vessels were involved in numerous environmental actions around the globe and had upset many governments. But in an act of remarkable international irresponsibility and brigandage, in July 1985, French agents blew up the Greenpeace vessel *Rainbow Warrior,* which was berthed in Auckland, killing a crew member (See A to Z). When some of the French agents were captured, the international furor was immense, but the French government brazenly denied full responsibility and continued testing until 1992, conducting a total of 134 underground explosions. Testing was suspended in 1992, but began again in 1995 with a promise that this would be the last series, after which France would sign the international test ban treaty. The protests in New Zealand, Australia, and the Pacific countries were intense, but the French conducted six more tests in 1995 to 1996 before finally discontinuing them (Hayes, et al. 1986; Delgado 1996; Shears and Gidley 1985; Nossal and Vivian 1997; *Polynesie Francais* 1990; McIvor 1991; Tame and Robotham 1982; Howe, et al. 1994; Denoon 1997).

In contrast with the British who, from the 1950s, moved to decolonize their empire in the Pacific and elsewhere, the Americans and French maintained a hold on their Pacific dependencies while granting some nominal independence (Denoon, Mein-Smith, and Wyndham 2000). Hawai'i was an exception, gaining statehood in 1959. Whatever their political status, the often tiny, scattered new nations of the Pacific, many with populations smaller than a reasonably sized continental city, needed to find ways to establish a secure economic future and obtain a share of world prosperity. To do so they needed to overcome the daunting problems of limited and scattered land areas and poor resource bases. Plans for modernization and development were often ambiguous or in conflict with traditional relationships with the land, as well as with Western consumerism and other values that had become prominent in local cultures. The Vanuatu constitution, for example, includes among its objectives for national development that it "ensure Vanuatu's unique environmental and cultural heritage is not damaged in the process of economic development." Nevertheless, in its Second National Development Plan 1987–1991, the government set goals to develop agriculture, tourism, forestry, secondary industry, fisheries, mining, transport, and other infrastructure while also exhibiting an awareness that these would have a negative impact on its environment. These tensions, ambiguities, and contradictions between traditional conservation values and anthropocentric Western ones are also found in a publication celebrating ten years of Vanuatu independence in 1990.

> In any case, the real value of flora and fauna in Vanuatu is the extent to which they provide for people—food, timber, medicines, clothes and cultural necessities. Assessed in these terms, they are a highly valuable resource. . . .

> Land that is degraded will not provide physical or spiritual well-being. Thus ni-Vanuatu (the Vanuatu people) living in a degraded environment will suffer a spiritual or cultural loss and a lowering of their quality of life. Therefore, for economic, cultural, biological and aesthetic reasons it is necessary to manage and develop natural resources in a sustainable way. (*Vanuatu* 1990, pp. 134 and 136)

Despite ambitious development goals and projects, many of the new nations struggled to achieve viability but suffered considerable ecological damage in their attempts. Financial and other necessities caused them to participate in or cooperate with the growth of four harmful extractive industries—whaling, fishing, mining, and timber logging.

Whaling had revived during the first half of the twentieth century, principally undertaken by Norwegian and other European companies using motor vessels and explosive harpoon guns, which made killing much easier, and factory ships, which made flensing more efficient. They traversed the Pacific and the New Zealand and Australian coastlines and pushed increasingly south into Antarctica. Shore stations were also established in New Zealand (Tønnessen and Johnsen 1982; Tong and Cox 2000). After World War II, large Japanese and Russian factory ships using a range of new technology such as sonar and aircraft spotters expanded the industry again, so effectively that by the 1970s, there were few whales left other than small and less desirable Minke whales. In the 1960s and 1970s, opposition to whaling became one of the early major environmental campaigns across the Western world. A ban on whaling was adopted by most nations, but the Japanese continued to kill Minkes under the guise of research, and to press for access to larger species.

Japanese vessels and technology, along with America's, also came to dominate ocean fishing in the Pacific. The extension of exclusive economic zones of up to 200 miles by Pacific nations in the 1960s and 1970s offered some chance to control the excessive exploitation of their oceanic environments. However, some of the small nations under economic and political pressure (principally from the Japanese and Americans) opened their zones to foreign exploitation. Licences to fish the waters were lucrative, while hosting and resupplying the large fishing factory ships brought business and revenue. The licence fees became an important source of income for some of the tiny nations, up to 45 percent of government revenue in Kiribati and 25 percent in the Marshall Islands (Lal and Fortune 2000, p. 367). New Zealand also exported large quantities of fish, which were taken from its expanded economic zone. By the 1990s, overfishing had become a major problem as more than 50 million tons of fish were taken annually from the Pacific, largely with the use of drift net and long line fishing. By the start of the twenty-first century, catches were in decline and the

future of the industry, and of species such as southern bluefin tuna, swordfish, marlin, and gemfish appeared bleak. An equally serious problem was the millions of tons of bycatch deaths that resulted from modern fishing practices. Large drift nets caught and killed huge volumes of unwanted species including dolphins, sharks, and turtles. Remnants of driftnets also float around in the ocean catching and killing as they go. Baited longlines that are let out behind fishing vessels also kill thousands of albatross and other bird species. As populations of fish and other species plunged, international controls were tightened late in the century, but they were insufficient, especially as poaching had become a serious problem (Taylor, et al. 1997).

Deposits of minerals are not common in the Pacific and are essentially restricted to the large shards of Gondwanaland—New Caledonia, the Solomons, and New Zealand. In New Caledonia, open-cut nickel mining on the main island of Grande Terre has caused considerable environmental damage through deforestation and runoff, while emissions from the smelter near Noumea threatened the adjacent reef. In the Solomons, deposits of gold, silver, bauxite, and manganese were being developed late in the century until political unrest intruded, while on nearby Bougainville the world's biggest copper mine operated from the 1970s until civil war caused its closure in 1989 (Lal and Fortune 2000). Mining in New Zealand is limited, but the country was fortunate to have discovered useful quantities of oil, which supplied part of its needs from the 1970s, but declined in the 1990s.

Land clearance for plantations and other purposes continued in the decades after the war, but even more problematic has been the opening of several of the western Pacific islands to timber logging. Papua-New Guinea has seen the worst deforestation and degradation which, like the Solomon Islands, has been poorly supervised by governments weakened by internal instability and corruption. Because of the need for export income, significant areas of those islands, as well as of the Solomons, Fiji, and Samoa, have been deforested (Lal and Fortune 2000; Bennett 2000).

Arguably, however, the most damaging development in the Pacific in the second half of the century, as with much of the planet, has been the increased number of humans, although the Oceanic experience has been rather more patchy than other parts of the planet. Advances in disease control and treatment, in medical care, and in food production contributed to some Pacific islands experiencing considerable population growth—by the end of the century many nations were supporting very large numbers of humans for their size. The largest populations were in Hawai'i (1.187 million), Fiji (868,000), French Polynesia (260,000), and New Caledonia (211,000), while tiny Tuvalu had over 11,000 people living in its 26 square kilometers. This placed extra pressure on islands that

are not resource rich and are totally dependent on the expensive importation of such vital commodities of modern life as fossil fuels and electrical appliances. Elsewhere, notably Nuie and Wallis and Futuna, limited employment opportunities and the relative lack of excitement of island life led to the emigration of young people to places with the attractions of modern consumer societies. The Cook Islands are notable for their struggle to keep their people and, by late in the century, there were fewer Cook Islanders living on their own islands than in the cities of New Zealand and Australia. On Atiu, for example, the population was in such decline that the future of the community was uncertain.

By contrast, on some of the more popular islands there were very substantial increases in foreign tourist numbers in the late decades of the century, attracted by a revival of the Pacific paradise mythology and made possible by relatively fast and cheap jet aircraft services (Howe 2000). Tourists on Waikiki beach can combine two activities—sunbathing while also observing the constant flow of aircraft in and out of Honolulu airport. Tourists were attracted to the Pacific by its reputation and image—the warm climate, the friendliness of the people, the palm-lined lagoons, and the life and beauty of coral reefs. For the small nations, tourism became increasingly important as a source of income, but it is a double-edged sword. As with Guam, tourists can also destroy the very paradise they have come to experience because of the environmental pressure they create—the resorts built along coastlines, the volumes of rubbish and waste, the importation of commodities and materials, the number of visitors to fragile reefs, and the level of infrastructure and services that is expected.

NEW ZEALAND—LAND OF THE HYBRID LANDSCAPE

To the Makomako, or Bellbird (Now rapidly dying out of our land)

Merry chimer, merry chimer,
Oh, sing once more,
Again outpour,
Like some long-applauded mimer,
All thy vocal store
Alas! we now seldom hear
Thy rich, full note
Around us float,
For thou seem'st doomed to disappear,
E'en from our woods remote.

But as the old we love the new;
Fain we'd retain
Thy chiming strain,
Thy purple throat and olive hue:
Yet we wish in vain
Thy doom is fixed by nature's law;
Why, none can tell.
Therefore, farewell;
We'll miss thy voice from leafy shaw
Living silver bell.

Some say the stranger honey-bee,
By white men brought,
This ill hath wrought;
It steals the honey from the tree,
And it leaves thee naught.

Why should we ever know new joys,
If thus they pass?
Leaving, alas!
Wistful regret, which much alloys
All that man now has.

The songsters of our Fatherland
We hither bring,
And here they sing,
Reminding of that distant strand
Whence old mem'ries spring
—Alexander Bathgate, c 1906

For all the distinctive majesty of the digitally enhanced New Zealand scenery that appears in the *Lord of the Rings* movies, there are substantial areas of the New Zealand landscape that are a hybrid, modified concoction with little indigenous biota. This has been the case for over a century. A traveler in New Zealand who heads south from Auckland on the North Island into the Waikato, or who on the South Island sets out from Christchurch across the Canterbury Plains, is confronted with landscape challenges. Looking across the lush green fields and farmlands of the Waikato, neatly lined with hedgerows, one sees a created landscape in which there are few indigenous species of flora. Most of the avifauna have disappeared, so in all likelihood the occasional bird one sees is of exotic origin. The grasses are introduced, the trees are nearly all introduced deciduous or conifer species, and the streams have bare banks or are lined with willows and poplars. Even the trees used to revegetate land that has been badly eroded by the heavy rainfall are almost universally exotic species, notably Lombardy poplars. In the South Island, the vivid green grazing country of Canterbury or around Queenstown, dotted with white sheep and backed by the dramatic snowcapped mountains of the Southern Alps, could well be in Switzerland rather than the South Pacific. Around Queenstown in Spring, the flowers of lupins and hawthorn line the roads together with other exotic trees, while the yellow of gorse and broom are accompanied by a diversity of conifers as they creep up the hillsides. It is all a bit disorienting, for these are not the landscapes one expects in the Pacific. New Zealand is highly modified, much more a transplanted Europe than any other part of Oceania. At the start of the twenty-first century, only 32 percent of the country resembled its natural state, 65 percent was cultivated, and the rest was under urban centers and roads (Tong and Cox 2000, p. 30). However, even if only because of its large Maori population and cultural influence, it is also very much a part of Oceania.

One of the principal reasons for this ambiguity is that New Zealand is more climatically and geographically suited to European agriculture and habitation than most of Oceania. Apart from areas of New Caledonia, Hawai'i, and Fiji, it was the only part of Oceania that became a colony of significant European settlement, and it now possesses a greater diversity of blended or hybrid people, biota, and landscapes than any other part of the region.

New Zealand's history and environmental history illustrate this ambiguity and hybridity, for they share major elements with what occurred both in Australia and in more tropical places in the Pacific. The early European history, for example, is essentially in accord with that of Oceania. After Cook and other explorers, the initial contacts were by seamen involved in extractive industries and trade, and by missionaries. Maori were a strong and independent people, often described as warlike but, just as characteristic, they were skilled at adapting and trading. As sealers, whalers, and merchants touched on New Zealand shores, Maori quickly learned the possibilities of exchanging food and timber for European goods, including guns. They also received, starting with Cook in 1770, pigs, potatoes, wheat, and many other food and weed plants, not to mention stowaway black rats, which had the same environmental impact here as they did elsewhere in Oceania. Pigs and potatoes were quickly adopted and became significant trading commodities as well as new sources of food. Pigs were generally allowed to roam freely, and in doing so profoundly impacted indigenous flora and fauna. In 1814, the first Christian mission arrived from Sydney, establishing in the Bay of Islands where Russell became the major European settlement and port of call for the increasing number of sealers and whalers, as well as for merchants in search of flax, kauri timber, and other trade items. The volume of traffic between New Zealand and Sydney grew rapidly through the 1820s and 1830s. Also symptomatic of contact with Europeans, disease, alcohol, and social disruptions such as the erosion of traditional authority structures, began to take their toll on Maori population and culture. By the 1870s, Maori numbers had fallen to about 50,000 and, at the 1896 census, to a low of 42,000, before starting to recover (Crosby 2001, p. 329; Belich 1996; Clark 1949; McNab 1913; Morton 1982).

Where New Zealand history began to diverge from the patterns of Oceanic history and follow that of Australia, was with the increasing interest in New Zealand as a colony of settlement. The land and the climate, while not unproblematic, offered a better chance for European agriculture and grazing than most parts of Oceania. Australian merchants and colonists not only looked inland to their own grasslands for expansion, they looked across the Tasman to the fernlands and forested valleys of New Zealand. They evaluated and commodified that landscape as they did in Australia, and found potential for European agriculture

and grazing. However, Maori were more numerous and better able to defend their lands than the Aborigines, and the country would only be won after sustained contestation and negotiation.

Initial British settlement was based on mixed farming and grazing and developed slowly in the Bay of Islands and around Nelson, Wellington, and Auckland. In the 1840s, once the most readily available pasture land in Australia had been occupied, Australian pastoral attention was directed toward the South Island with its tussock plains and fernlands. These open lands, substantially created by Maori fires, had pastoral potential. Sheep were imported and the industry developed rapidly from the late 1840s; the Canterbury Plains were swiftly occupied, with Otago and other suitable land soon following. However, the environment of much of the South Island, its mountains, forests, and wetlands, limited the pastoral expansion. In those areas that were suitable, the burning of the pasture lands and the introduction of foreign grasses profoundly changed the floral communities and the fauna dependent upon them. Elsewhere, particularly in the North Island, vast tracts of forest were cleared for a combination of farming and grazing.

For New Zealand, even more than Australia, for the next century much of its economic survival and well-being was to be based on the grazing animals. At first, pastoralism was devoted to wool growing, and the number of sheep exploded from 23,000 to 11,705,000 between 1851 and 1876, and to over 20 million in 1901 (Bloomfield 1984). The introduction of refrigeration in the late nineteenth century changed the basis of New Zealand's economy by enabling the export of beef, mutton, and dairy products (particularly butter), principally to Britain. In some respects, this was New Zealand's *raison d'etre* until after World War II—as a prosperous outlying farm for Britain. The other principal industries were few. Timber, as will be discussed, became another significant export. Gold mining flourished in the Coromandel on the North Island and around the Otago region and in other parts of the South Island for a period beginning from the 1860s—its environmental impacts were a replication of those described in Chapter 3 in the Australian context. Until the twentieth century, agriculture was largely for the domestic rather than the export market, but it was responsible for extensive land clearance. Coal mining was less important than these industries, but deposits were exploited on a small scale, principally on the west coast of the South Island in the nineteenth century before production rose early in the twentieth century before again declining (Taylor 1997; Tong and Cox 2000; McKinnon 1997; Pawson and Brooking 2002).

New Zealand gained a substantial level of responsible government in 1856 and moved slowly and somewhat reluctantly to full constitutional nationhood in the twentieth century. By the end of the twentieth century, with its popula-

Sheep have been an integral part of the New Zealand economy for more than 150 years, and one of the country's most identifiable images is of contented sheep grazing on the emerald green grass of the Canterbury Plain with the alps in the background. From the environmental perspective, scenes such as these are problematic because it is unlikely that any of the biota in the scene are indigenous. (Photo courtesy of Don Garden)

tion of a little under 4 million people, it had become a small but dynamic, socially advanced, and relatively affluent nation. New Zealand had established itself as a country that was prepared to stand by its own independent views and policies on such matters as nuclear issues. It was also a cultural hybrid with a mixed population consisting of 76 percent European or Pakeha, and 19 percent Maori and Pacific Islanders, with small numbers of Asians and other groups. By then, large areas of the New Zealand landscape were badly degraded and under stress, a situation that can be encapsulated by an examination of three aspects of New Zealand's environmental history—the impact of introduced species, land and forest clearance, and conservation.

At the start of the twenty-first century, the Auckland Museum had a gallery devoted to "Human Impacts" on the natural environment, but in reality

Gold mining, such as this at the Taitapu Gold Estate in about the 1880s, caused localized environmental devastation and serious downstream siltation. (Tyree Collection, Alexander Turnbull Library)

this was an exhibition of the introduced species of flora and fauna rather than the wider range of human-caused environmental change. Large numbers of fish, insects, and flora were represented, besides numerous stuffed birds and animals. There was also a feature display on Tiritiri Matangi Island in the Hauraki Gulf, which had recently been the site of major environmental regeneration work. Possums and rats had been eradicated on the island with 1080 poison. This is an American-manufactured poison that is widely used in Australia and New Zealand to target animals considered to be pests, but its use is controversial because it frequently impacts non-target species. Its use against possums on Tiritiri Matangi Island was not so controversial because their removal, together with that of other introduced species, was enabling revegetation, restoration, and the reintroduction of threatened avifaunal species.

On a small island environmental reclamation had been quite successful, but on a national scale it appears an impossible challenge as alien species have poured into New Zealand from the start of European contact. At first, the species were essentially utilitarian and accidental, but subsequently many were imported in an endeavor to "improve" the landscape by making it more culturally appealing. Alfred Crosby (2001, p. 330) identified the first New Zealand weed as canary grass, which Cook left behind in 1770. Since then, more than 2,000 species of plants have arrived both intentionally and as hitchhikers, many becoming pests such as gorse, broom, lupins, blackberry, briar rose, heather, Californian thistle, and in recent decades mouse-ear hawkweed (Clark 1949; Johns and MacGibbon 1986; Pawson and Brooking 2002; McKinnon 1997). On his various visits, Cook also deposited a small menagerie of fauna species including pigs, goats, fowl, and probably the black rat. Later arrivals brought a range of grazing and work animals (goats, sheep, cattle, horses) and cats and dogs, the last being dog breeds that were much more ferocious hunters than those that had arrived with Maori.

Perhaps of even greater consequence to local ecosystems, as in Australia, settlers found the New Zealand landscape rather disappointing in the faunal species that it had to offer, and for various reasons set out to rectify this "fault." In the second half of the nineteenth century, New Zealand founded a particularly active and long-lived collection of acclimatization societies whose major focus was the introduction of hunting and fishing species. Over a period of about sixty years the societies, and sometimes individuals, imported several kinds of deer and their cousins—thar, chamois, red deer, Virginia (white tailed) deer, wapiti, fallow deer, sambar deer, sika deer, and even moose. Some of these species were introduced or encouraged by the New Zealand government and the New Zealand Tourist Department, and some were so successfully acclimatized that they multiplied into populations of hundreds of thousands, which did immense damage to flora and soils (McDowell 1994; Johns and MacGibbon 1986; McKinnon 1997). Other attempts to acclimatize species included robins, nightingales, house sparrows, gnus, zebras, llamas, and wallabies. Fortunately, only a few foxes were imported and they died out. This work was considerably promoted by Sir George Grey (Governor 1845 to 1853 and 1861 to 1868, Premier 1877 to 1879), both officially and privately on the island of Kawau in the Hauraki Gulf, which he purchased in 1862. There he introduced a bewildering range of species including (besides various flora) peacocks, kookaburras, Chinese pheasants, emus, ducks, geese, turkeys, guinea fowl, quail, and many other birds, plus antelopes, several species of deer, monkeys, zebras, possums, and six species of wallabies (Rutherford 1961; Brennan 2004). That was a hybrid landscape!

One of the most interesting insights into the subject of alien species in New Zealand has been put forward by Australian biologist Tim Low. He points out that over millions of years, Australian species of birds, insects, and plants were blown or floated across the Tasman. Most of them did not survive in the unsuitable New Zealand environment, but after the extensive land clearing and other environmental changes that accompanied first Maori and then British colonization, conditions were created that enabled many to settle. Immigrant birds in Maori times included harriers, purple swamp hens, bittens, shovellers, and stilts, and in the European era, Australian shelduck, Australian grebe, white-faced heron, nankeen night heron, royal spoonbill, Eurasian coot, black-fronted dotterel, masked lapwing, welcome swallow, and silvereye (Low 2002, pp. 133–139).

As this suggests, one of the most significant changes in the New Zealand environment was the immense amount of land clearance that was undertaken to create a more utilitarian and cultured landscape. The area under forest was reduced from 18 million hectares to 6 million hectares between 1840 and 1980, while the area of grassland rose from 8 to 14 million hectares (McNeill 2001, p. 101). At its peak in the decade 1890 to 1900, land clearing removed 3.5 million hectares or 27 percent of indigenous New Zealand forests (Tong and Cox 2000, p. 32). It is not surprising that in this context there was a flowering of concern about the loss, as exemplified by the two poems quoted earlier in this chapter and in other literary works (Kuzma 2003). However, literary expressions of concern did little to stop the advance of "progress." While the cleared forest was principally used for grazing and, as with large areas of fern and tussock land that were also converted, came to be mostly covered in imported grasses, a large area was also cleared for agriculture. On top of this, 85 percent of the country's wetlands (and this is a rainy country) was drained (Taylor 1997; Pawson and Brooking 2002).

Before Pakeha arrived, the North Island had been particularly heavily forested and, to make way for their farms, the settlers resorted to fire as their principal tool—smoke filled the air for generations. Geoff Park has noted:

> When the smoke of the colonists' fires cleared at the end of the 19th century, New Zealand had become a different country. Maori had lost their most precious life-support system. Only in the hilliest places did the forest still come down to the sea. Huge slices of the ancient ecosystem were missing, evicted and extinguished. (1995)

Like Gippsland in Victoria, the country was ravaged as settlers and farmers destroyed vast volumes of trees, which, in purely economic terms, were worth far more than the cleared agricultural land could hope to produce. J. R. McNeill

Many New Zealand settlements, such as Rungana on the west coast of the South Island, were carved out of the New Zealand forests in the last two decades of the nineteenth century. (Alexander Turnbull Library)

has commented, in a nice piece of understatement, that "New Zealand did not make the most of its environmental transformations (millions of cubic meters of good timber have gone up in smoke)" (2001, pp. 331–332). The speed and extent of forest clearance also produced a range of environmental problems, notably erosion, stream siltation, and sand drift, as well as giving rise to expressions of sorrow at the loss (Beattie 2003; Kuzma 2003).

Nevertheless, logging of forests for timber formed an important industry that, from the second half of the nineteenth century, penetrated ever-deeper into the forest, establishing hundreds of mills and degrading the landscape. Graeme Wynn has remarked:

> Skid roads, chutes and tramways, dams built to flush logs downstream, the shanties and cookhouses of the workers, marked the landscape. Logging was never a tidy operation. Stumps, sawdust, and vast quantities of debris were left behind; the earth was gouged and disturbed; soils were exposed to rain and wind. (2002, p. 107)

The gravest tragedy of New Zealand forestry was the attack upon the tall and beautiful kauri forests, which were cut without thought for conservation or

sustainability. By 1900, the 1.2 million hectares of kauri forest had been reduced to 200,000 hectares. Production slumped in the 1920s as the trees disappeared, and extinction seemed possible; fortunately, conservation and the inaccessibility of some stands of the trees enabled the species to survive. At the end of the twentieth century, the few small surviving stands (now greatly treasured) inhabited a mere 5,000 hectares (Halkett 1991; Pawson and Brooking 2002; McKinnon 1997).

Stephen J. Pyne has colorfully described the European impact on New Zealand's biota as having been "smashed in a geological heartbeat" (1997, p. 431). Pakeha truly have been, in Tim Flannery's phrase, "future eaters." Like other peoples arriving in the Pacific, they found an advent abundance that they exploited enthusiastically and ruthlessly. In doing so, they generated wealth, which afforded a high standard of living and created an impressively dynamic society. However, while the country is larger and more highly resourced than others in Oceania, like the smaller nations, it was very limited in such critical areas as fossil fuels (though there is plenty of wind to be harnessed). New Zealand became dependent on being able to export commodities from its limited land mass and declining environment in order to continue to generate wealth and to sustain the quality of life enjoyed by its citizens. The jury is still out on when, rather than if, New Zealand's Pakeha satiation slump will occur, and whether this generally advanced nation will manage the revolutionary change to long-term sustainability.

Despite this devastation, one should not gain the impression that Nature has meekly succumbed to human exploitation in New Zealand. One of the major exhibitions in the famous Te Papa museum in Wellington is about the "awesome forces" that shaped New Zealand's natural history and have challenged the impudence of its human occupants—volcanoes, earthquakes, El Niños, storms, landslides, and tsunamis. New Zealand is not known as the "shaky isles" without reason. An earthquake in 1855 lifted the Wellington waterfront by about 2 meters—Lambton Quay is now one of the main shopping streets situated a few hundred meters from the ocean. The town of Napier was destroyed by an earthquake and resulting fire in 1931 and quickly rebuilt in elegant *art deco* (Hicks and Campbell 2003).

Because of the rapidity and the high level of human-induced environmental destruction in New Zealand in the nineteenth century, some colonists expressed concern about the decline of the landscape and the disappearance of indigenous species. The poem by Reeves at the start of this chapter is a remarkable cry against the destruction of New Zealand's forest and dependent species. Such literary sentiments were not uncommon and played a role in promoting a small but valuable body of the nineteenth century conservation legislation. The New Zealand government introduced measures beginning in the 1860s to insti-

tute limited conservation protection, many of which appeared a decade or two before similar ones in the Australian colonies/states. Much of the legislation was essentially anthropocentric and utilitarian, and was limited in its impact and effectiveness, at most doing no more than slightly slowing the headlong rush to degradation. Nevertheless, New Zealand can boast to have on its statute books its first game preservation act in 1864, legislative protection for threatened indigenous birds from 1872, some forest conservation controls from 1874, marine resources protection from the 1870s, and in 1891, the first fauna preservation reserve. Scenery preservation commenced in 1885 with a reserve established around the tourist-attracting lakes and thermal springs at Rotorua. The 1903 Scenery Preservation Act provided a broad framework for the protection of many new regions of natural beauty, largely for tourism (Star and Lochhead 2002; Barton 2002; Kuzma 2003; Star 2003; Beattie 2003).

As the twentieth century advanced, there were many other published expressions of conservation and ecological consciousness (Galbreath 2002; *Environment and History* 2003). The poem at the start of this section by Dunedin barrister Alexander Bathgate, like the earlier Reeves poem, bemoaned the loss of the makomako, or bellbird. However, Bathgate saw the disappearance as an inevitable manifestation of Darwinist evolution, and accepted the passing of the "old" species in the face of progress and the introduction of "new" species from the Fatherland—"Thy doom is fixed by Nature's law." One of New Zealand's most famous poems is Blanche Baughan's "A Bush Section" (c. 1908), which reflected on a damaged land, the use of fire to clear the land, and the resulting "tumultuous landscape . . . prickled, and spiked with standing black and grey splinters" (Kuzma 2003; see Document section).

There were also less literary environmental messages. Botanist Leonard Cockayne presented ecological arguments in favor of conservation and preservation from early in the twentieth century (Pawson and Brooking 2002). A remarkable example of observation and awareness of the changes to the environment was *Tutira: The story of a New Zealand sheep station,* published in 1921 by the station owner, Herbert Guthrie-Smith (See Documents). While lacking the impact and readership of Gilbert White or Henry David Thoreau, Guthrie-Smith rivals them in his perception. His close observation of indigenous species was notable, but even more remarkable was his understanding of changes in the land and its inhabitants resulting from alien invaders, particularly weeds (Guthrie-Smith 1921). More conventional scholars also expressed conservation concerns, notably Canadian historical geographer Andrew Hill Clark who, in 1949, published *The Invasion of New Zealand by People, Plants and Animals: A Study of the South Island* (Clark 1949). It is interesting to note that a number of the early studies in Australia that formed the foundation from which environmental history grew

were also undertaken by historical geographers from overseas, particularly North America.

Despite these early signs of vigorous conservation and environmental concern, New Zealand shared the global explosion of development and population after World War II, and the consequent environmental decline. In response, from the 1960s, a number of conservation groups appeared on the scene to fight both broad and specific campaigns. Nuclear concerns were notably important in New Zealand but, like Australia, the logging of forests and the damming of waterways for hydroelectricity became key issues. There were battles over the logging of beech forests in the South Island and podocarp forests in the North Island.

The greatest environmental confrontation in New Zealand's history, however, was about damming and hydroelectricity. In the early 1960s, the Royal Forest and Bird Protection Society and the Scenery Protection Society lobbied unsuccessfully to prevent the construction of a hydroelectric power station and interference with water levels in Lakes Manapouri and Te Anau in the Southern Alps. The threat arose again in the late 1960s when it was proposed to raise the levels in Manapouri by up to another 11 meters. A strong resistance was mounted and the controversy dragged on until the early 1970s, overlapping with the somewhat similar campaign in Tasmania over plans to flood Lake Pedder. The growing environmental lobby and the election of a New Zealand Labour government in 1972 were finally successful in putting an end to the project. The government commenced a new era of tightening controls over forest clearance and protection of waterways. Over time, a Department of Conservation was established and, in 1991, an important Resource Management Act was introduced. Between 1961 and 1991, the area under national parks was doubled. Nevertheless, pressure for development, energy generation, and timber has ensured that the damming of water systems and clearing of forests have continued in New Zealand, as have resulting controversies and campaigns (Peat ND; McKinnon 1997, pp. 97–98; Pawson and Brooking 2002; Tong and Cox 2002; Le Heron and Pawson 1996; Martin 1991, chap. 10; King 2003).

At the end of the twentieth century, the New Zealand environment had been dramatically changed by less than two centuries of European occupation—much of its landscape had become a hybrid in which indigenous species were in low numbers or were missing. The signs for the future were not good for, despite its relatively large and fertile land mass, New Zealand is a small Pacific nation with limited resources. To maintain its population and hard-won standard of living, the country needed to continue to extract as much as it could from the environment—through grazing, agriculture, forestry, hydroelectricity, and any other exploitable resources. Immediate needs generally overwhelmed environmental concerns and measures.

As they moved into the twenty-first century, New Zealand and the other small and vulnerable Pacific nations shared these unresolved tensions.

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6

CONTEMPORARY CONCERNS

The Gouldian finch (*Chloebia gouldiae*) is a remarkably beautiful little bird. The males boast a black, crimson, or yellow head with red-tipped ivory beak, lilac chest, yellow abdomen, green wings, and cobalt-blue rump. The female is similarly colored, but somewhat less brilliant. Two centuries ago, the Gouldian finch was found widely across the open woodland regions of northern Australia, living in large flocks. In 2003, it was estimated that there were fewer than 2,000 in the wild, and nowhere a colony of more than 250 birds. The principal reason for their decline is believed to be loss of habitat, notably the changed burning practices since Aborigines were displaced from their lands. Pastoralists burning native grasses late in the dry season when it destroys the seeds deprived the Gouldian finches of their principal food source. By contrast, there are many thousands of the birds scattered across the world, kept in cages, and successfully bred by bird fanciers (Melbourne *Age,* 2 Aug 2003).

Meanwhile, across the Tasman in New Zealand, the future of the kakapo (*Strigops habroptilus,* a large flightless nocturnal parrot that looks like an owl) is equally paradoxical. Prior to Maori arrival, it numbered in the millions, but Maori hunting and introduced predators such as dogs and rats reduced the bird to the point that, in the 1960s, it was feared extinct. In the 1970s, a population was found on an offshore island, Stewart Island, although this remnant was steadily disappearing into the stomachs of feral cats. The survivors were removed in 1982 to other remote areas but they did not prosper and in 1995, the kakapo had been reduced to a mere fifty individuals. An intensive campaign then commenced, involving a large team of people, extensive resources, and removal to other new environments. These efforts were rewarded by more successful breeding and an increase in numbers. By 2002, their future seemed cautiously optimistic, but only so long as human intervention and protection was maintained (*New Scientist,* 1 June 2002).

Two centuries ago, the Gouldian finch was found widely across the open woodland regions of northern Australia, living in large flocks. In 2003, it was estimated that there were fewer than 2,000 in the wild, and nowhere a colony of more than 250 birds. (Photo courtesy of Jim Frazier)

One could add several other birds whose future is not guaranteed outside of captivity or without intensive human protection, including the kagu, or cagou (*Branta sandvicensis*), a barking, ground-dwelling bird in New Caledonia, the kiwis (*Apteryx*) of New Zealand, the Hawaiian goose or nene (*Branta sandvicensis*), and the kakerori (*Pomarea dimidiata*) in the Cook Islands. Perhaps these birds point to the human-created future when wild nature will be largely destroyed and it will only be in captivity or intensively protected programs that many species will exist. It is a surreal, science fiction future, but an increasingly likely one. In Australia, 1,324 species are listed as endangered, including 527 species of plants and animals that are critically endangered or vulnerable—the United States is the only country with a longer list (Melbourne *Age,* 20 Nov 2003).

At the start of the twenty-first century, it is increasingly apparent that because of human activities the future of all biota on the planet—including humans—is at a crossroads. In the last 10,000 years, humans have developed rapidly from a skilled and intelligent hunter-gatherer to the point where many of us live in large, complex, and sophisticated consumer societies, often urban,

and in which our technology (at least for the time being) has largely overcome "nature" and the limitations that it once placed upon us. We have also become an organism that is in plague proportions, is consuming the "resources" and other species on the planet at a gathering pace, and is likely to cause a satiation slump—an enormous ecological and social crash—within the next century unless we change our practices.

One of the principal factors in this global crisis has been the dispersal of Europeans across the planet, particularly in the last 250 years. They have taken Western economic structures, tastes, values, expectations, technology, and environmental exploitation wherever they have gone. Europeans found the resource-rich environments of an advent abundance in much of the planet, and these they have exploited and developed. They also passed to other peoples a taste for Western technology and comforts, many of whom are now contributing quite significantly to the rapid destruction of the natural world. Much of the planet now faces a potential satiation slump as the resources upon which modern societies have been built become exhausted, and as global climate change and a collapse of ecosystems are threatened.

While they possess some of the least densely inhabited parts of an increasingly overcrowded planet, Australia and Oceania are profoundly threatened by the developments and practices of the past two centuries. Australia is facing an uncertain future because of its declining water and soil quality. Because of their small land masses and limited resources, the Pacific Islands also suffer particular problems as net importers of commodities, from clothing to refrigerators to chemicals to packaged food. Once no longer utilized, much of this material remains in the environment on many islands as an accumulating volume of rubbish. They also share the potential devastation that will accompany the onset of global warming.

There are three aspects of the environmental situation in Australia and Oceania, three contemporary concerns, which can be used to demonstrate the problems confronting this quarter of the globe—and of the globe in general. These are: climate change and global warming; hybrid landscapes and blended biotas; and land clearance and soil degradation. But, to finish on a positive note, it must be recognized that at the international, national, and local levels, a great deal of attention has now turned toward finding solutions to our enormous environmental problems.

CLIMATE CHANGE AND GLOBAL WARMING

Most of our human transformation from glorified chimpanzee to dominance of the planet has occurred within the last 250 years, since the commencement of the

industrial revolution and its accompanying agrarian and commercial revolutions. This is the period in which we have developed the technological capacity to "master Nature" and, therefore, to change the nature of the planet. Central to this mastery has been the revolution in our relationship with photosynthesis, the process whereby plants use light from the sun to convert carbon dioxide (mainly from the atmosphere) and water (mainly from the ground) into carbohydrates stored in the plant. As a by-product, oxygen is released into the atmosphere. The presence of carbon dioxide and other so-called greenhouse gases in the atmosphere is a naturally occurring phenomenon and these gases, together with water vapor, trap the sun's warmth and create the conditions for life on earth.

Historically, therefore, photosynthesis was critical in the creation and evolution of human life—in producing the oxygenated air we breathe, the plants we eat, and the wood we burn which has served as our predominant utilitarian material. The industrial revolution changed the way humans accessed the energy stored by photosynthesis. First, recently felled trees were gradually superseded

Low-lying islands like these motu at Aitutaki in the Cook Islands are in grave danger of being the first land masses to disappear as ocean levels rise as a result of global warming. (Photo courtesy of Don Garden)

as the principal source of energy as industrializing societies turned increasingly to prehistoric photosynthesis—carbon trapped in fossil fuels. Coal became the main energy source for industrialization, notably in steam engines. (Muscles, humans' as well as other animals', were another major source of power and energy but they, too, were increasingly superseded by fossil fuels during industrialization.) Coal was also central to great advances in iron and steel production during and since the industrial revolution, and therefore in the manufacture of materials that were much stronger, more durable, and more malleable than timber. Finally, coal came frequently to be used to fire the turbines that generate the electricity that powers modern homes, businesses, and industries. From late in the nineteenth century, another form of fossil fuel, petroleum oil, grew in significance as a source of energy, particularly in the transport revolution brought about by the internal combustion engine and subsequently the jet engine. In the second half of the twentieth century, natural gas was also adopted as a source of transport and general energy. Australia, New Zealand, and the Pacific Islands are dependent on importation of fossil fuels for energy and for economic survival (although Australia has some limited oil and large volumes of natural gas) and have not yet progressed far toward other, sustainable energy sources. Across the planet, fossil fuel reserves are finite and humans, especially in North America and Europe, have used them in such vast amounts for over a century that their future availability will be limited.

To this point, most opinion is essentially in accord in accepting this chain of events. However, when it comes to analyzing the results and predicting the likely repercussions of these changes for the world's temperature and climate in the coming decades, the subject becomes much more contentious. There is a small but declining body of skeptics who argue that, as natural climatic and atmospheric changes are always occurring and as we do not have sufficiently conclusive data, we cannot be sure that human actions are having any significant impact on the atmosphere, temperatures, and the global climate. Some also question whether, even if it were demonstrated that human actions are changing the planet, it is something we should worry much about—as long as humans survive. Others, perhaps ignorant of the lessons of environmental history, naively express faith in the capacity of human ingenuity to overcome any problems we may have created.

By contrast, it is increasingly clear that scientific and public opinion accept that the massive human intervention in natural processes is changing the atmosphere of the planet sufficiently to cause global warming and climate change—and that we should be both concerned and doing something about it. The burning of fossil fuels by petroleum and diesel engines and by coal furnaces, and the extent of land clearing, have resulted in extraordinary increases of carbon dioxide

in the atmosphere. The volume has been overwhelmingly greater than the absorptive capacity of the planet's natural "carbon sink"—the absorption of carbon dioxide by the oceans and through photosynthesis by forests and other vegetation of carbon dioxide into plant carbohydrates. As a result, the levels of carbon dioxide in the atmosphere have been growing since the middle of the nineteenth century, and gathered pace in the second half of the twentieth century. Carbon dioxide, however, is only the worst culprit in the changed balance of greenhouse gases. Another is methane whose presence also rose rapidly in the twentieth century, a product of increasing livestock numbers, rice cultivation, organic waste, and landfills (Pittock 2003).

It is now generally believed that the changed balance of greenhouse gases caused by human activities is inhibiting the escape of heat from the atmosphere, as a result of which the planet is gradually warming. This is likely to cause a diversity of impacts on climate including greater unpredictability and an increase in extreme events such as storms and drought, and notably a possible change in the frequency and severity of El Niño and La Niña episodes. Australia and Fiji, for example, suffered severe El Niño droughts in the early 1980s, the 1990s, and the early twenty-first century, which were both chronologically unusually close together as well as at the severe end of the spectrum (*Scientific Assessment* 1990; Philander 1998; World Meteorological Association 1999). A major study of the impact of global warming announced in January 2004 that the evaluation of data in a sample survey concluded that, while there would be regional differences, 15 percent to 37 percent of species would become extinct as a result of the climatic changes expected by the year 2050 (*Nature,* 8 Jan 2004). There is concern that extreme climatic events are becoming more frequent and severe. There is also clear evidence that the warming of the planet is melting the polar ice caps and alpine snowfields and glaciers, all of which is contributing to changes in ocean levels, which have been predicted to rise by up to a meter in the next century.

While only time will prove or disprove these predictions, it seems wise to take heed of the warnings and to do something to alleviate the situation. Nevertheless, there are many people, particularly on the conservative side of the political spectrum, who prefer to ignore or deny the signs, or who accept that change is occurring but are unconcerned as long as it does not disadvantage humans as well as other species.

Australia is one of the nations most morally responsible for this situation, while the Pacific Islands are among the areas that will suffer most from the consequences.

In Oceania, the rise in sea levels has already contributed to some flooding, coastal erosion, and increased salinity of groundwater, especially on low-lying

atolls. Many countries, such as Vanuatu and the Cook Islands, depend heavily upon groundwater. In the future, shortages of domestic water and flooding will make some of the small Pacific nations uninhabitable, and degrade large areas of others. Those facing an uncertain future include Kiribati, Federated States of Micronesia, Palau, Niue, the Northern Mariana Islands, and Tonga. The small nations with high islands will be able to move populations to higher ground, but as most agriculture and other human activity is coastal or on lowlands, they will still be badly affected. The inhabitants of countries that are largely or completely made up of atolls and low islands will be in a disastrous position and will become "greenhouse refugees." Tuvalu, for example, consists of a chain of nine coral islands no more than 5 meters above sea level. It has a population of only about 11,000 citizens, but they will become homeless. Tokelau, Kiribati, and the Marshall Islands are not much better off, and these nations may simply cease to exist (Woodard 2000; Asian Development Bank 1995). In January 2004, a severe cyclone, the worst ever recorded, did great damage in Samoa before devastating the tiny nation of Niue to the extent that it was questioned whether the country could recover.

Australia's moral responsibility for this situation is both environmental and political. Together with New Zealand and Hawai'i, Australia is a first world country in its patterns of consumption, and its extensive ecological footprint encompasses such issues as energy use, area of land occupied for food production (especially meat animals), water consumption, and wastes. On top of these, while it contributes only a small proportion of the world's greenhouse gases, Australia has one of the highest per capita outputs of emissions. Nevertheless, the Australian government has refused to accept its international responsibilities and has ignored the needs and lobbying of Pacific nations. Despite approaches by the Oceanic countries, the conservative Howard government, which came into power in 1996, refused to cooperate with the principal international attempts to reduce greenhouse gases. When the United Nations Framework Convention on Climate Change met in Kyoto, Japan, in 1997, its purpose was to obtain agreement from all the industrialized powers to reduce emissions of six greenhouse gases over the coming decade. Under the Kyoto Protocol, most developed countries committed themselves to reduce their greenhouse emissions by at least 5 percent below 1990 levels by 2008 to 2012. However, the Australian government doggedly refused to accept any reduction and effectively forced the other nations to accept that Australia would increase its emissions by 8 percent rather than decrease them. More than 170 nations signed the Protocol at the conference, including Australia, but when the Protocol was subsequently made available for ratification, a number of the worst polluters, including the United States and Australia, refused. In March 2001, President George

W. Bush announced that the United States would withdraw from the Kyoto Protocol. Australian Prime Minister John Howard announced that in this, as in many matters, he would follow President Bush.

The Australian government has also rejected requests from some of the Pacific nations to resettle their people in Australia if their islands are inundated. New Zealand has been more responsive in both ratifying the Protocol and offering refuge, perhaps recognizing that, while its emissions of carbon dioxide are low by OECD standards, they are nevertheless 50 percent higher than the global average (Melbourne *Age,* 19 July 2001; Taylor, et al. 1997; Hutton and Connors 1999; McGlone 1990). Meanwhile, whereas Australia had insisted upon being permitted an 8 percent increase in greenhouse emissions, by the end of the century Australian emissions had not only exceeded that target but had more than doubled, leaping by 17.4 percent between 1990 and 1999 (Australian State 2001, p. 25). Australia's solution to this, announced by Prime Minister Howard in mid-2004, was to be the injection of half a billion dollars of research money. However, the money was not to be invested in developing sustainable sources of energy such as solar, wind, and wave. Such was the influence of the coal mining industry in Australia that the vast majority of the research was to be invested into ways to capture carbon dioxide when it is released and to then trap it underground. Another "Band-Aid" coverup has been endorsed rather than offering or supporting a sustainable solution. Such is the anthropocentric, dollar-driven fantasy world in which some elements of Australian industry and politics still live.

A further repercussion of global warming is rising ocean temperatures. As a result, the great kelp beds that ring much of the Tasmanian coast are slowly dying. More broadly, coral reefs across the Pacific are under threat. Coral grows in shallow, clear, and low-nutrient coastal waters in temperatures from 21°C to 28°C. They cannot survive in temperatures of more than 30°C, a temperature that kills the symbiotic algae that live within coral and provide their color. If that happens, the coral dies and whitens. In 1998, there was a dramatic bleaching event that seriously damaged about 20 percent of the world's reefs. Many reefs across the Pacific suffered badly, although only 3 percent of Australian reefs were affected. The bleaching event, while its causes were complex, is generally attributed to a period of increased ocean temperatures. Such temperature fluctuations are expected to continue with increased intensity as the planet warms in the coming century, and the death of coral and the ecological repercussions will be immense. Dead reefs will cause an ecological crash throughout the Pacific and leave the islands more open to erosion and storm damage. Much of the Great Barrier Reef is also expected to die (Woodford 2004).

HYBRID LANDSCAPES AND BLENDED BIOTAS

As a university student, postgraduate, and young lecturer in the late 1960s and 1970s, I often undertook research at the State Library of Victoria and ate my frugal lunch on its front lawns. There I observed a phenomenon that intrigued me, but the significance of which I only understood some years later. When I first started using the library, its forecourt was inhabited by large numbers of introduced pigeons, which made a living from the scraps of food they could entice from picnicking researchers and parties of schoolchildren. Over time, I noticed that the pigeons were joined by small numbers of silver gulls, which in due course increased in number and eventually out-pestered the pigeons with their aggression The pigeons were driven out of the area and the seagulls reigned supreme, although the pigeons have periodically made a return.

The Waikato region on the North Island of New Zealand has been transformed by European agriculture and introduced species. It is unlikely that any of the living things in this scene are indigenous. It is not even a hybrid landscape. (Photo courtesy of Don Garden)

While I disliked the disturbance of the harsh shrieks and fighting among the gulls, on one level I was quite pleased to see an indigenous species triumph over an alien. However, as I traveled further and read more, I realized that the gull phenomenon was not restricted to the library forecourt, nor to harassing pigeons. The silver gull is one of those species that has benefited greatly since British occupation and, with the increase of edible rubbish, their numbers have exploded and they have become a threat to other species. In particular, they raid and pillage the nursery colonies of banded stilts that briefly flourish in inland Australia after rare flooding rains fill the intermittent lakes (Low 2002, pp. 66–69).

In *The New Nature,* Australian biologist Tim Low has examined the "winners and losers" among Australian species since the British occupation of Australia. While some attention is given to the losers, he devoted a good deal of the book to the "winners," or those species that have benefited from European occupation, such as the silver gulls. He also emphasized the species that, although deprived of their natural habitat, have survived and prospered in environments cre-

Weeds choking a stream and its banks, Raratonga, Cook Islands. (Photo courtesy of Lucinda Sargent)

ated by humans. And there are many. For example, the barn swallow now nests almost exclusively on human constructions and in many other ways takes advantage of human activities. In many urban centers, possums nest in residential roof cavities and have thrived on food scraps and the rose bushes and other alien flora that they have found in public parks and suburban gardens. Soon after dusk on many evenings, one of the interesting sights in Melbourne is the parties of camera-clicking Japanese tourists pursuing possums around the Fitzroy gardens—and in these gardens many of the magnificent introduced trees are showing distinct signs of degradation caused by the large possum population they are now required to support. Many indigenous species have benefited or become "pests" because of human-attributable disruptions to the environment (Low 2002).

Another example of vagrant indigenous species is close to me. A family member has a house on an acre of land on the Mornington Peninsula in Victoria. Until recent years, it was quite well covered with local species such as paperbarks, eucalypts, and wattles, but partial clearing has facilitated the invasion of weeds, three in particular: sweet pittosporum, bluebell creeper, and boneseed. A fourth species, *Polygala myrtifolia,* is also showing signs of invading the land. The pittosporum (*Pittosporum undulatum*) is a large shrub or small tree with tasty berries that are spread by birds, and is now growing thickly, drawing so much moisture and fertility from the soil that it is contributing to the decline and death of the eucalypts. The bluebell creeper (*Sollya heterophylla*) is strangling the young saplings that manage to force their way up between the pittosporum and the boneseed (*Chrysanthemoides monilifera*). Of particular interest here is that only two of these invaders are not Australian—the boneseed and the *Polygala* are from South Africa. *Pittosporum* is originally from the Sydney region, and the *Sollya* is West Australian. All four were introduced to the region as garden plants, and all have become major problems on the Mornington Peninsula and its extension, Point Nepean (Nepean 2003; Low 2002). As I know, controlling such weeds can be rather time consuming.

Such cases show that hybrid landscapes and weeds are not only a result of exotic imports. While Australian plants have seldom been among the most favored ornamental species, for over a century there have been a few that have been transported widely to brighten gardens. Other species have distributed themselves across the nation, hitchhiking on vehicles (notably with the explosion in the number of four-wheel-drive recreation and work vehicles), with fresh fruit and vegetables on the way to market, and with other freight and in a multitude of other ways. The created landscapes of European Australia have offered the opportunity for many species to spread well beyond their original ecological niches or, as with kangaroos and seagulls, to explode in number. Nature is opportunistic, and human intervention in the environment has offered

wonderful opportunities for those species able to take advantage of changed conditions.

Another book by Tim Low, *Feral Future,* presents in alarming detail "the untold story of Australia's exotic invaders" and makes it very clear that, while indigenous tramps are problematic, it is alien species that more generally threaten Australia's ecosystems. According to Low:

> More than 2700 weeds have become established in Australia so far, at a cost to the economy of more than $3 billion, and each year another ten take root. Weeds now make up 16 per cent of Australia's wild plant species. Two hundred or more foreign animals and algae infest our seas. The number of exotic insects, fungi and micro-organisms is anyone's guess. These figures will keep growing. (Low 1999, p. xv)

New Zealand and the Pacific Islands are experiencing the same phenomenon, but it is arguable that their millennia of isolation, followed by comparatively limited human contact and exploitation, has made them particularly susceptible to the effects of invasive species. The toll taken on the Hawaiian environment, which is outlined in Chapter 7, is perhaps extreme, but is certainly representative of the Pacific experience.

An important factor in the contemporary and future redistribution of species is the sheer volume of international trade that has built up since World War II. Every shipping container, each box of fruit, every car or piece of agricultural equipment (especially used ones), and every passenger is likely to be carrying some form of alien life between international ports and airports. Under such circumstances, prevention of further species transfer and the advent of more pests is effectively impossible. Christine Dann has pointed out that, in the case of New Zealand, the number of inward shipping containers rose from 200,000 to 316,000 between 1994 and 1999, and the number of used motor vehicles from 50,000 to 120,000 (Dann 2002, p. 277). How many insects, invertebrates, microbes, and other biota took the opportunity of free migration to the Land of the Long White Cloud is unknown.

The high mobility of humans and their property dispersed innumerable species across Oceania in the twentieth century. One notable invertebrate is the Giant African Snail (*Achatina fulica Bowditch*), which now inhabits Hawai'i, New Caledonia, Samoa, Tahiti, and Vanuatu. A colony was also found near Cairns in Australia in 1977 but it was eradicated, and at least one more arrived in Queensland early in 2004. This voracious African snail traditionally feeds on decomposing vegetation but in the Pacific it has become a major garden and crop pest that, as well as garden plants, attacks cocoa, rubber, bananas, sweet potatoes, cassava, yams, breadfruit, and papaya. It has out-competed some indigenous snail

species and brought them close to extinction. In Hawai'i, as discussed in Chapter 7, it has been indirectly responsible for the decimation of extant indigenous snails. A plant pest that is widely distributed across the region, including Hawai'i, Fiji, and parts of northern Australia, is Koster's Curse (*Clidemia hirta (L.) D. Don*). Originally a shrub from tropical America, it has become a garden plant and then a weed around the globe. Once established, it forms dense thickets that can smother plantations, pastures, and native vegetation. It produces large numbers of berries which are dispersed by birds—and the infamous Indian mynah seems to be a principal vector (Queensland Fact Sheets). The taro planthopper, an insect that eats taro leaves and spreads diseases in the crop, has spread out of Southeast Asia and across the Pacific to almost everywhere that taro is grown. These three species are just a tiny sample of Oceania's blended biota.

New Zealand's hybrid landscape is more complex than most, because of both the high proportion of land that has been cleared and converted to various forms of economic production, and also the extraordinary number of introduced species. Whereas before human arrival the islands had about 2,700 species of indigenous plants, about 20,000 species of plants have since been introduced by humans (besides 53 species of mammals, more than 30 birds, many fish, and innumerable insects). More than 200 of the flora species have become pests, most of which were imported as garden plants. In various ways these exotics threaten the long-term viability of indigenous ecosystems, including the remnant forests that the weeds are invading. There are now as many introduced conifers and flowering plants in the wild as there are native species (Taylor, et al. 1997). It is difficult to select the worst culprits, but the website of the New Zealand Conservation Authority features among many weeds the Japanese honeysuckle (*Lonicera japonica*) from Asia, Pampas grass (*Cortaderia selloana* and *Cortaderia jubata*) from South America, wild ginger (*Hedychium gardneranium*) from India, and Old Man's Beard (*Clematis vitalba*) from Europe and Southwest Asia.

New Zealand waterways are also suffering from exotic weeds such as Alligator weed *(Alternanthera philoxeroides*) and *Egeria densa* from South America, Clasped pondweed (*Potamogeton Perfoliatus*) from North America, and many others that choke streams and lakes (New Zealand, Department of Conservation website). Alien fish that have become numerous and are displacing indigenous species include brown and rainbow trout, the European carp (*Cyprinus carpio),* rudd (*Scardinius eyrthrophthalmus*), and catfish (*Amerinus nebulosis*) (Taylor, et al. 1997). Just three of innumerable new insects to arrive in the late years of the twentieth century included the gypsy moth, the white-spotted tussock moth, and the varroa bee mite (Pawson and Brooking 2002, p. 278).

Of the introduced mammals in New Zealand, thirty-three now dominate the landscape, the five most significant of which, besides humans, are sheep,

Possums were accused of carrying bovine tuberculosis, which threatened farm animals, and through their consumption of flora (an estimated 20,000 tons of vegetation devoured per night) they contributed significantly to a decline in indigenous birds, notably the kiwi, the nation's emblem. (Geoff Moon; Frank Lane Picture Agency/Corbis)

cattle, possums, rabbits, and rats, the last especially impacting on flora and fauna on the smaller islands. Possums and rabbits (assisted by goats and deer) have the most direct impact on the remnant indigenous landscape through their eating of trees and seedlings. The Australian brush-tailed possum (*Trichosurus vulpecular*) was first introduced in the 1830s in an attempt to establish a fur industry, and importations continued until the 1920s. Locally bred stock were liberated until 1952. By the late twentieth century, possums were in plague numbers, calculated at 70 million. They were accused of carrying bovine tuberculosis, which threatened farm animals, and through their consumption of flora (an estimated 20,000 tons of vegetation devoured per night) possums were contributing significantly to a decline in indigenous birds, notably the kiwi, the nation's emblem (Johns and MacGibbon 1986; Pawson and Brooking 2002; Taylor 1997; *NZ Listener,* 13 April 2002). Rabbits, introduced for fur, meat, and sport from as early as the 1830s, had become a major environmental invader in some areas by the 1860s. They severely damaged indigenous flora and con-

tributed to soil degradation and thereby to a decline of indigenous fauna, especially in the South Island. To compound their problems, New Zealanders attempted some untested biological control, introducing cats, stoats, weasels, and ferrets, which found kiwis and other indigenous fauna to be much easier prey than rabbits. However, the new predators did have some impact on rats on the main islands. The efforts to eradicate or control rabbits have been immense but were limited in their success until the illegal arrival of calicivirus from Australia in 1997. While the disease gets best results in hot and arid areas, conditions with which New Zealand is not widely endowed, its reduction of rabbit numbers has been significant (Johns and MacGibbon 1986; Isern 2002; Taylor 1997).

As a result of habitat destruction, human predation, and the impact of alien invaders, about 800 of New Zealand's species of fauna and 200 subspecies are now considered threatened. In the late 1990s, weeds, animal pests, and pathogens were calculated to cost the New Zealand economy $840 million per year, or 1 percent of gross domestic product (Taylor 1997; New Zealand Conservation Authority 1999; *New Zealand Herald,* 5 Dec 2003).

In Australia, despite the immense problems with weeds and feral animals that had become apparent in the nineteenth century, the twentieth century brought a continuing influx, both deliberate and accidental. More than 2,850 introduced plant species have become weeds, and the number is increasing by at least 15 per year. Two aspects of the invasion stand out for their minimal control and maximum impact. The first is the continuing importation of garden plants. Despite the earlier history of escapees, garden imports were only loosely controlled during the twentieth century, and inevitably many of those that arrived both legally and illegally became environmental weeds. There are many plants that are proscribed in some states but permitted in others—and many more that are invasive but are as yet uncontrolled anywhere. Nominating representative examples of the worst ornamental weeds is highly challenging, but in Queensland and New South Wales two vines from tropical America, Cat's claw creeper (*Macfadyena unguis-cati)* and Madeira vine (*Anredera cordifolia*), are steadily encroaching upon disturbed rain forests, waterways, and forestry plantations. Also from tropical America, the Bellyache bush (*Jatropha gossypifolia*) has spread widely across tropical Australia, from the Kimberley to the Gold Coast. The Noogoora Burra (*Xanthium* species) from southern North America is becoming a major problem in many parts of northern Australia. Further south, blackberry infests 8 million hectares, Prickly Acacia 7 million hectares, and Lantana 4 million hectares. Among the visual joys of travel in some of the moister parts of southern Australia in late winter and early spring are alternate fields of beautiful golden and purple flowers. Unfortunately, the golden flowers are Cape

weed (*Arctotheeca calendula*) from South Africa, and the purple are Salvation Jane (*Echium plantagineum L.*) from the Mediterranean. Both arrived as garden plants in the nineteenth century and spread widely in the twentieth century. In New South Wales, the purple flowers are known as Paterson's Curse after the family who brought the seed from Europe for their garden. As that name and the large expanses now dominated by these weeds indicate, both are highly invasive and tend to choke out all other species. The annual cost of weeds to Australian agricultural industries, most of which arrived as garden plants, is calculated at more than $4 billion (*Australian*, 3–4 Jan 2004).

The second notable area of the Australian invasion has been the arrival of a diversity of water species that are increasingly dominating Australia's coastal regions, destroying indigenous species along coasts and in inland waterways, as well as clogging streams with weed infestations. The threat of introduced marine pests became serious in the second half of the twentieth century largely because of the number arriving on vessels laden with large volumes of seawater ballast, which was then pumped into local waters before cargo was loaded. At least 200 species have been introduced into Australian waters in this way, including the Northern Pacific Seastar, which eats oysters, mussels, and other species. In 1999, the Black Striped Mussel was found in Darwin Harbour and was only eradicated after a very expensive program (Australian State 2001, pp. 42–43).

Alien fish and choking waterweeds have long been a problem in Australia's inland waters. At the start of the twenty-first century, thirty-five exotic fish species are established in inland waters and eight are identified as having a significant effect (Australian State 2001, p. 68). Among these is the American mosquito fish (*Gambusia holbrooki*) which was released in the 1920s in order to control mosquitoes, and is now in plague proportions in Australian waterways where they have a greater impact on native fish and frogs than on the mosquitoes. Water weeds such as the tropical American water hyacinth (*Eichornia crassipes*) and Alligator weed (*Alternanthera philoxeroides*) (both also found in New Zealand) were introduced as decorative pond plants and have spread widely, choking Australian streams and lakes. The common or European Carp had been present in Australia since the second half of the nineteenth century, but an escape into the wild in the 1960s, apparently of a newly imported strain, dispersed rapidly and reached the Murray system. These large, slow creatures are bottom feeders that suck in and spit out silt, muddying the water and making it hard for other fish to breathe. Females can lay up to 1.5 million eggs per annum, a fecundity that gained carp a reputation as "water rabbits." They quickly became the most common fish in much of the Murray River and have recorded up to 93 percent of fish sampling catches. Carp are popular for food in Europe, but have not found their way to many Australian tables. Consequently,

the tons that are dragged from the river each year are used for fertilizer or are disposed of as waste, but have little impact on remaining numbers (Low 1999).

Despite such catastrophes, the aquarium industry has had only minimal control and continues to be responsible for imports of water weeds, fish, fish diseases, and snails. Millions of fish are imported each year from Southeast Asia, often carrying diseases and bacteria. Many have been released into Australian waterways, although it is mainly in northern tropical waterways that conditions are conducive for them to establish feral populations (Low 1999).

The invasion of foreign species has created new and paradoxical relationships in Australia's hybrid landscape, a good example of which is centered around the rabbit. As discussed earlier, rabbits devastated Australian and New Zealand landscapes beginning in the second half of the nineteenth century. Numbers rose and fell, with one of the highest peaks in the early 1930s, partly because expensive control measures could not be afforded during the Depression. However, that peak in numbers was also fortuitous because "underground mutton" helped many rural families to survive. Nevertheless, the number of rabbits was devastating for the environment (Garden 1979; see Documents).

Attempts to control rabbits became a huge and costly national enterprise. A number of amazing "rabbit-proof" fences were erected to try to stop their inexorable spread, the most spectacular of which ran 1,900 kilometers from the south coast to the north coast of the continent in Western Australia. It failed, as did the many other barrier fences, and most of the hundreds of thousands of kilometers of private fences that were constructed in and around individual properties. Hardly more successful were diverse methods to trap, poison, gas, dig, and blow up the pest. It was not until after World War II that a reasonably effective form of biological control was found in myxomatosis, a rather unpleasant disease spread by mosquitoes and fleas. Following appropriate testing, it was released at points on the Murray River in 1950, and after an initial lapse, it took off, spreading rapidly along the river systems. The initial impact was devastating and rabbits were nearly eradicated in large areas of the country. Their disappearance enabled a marked increase in the grazing carrying capacity of the land, higher crop productivity, and a revival of indigenous vegetation and dependent fauna. In due course, rabbits developed a resistance to the disease, but their populations stabilized at as low as 5 percent of pre-myxomatosis numbers in wet regions, and at up to 25 percent in arid regions (Coman 1999).

At these levels, rabbits were still an environmental and economic problem, and research for better controls continued. In 1995, experiments were being conducted with rabbit calicivirus disease, or rabbit haemorrhagic disease, on an offshore island in South Australia. In October, dead rabbits were found on the nearby mainland—apparently the disease had escaped, carried by flies. From

there, calicivirus spread rapidly across southeastern Australia, probably with a substantial degree of human assistance, and quickly reduced rabbit populations, particularly in arid zones. Death tolls of up to 90 percent were noted. New Zealand farmers were keen to follow, and when their government refused to allow release of calicivirus, the disease mysteriously appeared on the South Island in 1997. Because full environmental tests were not completed in either country, there is still some uncertainty about the long-term environmental safety. So far, fortunately, the signs are good (Coman 1999; Rolls 1969; Low 1999; Pawson and Brooking 2002).

Nevertheless, the decline of rabbits has posed some interesting environmental paradoxes because new interspecies relationships had developed during the many years of rabbit occupation. Some Australian predators such as eagles and barking owls had incorporated rabbit into their diet, partly as a response to the decline of their traditional prey. What effect the loss of rabbits has had and will have on these species is still unclear. A similar issue arises with feral foxes and cats, which had developed an intriguing symbiotic relationship with rabbits. The decline in rabbit numbers has deprived these rapacious predators of an important prey. Will foxes and cats decline as well, or will they compensate by increasing their dependence on what is left of the indigenous bird and marsupial populations? It is ironic that calicivirus and the long-awaited reduction of rabbit numbers may threaten indigenous fauna. Initial indications are good that the decline in rabbits is causing a similar decline in the two predator species. However, there has not been a noticeable rise in indigenous fauna or regeneration of vegetation ("Australia's Most Wanted" 1994; "Australia After Rabbits" 2003).

While calcivirus has so far proved to be a relatively successful and safe form of biological control, there have also been disastrous cases, such as the mosquito fish described earlier. Arguably the most infamous, however, is the cane toad (*Bufo marinus*). In the 1930s, this large Central American toad was believed to offer a solution to insect pests that were destroying crops on Queensland sugar farms, in particular the indigenous greyback beetle. The toad was introduced into Hawai'i in 1932, where it rapidly established in the Honolulu region and spread into the suburbs. This capacity to multiply was seen as a major attribute, and in 1935, a hundred or so toads were imported from Hawai'i to Cairns to breed up before release. Despite some opposition, and without environmental testing, within a few months more than 40,000 had been bred and released. The toads had little impact on the greyback beetle, which remained inconveniently ensconced in the upper parts of the canes while the toads patrolled at ground level. However, the toads were voracious, and at ground level found plenty of other insects, amphibians, small mammals, and other indigenous creatures to eat. The toads bred even faster than rabbits and,

while their spread was not as rapid, it has nevertheless been alarming. Tim Low believes the toad is now the most common vertebrate in much of Queensland, having population densities of up to 5,000 per hectare around waterholes. By the start of the twenty-first century, the toads had migrated south through Queensland and into New South Wales, and north and west as far as the Northern Territory, where they were invading the Kakadu National Park. Wherever they traveled they took a terrible toll on those species on which they preyed, and thereby also on indigenous predators. In Kakadu in 2003, they had already been attributed with having brought about the local extinction of the Northern Quoll as well as with causing a crash in reptile numbers (Glasby, et al. 1993; Low 1999; Australian Museum 2003). Besides Hawai'i, cane toads were also introduced into Fiji, the Solomons, Guam, and Palau, where they have also done significant environmental damage.

Ironically, in one sense, the arrival of new biota in a region adds initially to its "biodiversity" by increasing the number of resident species. However, in the long term, the invasion of ecosystems by newcomers that are not controlled by the diseases, predators, or climatic and other conditions of their own habitat, impacts profoundly on indigenous species and reduces biodiversity. There are already too many alien species in Australia and the Pacific to be able to do more than partially alleviate the problem. Hybrid landscapes, blended biotas, and a "feral future" are inevitable.

LAND CLEARANCE AND SOIL DEGRADATION

In their book, *The Vanishing Continent: Australia's Degraded Environment*, Beale and Fray noted that:

> . . . no other single course of action in the past two centuries has contributed so much to the nation's soil, water and biological degradation as the mass removal of native trees, bushes and grasses. . . . The result of excessive tree loss can be seen almost anywhere in Australia, in a myriad of forms—deep gullies scarring the hillsides, a rising tide of underground salt, choking dust storms, biological graveyards caused by dieback, ragged riverbanks and silted streams. (Beale and Fray 1990, p. 27)

Leaving aside some of the distinctively Australian characteristics of soil degradation in this description, such as dust storms and salination, many of the most serious environmental concerns throughout the Pacific and Australia revolve around the continuing clearance of forests and other vegetation. The damage from past and present clearing to the land, water, and biodiversity potentially

threaten the future of human societies in the region. The advent abundance that Europeans began to exploit 200 years ago may be nearing exhaustion, and a satiation slump seems inescapable unless more sustainable practices are implemented. Nevertheless, so far the economic imperative has reigned supreme—to exploit land and water to the fullest, to cut timber for forestry, to clear more land for agriculture.

In Australia, clearing and other activities have produced an enormous transformation of the distribution and types of vegetation. In about one third of the country the original vegetation has undergone major changes, in another third about half has been noticeably changed, and in about one third (mainly arid and desert) there has been less significant change. The area under grassland has risen by over 130 percent, while the area under rain forest or dense forest has halved—an area equivalent to the British Isles has been stripped of trees and

Appreciation of the ecological significance as well as the beauty of Australia's forests, such as this stand of karri trees in southwest Western Australia, have contributed to the defense of old-growth forests becoming one of the major environmental issues in Australia. (Photo courtesy of Don Garden)

much of it replaced with weed-infested land. Woodlands and shrublands have been reduced by about a third. Only 15 percent of the mallee country, which used to cover 11 million hectares in New South Wales, Victoria, and South Australia, is now left. Beale and Fray calculate that Australia has about 20 billion fewer trees of at least 10 meters tall than in 1788, which equals a loss of about 1,200 trees for every Australian alive at the end of the twentieth century (Beale and Fray 1990, pp. 32–33, 76).

The process continues, and in 1995 to 2000, a further 1.2 million hectares of native trees and woody species were cleared (Australian State 2001, p. 49). The Australian Conservation Foundation estimated that over 564,800 hectares of native vegetation was cleared in the year 2000 alone, much of it in Queensland. Such an area was exceeded by only four other countries—Brazil, Indonesia, the Democratic Republic of the Congo, and Bolivia. Australia is the only developed nation with such a level of clearing (Australian State 2001, pp. 73–74).

In the late decades of the twentieth century, most Australian states introduced controls on the clearing of indigenous vegetation, with South Australia the most rigorous. However, broadacre land clearing continued in Queensland and, to a lesser extent, New South Wales. Queensland, in many respects the most politically and environmentally conservative of the states, refused to heed the environmental and economic lessons from the south. Despite the potential for soil salinity and other degradation, bulldozers were kept busy both along the seaboard plains and in the more arid interior. Indeed, in the 1990s and early twenty-first century, clearing increased pace because of concern that the Queensland government might eventually follow the other states and introduce controls. Queensland developed the unenviable reputation of being one of the largest ongoing land clearance regions in the world. (Chapter 7 contains a discussion of some aspects of Queensland's role in recent environmental issues.) When it was eventually announced in 2004 that controls would be placed on native vegetation, a two-year warning was given and, during that time, extensive clearing was to be allowed to continue. Pursuit of immediate well-being outweighed the caution and wisdom that should be among the main lessons learned from environmental history.

The repercussions of such levels of land clearance in Australia are profound. At the start of the twenty-first century, dark and gloomy predictions are being made about the future of Australia's main food-producing regions because of the level of soil degradation that has followed two centuries of land clearance and European agricultural practices. One of the major concerns is changing chemical composition of the soil across large areas of the nation, but particularly in those soils used for cropping. There are three particular soil chemistry changes taking place—soil acidity, soil sodicity, and soil salinity.

A steep increase in soil acidity has become apparent in the wheat and sheep belt of southern New South Wales and northern Victoria, as well as in coastal areas of Queensland. In the inland areas, a combination of fertilizers and subterraneum clover have changed the soil chemistry and, by 1990, had turned it acidic over an estimated 26 million hectares, with a further 13 million hectares added in the next decade. In coastal regions of Queensland, there are significant areas of soils rich in iron sulphide which are stable while moist but, once exposed to the air by clearing, draining, and other activities, form deposits of sulphuric acid. This acid is washed into the environment, causing considerable damage on land, in streams, and in the ocean where it kills fish, prawns, oysters, and other aquatic life. Acidic soils can be treated with large quantities of lime, itself a potential hazard (Bell 2000; Beale and Fray 1990; Australian State 2001).

Soil sodicity, as distinct from salinity, has only recently been identified as a major problem for Australian agriculture. Heavy clay soils with large numbers of sodium ions occur over nearly a third of the continent. When this land is cleared and used for agriculture, its exposure to water is increased, producing a change in the chemical structure of the soil known as sodicity. This results in poor water infiltration, surface crusting, increased likelihood of erosion, waterlogging, and water runoffs, which carry high levels of nitrogen and phosphate, causing turbidity in streams and wetlands. Sodicity can be treated with the application of large quantities of gypsum, but it has been described as potentially greater in spread and impact than salinity (*Nova* website; Naidu, Summer, and Rengasamay 1995; Australian State 2001).

At the end of the twentieth century, it was soil salinity that was most apparently threatening the future of agriculture and biodiversity in Australia. It had not been realized in the early decades of settlement that much of Australia, in effect, floats on a sea of salt. Besides naturally occurring salts in the soil, in past ages large areas were covered by oceans, which have left a legacy of salt impregnation. Over the millennia, the salt was leached down below the sub-soil, to the level of the water table, and was kept there by trees and deep-rooted grasses, which pumped water into the atmosphere through respiration. Clearing the natural vegetation for agriculture allows the water table to rise, bringing salt toward the surface where it destroys vegetation, reduces habitat, and makes the land impossible to crop. As the vegetation dies off, erosion sets in and silt and salt are washed into drainage systems. Such effects can become apparent from a decade to a century after initial clearing, depending on local conditions. The signs of white poison were becoming evident in some areas early in the twentieth century, but the full impact was not felt until after World War II.

As described in Chapter 4, pouring water onto the land to irrigate, most notably in the Murray-Darling Basin, has further contributed to waterlogging, rising water tables, and therefore to increasingly saline soils. Both dryland salinity and irrigation salinity have taken a terrible toll on the land and, by late in the twentieth century, were threatening Australia's agricultural future and its sustainable human carrying capacity. Figures vary, but in 1982 it was estimated that 4.2 million hectares across Australia were salted as a result of human activity (Young 2000, p. 51; Woods 1984). By 1990, rising salt was claiming about 250 square kilometers per year of Western Australia's 140,000 square kilometers of cropping land, a region that produced about 40 percent of the country's wheat exports. In 2001, about 5.7 million hectares across Australia were affected by or were at risk from increasing salinity, half a million hectares having

One of the gravest ecological and economic problems facing Australia is the increasing salinity of vast areas of agricultural and pastoral land. The principal cause has been the removal of indigenous vegetation, although in irrigation areas the problem can be attributed to pouring large quantities of water onto the soil. Both cause the rise of the water table, which brings salt to the surface or within the root zone of plants. The Western Australian wheat belt, such as this area near Katanning, is among the worst affected. (Photo courtesy of Don Garden)

been added since 1996. Up to 17 million hectares of land and 20,000 kilometers of waterways are predicted to be salt affected by the year 2050. The economic and human cost will be enormous, as will the continuing impact on remnant vegetation, water systems, wetlands, and indigenous species (Beale and Fray 1990, pp. 99–101; Australian State 2001; Rozycki 2003; White 1997; Beresford, Bekle, Phillips, and Mulcock 2004).

Land clearance in New Zealand has been even more intense than in Australia, although the repercussions are somewhat different from those in Australia. Native forests that covered 85 percent of the land when Maori arrived, were reduced by Maori to 53 percent and, at the end of the twentieth century, occupied less than 23 percent of the land area (Taylor 1997, p. 8.5). By contrast, more than 1.6 million hectares are now planted in plantation timber—virtually all exotic species. Europeans have increased the area of grassland from about 8 million hectares to more than 14 million hectares, or more than 50 percent of the country. Much of the grassland consists of introduced grasses, but even areas with remnant indigenous grass are badly damaged by sheep, rabbits, deer, and weeds. Additionally, about 90 percent of New Zealand's wetlands have been drained (Taylor 1997, p. 8.5; *New Zealand Herald,* 5 Dec 2003).

New Zealand's soils and water systems have been profoundly changed by such enormous land clearance and intervention in vegetation cover. Most notably, the removal of vegetation on the hills and slopes, and along the sides of its many fast-flowing streams and rivers, has been a cause of severe erosion. In nearly 10 percent of the country, soil erosion is classified as extreme, with a further 50 percent categorized as moderate and light (Taylor 1997, p. 8.6). While the water quality of New Zealand's lakes and rivers is still high by world standards, water systems are nevertheless suffering runoff problems of turbidity and siltation, while nutrients (notably nitrogen and phosphorus), pesticides, and waste from agriculture and other human activities are contributing to a decline.

Throughout Oceania and Australia both terrestrial and aquatic biodiversity are being reduced by land clearance for economic activities and for more urban settlement. In Australia it is estimated that between 1,000 and 2,000 birds permanently lose their habitat for every 100 hectares of woodland that is cleared, while clearing mallee country kills more than 200 reptiles per hectare (Australian State 2001, p. 74). Frogs, which are seen as an environmental indicator, are providing a clear sign of the sickness in Australia's inland waterways. Of the 208 frog species in Australia, 20 are considered endangered and 7 vulnerable. Of 200 freshwater fish species in Australia, 11 are considered endangered and 10 vulnerable (Australian State 2001, p. 68; Low 1999). Throughout Australia and Oceania, coastal and estuarine waters are suffering from inland clearances and changes in localized land use, including increasing densities of settlement along

The New Zealand countryside is often very beautiful, blessed by stunning vistas of water and snow-capped mountains. Unfortunately, all too often the foreground is dominated by alien weeds such as these lupins and conifers on the South Island. (Photo courtesy of Don Garden)

coastlines in the more populous and tourist-popular regions. The results include turbidity and higher nutrient levels, both of which are harmful to coastal species of flora and fauna, and are damaging offshore coral reefs in tropical zones. Every estuary in New South Wales is severely polluted, while across Australia as a whole, the figure is more than 10 percent. One of many repercussions of coastal pollution is declining fish catches (Beale and Fray 1990, pp. 54–55; Australian State 2001).

The economic implications for agricultural industries from excessive land clearance in Australia and New Zealand are likely to be profound. Both countries are major food exporters whose economies are dependent on continued "mining" of their soils to maintain their high standard of living. Both are facing severe repercussions from soil loss and depletion. Both are proud of their "clean and green" image as food producers compared with the United States, Europe, and other longer-settled and more intensively developed countries. In both countries, but more particularly New Zealand, there has been support for organic farming as an even greener manifestation of food production, although in both cases the image is somewhat exaggerated because past and present agricultural practices have been so damaging to the land. Eric Pawson has described New Zealand's claim to be green and clean as "one of its most powerful contemporary myths" (Le Heron and Pawson 1996, p. 273). Nevertheless, despite Australian cotton, rice, sugar, and horticultural industries using very substantial quantities of fertilizers and pesticides, both Australia and New Zealand use lower levels of these chemicals than most other countries and consequently, so far, have suffered less environmental contamination.

Another issue clouding the "clean and green" image is the genetic modification of food crops and animal species (GM). There has been strong public resistance, particularly in Europe, to GM foods, and many Australasian food producers are concerned that their overseas sales might decline if their industries are associated with such practices. There is also much public disquiet in Australia and New Zealand about the unknown effects of consumption of GM foods, and about the potential for GM insecticide- and herbicide-resistant species escaping into the environment. The Australian government has shown some caution but has allowed limited GM cropping and importation of food and non-food species (e.g., canola and cotton). Because of public and industry concerns, New Zealand introduced a two-year ban on GM crop trials in 2001 but lifted the ban in October 2003, triggering strong public protests (*London Guardian,* 30 Oct 2003; Norton 1998; Lawrence and Vanclay 1998; Hutton and Connors 1999).

It says much about the human relationship with "nature" that, while we are causing the extinction of so many of the species around us, we are pouring

huge financial and scientific resources into creating new and modified forms of life whose sole purpose is to suit human needs better.

SUSTAINABILITY AND ACTION

In Vanuatu, the Wan Smolbag Theatre uses drama as a means of environmental education, giving performances and creating films to make Pacific Islanders aware of environmental issues and how to treat the environment better. One of its projects has been a play that was presented to local communities on Ambryn to encourage them to save the threatened Vanuatu Megapode, or Namalao, a scrub-duck. In response, in 2002 the local people agreed to place an annual four-month taboo on egg collection. The Wan Smolbag group has also traveled to the Cook Islands to perform and educate (*Wan Smolbag* 2003).

On many Pacific islands that are not excessively populated, human settlement and the natural environment manage to coexist successfully amid the beauty. Efate Island, looking toward Mele or Hideaway Island, Vanuatu. (Photo courtesy of Lucinda Sargent)

This small but active environmental theater group, and this agreement among the people of Ambryn, will not save the world. However, such activities represent the understandings and actions that are needed if environments are to be protected, species are to be saved, and ecosystems are to be rescued.

Australian Aborigines and the people of Tikopia, among others, demonstrated historically that it is possible for human societies to learn to live sustainably within limited environmental resources. So far, few European immigrants and modern indigenous peoples in Australia and Oceania have demonstrated the understanding and capacity to achieve sustainability under contemporary conditions. Meanwhile, environments continue to decline, resources to disappear, and species to become extinct. Clearly this cannot continue indefinitely. The future will have to be made sustainable or our societies will fall into ecological and social crash—probably within the next century.

The achievement of sustainability will require revolutionary changes in the way we think, the way we live, and the way we deal with the environment. A change in mentality and ethics is required so that we see ourselves as part of the environment, not apart from it. We need to recognize that humans are not an intrinsically superior creature with the right to exploit the planet purely for human benefit. We also need to recognize that it is in the interests of our own species as much as all others that we should treat the environment better. However, being realistic, a major change of mentality will probably only come when people are faced by environmental crises and when those gods of the capitalist economy—market forces—are reconceived so that they fully factor in environmental costs. Nothing grabs the attention of business more than the bottom line, and once it is realized that there is no economy without an environment, that there is no profit in a devastated world, attention will turn seriously to protecting what is left—and making a profit out of it.

To accomplish such transformations will require the education of all people so that we understand how the environment functions, and comprehend the human place within it. Only when we have such understandings among the general population will we have electorates that are sufficiently aware and concerned to elect politicians who are environmentally conscious and are prepared to make the hard political decisions. While people resist the environmental message and while we have politicians who follow public opinion rather than provide leadership, we will not advance very far.

It is difficult not to be gloomy about the future when one reads the environmental history outlined in this book or observes the degree of environmental degradation across Oceania and Australia. However, it is essential to maintain optimism and to keep working for improvement. Indeed, one does not have to try very hard to find signs of change in late twentieth and early twenty-first

century society. In business, terms such as ethical investment and the triple bottom line (a means of measuring a company's success that makes allowance for environmental impacts as well as economic and social performance) are finally being heard, and are being taken more seriously. At the international level, there are increasing discussions, treaties, and agreements such as the allocation of RAMSAR sites to protect wetlands used by migratory birds, and the establishment of World Heritage listing for the preservation of natural history sites that are considered to be of international significance.

Pacific Island countries realized quite early that there was a threat to their survival from global warming and rising seas, and their governments have been working together since the 1980s (and in concert with island nations from other parts of the globe) to gain the attention and concern of larger and more affluent nations. The South Pacific Forum (since 2000, the Pacific Islands Forum) was established in 1971 as a regular meeting of the heads of Pacific nations, including Australia. Inevitably, a substantial part of its focus has been on shared environmental concerns such as nuclear testing, fisheries, and global warming. In 1989, a meeting of South Pacific nations and environmental bodies met at Majuro in the Marshall Islands as the Environmental Intergovernmental Institutions Meeting on Climate Change and Sea Level Rise in the South Pacific. This assisted in the presentation of a united front at various international forums, including the World Climate Conferences (Asian Development). Australia and New Zealand have been active participants in the South Pacific Regional Environmental Programme, and from 1991 to 2001 cooperated through the Australian and New Zealand Environment Conservation Council, a nonstatutory ministerial council. ANZECC provided a forum for member governments to exchange information and experience and develop coordinated policies in relation to national and international environment and conservation issues.

A number of international nongovernment organizations such as Greenpeace, Friends of the Earth, and the World Wildlife Fund for Nature have been active in Australia and Oceania, and have been effective in a diversity of campaigns.

At a national level, there are active environmental groups such as the Sierra Club in Hawai'i, the Forest and Bird Protection Society and the Native Forest Action Council in New Zealand, and the Australian Conservation Foundation and the Wilderness Society in Australia. These groups lobby governments, organize campaigns, and act as channels, for environmental defense. In Australia, the Wentworth Group was established in October 2002 when much of Australia was suffering from a severe El Niño event and profound water shortages. It was formed by a number of leading environmental scientists and economists who came together at Wentworth, at the confluence of the Murray and Darling

Rivers, to press for changes in the way Australia conserves and distributes its water, as well as in the clearing and protection of native vegetation.

The late decades of the twentieth century saw the rise of a vocal political environmental movement that achieved some presence and influence in New Zealand and Australian parliaments as well as in the governments of several of the Pacific nations. In response to this, and in recognition of environmental problems, governments have passed many pieces of legislation, established departments of conservation and environment, and have created many new environmental committees and authorities. In New Zealand, the 1987 Conservation Act and other legislation has led to the protection and conservation of about 8 million hectares of land and a number of marine habitats. The aim of the 1991 Environment Resource Management Act was to enable New Zealand to achieve sustainability, although its successes have been limited. Other legislation has resulted in provisions of funds to protect habitat on private land, and a diversity of government programs to recover wildlife (as in the case of the kakapo) and to protect the remaining natural heritage (Taylor 1997; Le Heron and Pawson 1996).

The Australian government set up a bewildering range of authorities, programs, and committees with an environmental orientation in the last decades of the twentieth century, such as the National Environment Protection Council, the National Action Plan on Salinity, the Murray-Darling Basin Commission, and the Natural Heritage Trust, which distributes grants to community environmental projects. The 1999 Environment Protection and Biodiversity Act, which came into force in July 2000, provided for protection in matters of national environmental significance such as World Heritage properties, RAMSAR wetlands, nationally threatened plant and animal species, and ecological communities. Under the Act, in 2001 the Commonwealth government declared land clearance a key threatening process for biodiversity. Whether these bodies are sufficiently coordinated and funded to make much difference is a matter of ongoing debate. They have certainly generated a lot of talk in a lot of committees.

One of the mottoes of the world environment movement in recent years has been to "think globally and act locally." Putting this into action, there has been a very large range of local environmental activities and groups in action throughout Australia and Oceania. In Australia and New Zealand, while some local government bodies are fixated on the development of local resources and creating business opportunities, grassroots movements have also resulted in the election of green candidates to councils, which have then taken a greener line. In many areas, local government is much more environmentally conscious and active than at the higher levels of government. Across all the nations there are many small local groups as well as national organizations working to educate people and to protect or regenerate environments. These range from the Wan

Smolbag Theatre in Vanuatu, to the Coromandel Watchdog and Whangarei Green Team in New Zealand, and the many Land Care groups in Australia. To protect indigenous species, individuals and trusts have been buying up land to revegetate and in which to create feral-free regions for remnant indigenous fauna populations (McVarish 1992; Pawson and Brooking 2002; Hutton and Connors 1999).

All these positive actions provide some hope, some reason for optimism, that attitudes are changing and that our communities are learning to live with their environments. While conceding that many government programs are underfunded and poorly directed, there is hope that they provide the starting point for an environmental future that will see humans overcome our tendency toward a satiation slump and enable us to achieve sustainability.

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7

CASE STUDIES

The purpose of this volume has been to give readers a broad introductory overview of the main patterns of environmental history across Australia, New Zealand, and Oceania. The following three case studies—of Rapa Nui, Hawai'i, and Queensland—provide somewhat more detailed examinations of three very important environmental history themes. These are: the danger to human societies as well as ecosystems from excessive consumption of resources; the reasons for and the problems related to the spread of alien species and the creation of hybrid landscapes; and the problems facing the modern environmental movement when the general population is indifferent or hostile and governments lack understanding and political will.

RAPA NUI—A LESSON FOR THE WORLD?

Late in the twentieth century, the story of Rapa Nui, or Easter Island, changed from one of great mystery to an object lesson for humanity on the need for wise, sustainable use of the environment. In effect, it came to form the classic example of a satiation slump.

Rapa Nui has long been a focus of fascination because of the mystery about the origin and erection of the large impassive statues or *moia* that are scattered across the island. How could this tiny dot have been the scene of such a marvel? It is the most remote and isolated piece of inhabited land on the planet, treeless and with a population of perhaps 2,000 people when Europeans first arrived. Explanations have been diverse, scientific, pseudoscientific, and paranormal. Speculations about Rapa Nui have included, perhaps most popularly, Norwegian adventurer Thor Heyerdahl's conjecture of South American influence, and Erich von Daniken's attribution to visitors from outer space (Heyerdahl 1950 and 1958; von Daniken 1969). Archaeological and other discoveries and

One of the rows of statues, or moia, that are scattered across Easter Isalnd/Rapa Nui. (Mark A. Johnson/Corbis)

analyses late in the twentieth century put together a more plausible yet perhaps more alarming understanding of what occurred, a tale that was brought together in 1992 by Paul Bahn and John Flenley in *Easter Island: Earth Island* (the following is informed by Bahn and Flenley 1992 and 2003; Kirch 2000; Ponting 1991; Young 1999; Flannery 1994; Wright 2004; Diamond, 2005).

Rapa Nui is unique among the volcanic Oceanic islands in being far to the southeast in the Pacific, 2,250 kilometers from Pitcairn Island, the nearest land, and in cooler latitudes than nearly all Pacific islands except Norfolk Island and New Zealand. These circumstances greatly affected the biota and climate and it is perhaps the prime example of the general rule that the further east in the Pacific an island lies, the poorer the biodiversity. Rapa Nui had no indigenous land vertebrates, few plant species (only forty-six were found in a study in the 1950s although by then some were extinct), and perhaps twenty-five species of sea birds. It lay south of the warm temperatures required for coral reef building, and so there were relatively few fish species in its waters. Nevertheless, before humans arrived, Rapa Nui was not bare and treeless, and much of it was covered

by forests of a large palm tree, a form of *Jubea* related to the Chilean wine palm (Bahn and Flenley 1992; Kirch 2000).

There has been immense speculation and debate about the who, how, when, and why of human occupation of Rapa Nui. The broad consensus now is that the islanders were Polynesians and that there were no South American (or intergalactic) connections. They almost certainly came upon the island by near-miraculous chance after a long and hazardous exploratory voyage in about the fifth century, perhaps from the Marquesas, an impressive 3,360 kilometers to the northwest. How many other voyagers might have missed this dot we can only speculate upon, but it is highly unlikely that there were any return voyages once Rapa Nui was found (Howe 2003).

Like other Polynesian voyagers, the new settlers had loaded their vessels with animals and plants to colonize their discoveries, though not all survived the voyage or were suited to the climate and land. When Europeans arrived, the islanders grew kumara, bananas, sugar cane (which contributed to a high rate of tooth decay), and yams. They had likely brought breadfruit but it did not survive in the cold climate. Chickens and the edible Pacific rat had survived, and skeletal evidence indicates that there had been dogs for a period although, like the Maori, the islanders had no pigs. Probably unwittingly, it appears that they also brought two species of lizards (Bahn and Flenley 1992). As Rapa Nui has virtually no reef, and therefore limited marine fauna, birds were probably a major source of protein for the islanders in the early years. Excavations indicate that as elsewhere in the Pacific, the arrival of humans caused a substantial reduction in bird species and populations.

Nevertheless, this was a reasonably resource-rich island with sufficient birds, fish, and shellfish to provide protein while chicken and rat numbers increased. Rapa Nui contains about 160 square kilometers and, unlike most Pacific islands, nearly all was arable. The volcanic soil was fertile and the rainfall adequate to support the establishment of extensive agriculture. Kumara, or sweet potato, the predominant crop, can produce high yields even in poor soil and, according to Kirch, fueled "a political economy bent on spiralling competition of architectural display" (Kirch 2000, p. 273). It is believed that the population grew rapidly to around 10,000 people at its peak, facilitating a culture that from the twelfth century, expressed itself in the carving, transportation, and erection of large *moia.* The volume of food that was grown enabled a substantial proportion of the population to devote much of their time to this activity—and a population of that size was also required to sustain such an enormous enterprise. Statues were being quarried by 1100 A.D. and over the next four or five centuries, the islanders constructed some 245 *abu,* or temple platforms, mainly

around the coastal perimeter, with 324 statues erected on them. Mysteriously, construction declined in about 1500 A.D. and then stopped with 200 statues incomplete, as the island descended into a state of intense intertribal raiding and warfare. What had happened to precipitate such decay?

Bahn and Flenley have argued that the seeds of the islanders' downfall lay partly in the seeds of the *Jubea.* The once-numerous palm trees were already under pressure from clearing for agricultural land, to build canoes, and for firewood, but were also essential for moving the statues. There has been intense debate how the statues were transported but, whichever of the many speculated methods was used (principally rocking or rolling), *Jubea* trunks were critical. The final blow in their depletion, according to Bahn and Flenley, was inhibition of their regeneration by the proliferation of the Polynesian-introduced Pacific rats, which ate the palm nuts or seeds and therefore sped their extinction. Another large shrub, which was used to manufacture the great lengths of rope that were required to maneuver the statues, was also pushed close to extinction by its overexploitation. The decline of these two species initiated the winding down of the Rapa Nui environment and society into an ecological and social crash. Deforestation and depletion of other vegetation through clearing and burning also contributed to the conversion of the once-forested island into a treeless and windswept grassland on which agriculture was increasingly difficult. Soil erosion; leaching, which caused a decline in soil fertility; and depleted supplies of fresh water, through evaporation and the drying-up of springs, reduced crop yields. There is evidence of a transition to greater exploitation of marine resources, but the shortage of timber for canoes curtailed fishing at sea. The overexploitation of sea birds and their eggs virtually eradicated them from the island. Chickens survived as a major and increasingly important form of protein, but their possession and security became a source of competition and conflict, and they were hidden away in bunkers for protection. Bahn and Flenley believe that the islanders became locked into endemic warfare and were forced to live in caves for security and because of the absence of timber. Archaeological examinations of the remains of their fortifications have found weapons and charred human bones in the middens, an indication that they turned to occasional cannibalism, perhaps partly as a source of protein.

However, there is some difference in interpretation as to the reasons for the collapse of Rapa Nui society, how rapidly it occurred, and how profound the effects of the collapse were. Geographer Patrick Nunn has argued that it was climate change rather than human action which provides much of the explanation. The greater aridity of the Little Ice Age after 1300 brought a rapid decline in food resources, which in turn led to population and social decline (Nunn 2000). Dutch environmental scientist Jan Boersema reexamined the scientific

and historical evidence and concluded that, while there was an overuse of resources, there was not a collapse in the way some scholars have described it, involving hunger, war, and cannibalism. Rather, the people experienced a smoother transition from a "rich culture" into a "poor culture" (Boersema 2002). It is a similar argument to the one now mounted by those who question the rapid degeneration of Maori society in New Zealand.

Most likely, this ecological decline and social disintegration stretched over several centuries. Pollen cores and other evidence date the decline of the trees and the increased ecological stress from at least the fourteenth century, although the islander population was probably sustained for another two centuries. However, the breakdown of the systems of food production and distribution, and of economic exchange networks, led to the abandonment of statue erection by early in the fifteenth century. The critical period of population and social crash is dated to the second half of the seventeenth century, soon before the first generally recognized European visitor, Dutchman Jacob Roggeveen, on Easter Day in 1722. Early European visitors all commented on the island's barren, treeless appearance. They gave various population estimates, but around 2,000 people seems likely. Periodic later visits in the eighteenth century and into the nineteenth century found further evidence of internal conflict and population decline.

Whatever the specifics of the chronology, the social decline that followed environmental satiation also affords us two examples of the importance of the environment in shaping human cultures—two examples of what appear to be cultural adaptation to, or manifestations of, the declining resource base. The first of these was a series of rituals, perhaps a cult, surrounding the annual arrival of the migratory sooty tern (*Sterna fuscata*) to nest on offshore rocky outcrops. The event became the focus of an annual birdman competition among young men to find and bring back to the island the first egg. The winner was granted exalted status for the coming year. The development of this cult surrounding the arrival of the birds is seen as a response to, or a recognition of, the resource scarcity faced by the islanders following the destruction of their ecosystems.

The other cult was a similar response to changed environmental circumstances, but in this case a concern about low fertility in a people suffering population decline largely as a result of poor nutrition. A series of fertility rituals concerned with female genitalia emerged, one expression of which was a multitude of carvings of the vulva:

> It is known that girls had their clitoris deliberately lengthened from an early age, with the longest and finest destined to attract the best warriors as husbands. At special ceremonies girls would stand on two rocks at Orongo to be

> examined by priests, and those judged best would have their genitalia immortalized in stone. (Bahn and Flenley 1992, p. 200)

Several authors, including Paul Bahn and John Flenley, Patrick Kirch, Clive Ponting, Tim Flannery, Ronald Wright, and Jared Diamond, have emphasized the lessons to be learned by humanity from the Rapa Nui example of overexploitation of resources. The bare, windswept character of Easter Island, modern understandings of how this happened, and the human repercussions have been interpreted as a warning to all mankind of our future decline if we do not live sustainably. The people of Rapa Nui were a prime example of Flannery's "future eaters."

THE HAWAIIAN WALLABY AND OTHER ALIENS: A HYBRID LANDSCAPE

In the Koolau Range on the island of O'ahu in the Hawaiian Islands, high above Honolulu, a very strange creature lives. In a scattering of ravines and ridges, there is a colony, or perhaps a number of small colonies, of Australian brush-tailed rock wallabies (*Petrogale pencillata*). When Europeans arrived in Australia, these wallabies had ranged widely from southern Queensland across the eastern half of New South Wales and down into some parts of Victoria, probably including a colony in the Grampians. It is now extinct from most of its range, although there are populations in northern New South Wales and southern Queensland. There are discrepancies in the accounts of how the Hawaiian group became established, but in essence it seems that in 1916, a number of the wallabies were *en route* to a zoo in the United States. In Honolulu, two or three managed to escape, most likely consisting of at least one female and one male, and therefore a limited gene pool. However, one aspect that it seems has not been known or considered is the form of reproduction in wallabies and kangaroos that enables females to carry dormant but fertilized eggs, which are then activated and released when required. In all likelihood, any escaping females were carrying fertilized eggs, a condition that opens the possibility of a wider gene pool in the escapees that moved into the hills and became established. However many there were initially, the wallabies' numbers increased and, at their peak in the decades after World War II, perhaps reached up to a few hundred. At the end of the twentieth century there were probably 100 to 150 (Eyre 2000; Lazell 1993; Tomich 1986).

The dramatic difference between their new semitropical habitat and that of their more arid homeland in southern Australia created a need for rapid adapta-

Brush-tailed rock wallaby. (Photo coutesy of Studio Ni/Amanda Collie)

tion, but the degree and significance of the adaptations is the subject of some interesting debate. The presence of the animals gained attention in the 1980s and 1990s and stimulated research, much of it by American zoologist James D. Lazell. He visited Australia and made some contacts to provide him with comparative data on the species. This enabled him to conclude that the animals in Hawai'i were smaller, paler, and shorter-haired than their Australian ancestors, and that they were distinct in body proportions, skull anatomy, blood proteins, liver enzymes, and DNA. He even went so far as to claim that "they are the most remarkable example of rapid evolution known in a mammal" (Lazell 1993, p. 1). They had, in effect, become a new species—the Hawaiian rock wallaby. Lazell asserted this conclusion even more strongly in a television documentary on the "Hawaiian Rock Wallaby" in 1993 (Sprinkle 1993). If his argument is accepted, these wallabies represent at least a novelty, and at most a major biological development as a consequence of human intervention in the redistribution of the species.

Lazell's view has not been fully accepted by other scientists, at least some of whom argue that the time span has been too short for such an evolutionary

change. Other research has also disputed Lazell's conclusions. Most notably, a study by Eldridge and Browning published in 2002 found that the DNA of the Hawaiian wallabies indicated that their ancestors probably came from a population in southern Queensland and that the Hawaiian animals have not changed sufficiently to be considered a "new" species. However, as they might represent the survivors of an otherwise extinct Queensland population, they were judged to be genetically important (Eldridge and Browning 2002).

The Hawaiian animals have apparently had a minimal impact on the Koolau environment, and a few wallaby colonies that, equally strangely, have become established and are now protected in Britain have also been relatively unobtrusive (Low 1999). The same cannot be said of a group of brush-tailed rock wallabies, and three other species of wallabies, which were established by Sir George Grey on Kawau Island in Auckland harbor in New Zealand in the 1860s and 1870s and have done great damage to indigenous vegetation communities. As a result, in the 1990s and early twenty-first century, the New Zealand immigrants were being eradicated in order to return Kawau closer to its pre-European state. Such exchanges of species through, into, and out of Oceania and Australia have created a bewildering range of blended biota, of hybrid landscapes.

The Hawaiian wallabies form a tiny niche in what now is one of the most highly transformed, hybrid landscapes in Oceania, and indeed in the world—modern Hawai'i. Alfred Crosby, Richard Grove, and others have emphasized that during their great colonial expansion from the fifteenth to the twentieth centuries, Europeans transferred a great diversity of species from one part of the planet to another (Crosby 1986; Grove 1995). The infamous William Bligh's voyage on the *Bounty* in the late 1780s, for example, had as its principal purpose the introduction of breadfruit from the Pacific into the West Indies in order to feed slaves. However, Bligh's crew developed other plans, staging a mutiny which delayed the transfer of breadfruit for a few years, and even then they were not successful.

Crosby popularized the phrase "ecological imperialism" to capture this biological phenomenon. It signifies that wherever Europeans went they took with them, consciously and unconsciously, a panoply of other life forms—including food plants and animals, productive plants, beasts of burden, weeds, and microbiological forms that cause disease. Another way of expressing this is that European activity was like a giant biota blender. This blending of the world's biota can be assessed from a variety of perspectives. For example, its contribution to human food and economic production can be seen as a laudable project that has brought great benefits to our species. By contrast, the creation of hybrid land-

scapes has caused immense ecological damage to indigenous species, ecosystems, and landscapes in many parts of the world. The damage has been among the most extreme in Oceania because of the vulnerability of the small, isolated island environments. Because of the erratic nature of the arrival of species in the islands in the millennia before human arrival, many niches that one would expect to be occupied were vacant. These niches were available to species that arrived with human assistance. According to Sherwin Carlquist, "The fact that so many animals and plants introduced by man have prospered fantastically, gone wild and 'taken over' shows that the Islands have supported many groups not originally there, and that poor dispersibility is indeed the bottleneck" (Carlquist 1980, p. 124).

Few Pacific islands have seen greater change since European arrival than the beautiful islands of Hawai'i. It is estimated that almost 6,000 species of terrestrial and freshwater biota have been introduced (Juvik and Juvik 1988, p. 146). J. R. McNeill has pointed out that prehistorically, Hawai'i acquired a new species every 100,000 years, but in the 1990s, twenty invertebrates arrived each year, mainly by plane (McNeill 2001, p. 97). One result is that the subject of alien species in Hawai'i has attracted a great deal of attention, and there is a substantial body of literature on the subject written, among others, by David Eyre, George Staples, and Robert Cowie; Linda Cuddihy and Paul Stone; Alan Ziegeler; and in the *Atlas of Hawaii* (Eyre 2000; Staples and Cowie 2001; Cuddihy and Stone 1990; Ziegeler 2002; Juvik and Juvik 1988).

Tragically, one consequence partly attributable to this tidal wave of aliens is that three quarters of the extinct plants and birds that once inhabited the territories now occupied by the United States were found in Hawai'i (Royte 1995, p. 14). It is massively disproportionate to the size of the archipelago state. Alien rivals and predators have been a major factor in the decline of indigenous species and changing the Hawaiian landscape. More than twenty flightless Hawaiian birds have become extinct since the arrival of the Polynesians, besides various other ground feeders and seed eaters. One of the saddest of these ecological losses has been among the more than fifty species and subspecies of Hawaiian honeycreepers, which played a similar ecological role to the famous finches of the Galapagos Islands. They were a predominant species that evolved a range of adaptations to diverse ecological niches and, like the Galapagos finches, showed great variety and adaptation in their beaks. Only twenty-one species of honeyeater survive, fourteen of which are endangered and exist only in the remotest areas (Royte 1995, p. 19; Ziegler 2002).

Indeed, on several of the islands, many Hawaiian bird species now survive only in higher altitudes and in isolated valleys. By contrast, humans have

introduced about 170 bird species into Hawai'i, of which around 60 have become naturalized or established wild populations (Juvik and Juvik 1998, p. 134). More broadly, unless tourists are prepared to travel far beyond their resorts and high into the hills, they are unlikely to see many species of indigenous flora and are far more likely to see an introduced bird like the South American rose-ringed parrot than a local species. The Kalaupapa peninsula on Moloka'i is a good (or bad?) example because, as the leprosy settlement guide points out, there is virtually nothing indigenous in sight. Even high on the hills and ridges above the peninsula, there are large areas covered with alien species, which were planted in the middle decades of the twentieth century to counteract the erosion caused by goats. Weeds dominate much of the landscape on all the islands (Hawaiian Ecosystems 2003).

The usual suite of factors have contributed to decline of indigenous species, including loss of habitat through land clearing and the diversion of water systems. However, Hawai'i's ecological degradation has, to a substantial degree, resulted from the introduction of alien species. The highly evolved nature of the Oceanic environments, and the evolution in isolation of species that have few defenses against introduced predators and rivals, means that they are particularly vulnerable to displacement and destabilization.

The motives and reasons behind the introduction of alien species since 1778 are essentially the same as elsewhere across the Pacific and around the globe. They can be variously categorized, but it is useful to see these in terms of five (not mutually exclusive) categories, motives, or reasons—utilitarian/philanthropic, aesthetic/nostalgic, accidental/stowaways, biological control, and cultural.

Utilitarian/Philanthropic

Historically, the European view of indigenous human populations in Oceania and their islands was complex, but it generally included an assumption of the superiority of European religion, culture, and biota. Prior to European arrival, Oceanic peoples had developed food sources to the limit of their environments and the available flora and fauna. To produce increased quantities of food would require new species whose cultivation and husbandry could support a larger population. It became part of the European civilizing mission, of their philanthropic desire to introduce the advantages of the "superior" culture, to give the islanders more productive species for food and industry. As a result, the first species distributed by Europeans were essentially those with utilitarian value, particularly as food. It was common practice among early explorers to distribute

plants and animals both for the benefit of the local people and for Europeans who would follow.

Captain Cook was particularly keen to offer the indigenous people such advantages, and he distributed animals and seeds in many places across the Pacific. On his third Pacific voyage in 1778 his party made the first known European sighting of the Hawaiian islands (or the Sandwich Islands as he named them). Early in the visit he went ashore, "taking with me a ram-goat and two ewes, a boar and sow pig of the English breed; and the seeds of melons, pumpkins, and onions; being very desirous of benefiting these poor people, by furnishing them with some additional articles of food" (Cook 1784, vol. 2, p. 217). Over subsequent decades the pigs, together with later European pigs that were spread across the islands, interbred with the smaller Hawaiian pigs. They thrived in the Hawaiian forests where they became one of the greatest threats to indigenous species as they ate the eggs of ground-nesting birds, disturbed the forest floor and encouraged erosion, and in their dung spread seeds from fruits and other weed species (Eyre 2000).

Goats spread equally quickly, and with similar results, and other grazing animals followed, including sheep, which had established a wild population on the Big Island by early in the nineteenth century. Most were killed by dogs and hunters, and a "Report on Sheep" by G. S. Kenway in 1851 recommended their reintroduction. His belief in the capacity of utilitarian European species to bring benefits and improvements to otherwise wasted land was very similar to sentiments voiced by settlers in Australia and New Zealand:

> The outer plain of Waimea, extending to the base of Mauna Kea and sloping toward the sea, a hitherto unused and useless tract . . . is a fine example, and on this land alone, a profitable and interesting population (of sheep) might be brought to exist, break the dismal silence and redeem the idle wilderness. (cited in Tomich 1986)

The first cattle were introduced by Captain George Vancouver in 1793, also on Big Island, a present for Kamehameha I. When Vancouver returned in 1794, he brought both cattle and sheep and requested a ban on killing them for ten years so they could establish. The cattle thrived and formed the basis for a major industry, which developed particularly on Big Island during the nineteenth century. Land was cleared and large ranches sown with foreign grasses increasingly replaced forests and shrublands. Cattle, together with horses, sheep, and goats, damaged the fragile Hawaiian foliage with their teeth, while their hooves destroyed surface roots, which led to soil degradation, erosion, and weed infestation. Alien species tend to assist each other's spread and the indigenous flora and the fauna, which had evolved free of herbivores, was widely eradicated and

It would be hard to identify this pastoral scene as being in the Pacific islands because it is so far from the usual image of Oceania. Nevertheless, this hybrid landscape of European cattle, introduced grasses, and Australian eucalyptus is on Hawai'i (Big Island) in the Hawaiian archipelago. (Photo courtesy of Don Garden)

a new landscape developed that was increasingly dominated by alien organisms (Tomich 1986; Juvik and Juvik 1988; Carlquist 1980).

As this illustrates, in addition to animals, Europeans brought numerous new cultivated plants including more than 100 species of food plants in the first sixty years after contact and 175 species of plants in the first century (Cuddihy and Stone 1990, pp. 37ff; Juvik and Juvik 1988). The process continued throughout the nineteenth century and into the twentieth, one of the motivations being the search for an export staple suitable for the soils and climate. Of those crops that were introduced, one of the most environmentally damaging was sugar. In the nineteenth century, sugar plantations were concentrated on Moloka'i where, from the 1830s, large areas were cleared. This, together with damage from grazing animals, brought rapid siltation of streams and coastline, and destruction of the islanders' fishponds that had been established along the coast

(Kepler and Kepler 1991). Other monocultural plantation crops that developed into the twentieth century included pineapples (which dominated a substantial part of the island of Lana'i for several decades), coffee, macadamia, and papaya.

By the end of the nineteenth century, the grazing and hoof disturbance of ungulates, the damage by feral animals such as pigs and goats, the impacts of cropping, and timber cutting for the sandalwood trade and other purposes, had caused immense damage across the islands. Erosion and siltation had become major issues and, during the twentieth century, there were attempts to repair damaged lands and watershed forests by revegetation. However, as mentioned with regard to Kalaupapa, in most cases this involved the use of alien species that, once established, continued the eradication of indigenous species in the lower altitudes on many of the islands. One result is that Australians can feel at home in many parts of the islands because of the number of Australian plants that have been used for revegetation and erosion control as well as for aesthetic

It is unlikely that most travelers on the road to the beach on the island of Kaua'i in Hawaii would realize that this beautiful avenue of trees consists of Australian eucalyptus. (Photo courtesy of Don Garden)

reasons. On part of the road to the popular Poipu beach area on Kaua'i, the Australian traveler could be excused for thinking they were in one of the moister parts of home, for the road runs through a tunnel of swamp mahogany gum (*Eucalyptus robusta*). Elsewhere in the islands, Australian nostalgia might be pricked by periodic sightings of bottle brush (*callistemon*), silky oak (*Grevillia robusta*), or wattles (*acacias*), while along some coastlines are large groves of what is locally named ironwood but is actually Australian she-oak (C*asuarina cunninghamiana* or *Casuarina glauca*) (Pratt 1998).

Aesthetic/Nostalgic

One of the characteristics of the Big Island is the harsh landscapes created by volcanic activity. Large areas are covered with the deep charcoal and dark browns of slabs and rocks of lava flows. The region along the coast road north of Kona is renowned for the way thousands of people have used white coral to pick out love messages and other short statements and which stand in stark contrast to the dull brown background. Also along parts of this road, as well as to the south of Kona, not far from where James Cook was killed in 1779, the authorities have resorted to another means to distract attention from the starkness and to beautify the landscape. Bougainvillea bushes have been planted at regular spaces beside the road, trimmed into balls that glow with pink and orange flowers when in season. Bougainvilleas seem to be a Hawaiian favorite, and in many places one sees walls and trees covered by these brightly colored plants from Brazil.

While Pacific landscapes often conform to paradise mythologies, it seems that to European colonists and to later generations, there were no environments that could not be "improved." Wherever they migrated across the planet in the eighteenth and nineteenth centuries, Europeans carried with them their favored plants to recreate gardens and to make the local landscape more familiar or aesthetically pleasing. Pacific environments were often unsuited to the growing of roses and other temperate garden plants, but surprisingly large numbers were acclimatized. Besides, as Europeans traveled and colonized the world, they encountered a diversity of new warm climate and tropical species, often with vivid flowers or dramatic foliage. Many, like the bougainvillea, were transported for use as garden plants in new tropical colonial environments in Hawai'i and other parts of Oceania.

Because of its volcanic soils, temperate climate, and good rainfall, Hawai'i was able to acclimatize plants from many parts of the world. Over time, hundreds of alien garden plants arrived, and inevitably many thrived and became weeds and environmental pests. In 1929, Willis Pope listed eighty-five plants

that had become weeds, including prickly pear and periwinkle from the tropical regions of the Americas, common ragweed from broadly across America, the Asiatic pennywort, sweet fennel from southern Europe, and the common thistle from Europe (Pope 1929). A particularly significant proportion of garden plants were brought from South America and tropical America in the twentieth century, so it is not surprising that they feature among the worst of the weeds. One of the most invasive is the South American banana poka (*Passiflora mollissima*), a vine that grows into and smothers forest canopy, understorey, and ground cover. It is spread by pigs and alien birds, notably the Nepal kalij pheasant, which carries the seeds in its gizzard. The Brazillian strawberry guava is another serious pest, forming dense thickets that crowd out native trees. These species, and hundreds more, contribute to a very cosmopolitan, hybrid landscape (Staples and Cowie 2001; Eyre 2000).

As mentioned above, the avifauna in the landscape is also dominated by alien birds largely because Europeans, and then other new arrivals and local people, wanted familiar birds or exotic strangers to sing in the alien trees in their gardens. Among the most commonly seen garden introductions are sparrows, white eyes, house finches, pigeons, and doves (Staples and Cowie 2001).

Accidental/Stowaways

It is said that whalers refilling their water casks on the island of Maui in the 1820s poured out the dregs of the barrels and rinsed them, depositing mosquito larvae into the stream. The mosquitoes thrived and within weeks, Hawaiians were for the first time experiencing the sting and itch of their bites. In due course, these uninvited pests and a number of other accidentally introduced mosquito species had spread across the islands. When Europeans arrived on the island of O'ahu, much of the area where tourists now throng in Waikiki and Honolulu was covered by wetlands, and in due course, these became mosquito-ridden and stagnant. They were drained at least partly in order to get rid of the mosquitoes. Fortunately, no human malaria arrived with them, but at some stage early in the twentieth century, cage birds carrying avarian malaria and bird pox were imported, and mosquitoes acted as vectors to carry these diseases into the indigenous bird populations. These diseases have taken a particular toll on native honeycreeper, helping to push the surviving species toward extinction (Royte 1995; Eyre 2000; Staples and Cowie 2001).

On whaling ships and other early vessels came rodents. The resident Pacific rat was now joined by the house mouse, the Norway rat (*Rattus norvegicus*), and the black, or roof, rat (*Rattus rattus*) that spread to the main islands and is

believed to have had particular impact on indigenous birds and on plants, which it girdled or ring-barked (Tomich 1986). Rats forage on the ground and in trees, feeding on insects, snails, and birds' eggs as well as the seeds of native plants, and were a major factor in species decline. The Hawaiian po'ouli, a species of honeycreeper, had been reduced to a mere three birds in 1997 because rats ate the snails that were its prey. The last survivor died in December 2004 (*New Scientist,* 11 Dec 2004). In doing such damage, rats further facilitated the invasion by other alien species.

Mosquitoes and rats are just two examples of hundreds of species of fauna and flora that have arrived accidentally, generally as stowaways on ships but in recent decades have also arrived by air. Amongst the innumerable insect and invertebrate arrivals have been cockroaches, termites, many species of ants, wasps, millipedes, and centipedes. Some of these are principally human pests but many have competed with or preyed upon indigenous invertebrate species, such as ants and yellow jacket wasps whose predation on arthropods has been catastrophic.

One of the nastiest alien plants is the central American kiawe *(*also known as *mesquite* and *algaoroba),* which has taken over large expanses of drier land that was cleared for grazing and agriculture. It gives the country an appearance more of arid Africa than tropical Oceania, and its large thorns tear flesh and penetrate footwear. There is an old story that it was introduced by missionaries as a way to persuade Hawaiians to wear shoes, but a more likely version is that a French priest discovered a few seeds in his pocket after he arrived and decided to plant them. Where kiawe grows densely, it chokes out other species. Where it is less dense, it fosters new hybrid ecosystems of imported weeds. However, Hawaiians have taken advantage of the situation, and its long bean pods now provide a dry season cattle food, while kiawe honey is a delicacy and burning kiawe wood is prized as a barbecue flavoring (Eyre 2000; Carlson 1952).

Biological Control

Hawai'i offers many examples of another major environmental object lesson—the dangers of unresearched biological control. The most familiar story, often told with wry humor, is that of the mongoose. In the nineteenth century, alien rats became a major pest in the cane fields, so in 1883, cane farmers brought a number of Indian mongooses (*Herpestes auropunctatus*) from the West Indies where they had been introduced to control rats and other pests. They were released on the Hilo side of Big Island. However, the diuranal mongoose seldom encountered the nocturnal rat, but happily fed on indigenous insects and bird

eggs and fledglings (Royte 1995; Tomich 1986). The mongoose spread, probably with further uninformed but optimistic human assistance, and became firmly established on O'ahu, Hawai'i, Maui, and Moloka'i, where they are often seen scampering across roads. Its impact on indigenous birds and insects has been immense, its love of eating eggs being one of the factors that threatens the state's bird emblem, the *nene* or Hawaiian goose. (The mongoose was also introduced into Fiji where it became a pest.)

Unfortunately, the residents of Hawai'i showed no more caution than people elsewhere and continued in misguided attempts at biological control to introduce species without, or with insufficient, research. It is estimated that by late in the twentieth century, about 650 organisms had been introduced in attempts at biological control, mainly insects, and more than a third of these had become established. Like the mongoose, early biological control introductions were generalists and depleted many native species along with the intended targets (Juvik and Juvik 1998, p. 149). Among the most annoying is the ubiquitous Indian mynah, which was introduced across the Pacific to control insect pests in crops, but is omnivorous in its diet, territorial in its behavior, and irritating in its screeching.

Perhaps more alarming, however, is that unsuitable biological control introductions have occurred in more recent decades when scientific knowledge and warnings made such dangers apparent. This is particularly disturbing in the case of a profound threat to Hawai'i's renowned tree snails. One of the most significant elements in Hawai'i's endemic biota was the brilliantly colorful range of snails, the world's most extensive and spectacular radiation. Estimates of the number that existed when Polynesians arrived vary from 750 to over 1,400 species and subspecies. They had developed in their own microenvironments up, down, and across the islands. The sight of trees filled with their brightly colored shells—trees full of little rainbows—must have been spectacular. In all likelihood, many species became extinct as a result of Polynesian modifications of the environment through land clearing, fires, and the introduction of pigs and the Pacific rat. The Hawaiians also used snails in making their leis. European settlement sped up the decline through further clearing, the introduction of grazing animals which trampled and grazed the vegetation, and the importation of alien predators. For example, the arrival in the 1870s of the tree-climbing black rat had a substantial impact. Another factor in their decline was the late nineteenth and early twentieth century interest in hobby collecting. Adults and schoolchildren collected them by the bucketful, amassing collections numbering up to 100,000 specimens (Eyre 2000).

The decline of these spectacular endemic snails makes the introduction in the 1950s of the Florida cannibal snail (*Euglandia rosea)* even more disturbing, a

clear case of an inept and wrong-headed attempt at biological control. It was probably during the 1930s that the Giant African Snail (*Achatina fulica)* arrived in Hawai'i, its spread across the Pacific apparently associated with the Japanese diaspora for whom it was edible. The giant snail was released into the wild near Honolulu to assimilate and multiply, which it did all too well, rapidly becoming a major garden pest. In the 1950s, the Hawaiian Department of Agriculture proposed to counter it by introducing *Euglandia,* a Florida snail. Despite warnings of the possible repercussions, and without adequate trials, the department pushed ahead. As feared, it spread rapidly, developing a taste for indigenous snails and forcing several species toward extinction. By the end of the twentieth century, more than half of the Hawaiian snails were extinct, most since the 1930s, and survivors were effectively limited to areas near the mountain summits on only some of the islands (Solem 1990; Eyre 2000; Juvik and Juvik 1988). Meanwhile, the Giant African Snail lives happily on, untroubled by the Florida snail.

Cultural—Companion Animals and Hunting

Wherever they went, Europeans took species with them to fulfill what can be described as essentially cultural needs and purposes. Among these were their companion animals including the obvious ones—cats and dogs—which have had an effect in Hawai'i similar to that other parts of Australia and Oceania (Tomich 1986). Over time, collectors and people seeking more unconventional pets have brought in a wide diversity of species including a number of reptiles such as the South American green iguana, which is now in the wild on O'ahu, and Jackson's chameleon (Eyre 2000; *Honolulu Advertiser,* 7 Dec 2002). These have shown a taste for native insects and flowers and compete with indigenous birds.

Another intriguing aspect of cultural introductions is the range of species that was introduced for hunting and, more particularly, are now protected because of their status as quarry animals. Sport hunting was a significant cultural phenomenon among European peoples in the nineteenth century and was introduced to their colonial possessions. It was an activity redolent with significance for masculine image and prowess, and as a symbol of mastery of the landscape. American President Theodore Roosevelt exemplifies the American form of this masculinist preoccupation with hunting, and his home on Long Island in New York is stuffed with animal heads and skins. As mentioned previously, Australia and New Zealand were found to be lacking in desirable quarry animals that offered sufficient status and challenge, and therefore many were imported. These notably included various species of deer and, in Australia, the fox. However, apart from Hawai'i, there appears to have been little interest in introduc-

ing quarry animals into the Pacific islands. Hence it was rather unusual that in 1867, eight Indian axis deer arrived as a gift to Kamehameha V. He released them onto Moloka'i in 1868, where their numbers increased rapidly. Some were later transferred to O'ahu and Maui. Wherever their numbers expanded, they damaged flora and contributed to erosion. Large areas of Moloka'i are now scarred by deer (and cattle) tracks (Tomich 1986).

As an American colony and with a large military base, it is not surprising that Hawai'i became imbued with the American love of hunting, and it became a significant part of the local culture. One of the characteristics of the United States in the twentieth century was the power of the hunting and gun lobby, a phenomenon that was also found in Hawai'i. A source of concern for Hawaiian hunters was a mounting desire among environmentalists to rid the islands of feral species including goats, deer, and pigs. These had, in the absence of more exciting species, become the main quarry for Hawaiian hunters. The hunting lobby fought back and succeeded in having deer, goats, and even sheep brought under hunting laws that protected, managed, and maintained their numbers. In the 1960s, there was an attempt by hunters to import axis deer to the Big Island and only after a heated debate was the proposal rejected. However, other species were introduced or were further distributed throughout the islands. Mouflon sheep (a wild, game sheep with the appearance of a goat) were introduced in the 1950s and established populations on Lana'i and the Big Island. Pronghorn deer were imported in 1959 and mule deer in 1961. In the late 1970s, the Sierra Club took successful legal action in the face of opposition from hunters to force removal of mouflon sheep from the slopes of Mauna Kea because they were causing a decline in one of the species of native honeycreeper (Tomich 1986).

Pigs are another interesting case—in the late twentieth century, more than 100,000 roamed the islands, causing considerable damage. However, hunters, including many native Hawaiians, wanted them protected, at least from excessive culling, in order to maintain numbers for hunting. The native Hawaiians saw pigs as an important element in their traditional Polynesian culture, and some Hawaiians still hunted them as a source of food (Royte 1995; Tomich 1986). This tension between traditional cultures and modern environmental concerns is problematic and can be found throughout Oceania and in Australia.

The arrival and ramifications of alien species in Hawai'i and elsewhere in Australia and Oceania, as well as the creation of hybrid landscapes and consequently degraded ecosystems, is one of the most severe environmental issues facing the Pacific nations as they enter the twenty-first century. Given the amount of international exchange and mobility in the global age, it is one that appears likely to only become even more complex.

THE GREAT BARRIER REEF, WET TROPICS, WORLD HERITAGE, AND POLITICS: ANTHROPOCENTRISM VERSUS ECOCENTRISM

While the red-brown aridity of the outback is representative of much of the Australian landscape, it is not the complete picture. The greens, blues, and golds of tropical rain forests and beaches are also a part of it. The area of Australia that best conforms to this Oceanic idyll lies in a narrow fringe along the Pacific coast in the northern part of Queensland. It is a subtropical to tropical region, with dense remnant forests on mist-covered mountains notable for torrential rainfall during the wet season. Along the shore are stretches of sandy beaches and mangrove wetlands, interspersed now with tourist towns such as Townsville, Cairns, and Port Douglas, and innumerable resorts shaded by introduced coconut palms. Off shore is the magnificence of the Great Barrier Reef, a 2,000-kilometer series of ecologically and visually magnificent coral reefs with numerous reeftop islands and sandy cays.

In the 1960s, botanists discovered that parts of this tropical rain forest were of immense ecological significance for their possession of a substantial Gondwana inheritance. Detailed floral assessments brought a realization that some areas of Gondwana forest had escaped the periodic volcanic activity that had altered landscapes to the north and south, and that they had avoided destruction during the dry glacial periods and oceanic inundations during warmer periods. Much of the surviving biota was threatened, rare, or unique, and there was immense biodiversity in the forests. The area also gained significance from its rare association of tropical rain forest coastline and fringing coral reefs (Wet Tropics website; Breeden ND). Because of the area's tropical climate and ruggedness, significant parts of the coast had seen minimal European exploitation apart from some timber cutting and clearance for sugar cane farming on coastal flats (Kerr 1995; Bolton 1963). It was an ecological wonderland demanding preservation for its own intrinsic and ecocentric value.

As discussed previously, attitudes regarding trees and forests played a fundamental part in the evolution of environmental thought. From the late nineteenth century, there was increasing aesthetic and scientific appreciation of trees and forests in western societies. Forests were often seen as places of sublime beauty offering physical recreation and spiritual revival for urban dwellers. Recognition of their scientific complexity, and later of their ecological value and importance for the well-being of the planet, also changed public consciousness, at least among many residents of the big cities. In the late decades of the twentieth century, such sentiments made the defense of forests one of the focal aspects of the environmental movement. In a land that was mainly arid and

semi-desert, and that was being rapidly salinated, trees and the remaining areas of forest gained greater significance. However, as noted in Chapter 6, land clearance and forest felling gathered pace in the second half of the century, with Queensland becoming the worst state for the former and, given its limited forest areas, almost the worst of the latter.

The late twentieth century history of the tropical rain forests of North Queensland offers a suite of examples of what is best and worst about the way white Australians have treated and cared about their environment, especially the forest remnants. In the 1970s and 1980s, the preservation of these tropical rain forests became caught up in one of the worst cases of political rivalry and expediency. These controversies not only offer an apt although unfortunate case study of how environmental issues have been mishandled by governments, but also of how community groups have been prepared to undertake environmental battles and have had some major successes. Development versus conservation conflicts are part of the modern history of most countries, but they have been made particularly complex in Australia by the divided authority and rivalry of the three-tiered system of government (national, state, and local) and the diverse, competing approaches to environmental issues of Australia's main political parties.

When the six Australian colonies came together as States of the Commonwealth of Australia in 1901, environmental issues were neither envisaged nor allocated as a responsibility in the federal Constitution. As environmental care emerged as a need during the century it was, by default, technically a state matter. The result was that, effectually, little was done. The Commonwealth held the purse strings for much of the century, leaving state governments deeply concerned to find ways to generate revenue and employment to enable their regions to prosper. States' rights were defended, and any sign of further encroachment of Commonwealth power was strongly resisted. Similar parochial motivations meant that most local Councils within the states were keen to encourage economic development. In the absence of effective state legislation to control their activities, some Councils encouraged and facilitated environmental desecration and vandalism.

While it had no direct environmental powers under the Constitution, the Commonwealth had responsibility for external relations, including the right to make Australia a party to international treaties and conventions. From the 1970s, federal governments involved Australia in a number of such international agreements relating to environmental matters, much to the concern of many supporters of States' rights.

Philosophical divisions between political parties, and the intense and bitter rivalry this sometimes generated when there were governments of different political complexions in Canberra and in state capitols, produced a further layer of

complications in environmental issues. In the 1970s and 1980s, the environment became the focus of some of the most bitter of these State-Commonwealth political battles. The conservative National and Liberal parties are traditionally cool if not hostile to the care of the environment because it is seen as opposing "development" and "progress." The more left-wing Labor Party has tended to be slightly more sympathetic, but is nonetheless deeply divided because of its labor union links and accompanying concern with the need for employment security and growth through economic development—both of which were viewed as incompatible with conservation. Since the 1980s, there has been a more assertive environmental voice in the federal parliament, coming from a small and fluctuating number of Australian Democrat and Australian Green Senators. At times these groups have held the balance of power in the Senate and their call has been more likely to be heard. However, in the second half of the 1990s, the Democrats drifted to the right, leaving the Greens as virtually the only party profoundly concerned with environmental issues.

Queensland in the 1970s and 1980s provides a case study of this complex set of political, economic, and philosophical conflicts over the environment.

The major European invasion and development in Queensland took place somewhat later than in the cooler temperate regions of southeastern Australia. In the nineteenth and the first half of the twentieth centuries, it was widely believed that Europeans were limited in their suitability to live and work in tropical regions. As discussed in Chapter 4, geographer Thomas Griffith Taylor argued in the 1920s that Australia could effectively be divided into a number of "homoclimes" that were more or less appropriate for occupation by different races. Tropical north Queensland was not, he believed, climatically suitable for extensive European habitation, and he specifically drew attention to the similarities in climate between Calcutta and Townsville to underline the difficulties facing white settlers (Taylor 1923). As a consequence of such views, as well as the hot and humid reality, large areas of Queensland, including the northern coastal tropical rain forests, had a relatively small European population. There was land clearance on coastal flatlands for sugar cane, and cattle grazing and mining were the major activities further inland, but coastal towns such as Cairns and Townsville remained tiny (Kerr 1995; Bolton 1963).

In the changed world after World War II, development and population began to push north. Cultural changes within Australia brought an acceptance and love of the hot climatic regions that had been avoided by earlier generations of British Australians. The beach became a major recreational focus. Acclimatization to heat was facilitated by the introduction of air conditioning in buildings and then in cars, which made life in hot and humid regions increasingly com-

fortable and popular. From the late 1950s, there was a steady demographic drift from the southern states into Queensland. Population and coastal development crept northward, through Surfers Paradise and the Gold Coast, beyond Brisbane along the Sunshine Coast to Noosa Heads, and then toward Rockhampton and the Capricorn Coast. Unfortunately, much of this scourge of development, epitomized by Surfers Paradise, was crude, brash, ill-planned, greedy, and environmentally hostile. Sensitive coastal land was cleared and wetlands and mangroves were drained and built over. By the 1970s, such development had moved into areas of tropical climate and wet forest, and Townsville and Cairns had become major tourist destinations. Again, a great deal of relatively uncontrolled development saw inappropriate environmental impacts and mounting threats to offshore ecosystems including the Great Barrier Reef.

While such development did not go unopposed by environmentalists, in the unusual culture of Queensland at that time, environmental voices were generally drowned out by greed and by a National Party government that was politically conservative, and exhibited an extreme form of prodevelopment mentality. It was a government notable for its use of the police to overcome any protest or resistance to its decisions and policies. For a complex number of reasons, including a bizarre gerrymander, and in the face of mounting evidence of corruption, the people of Queensland repeatedly elected the government of Joh Bjelke Petersen from 1968 to 1987. Although strangely inarticulate, he was a highly skilled politician whose incoherent populist mumblings struck a chord with the spirit of many Queenslanders, including a significant proportion of older people who had migrated north in their retirement. Bjelke Petersen's was not an appropriate government at a time when conservation and environmental issues were becoming pressing. In the 1960s, the government promoted mineral and oil exploration on the Great Barrier Reef, encouraged land clearing and forestry in ecologically rich areas, and resisted mounting pressures to stem environmentally damaging urban development along the coast.

Bjelke Petersen was particularly hostile to the Labor government of Gough Whitlam, which was in power at the federal level between 1972 and 1975. The Whitlam government was arguably the first government in Australian history to exhibit significant concern about environmental issues, but because of constitutional limitations it could only act indirectly through use of its powers in the areas of overseas trade and other external issues. One of its important initiatives in 1974 was to make Australia a party to the "Convention for the Protection of the World Cultural and Natural Heritage," which was drafted by a UNESCO conference in 1972. It established a mechanism to enable areas of "outstanding universal value from the point of science, conservation or natural

beauty" to be World Heritage listed. Certain responsibilities for "protection, conservation and preservation" then devolved upon each "State Party" to the Convention (Hall 1992; Kerr 1993).

Bjelke Petersen used every means at his disposal to oppose and undermine Whitlam, and environmental protection became one of the significant areas of conflict between the two levels of government. Bjelke Petersen's enmity was triggered when the Whitlam government interceded to protect the Great Barrier Reef. In 1973, the federal government passed the Seas and Submerged Lands Act, which asserted Commonwealth sovereignty over coastal waters. The federal government then used the legislation to try to stop further drilling exploration, which Bjelke Petersen had allowed on the Reef. The New South Wales government (also conservative) challenged the validity of the legislation, but it was confirmed by the High Court. Then, in 1975, amid further controversy and obstruction from Queensland, the Whitlam government established the Great Barrier Reef Marine Park over the whole Reef, placing it under a management authority. By 1983, 344,000 square kilometers were included, making it the largest marine park in the world. Management was shared, at times uneasily, by the Commonwealth and Queensland governments. Meanwhile, the Commonwealth nominated the Great Barrier Reef for World Heritage listing, despite Queensland opposition, and in 1981, the World Heritage Committee agreed (Hall 1992; Hutton and Connors 1999; Woodford 2004).

A parallel conflict between the Whitlam and Bjelke Petersen governments arose in the early 1970s as a result of Queensland granting permits for mineral sand mining on Fraser Island, the world's largest sand island just off the Queensland coast near Maryborough. A campaign was undertaken by the Fraser Island Defenders Organisation (FIDO), but the Commonwealth had limited powers in the matter except through its capacity to grant or deny export licences. As Colin Michael Hall has described it:

> In 1974 the Whitlam Labor government merged its concern for environmental protection with the export power in the *Environmental Protection (Impact of Proposals Act)* 1974. All projects which are to be undertaken through an office of the Commonwealth, or which require Commonwealth approval or finance, are subject to the requirements of this Act. The Commonwealth was able to announce an inquiry into land-use on the island in April 1975, known as the Fraser Island Environmental Inquiry, because of the potential environmental impacts of an export industry. (Hall 1992, pp. 143–144)

The inquiry reported in 1976, but now to the conservative Fraser government that had succeeded Whitlam, and its recommendations for the cessation of mining were effectively accepted. There continued to be further threats until Fraser Island was awarded World Heritage listing in 1991.

These were two of a large number of issues and skirmishes that mark the 1970s and 1980s as one of the most important periods in the development of Australian environmental relationships and laws, and for the increasing importance and expertise of the emerging environmental lobby. Historically, most attention has been focused on Tasmania, where the damming of rivers for hydroelectricity and the felling of forests for timber and wood chips became national causes. As discussed in Chapter 4, the failure to save Lake Pedder from being flooded in 1972 greatly galvanized environmental concerns across Australia and led to strong resistance campaigns in Tasmania and other states during the next two decades. One of the most important of these was in response to the Tasmanian government's determination to dam the Gordon and Franklin Rivers. To circumvent the Tasmanian plan, the federal Fraser government nominated a large part of southwest Tasmania for World Heritage, and the Western Tasmanian Wilderness Parks were listed in 1982. Thumbing its nose at the obligations this imposed, the Tasmanian government revoked the National Park status around the proposed dam site and pressed ahead, threatening the environmental values in the World Heritage area. The Fraser government made it clear that World Heritage nomination was as far as it was prepared to go in challenging the Tasmanian sovereignty—it would not use its external relations powers as a signatory to the World Heritage Convention to stop the work. However, that was done in 1983 by the incoming Hawke Labor government, which passed the World Heritage Properties Conservation Act to protect Tasmania's southwest. The legislation was challenged by Tasmania in the High Court, but it was upheld by the Court, ruling that the Commonwealth's constitutional external affairs power enabled it to undertake and enforce such international treaty obligations (Hall 1992; Hutton and Connors 1999; Kerr 1993).

Meanwhile, a confrontation was looming in Queensland where, during the 1970s, there had been moves toward declaring a number of national parks in the wet tropics region along the coast north of Townsville. There were also suggestions from environmentalists that the region should be nominated for World Heritage listing. Even Bjelke Petersen (or one of his speech writers) was moved to remark in 1980 that "the area provides a living museum of plant and animal species in what is one of the few remaining examples of undisturbed coastal rainforest in the world" (*Trials of Tribulation* 1984, p. 1). The Daintree National Park, which was declared over a region north of Cairns in 1980, contained as one of its most important parcels, the Cape Tribulation National Park, which consisted of 17,000 hectares of highly significant tropical lowland rain forest including invaluable Gondwana remnant vegetation.

Three years later, just a few months after the Commonwealth had intervened to stop the damming of the Franklin River in Tasmania, a small but

Where ancient tropical rain forest meets the Pacific Ocean—Daintree National Park in Queensland, a World Heritage area. (Photo courtesy of Don Garden)

crucial parallel crisis arose in the Daintree National Park. The Douglas Shire Council, which covered the area along the coast north of Port Douglas, including the National Park, announced in August 1983 that it intended to build a 32-kilometerter road parallel to the coast from Cape Tribulation through the Cape Tribulation section of the National Park to the Bloomfield River. There was an existing track along part of the route that had been illegally and roughly bulldozed by timber cutters in the 1960s and again by developers in the 1970s, but each time it had deteriorated quickly and was used only as a popular walking track. Under the new plan, the track was to be considerably widened and access was to be gained by carving through an area of steep, undisturbed National Park forest. While various justifications were put forward, the principal motive appears to have been to facilitate tourist traffic, subdivision, and development in the Douglas Shire. It had the further advantage of providing easier access further north to Cooktown and to the Cape York

Peninsula, rather than having to follow the somewhat longer inland road that skirted the rain forest. The Bjelke Petersen government not only endorsed the building of the proposed road—without an appropriate study of the environmental impacts—it also provided financial assistance (Neilsen ND; *Trials of Tribulation* 1984).

The potential ecological repercussions were profound. The road could contribute to the drying of the adjacent forest, thereby dividing it into compartments. There was also the potential that, in such a high-rainfall region, the road would suffer from washaways and erosion. In turn, this would result in siltation of nearby streams and the potential for silting of adjacent areas of the Great Barrier Reef. There was also a well-based concern that the road was intended as the thin end of a wedge of resort and residential development around the National Park.

Such a road had been suggested and investigated on a number of previous occasions, but rejected as not being technically or economically feasible. The legal situation of building such a road through the National Park was also unclear, given the weak state of Queensland environmental and National Park law, but it was possibly illegal (Barker 1985; Hall 1992). Now, perhaps with the fresh memory of the Franklin case in mind, and in order to act before opposition mounted, the Shire Council planned to commence work almost immediately. Somewhat astoundingly, no route surveys were undertaken, and work was timed to commence late in the year, just before the full onset of the wet season in one of Australia's highest rainfall regions. It would not be possible to complete the road before "the Wet." At best, there would be a semistabilized scar through the forest.

Local environmentalists were determined to prevent this, and a public meeting in September established the Wilderness Action Group. A campaign of opposition was commenced and there was some indication that the Shire might back down. However, led by Tony Mijo, its particularly determined chairman, the Shire surprised everyone by moving quickly at the end of November to transport its bulldozers into the Cape Tribulation end of the road. As the Wilderness Action Group later noted, "Mijo had broken his word. It was anger that drove people to the barricade—anger at the secrecy, arrogance and pigheadness of the Douglas Shire Council, anger at the lack of democracy in this State" (*Trials of Tribulation* 1984, p. 6).

As the bulldozers commenced work, a dogged campaign of opposition began. Day by day the protestors established blockades, stood in front of bulldozers, and were arrested by the police whom Bjelke Petersen had sent. Despite the resistance and periodic heavy rain, the destruction of the forest pressed slowly on. As December advanced, protestors responded with more inventive measures

such as tree sitting and being buried up to their necks in the line of the road. The daily routine of blockades and arrests near Cape Tribulation were given nationwide publicity. Meanwhile, at the northern, Bloomfield, end, a similar story initially unfolded, but in the absence of a significant protestor and police presence, the bulldozers pushed ahead.

The resistance campaign stretched far beyond the rain forest. Drawing upon lessons learned in other high-profile campaigns, the Wilderness Action Group and other bodies such as the Australian Conservation Foundation, lobbied widely and attracted publicity across Australia. The Cape Tribulation protests received daily national attention in news broadcasts and press. Environmentalists sought to emulate the success of the Franklin campaign by calling on the Commonwealth government to nominate the area for World Heritage listing. However, as the Queensland government would not support the nomination, the federal Hawke Labor government sat on its hands, refusing to nominate the region or take other action. The main reasons were the long history of antagonism between Labor and Bjelke Petersen, as well as concern about the possible electoral repercussions in Queensland. In particular, there was an election due soon, and therefore a threat of an anti-Labor backlash in this notoriously anti-environment state. The federal Environment Minister dismissed Cape Tribulation as a "local issue," and made it plain that he would not nominate the area for World Heritage as a means of stopping the road. Nor was he prepared to use the powers available to the Commonwealth under existing legislation, as had occurred with the establishment of the Great Barrier Reef Marine Park (Formby 1985).

The road progressed slowly during December 1983, but the wet season set in at Christmas and further work became impossible. Unfortunately, the predicted repercussions followed. Torrential downpours brought landslides and washed away the freshly exposed mud, destroying much of the road and washing huge volumes of silt into nearby streams and then into the ocean.

In the following months, there were ongoing moves to stop further work on the road, but without federal support there was little chance of success. In August 1984 during the dry season, work recommenced. The story of protests and arrests was repeated, but the road was finally completed. On October 7, 1984, the grand opening took place, but rain set in and the official motorcade became bogged down and had to be towed out. It was an experience that many others have since shared because the road has remained little more than a poorly maintained four-wheel-drive track that is often impassable in the wet season.

The campaign had been lost, the road had been built, and many of the fears about its environmental repercussions were confirmed. However, the issue stimulated efforts, particularly by the Rainforest Conservation Society of

Queensland, to have the Daintree region nominated for World Heritage listing. While the federal Labor government now showed itself willing to proceed to nomination, it was not prepared to do so unilaterally without the cooperation of Bjelke Petersen. That cooperation was not forthcoming and the Queensland government remained hostile and obstructive. Finally in June 1987, the Commonwealth government lost patience and announced that it would proceed to nominate the Wet Tropics even without Queensland support. It did so in the face of bitter Queensland opposition, and passed legislation to ensure that the region was protected while waiting for listing. It was a wise precaution because deliberate sabotage of the region's ecological values was not beyond the mentality of the Queensland government. Finally, the area was inscribed on the World Heritage list in December 1988. The area covered 900,000 hectares between Townsville and Cooktown in 620 parcels of land in both private and public ownership (Neilsen ND).

Predictably, the Queensland National Party government continued to oppose the listing, refusing to be involved in joint management and undertaking two unsuccessful court challenges. In December 1989, the National Party lost office after twenty-three years in power and was replaced by a Labor government that now supported the listing and joined the management authority. While environmental threats have by no means disappeared, and cooperation between the two levels of government has not always been full, the area has enjoyed an enhanced level of protection. In particular, the 1994 Daintree Rescue Program was established as a cooperative movement between the three levels of government, the Wet Tropics Management Authority, and local conservationists. It was funded to buy up large areas of the privately owned land that lay within the World Heritage area. It is also worth noting that since the Cape Tribulation crisis, the Douglas Shire Council has had a strong presence of environmentalists among its members. However, none of this has prevented sustained campaigns by developers to clear more of the unique forest and endangered ecosystems (King 2004).

The history of the environment in Queensland in the 1990s receives a mixed report card. On the one hand, there was clearly an increased appreciation of conservation values and an acceptance of the tourist and economic significance of World Heritage listing, and even a pride in the possession of World Heritage areas. On the other hand, there were massive pressures from continuing coastal development, and Queensland remains one of the places of greatest annual land clearance on the globe.

A lesson to be learned from the Queensland experience is that while National Park status and World Heritage listing offer some localized protection for regions of ecological significance, such protection is limited. Governments

at any level, given the political or economic motivation, can ignore or change environmental controls. Agricultural practices and runoffs, and pressure from coastal developments, continue to threaten both the remnant unique forests and the Great Barrier Reef. The Reef is also under great pressure from other directions, such as increased tourism, and climate change and global warming, which threaten coral bleaching and other damage to coastal and aquatic ecosystems. The future is anything but certain (Woodford 2004).

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Terry Yumbulul and Keith Djiniyini, "My Island Home—A Marine Protection Strategy for Manbuynga ga Rulyapa (Arafura Sea)," in Galarrwuy Yunupingu (ed), *Our Land is Our Life: Land Rights—Past, Present and Future,* University of Queensland Press, 1997, pp. 181–182.

Australoids, the most numerous of whom were the Australian Aborigines, were the first humans to arrive in the region of this study, inhabiting northern Australia for more than 50,000 years before Europeans arrived. They developed a culture which was intimately tied to the natural environment, both land and sea, for both spiritual and economic sustenance. This modern expression from the Northern Territory of that relationship is notable for evidence that oral traditions still honor spiritually important totemic sites which disappeared under the sea when large coastal areas of the continent were flooded perhaps 12,000 years ago, after the last ice age.

The sea dominates Yolngu life. More of our totems come from the sea than from the land. There are sacred sites in the sea which, although they have been under water for thousands of years now, are still sung about. Our dances are about the sea. We dance the creatures of the sea—the shark, the crocodile, the whale, we dance the octopus. Our creation spirits, even those of people inland to whom we are ceremonially connected, began in the sea. The rainbow serpent, the Djan'kawu Sisters, which are important beings throughout the Northern Territory—both of these came up out of the sea.

A further issue is our sustenance. Most of our food traditionally comes from the sea. Both spiritually and physically the well-being of the sea has always been and remains crucial to our well-being.

Creation Story—Niue. Oceania Mythology Homepage, www.janeresture.com/oceania_myths.

The peopling of most of the Pacific occurred within the last 5,000 years, and on the islands equally complex cultures developed. Many Pacific creation stories explain not only how the physical world was created, but are also grounded in legends about the migration of people between islands.

The story is told on Nuie that once a group of spirits who lived beyond the horizon decided to swim around the ocean. After they had gone hundreds of kilometers, their leader decided that they should rest. So he signalled for them to gather together in a circle. When they had rested he decided that they should mark the spot. Accordingly, they all dived down to the ocean bed and started heaping up stones, mud, and sand into piles that eventually appeared above the waves. They then swam on, and marked each resting spot in a similar manner. In this way, Nuie and many other islands were made. The matter in which they were made explains, it is said, why they are round in shape and have a lagoon in the middle.

Creation Story—Kiribati. Oceania Mythology Homepage, www.janeresture.com/oceania_myths.

The wind, the weather, and the stars were crucial elements in Pacific environments and understanding them was central to many islander belief systems as well as to survival.

Nareau the Wise then took his father's right hand and threw it northward and said, "Go and become the northerly wind, and you shall be associated with strong winds, rain and bad weather." He then pulled off the left hand and threw it southward and said, "Go and become the southerly wind, and you shall be associated with light winds and calm days. These will be days to labour for food."

Then he tore off the right leg of his father, Na Atibu, and threw it westward and said, "Go and become the westerly wind, and you shall be associated with fine days for navigation."

Nareau the Wise gathered all the intestines and threw them upwards and they became people. The spine, and the remnants of flesh and skin, remained to become Te Kaintikuaba and Samoa, the first of all lands, respectively.

Nareau the Wise went back to Riiki and asked him to raise the sky as high as he could. As Riiki tried to do this, Nareau the Wise stamped hard on his tail, Riiki jerked with pain and carried the upper portion of Te Bomatemaki to its present height and he stayed there in the sky as Aiabu (The Great Milky Way).

The earth, the sky, the sun, the moon, the stars and the weather had all been created by Nareau the Creator and Nareau the Wise, and their world was inhabited by spirits.

"**Legend of the coconut tree" Government of Guam website.**

Many Pacific islander legends, such as this one from Guam, sought to explain the origin of the food and plants on which they depended.

Long ago there was a Chamorro family belonging to the Achote tribe. The family had a beautiful young daughter who was admired by everyone in the tribe.

One day the girl became very thirsty. She wanted to drink the juice from a special fruit. Everyone tried to find the fruit she described but to no avail. Soon the girl became very ill and died.

The father buried the girl on a hill over looking the village. He placed a beautiful headstone on her grave and the people covered it with many beautiful flowers.

One day the villagers noticed a strange plant growing on the girl's grave. They thought it was magic and built a shelter to protect it.

Five years after the plant appeared, it had grown 20 feet tall, strange-looking fruits appeared. One of the fruits dropped to the ground and cracked open.

The chief called on the father of the dead girl to eat the strange fruit but he refused. He called his wife to eat the fruit. She said it was sweet and chewy and called it coconut. It remains one of the main foods eaten by the Chamorro people.

Margaret Orbell, *The Illustrated Encyclopedia of Maori Myth and Legend,* Canterbury University Press, 1995, pp. 131–132.

The kumara was such a crucial part of Maori diet that there are many stories of how it came to New Zealand, including this one.

A man named Rongo-maui climbed to the sky to acquire the kumara from his elder brother Whanui (the star Vega). Whanui would not part with the kumara, but Rongo-maui stole it anyway and placed it in his penis. He then went back to his wife Pani-Tinaku [Seed-kumara pani].

When Pani became pregnant, she told her husband to take her to the waters of Mona-ariki. There she recited a ritual chant and gave birth to her "kumara children" [tamariki kumara], the many different varieties of kumara. Rongo-maui then performed the rituals appropriate to the kumara harvest, in this way setting the pattern for the future.

Teone Taare Tikao, *Tikao Talks: Treasures from the ancient world of the Maori,* A. H. Reed and A. W. Reed, 1939.

The Maori, like all Pacific people, hunted game birds as an important part of their diet. Many birds, especially ground-nesting species, did not survive such predation, but water birds were generally more resilient. These are the recollections of an elderly Maori in 1939.

The Maori found New Zealand swarming with birds, and the catching of birds for food was gone about very systematically at certain seasons. The *putakitaki* (paradise duck) is good eating, and during the period between December and March its big feathers drop out, and during the moulting (*maunu*) it was hunted in great style. Each *kaika* (village) facing lake Ellesmere made fences (*taiepa*) into the lake, something like sheepyards, and the birds were driven into these enclosures (*raihe*), and the gate shut. The birds cannot fly then, and canoes chased them around the lake, and so many went into each pen like yarding sheep, and so on right around the lake, so that each *kaika* could get its share. When the last one was served, the remainder of the birds were let escape, while the men and lads in the canoes and dug-outs came ashore and joined in killing the birds. Some were cooked in the *umu* (earth-ovens) at once to eat, while others were "boned" to preserve after cooking. The *parera* (grey duck), a blue bird called the *kukupako* (black

teal), the *tataa* (brown duck) and the *pateke* (grey teal) also moult, and were all caught in the same way at the same time.

Thomas Williams, *Fiji and the Fijians: The Islands and their Inhabitants,* 1858.

Thomas Williams was a Methodist missionary who worked in Fiji from 1840 to 1853. His recollections and observations provide one of the best views of Fijian (and indeed island) life, before the full impact of the European presence and religion transformed them. His observation of the foods grown by Fiji Islanders are indicative of the diets across much of Oceania, and of the range of species that the Pacific islanders had introduced.

The natives raise large quantities of taro, yams, kawai, banana, kumera, and sugar-cane. Rows of maize and ti-tree, and patches of tobacco, are often seen, and the papua-apple is cultivated. Some of these things are too familiar to need any minute description.

Of the yams there are in Fiji the usual varieties, and, in some parts of the group, two crops are raised in the year. Ordinary tubers of this valuable plant weigh from six to twelve pounds; extraordinary, from thirty to one hundred pounds. I have raised yams in my own garden nearly six feet in length, and weighing eighty pounds. A teacher on the island of Ono gave a yam nearly nine feet long to a Missionary's child, as a birth-day present. The soil is well cleared for the reception of the plants, which are placed in mounds, and the vines prevented from touching the ground, or playing too freely with the wind, by reeds planted cross-wise beneath, or piled like sticks for peas. Some of the yams grown in Fiji are for barter, and keep well for several months.

The tubers of the *kumera,* or sweet potato, vary in weight from half a pound to five pounds. The *kawai,* or sweet yam, resembles a kidney potato about eight or ten inches long. The vine is more woody than either of the two proceeding, and armed with spines. It is prolific, and yields tubers of an average weight of one pound and a half.

Dalo (*Arum esculentum*) is the *taro* of sea-faring men, and the Fijian's "staff of life," surpassing all his other esculents in nutritious value. One kind is grown on dry soil. Irrigated taro beds are generally oblong, and prepared with much labour. The most approved soil is a stiff, rich clay, which is worked into a consistency of mortar, and watered carefully, and often with skill. Valleys are preferred for these beds; but sometimes they have to be cut on the mountain slopes, which, when thus terraced with mature taro patches, present as beautiful a spectacle as any kind of agriculture can furnish. The deep, rich green of the broad leaves, which rise three feet or more from their watery beds in rank and file, contrasts beautifully with the profuse but irregular vegetation of the uncultivated ground. The root is oval in outline, and of a dark or light slate-colour showing in section an appearance like a finely veined marble. It is propagated by setting the tops of the ripe roots in deep holes prepared in the clay, and bringing to mind the celery-beds at home in England. In ten or twelve months the taro is fit to be drawn up, and yields well. From one to four pounds is a common weight; not unusually eight, ten, or twelve pounds. I weighed one head without the skin, and it reached twenty-one pounds and a half. The acrid taste of the raw root is removed by cooking, which renders the taro a useful and delicious food, the substitute for bread to the natives, and greatly esteemed by

foreigners. As a vegetable, it is served up entire, and, made into paste, forms the chief ingredient in many native puddings. The leaves, when boiled, eat like those of the mercury, and the petiole is little inferior to asparagus.

Qai or *masawe* (*Dracaena terminalis*)—the ti-tree—costs little care. Its slight stem, crowned with a tuft of lanceolata leaves, is sometimes seen in rows on the edge of a yam bed. The root weights from ten to forty pounds, and is used, after being baked, as liquorice, or for sweetening made dishes.

The banana and plantain are well known, and have been frequently described. The beautiful leaf of the former, when young, becomes the "mackintosh" of Fiji, by being warmed over the fire, and made into water-proof covers for the head. It is also used as a sort of cloth in which to tie up certain kinds of food, in the preparation of which oil has been used. On a remarkably fine specimen of this tree, I counted as many as one hundred and eighty in one bunch of the fruit. The natives cultivate at least thirty varieties, the fruits of which vary in form and size. It is propagated by suckers, four or six of which rise from the roots of the old tree. Besides its use as a simple vegetable and a fruit, it forms a stew with the expressed juice of the cocoa-nut, and stuffed with the grated nut makes a pudding. The white residents use it in pies, and procure from it by fermentation a superior vinegar. Dried in balls, it is little inferior to cured figs. This, with the bread-fruit tree, is among the most useful productions of the islands. The fibrous stem has never been used by the natives for cordage.

Sugar-cane is grown in large quantities, and thrives well, ripening in twelve to fourteen months. The canes girt from three to seven inches, and their juice appeases both hunger and thirst; it is also used in cooking. The leaves are largely employed for thatch.

Considerable care is bestowed in some parts of the islands on the cultivation of the *yaqona* (*Piper methisticum*), the *cava* of voyagers. The root, for its narcotic properties, and yielding the native grog, is the part most valued, and that which consequently receives the most care. So successfully is the root cultivated, as to be brought sometimes to a great weight. I had one at Somosomo weighing one hundred and forty pounds.

Another and very important object of agriculture attention in Fiji is the paper mulberry (*Broussonetia*), known to the natives as *masi* or *malo.* A *malo* plantation is like a nursery of young trees, having an average height of ten feet, and a girth of three and a half inches. It supplies the people with their principal clothing.

William Dampier, *A Voyage to New Holland in the Year 1699,* London, 1703.

William Dampier, a British sailor and adventurer, was a member of an expedition that spent three months on the Australian west coast in 1688. This description of the Shark Bay region on the mid west coast of Western Australia is one of the earliest European accounts of and responses to Australian flora and fauna. The slaughter of indigenous species for European scientific curiosity and dinner plates had commenced.

In this bay or sound that we now are in, the land is low by the sea side, producing a sort of samphire, which bears a white flower. Farther in the mould is reddish, a sort of sand; producing some grass, plants and shrubs. The grass grows in great tufts, as big as a

bushel, here and there a tuft; being intermix'd with much heath, much of the kind we have growing on our commons in England. Of trees and shrubs here are diverse sorts, but none above ten feet high; their bodies about three foot about, and five or six foot high before you come to the branches, which are bushy and composed of small twigs there spreading abroad, tho' thick set and full of leaves, which were mostly long and narrow. The colour of the leaves was one side whiteish, and on the other green; and the bark of the trees was generally of the same colour with the leaves of a pale green. Some of these trees were reddish and sweet scented within the bark, like sassafras but redder. Most of the trees and shrubs had at this time either blossoms or berries on them. The blossoms of the different sort of trees were of several colours, as red, white, yellow, etc. but mostly blue; and these generally smelt very sweet and fragrant, as did some also of the rest. There were also beside some plants, herbs, and tall flowers, some very small flowers growing on the ground, that were sweet and beautiful, and for the most part unlike any I had seen elsewhere.

There were but few land fowls; we saw none but eagles, of the larger sort of birds, but five or six sorts of small birds. The biggest of these was not bigger than larks, some no bigger than wrens, all singing with great variety of fine shrill notes; and we saw some of their nests with young ones in them. The water fowls and ducks (which had young ones now this being the beginning of the spring in these parts), curlews, galdens, crab-catchers, cormorants, gulls, pelicans, and some water fowl, such as I have not seen anywhere besides.

The land animals that we saw here were only a sort of racoons, different from those of the West Indies, chiefly as to their legs; for these have very short fore legs, but go jumping upon them as the others do (and like them are very good meat); and a sort of guano, of the same shape and size with other guanos, but differing from them in three remarkable particulars; for these had a larger and uglier head, and had no tail, and at the rump, instead of the tail there, they had a stump of a tail, which appear'd like another head; but not really such, being without mouth or eyes; yet this creature seem'd by this means to have a head at each end, and, which may be reckon'd fourth difference, the legs also seem'd all four of them to be fore-legs, being all alike in shape and length, and seeming by the joints and bending to be made as if they were to go indifferently either head or tail foremost. They were speckled black and yellow, like toads, and had scales or knobs on their backs like those of crocodiles, plated onto the skin, or stuck into it as part of the skin. They were very slow in motion, and when a man comes nigh them they will stand still and hiss, not endeavouring to get away. Their livers are all spotted black and yellow, and the body when opened had an unsavoury smell. I did never see such ugly creatures anywhere but here. The guanos I have observed to be very good meat, and often I have eaten them with pleasure; but tho' I have eaten of snakes, crocodiles, and alligators, and many creatures that look frightfully enough and there are but few I should have been afraid to eat of if prest by hunger, yet I think my stomach would scarce have serv'd to venture upon these New Holland guanos, both the looks and the smell of them being so offensive.

Alexander Home, "A Description of the Vale of Tiarabu with Some Remarks on its Inhabitants," National Library of Australia, MS 690.

Captain Alexander Home, RN [Royal Navy], was a member of Cook's third expedition. This is his account of a visit to a Tahitian valley, 1777–1778. It contains many of the sentiments which were to give Tahiti and the South Seas their paradisiacal image.

This delightful spot is ever green always Spring, always Harvest on the same tree the Fruit is half ripe Just Formed and Budding. The natives may Justly be said to perform no labour, what they do is merely Amusement, they set themselves no task for there is no need for it, they cannot be Behind hand. There is no winter Coming on, no particular season to sow or to plant and their food does not Depend upon what they sow or plant, these are but Luxurys. What they Depend upon for sustenance Nature would produce were none of them there. They have only got to Colect it from the trees and Bushes and prepare it for their palates or throw it to their Swine and Fowles, which are all the Domestic Animals they have. Making of the Cloath from the Bark of a tree is so Easy that a person May Make as much in 3 days as will Serve A Year. To build their Hut is not Above the Labour of 2 days when all the Family Sets to work. . . .

[The men] go A Fishing and Catching of Birds for wild Animals they have none. They are never at pains to grub out the rank grass and Other undergrowth from Amongst their trees, by which Neglect they must be deprived of half their Nourishment yet they Bear finely for all that. . . . The whole is Completely rude Exactly in the State of nature as are the people themselves.

These people certainly live very happy lives Notwithstanding they are in so rude a state . . . they have not got one Thousandth part of the knowledge of us, and yet from what I saw I have reason the think they live much more Contentedly. They live as long and its plain that we have got 10 times as Many Diseases, its A Maxim Amongst us to be wise is to be happy but here we find happiness without wisdom. . . . What shall we say then to this, can it be possible that providence has punished man for swerving from a State of gross Ignorance. . . .

an Acre will Maintain A man & his wife and 9 or 10 children so fruit full is the soil. . . .

But However Amazing this Fertility may seem it might be greatly Increased were the people only Industrious Enough to Hoe down the Coarse rank grass in there Plantations. This they Suffer to grow to the Hieght of 3 or 4 Foot which Must deprive the trees or More than half their Nourishment.

Sydney Parkinson, *A Journal of a Voyage to the South Seas*, London, 1773.

Sydney Parkinson was a draughtsman employed by Joseph Banks on Cook's first voyage. He died on the voyage but his account was published posthumously. This extract is an example of the complexities caused by the European frame of reference when it came to describing Australia's peculiar fauna, in this case a kangaroo.

. . . an animal of a kind nearly approaching the mus [mouse] genus, about the size of a greyhound, that had a head like a fawn's; lips and ears, which it throws back, like a hare's; on the upper jaw six large teeth; on the under on two only; with a short and small neck, near to which are the fore-feet, which have five toes each, and five hooked claws; the hinder legs are long, especially from the last joint, which, especially from the callosity below, it seems as if it lies flat on the ground when the animal descends any declivity. . . . The tail, which is carried like a grey-hound's, was almost as long as the body, and tapered gradually to the end. The chief bulk of the animal is behind; the belly being the largest, and the back rising towards the posteriors. The whole body is covered with short ash-coloured hair; and the flesh of it tasted like a hare's, but has a more agreeable flavour.

Arthur Phillip, *The voyage of Governor Phillip to Botany Bay, with contributions by other officers of the first fleet and observations on affairs of the time by Lord Auckland, with an introduction and annotations by James J. Auchmuty.* Angus and Robertson in association with the Royal Australian Historical Society, 1970, pp. 122–123. c. 1790.

Captain Arthur Phillip, the first Governor of New South Wales, was representative of the first generation of colonists in their arrival in the new land. To them, it was a wilderness, an undeveloped land that, with industry and the imposition of a British sense of order, might be made attractive, fruitful, and civilized.

There are few things more pleasing than the contemplation of order and useful arrangement, arising gradually out of tumult and confusion; and perhaps this satisfaction cannot anywhere be more fully enjoyed than where a settlement of civilised people is fixing itself upon a newly discovered or savage coast. The wild appearance of the land entirely untouched by cultivation, the close and perplexed growing of trees, interrupted now and then by barren spots, bare rocks, or spaces overgrown with weeds, flowers, flowering shrubs, or underwood, scattered and intermingled in the most promiscuous manner, are the first objects that present themselves; afterwards, the irregular placing of the first tents which are pitched, or huts which are erected for immediate accommodation, wherever chance presents a spot tolerably free from obstacles, or more easily cleared than the rest, with the bustle of various hands busily employed in a number of the most incongruous works, increases rather than diminishes the disorder, and produces a confusion of effect, which for a time appears inextricable, and seems to threaten an endless continuance of perplexity. But by degrees large spaces are opened, plans are formed, lines marked, and a prospect at least of future regularity.

Matthew Flinders, *A Voyage to Terra Australis,* London, 1814, Vol. II, pp. 71–73.

In 1801, Matthew Flinders was given the task of circumnavigating and charting the Australian continent. This observation of the landscape in the Broad Sound and Shoalwater Bay region of Queensland is representative of early attempts to evaluate and commodify the commercial potential of the new land.

There seems . . . to be a considerable extent of land about Broad Sound and on the

peninsula between it and Shoal-water Bay, if not calculated to give a rich return to the cultivator of wheat, would support much cattle, and produce maize, sugar and tobacco; and cotton and coffee would grow upon the more rocky sides of the hills, and probably even upon Long Island. . . . The pines of Port Bowen, Shoal-water Bay, and the Northumberland Isles, would furnish the necessary spars and lighter planking [for ship building]; and there is no reason to think that the eucalyptus, which grows all over the country, should not be fit for timbers, &c., as it is found to be further southward. No iron ore was seen in the neighbourhood; but were a colony established and the back ridge of mountains well examined, this and other metallic productions might be found.

Humpbacked whales frequent the entrance of the sound, and would present an object of interest to a colony.

Barron Field, "On the Rivers of New South Wales," in *Geographical Memoirs on New South Wales,* London, 1825, pp. 302–303.

Barron Field was a New South Wales judge who published some colorful accounts of his experiences and observations. This extract illustrates a widely held belief that it was a human (or British) duty to take the earth, which had been rough hewn by God, and through industry make it productive and civilized. Such sentiments were generally accompanied by a pejorative comment on Aboriginal society and use of the land.

The tracts of country, which are but newly inhabited by man, such as the great part of America, and the newly-discovered regions of Terra Australis, are still almost occupied by marshes and lakes, or covered with impenetrable forests; and they would remain long in this state, if population, continually increasing, did not increase industry, and multiply the hands of cultivators, along with their necessities. The Author of Nature was alone able to form the ridges of mountains, to model the hillocks and the valleys, to mark out the courses of great rivers, and give the first trace of every rivulet; but he has left to man the task of draining his own habitation, and the fields which are to support him, because this is a task not beyond his powers. It was therefore of great advantage to him, that those parts of the globe into which he has not yet penetrated, should remain covered with lakes, marshes, and forests, which keep in store the juices of the earth, which the influence of the air, and the vivifying warmth of the sun, would have expended long ere now in useless vegetation, and which the rains of heaven would have swept into the sea, had they not been thus protected by their situation or their cover. It is therefore the business of man to open up these mines of hoarded wealth, and to thank the Author of all good, who has husbanded them for his use, and left them as a rightful heritage for those of after days.

Barron Field, *Geographical Memoirs on New South Wales,* London, 1825. Appendix, Chap. 3, Journal of an Excursion to the Five Islands. pp. 460–461.

This comment by Field is a classic example of what became something of a literary artifice in the first half of the nineteenth century—the idea that Australia was so alien it

was a world turned upside down, a place in which many things in Nature were the reverse of their equivalent in the northern hemisphere. Some of his comments, such as the working of the barometer, were wrong, and some exaggerated.

But this is New Holland, where it is summer with us when it is winter in Europe, and *vice versa;* where the barometer rises before bad weather, and falls before good; where the north is the hot wind, and the south is the cold; where the humblest house is fitted up with cedar (cedrela toona); where the fields are fenced with mahogany (eucalyptus robusta), and myrtle trees (myrtacae) are burnt for fire-wood; where the swans are black and the eagles white; where the kangaroo, an animal between a squirrel and the deer, has five claws on its fore-paws, and three talons on its hind-legs, like a bird, and yet hops on its tail; where the mole (ornithorhynchus paradoxus) lays eggs, and has a duck's bill; where there is a bird (meliphaga) with a broom in its mouth instead of a tongue; where there is a fish, one-half belonging to the genus raaia, and the other to that of squalus; where the pears are made of wood (xylomelum pyriforme), with the stalk at the broader end; and where the cherry (exocarpus cupressiformis) grows with the stone on the outside.

Captain James Stirling to Governor Darling, 14 Dec 1826, *Historical Records of Australia,* Series 1, Vol. xii, p. 779.

In 1826, Captain James Stirling requested the opportunity to explore the west coast of Australia and commenced a campaign to have a colony established on that coast. His proposal carried expressions of largely unfounded optimism in the potential of "New Holland." Perhaps not surprisingly, despite the reality he encountered in what was a very harsh landscape, his report was so glowing and he was so persistent in his optimism that in 1829, he was given the task of founding the Swan River Colony.

Your Excellency is aware that the Coast, between Cape Leeuwin and Shark's Bay, has never been explored by any British officer; its Soil and Productions are as yet unknown; but, as it is situated in the same parallel as New South Wales, in the same climate and on the same Island, it is fair to assume that it is in other respects similar to this Country; if this assumption be correct, it will admit of labour by Europeans, and produce commodities well suited to the wants of neighbouring Countries, which being situated between Tropics are in a condition to exchange Tropical productions for those of the Temperate Zone; it might, for instance, supply India with Horses and wheat, and possibly Coal and Iron; it might supply the Mauritius with Live Stock and Grain; it might supply the Malay islands with various articles, adapted to their wants, and China with Wool, Hemp, Shipping, and the produce of the Ocean; with respect to its Productions generally, I do not think it too much to say that it may hereafter be to the various Countries in India that which the Colonies in North America once were to the West Indian Settlements.

St Hubert, "Foreign and Colonial Stations of the British Army—Van Diemen's Land," Rhodes House, Bodleian Library, mss Austr s.2.

St Hubert, a pseudonym, was a convict soldier guard who did a tour of duty in Van

Diemen's Land in the 1830s. His later reminiscences contain a good example of the ambivalence often experienced by British colonists to the Australian environment. Many, like St Hubert, did not find the bush to be aesthetically appealing, especially the gum trees, although this was by no means universal.

Dr Goldsmith in his "Animated Nature" has remarked that "the most obvious beauty that everywhere strikes the eye is the verdant covering of the earth," and in no country is the traveller sooner convinced of the truth of this passage, than in our Australian possessions. However much the eye may be delighted with the prospect in other respects, it is wearied sad-coloured foliage of the trees. Those persons who remain at home in the old country have been led to suppose, that the beauty of the scenery must be much enhanced by the trees described as "evergreens"; with far greater propriety would they have been called "nevergreen," for with the exception of the wattle (the emblem of Van Diemen's Land), I do not recollect to have ever seen a positively green tree. "Tis true they are not deciduous, but for all that there is little verdant about them, their foliage is of the most sombre hue, and very ill calculated to inspire the stranger with a favourable opinion of the fertility of the country. Nevertheless, there is no lack of good soil, or fine useful timber under this uninviting covering. The traveller, in pursuing his trackless course through the uncultivated districts of this island, will frequently find his attention unvoluntarily arrested by the majestic stature of the Stringy Bark. This tree is usually met with in large forests, and attains to a very great height before throwing out a single branch which adds much to its value for the purposes of timber, though little to its picturesque appearance. It forms useful timber for the formation of buildings, from the closeness of its grain, and durable properties. Wherever it grows the colonists may be certain of finding good soil, though from the density of the forests, he is at present unable to make proper use of it, in consequence of the vast expanse attendant upon clearing, which is much enhanced by the great scarcity of water carriage in the interior.

Sydney *Herald,* 7 November 1838.

This comment was made at a time when a slaughter of Aborigines at Myall Creek in New South Wales had been exposed, and colonists felt it necessary to justify the removal of Aborigines from the land. A comparison with the dynamism and capacity of the British, and the right of only those who were prepared and able to develop the land to possess it, was not an uncommon sentiment.

The vast country was to them a common . . . their ownership, their right, was nothing more than that of the emu or the kangaroo. They bestowed no labour upon the land—and that only—it is which gives the right of property to it. Where, we ask, is the man endowed with even a modicum of reasoning powers, who will assert that this great continent was ever intended by the Creator to remain an unproductive wilderness? . . . The British people . . . took possession . . . and they had a perfect right to so, under the Divine authority, by which man was commanded to go forth and people and *till* [sic] the land.

J. R. Wollaston, 28 Nov 1842, in A. Burton (ed), *Wollaston's Picton Journal, 1841–44,* Paterson Brokensha, 1955, p. 116.

J. R. Wollaston, an Anglican priest and early settler in Western Australia, experienced many typical difficulties in trying to carve a farm out of the bush. Experiences such as his with dingoes resulted in enormous efforts to exterminate them.

During our haymaking we experienced another loss from the native dogs, owing to the carelessness of Joe, the shepherd. Two of these cunning and voracious animals attacked the sheep in open day, when at too great a distance from their keeper and killed two lambs, one of which we only recovered and this by pursuit of Joe on foot, the other we saw nothing more of. They worried besides three others, one of them so much, that we were obliged to kill it. This is the first mutton of our own we have tasted and if we may judge from this specimen, our Down sheep, for eating, will far surpass the Merino. The fleece we know, is much inferior. One of the lambs was an ewe. We have never had the sheep attacked before although the goats have suffered frequently.

J. R. Wollaston, 30 Dec 1843, in A. Burton (ed), *Wollaston's Picton Journal, 1841–44,* Paterson Brokensha, 1955, p. 133.

This description of land clearing in a forest area, while it relates to Western Australia in the 1840s, could have been written about the pioneering experience in any of the Australian colonies and New Zealand in the nineteenth century.

The weather having been unsettled we have been afraid to proceed with our thrashing, so have been clearing instead. This clearing must go on for some years yet since we can only accomplish a small space at a time. The trees that were fallen last year were so hard they turned the edge of the axe; we can only subdue them by sawing and burning. Today we have been attacking a huge prostrate gum tree 60 feet in length without the top. It has taken several days to drag away with bullocks all that was moveable and now the stem remains, which we must tackle in some way or other. There are three more trees nearly as large which we must remove before we can begin to plough the piece we have been clearing. The stumps we cannot get up, so they must remain; some branching tough roots however will have to be cut and dug up. The land is valuable when you get it into cultivation, but where it requires such labour and expense to clear Government ought to thank anyone for taking it for nothing. I cannot but think it a providential mercy, considering what new hands we were, that none of our limbs have been broken, nor any serious accidents befallen us in the use of tools.

Henry W. Haygarth, *Recollections of Bush Life in Australia During a Residence of Eight Years in the Interior,* London, 1848, pp. 120–121.

While colonists generally appear to have applauded the clearing of the land and the imposition of a British sense of order, some admired the initial beauty and were saddened by the rapid deterioration that followed pastoral and agricultural settlement.

The most spirit-stirring sight which the sportsman can witness is the first view of a new pastoral district; and to the lover of the picturesque perhaps this is the most beautiful scene that Australia can afford . . . Plains and "open forest," untrodden by the foot of the white man, and, as far as the eye can reach, covered with grass so luxuriant that it brushes the horseman in his saddle; flocks of kangaroos quietly grazing, as yet untaught to fear the enemy that is invading their territory; the emu, playfully crossing and recrossing his route; the quail rising at every step; lagoons literally swarming with wild-fowl—these are scenes reserved for the eye of the enterprising settler, or the still more enterprising "overlander."

Then mark the change that follows hard upon discovery. Intelligence of the new country reaches the settled districts, and countless flocks and herds are poured into the land of promise. It is divided into "stations," and "improvements" are everywhere erected on it; disputes arise, and a commissioner is appointed to settle them; bushrangers are "out," and mounted police are sent to hunt them down; the wild blacks, indignant at the cool occupation of their territory, spear the cattle, and the settlers retaliate. The governor establishes a "protector of aborigines," who perhaps has most need of protection himself. To some the regions bring wealth, to others disappointment, while Anglo-Saxon energy at last triumphs over every obstacle. But Nature, as if offended, withdraws half her beauty from the land; the pasture gradually loses its freshness; some of the rivers and lakes run low, others become wholly dry. The wild animals, the former peaceful denizens of the soil, are no more to be found, and the explorer, who has gazed on the district in its first luxuriance, has seen it as it can never be seen again.

John G. Robertson, letter 26 September 1853, from Wando Vale, north-east of Casterton in Victoria, in T. F. Bride (ed), *Letters From Victorian Pioneers,* Melbourne 1898, pp. 167–169.

Robertson, one of the early squatters in western Victoria, made even closer observations than Haygarth of the impact of pastoral settlement on the land.

When I arrived [March 1840] through the thick forest-land from Portland to the edge of the Wannon country, I cannot express the joy I felt at seeing such a splendid country before me where my little all that I was driving before me was to feed. The whole of the Wannon had been swept by a bush fire in December, and there had been a heavy fall of rain in January (which has happened less or more for this last thirteen years), and the grasses were about four inches high, of that lovely dark green; the sheep had no trouble to fill their bellies; all was eatable; nothing had trodden the grass before them. I could neither think nor sleep for admiring this new world to me who was fond of sheep. . . .

[Within three or four years] Many of our herbaceous plants began to disappear from the pasture land; the silk-grass began to show itself in the edge of the bush track, and in patches here and there on the hill. The patches have grown larger every year; herbaceous plants and grasses give way for the silk-grass and the little annuals, beneath which are annual peas, and die in our deep clay soil with a few hot days in spring, and nothing returns

to supply their place until later in the winter following. The consequence is that the long deep-rooted grasses that held our strong clay hill together have died out; the ground is now exposed to the sun, and it has cracked in all directions, and the clay hills are slipping in all directions; also the sides of precipitous creeks—long slips, taking trees and all with them. When I first came here I knew of but two landslips, both of which I went to see; now there are hundreds found within the last three years.

A rather strange thing is going on now. One day all the creeks and little watercourses were covered with a large tussocky grass, with other grasses and plants, to the middle of every watercourse but the Glenelg and Wannon, and in many places of these rivers; now that the only soil; is getting trodden hard with stock, springs of salt water are bursting out in every hollow or watercourse, and as it trickles down the watercourse in summer, the strong tussocky grasses die before it, with all others. The clay is left perfectly bare in summer. The strong clay cracks; the winter rain washes out the clay; now mostly every little gully has a deep rut; when it rains it runs off the hard ground, rushes down these ruts, runs into the larger creeks, and is carrying earth, trees and all before it. Over Wannon country is now as difficult a ride as if it were fenced. Ruts, seven, eight, and ten feet deep, and as wide, are found for miles, where two years ago it was covered with tussocky grass like a land marsh. I find from the rapid strides the silk-grass has made over my run, I will not be able to keep the number of sheep I did three years ago, and as a cattle station it will be still worse; it requires no great prophetic knowledge to see that this part of the country will not carry stock that is in it at present.

Foster Fyans, 1853, in T. F. Bride (ed), *Letters From Victorian Pioneers,* Melbourne 1898, pp. 185–186.

Foster Fyans was an early local administrator in Victoria, a man with some pretensions to be a member of the colonial gentry. One manifestation of this was to see himself as a "sportsman" and to be involved in organized hunts. Here he describes a hunt in the late 1830s or early 1840s, a rather pretentious attempt to emulate the hunts of the British gentry.

Mount Emu is a beautiful country. A noble pack of hounds was kept up by gentlemen squatters who met every season, hunting twice and thrice a week, and meeting at each other's houses, where good cheer and good and happy society were ever to be met. I have sat down with thirty gentlemen at Mr. Goldsmith's to an excellent dinner given by that gentleman. There was ample provision of all that was good set before his guests, who, one and all, had hearty and joyful faces, talking of to-morrow and the day's sport before them. We retired to rest on our *shakedowns* on the floor at eleven o'clock; at daybreak the master of the hounds, a squatter, sounded his bugle; shortly after, his second, for breakfast; and in half an hour his third bugle, when a fine pack of dogs let loose from the kennel appeared, full of life and glee, led away by the well-known master of the hounds, Compton Ferrers, followed by thirty well-mounted gentlemen squatters. The game was not far distant. In half an hour we came on the scent of a native dog; he had a

long start; the pack took up the scent, and followed breast high; the ground was rather moist; some horsemen were thrown out; but there were twenty in at the death, after passing over sixteen miles of ground without one check. The wild dog is noble sport; and as to the day I speak of, I doubt even if Leicestershire ever turned out a better pack or a better set of sportsmen in a field during a season.

Foster Fyans, 1853, in T. F. Bride (ed), *Letters From Victorian Pioneers,* Melbourne 1898, pp. 191–192.

Strangely, Fyans did not seem to have realized that it was the activities of "sportsmen" such as himself that were partly responsible for the decline of "game" in the colony, and were thereby making it a less worthy place in which to live.

Emus and kangaroos on our arrival were plentiful in all parts of the district; also bustards in large flocks of from ten to thirty or forty, or perhaps more. The bustards now are scarce, and only met with in distant places. The kangaroo and emu are nearly extinct in the district; the country is almost void of game. Quails in years gone by were plentiful, but I think are fast disappearing; snipe we have in the season, but not in the same abundance as in other countries; we have also the painted snipe, the same bird that is met with in all parts of India; black ducks, large, and a delicacy; also various small ducks, and wood ducks, etc.; the bronzewing pigeon, a fine game bird, fully equal to an English partridge; black swans—useless and ugly; snakes of many descriptions, and some exceedingly bold—more so than I have known them in India. The longest snake I have met did not exceed six feet. For an idler or a sportsman this country affords nothing, and for a military officer it is the most damnable quarter in the world. There is nothing in the shape of sport except in the season a few snipe and quail; then it ends until the next September. At the approach of the snipe season, when you seek your "Forsyth" or "Joe Manton" to brush it up for the sport, it is more than probable that you will seek in vain, for some good and trusty servant has made it his own.

William Howitt, *Land, Labour and Gold, or Two Years in Victoria with Visits to Sydney and Van Diemen's Land,* 1855, p. 32.

William Howitt was an English journalist and writer who visited the Australian colonies during the height of the 1850s gold rushes. His writings provide one of the finest insights into the colonies at that time. On a number of occasions he expressed surprise and pleasure at the familiar animal species and garden plants that had been introduced into the colonies, and the extent to which the landscape was being made more familiar.

But, spite of foreign vegetation, the English stamp and English character are on all their settlements. They are English houses, English enclosures that you see; English farms, English gardens, English cattle and horses, English fowls about the yards, English flowers and plants carefully cultivated. You see great bushes of furze, even by the rudest settlers' cottages. There are hedges of sweet-briar around their gardens, bushes of holly, though rare, and, what is odd, the finest holly trees I have seen, were grown from seeds

of the fine old trees about our own house at home. There are hawthorns and young oaks in the shrubberies. There are cowslips and oxslips now in flower in the gardens, but no primroses that I have yet seen. There are lots of snapdragons of various hues, roses and lilacs, looking very English. England reproduces herself in new lands; and how feeble seem the native races against the sinewy, plucky, pushing, predominating Englishman. The hunter races of the earth, the forerunners of the house-building, shipbuilding, ploughing, busy, encroaching white man,—they who occupied the wilderness, and sat under the forest-tree, without commerce or ships, living easily on the animals of the chase,—they who lived with the mammoth and mastodon, the kangaroo and the emu,—have perished with them, and are daily perishing before the civilised and artistic tribes, indominatible in the spirit of the conqueror and the possessor.

William Howitt, *Land, Labour and Gold, or Two Years in Victoria with Visits to Sydney and Van Diemen's Land,* 1855, pp. 48–49.

Howitt captured the colonist's propensity to kill almost anything that moved, often casually and opportunistically.

It was a splendid moonlight night, and we went with two of this party to see them shoot opossums. They had some good dogs, which hunted up the opossums into the trees, at the feet of which they stood and barked until their masters came up.

The animals are about as big as good large rabbits, with a thick gray or brown fur, and a long and black bushy tail. They are sometimes difficult to spy out among the leaves; but at other times they sit on the dead branches, the very plainest of marks; and you may shoot at them two or three times, if you do not happen to hit them, before they will move. You have only to get them between the moon and yourself, and you are pretty sure of them.

The next morning these men came to borrow an axe to cut a wild-cat out of a hollow tree. These cats make their nests generally in the hollow trunks lying on the ground, or in the hollows at the feet of the trees. In this case there proved to be a nest of young ones about the size of rats. These cats, as they are called, much more resemble ferrets or polecats, and are about the same size. They have cats' tails with rats' feet, and sharp snouts of a red colour. They are of different colours, but principally brown or gray [sic], sometimes black, but invariably covered with large round white spots, about the size of a fourpenny piece. They have pointed teeth as sharp as needles, and fight furiously, giving the dogs severe bites. The young ones were taken alive, and they showed their ferocity by instantly fastening on the sleeves of their captors, where they hung all the way to the tent like so many leeches.

William Howitt, *Land, Labour and Gold, or Two Years in Victoria with Visits to Sydney and Van Diemen's Land,* 1855, pp. 198–199 and p. 205.

Howitt was one of the few who reported the extreme degradation caused by gold prospecting and gold mining.

Thus we had quietness and greeness, and the most deliciously cool water, sweet and clear. But this quietness and greeness cannot last. Prospectors will quickly follow us. We foresee that all these bushy banks of the creek will be rapidly and violently invaded. The hop-scrubs will be burnt, the bushes in and on the creek cleared away, the trees on the slope felled, and the very ground torn up for miles around. The crystalline water will be made thick and foul with gold-washing; and the whole will be converted into a scene of desolation and discomfort. . . .

We have begun to destroy the beauty of this creek. It will no longer run clear between its banks, covered with wattles and tea-trees, and amongst its shallow parts overgrown with foreign-looking shrubs, flags and cypress-grass. A little while and its whole course will exhibit nothing but nakedness, and heaps of gravel and mud. We diggers are horribly destructive of the picturesque.

Journal of Stanley Leighton, National Library, ms 360. pp. 30–32—at William Robertson's property near Colac, early 1860s.

The successful introduction of the rabbit in Australia is attributed to Thomas Austin on his property, Barwon Park, near Geelong in Victoria, in 1859. Austin was a "sportsman," and his principal motive was to provide game for his shoots, but he was probably also attracted by nostalgia for having rabbits hopping around the fields as they did in Britain. Within a short time, his neighbors were cursing his success, and within a couple of decades, property owners across much of the continent would be having unpleasant thoughts toward him.

Not long ago a neighbouring landowner Mr Austen [sic] introduced rabbits on his property 30 miles off. Mr Austen found a profitable market in Ballarat and Melbourne for his rabbits and had thousands in his warren. About two years ago these strangers spreading themselves over the country reached Mr Robertson's station. At first the newcomers, while as yet few in numbers, were rather encouraged, and in a little time they took possession of the holes of the wombats; these animals make large burrows through the soft rock and carry their excavations far and wide underneath; they have something of the habits of the badger, in size and appearance they are not unlike a little pig, they are scarcely ever seen out of their holes in daylight. Once installed in such strongholds the rabbits began to increase so rapidly that it became a question whether they or the cattle should remain masters of the herbage—Mr Robertson threw himself into battle on the side of the herds and gathered together a little army of 50 men whom I saw hard at work filling up the wombat holes with stones and covering over the top with soil and smothering the inhabitants wholesale. This was the only course left open for the burrows defied digging and blasting had been tried in vain. We assisted in the destruction of rabbits by going out shooting them. William Robertson the son provided us with two guns one of which was a breach loader and we went off for the day taking luncheon with us, some excellent patie de foi gras and bottled beer I remember were in the luncheon basket. We killed 25 rabbits but we only brought home 6. The rest seemed not worth the trouble of carrying in a place where rabbits were so plentiful. At certain

times of the year the paddocks here are full of quail, as many as 90 couple were shot here in one day by 4 guns last year.

Lady (Mary Ann) Barker, *Station Life in New Zealand,* Macmillan, 1870, pp. 144–145.

Lady Barker and her husband arrived in New Zealand in 1865 and bought a sheep run on the Selwyn River on the South Island, but it was ruined by a severe snowstorm in 1867 and sold. In 1870, Lady Barker published the letters she had sent home to her young sister. This extract exhibits some of the joy she obtained from the common New Zealand practice of using fire to clear the land.

If the weather has been very dry for some time and the wind is high, we attempt to burn a great flax swamp, perhaps, in some of the flats. This makes a magnificent bonfire when once it is fairly started, but it is more difficult to light in the first instance, as you have to collect the dead flax-leaves and make a little fire of them under the big green bush in order to coax it to blaze up: But it crackles splendidly; indeed it sounds as if small explosions were going on sometimes. But another disadvantage of burning a swamp is, that there are deep holes every yard or two, into which I always tumble in my excitement, or in getting out of the way of a flax-bush which has flared up just at the wrong moment, and is threatening to set me on fire also. These holes are quite full of water in the winter, but now they contain just enough thin mud to come in over the tops of my boots; so I do not like stepping into one every moment. We start numerous wild ducks and swamp-hens, and perhaps a bittern or two, by these conflagrations. On the whole, I like burning the hill-sides better than the swamp—you get a more satisfactory blaze with less trouble; but I sigh over these degenerate days when the grass is kept short, and a third part of a run is burned regularly every spring, and long for the good old times of a dozen years ago, when the tussocks were six feet high. What a blaze they must have made! The immediate results of our expeditions are vast tracks of perfectly black and barren country, looking desolate and hideous to a degree hardly to be imagined; but after the first spring showers a beautiful tender green tint steals over the bare hill-sides, and by and by they are a mass of delicious young grass, and the especial favourite feeding-place of the ewes and lambs. The day after a good burn thousands of sea-gulls flock to the bare ground. Where they spring from I cannot tell, as I never see one at any other time, and their hoarse, incessant cry is the first sign you have of their arrival. They hover over the ground, every moment darting down for some insect. They cannot find much else but roasted lizards and grasshoppers, for I have never seen a caterpillar in New Zealand.

Edward Wilson, *Acclimatisation: Read before the Royal Colonial Institute,* London, 1875, pp. 2–3, 17–18, and 19–20.

Edward Wilson was one of the leaders of the acclimatization movement in Victoria. In this 1875 address, he encapsulated the common nineteenth century belief that God had created the world and all its species for man, and it was man's right and duty to im-

prove the world by moving species to where they would be most useful and pleasing, and removing those that were considered a nuisance. Such anthropocentric attitudes were also representative of the contemporary ignorance of ecosystems.

It seems a singular fact that in the complete furnishing of the earth, so much has been left for us to do. A bountiful Providence has showered upon mankind a profusion of good things, but whether from wanton disregard, from a lazy want of observation, or from whatever other cause, there seems to have been a singular negligence in the use of opportunities of distributing them. It seems as if the task had been left to us of conveying suitable things from one place to another, and we have been contented to perform this task in a very perfunctory and hap-hazard way. . . .

Much has undoubtedly been done in the acclimatisation or distribution of useful things, but what has been done seems to be almost trivial in comparison with the possibilities: And I have long argued that what has been done, whether by private enterprise or by public effort, is a mere fraction in the work that we have to do. I hold that this is the proper interpretation of the original command to man; "Be fruitful and multiply, and replenish the earth, and subdue it; and have dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moveth upon the earth." I consider that it is a waste of opportunity to have done so little, and that, having paved the way by opening up fresh countries by conquest or colonisation, the grand scheme of distribution should be elaborated scientifically, systematically, and exhaustively. I hold that we should never rest until every country on earth is duly furnished with every good thing which that country is capable of maintaining. . . ."

"Meantime, grave mistakes may easily be made, and we must always be on our guard against the accidental introduction, probably through the agency of some lurking parasite, or seed of noxious weed, of something which may perhaps creep in amongst more eligible associates. It has always been held that we owe the Bathurst Burr, which for a long time gave such trouble to our settlers in new South Wales, to seeds introduced originally in the manes and tails of horses from Valparaiso. We know what the thistle has done for us in Australia, and remember the aggressive yellow "Capeweed" which is establishing itself in many parts of the colonies. We have, of course, heard of the misdeeds of the sparrow and the rabbit; and while we are certain to introduce incidentally such things as the housefly and the bug, and our faithful companion the Norway rat, and other troublesome camp followers which hang on the track of civilised man, we ought to always be on our guard to minimise these evils as far as possible.

But in dealing with great work, we must not be deterred by craven fear of possible danger. . . . We hear of certain wealthy gentlemen in Victoria who have been committed to the expenditure of thousands a year in endeavours to keep down the rabbit. I recollect seeing a paragraph in the *Field* newspaper many years ago, intimating that the natural enemy of the rabbit was the black pole-cat, and that the introduction of a few specimens of that animal would save those thousands a year. And, perhaps, when so modifying natural action as we do by the prosecution of our special form of enterprise, we ought to accustom ourselves to look to natural modes. Nature has a wonderful faculty for balancing the

various forms of animated life with which she has to deal. If a bird becomes too numerous, a special hawk appears to have been sent to check it; and so throughout the piece."

"Perhaps among the legitimate functions of acclimatisation may be enumerated Eradication. In setting about so serious a task as that of remodelling the arrangements of Nature herself, we ought, I think, to assert our right to destroy some things for the purpose of smoothing the path of more valuable things. Many of my hearers will recollect the terrible ravages of the wild-dog in Australia, and the serious expense and anxiety consequent upon his almost ubiquitous existence there. We have stood upon very little ceremony with this rapacious rascal; and over hundreds of miles of country where he once roamed, not a single specimen is now ever seen. . . .

Eradication may appear a singular form of acclimatisation, but it is not the less necessary to clear the way for the introduction of a good thing by the removal of something not so good. And in venturing upon so serious a business as that modification of natural resources with which it seems to have been part of the great design of providence that we should be charged, one must be prepared to deal resolutely with an injurious thing, whenever its mischievousness becomes apparent.

A. J. Cutlack, "Four Years in Queensland and New South Wales," Rhodes House, Bodleian Library, mss Austr. r. 1, 1875, Chap. 5.

Augustus J. Cutlack was an Australian colonist of German descent who migrated to Queensland in about 1866 and became a mail carrier between Roma and Charleville. The long distances he spent alone on horseback in the outback enabled him to observe local fauna very closely.

The birds of Queensland are very numerous and there are a great many that I have not seen.

The Emu is the largest, some of them standing five feet, the skin of which makes a very pretty door mat when properly cured.

Then there are cockatoos—parrots of all sorts & sizes & colours laughing jackasses, doves pigeons, scrub turkey, scrub hens, wild ducks, and many others too numerous to mention some of them, beautiful plumage, all birds of show although much prized in England, yet are not worthy to be placed on the same level with the English songster that makes nature seem glad and reminds us, though small as they are, they too sing their song of thanksgiving to their Maker who does not allow one sparrow to fall to the ground with out his permission.

The laughing jackass is a very curious bird, at the same time a very useful bird it kills snakes, rats, mice in fact allows nothing to creep about, if within its sight, they will assemble in half dozens and so on at break of day to commence there [sic] laughing noise at noon and sunset & at intervals during the day. They are called the shepherd's clock, for the crowing of a cock in a farm yard is not to be depended on out here, as they crow every hour eleven o'clock at night, & dogs general [sic] join in the chorus in barking.

The wild dog or *Dingo* has now assumed rather a formidable enemy to the station owners as they worry the sheep, pigs etc. & generally poisoned with "baits" set for them

in the shape of poisoned meat laid about the station. They have been known to follow a man on horseback for nearly ten miles, also to steal the meat from a bucket under a camp bed of a night.

Snakes are plentiful & beautiful, from the great Carpet Snake down to the little Whip-snake, But I sooner be bit by a *carpet* than a *whip* for the reason the great Carpet snake is not so venomous as the whip. But as a rule snakes are as frightened of you as you are of them, the black & brown snakes are the reptiles I cannot bear to meet with, for if there is now no water near, they are apt to give chase, & they can travel.

Centipedes are rather a species of reptile to be feared they are very like a caterpillar with scales on its back, sometimes blueish green & others yellow those of a blueish green are the most dangerous—sometimes measuring seven to ten inches in length & half an inch in breadth. but the yellow kind are in general much longer. I have killed them as long as sixteen inches, & a foot long under my bed . . . [etc. re other insects—bloodsuckers, spiders, adders, etc].

Alligators are found in the creeks & rivers in the North & it is a common occurrence to see an alligator lay basking in the full glare of a tropical blazing sun. Occasionally his mouth will open & then shut with a peculiar chop-chop, they prefer dogs, in the shape of food to anything else. although I do not think that anything goes amiss with, for should you be walking by the waterside you cannot tell at what moment an alligator of delicate proportions will seize hold of your legs, but should you have a dog with you he will make his way to the dog & snap him up like a strawberry I dare say you wonder that the dog does not run, but no the alligator fixes his eye on the dog, the poor brute is cowered & mesmerised to that extent that it is motionless whilst the Alligator is in *action* making the best of his way towards the dog.

Opossum or as they are commonly called "possum," is a pretty little animal, something like a cat & great fun I have had too whilst shooting which is [done] on moonlight nights. Winter time is the best time to shoot possums as the fur is much thicker.

The wild-cat is amongst the prettiest of all the animals especially the ringtail striped white tortoiseshell species, but so spiteful.

Kangaroo, the King of the Australian wilds, is a curious looking animal, so is the rock-wallaby, bandicoots etc. most of them belonging to the same family.

The native bear is an ugly little brute, making a hoarse croaking noise when disturbed if caught young can be tamed to a certain extent they do not care for confinement & whenever they get loose they are off to their native haunts of pleasure. They are very vindictive & revengeful their food is the leaves of the gum tree.

A. C. Grant, *Bush-life in Queensland,* or, John West's Colonial Experiences, new edit, Edinburgh, 1882, pp. 53–54.

A. C. Grant spent time in Queensland beginning from the 1850s and later published recollections of his experiences in the pastoral industry. As that industry spread across Australia, especially into more arid regions, there was great the concern about attacks on stock by dingoes. The result was an enormous investment of time and money—not

to mention poison and bullets—to eradicate them from the landscape. The impact that the spreading of poison across the country had on other fauna was not recorded.

The conversation now turned on *dingoes,* the Australian name for the wild dogs so destructive to sheep. They were . . . neither more nor less than wolves, but more cowardly and not so ferocious, seldom going in large packs. They hunted kangaroos when in numbers, or driven to it by hunger; but usually preferred smaller and more easily obtained prey, as rats, bandicoots, and possums. Many were run down by men on horseback for the sake of the sport,—the horseman undoing his stirrup-leather, and slipping the iron to the extreme end, knocked out the brains of the animal as he galloped past. Some were caught in traps made of gigantic hollow logs, with hanging doors fitted to them, after the common mouse-trap fashion; but most are destroyed by poison.

Each man on a sheep-station carries, or should carry, strychnine, in order to poison the carcass of any dead animal he may chance to find on his wanderings through the bush; also a pouch attached to his saddle, containing small pieces of meat already poisoned, each bait wrapped in paper. These dingoes break into a fold of sheep at night, and often bite and kill scores of them, generally endeavouring to tear out the liver. Their bite is poisonous in a great measure, and very difficult to heal.

Anthony Trollope, *Australia and New Zealand,* first published London 1873, Vol. II, pp. 322–324.

English writer Anthony Trollope spent a year in the Australian colonies and New Zealand in 1871 to 1872. He was struck by the British character of colonial settlement and of the landscape in New Zealand, especially in the South Island. By contrast, Australian nature was remarkable for its peculiarities.

I can hardly explain how it is that Invercargill, and indeed all New Zealand towns, are more like England, than are the towns of Australia;—but so it is. When one gets into the country the reasons for this are apparent. The everlasting gum forests do not belong to New Zealand, and the trees which are indigenous to the soil are brighter in hue than the dull-coloured foliage of the eucalyptus tribe. And "the bush," at any rate in the Southern,—or so-called Middle,—Island is not sempiternal, as it is over so vast a proportion of Australia. At first it struck me that there was an absence of timber, and in some places I found the fuel was terribly expensive, in consequence of the distances over which wood had to be carried. Again, no animal is now seen in New Zealand different from those which are familiar to us in England. There is, I believe, a rat in the country whose ancestors are said to have existed there previous to the coming of the English,—though some naturalists cast doubt even upon the rat,—but there is no other four-footed animal that has not been imported and acclimatized. There are few native birds, but those which are commonly seen are to the eye in no way different from English birds. The moas have left their skeletons, which are to be seen standing in the museum at Christchurch from 11 to 13 feet high,—but the last moa died some say more than 1,000 years ago, while others contend that they existed down to the coming of the Maoris, who

are supposed to have eaten the last of them not more than 250 years since. In Australia there is a whole class of animals very strange to British eyes, kangaroos, wallibies [sic], and paddymelons running about on their hind legs, and carrying their young in their pouches;—and there are parrots and cockatoos, laughing jackasses, and native-companions, lyre-birds, and bell-birds,—all of which savour of a strange land. But I found nothing strange in the province of Otago. All English animals have not only acclimatized themselves, but seem to thrive with a prolific increase beyond that which we know at home. The hens lay more eggs, the bees swarm more frequently, the rabbits breed more quickly,—the ewes are more certain with their lambs than they are with us. This is, no doubt, the case in Australia also,—but then in Australia there is an animal life of its own. In New Zealand everything is English. The scenery, the colour and general appearance of the waters, and the shape of the hills, are altogether un-Australian, and very like to that with which we are familiar in the west of Ireland and the highlands of Scotland. The mountains are brown and sharp and serrated, the rivers are bright and rapid, and the lakes are deep, and blue, and bosomed among the mountains. If a long-sleeping Briton could be awaked, and set down among the Southland hills, and told that he was travelling in Galway or Cork, or in the west of Ross, he might be easily deceived, though he knew the nature of those counties well,—but he would feel at once that he was being hoaxed if he were told in any part of Australia that he was travelling among Irish or British scenery.

Alfred Deakin introducing the 1886 Water Supply and Irrigation Bill, *Victorian Parliamentary Debates,* Vol. 51, pp. 443–437, 24 June 1886.

Alfred Deakin was a dynamic young Victorian politician and Minister in the 1880s who, in the early twentieth century, served as the Australian Prime Minister. In the 1880s, he took up the cause of irrigation and was responsible for Victorian legislation that led the way in irrigation in Australia. As he and others saw it, Australia did not have an absolute water shortage, but rather a maldistribution. Water was in the wrong place at the wrong time, a fault that could be rectified by storing it and then distributing it when required, thereby making the deserts bloom. This was part of his speech when introducing the legislation.

I think this House has had quite sufficient evidence in its time of the results of irrigation. . . . I will only refer the honorable member to a series of papers which have been published from time to time by the able and energetic president of the Central Irrigation League, the Rev E. C. De Garis, who has done a great deal indeed to popularize the most important facts with regard to irrigation, and who has done a great deal more by educating the farmers of the dry districts in his neighbourhood to organize so as to reap its benefits. He has shown, by specific illustrations in his own district, that, whereas unirrigated land produced only 3 bushels to the acre, irrigated land produced 20 bushels. In another case the produce was 20 bushels as against 4 bushels on unirrigated land, and in a third case 19 bushels as against 4 bushels. . . .

I have also before me a perfect mass of information showing the effect of irrigation not only in Victoria but also in the few places where it has been practised in New South Wales and South Australia. [It shows that], whereas in the natural condition nearly 16 acres of country was required to keep a sheep, less than 1 $^{1}/_{2}$ acres was sufficient after only one-third of the land had undergone irrigation. I quote this case to show that the benefits of irrigation relate to stock as well as grain, and it can be shown, if necessary, that they relate to fruit as well as stock. Irrigation is of vital interest to the pastoral proprietor as well as to the selector who grows grain, or the man who cultivates fruit. . . .

I believe that we shall be able to show the people of South Australia that the proposal with regard to the utilization of the Murray waters, which has been agreed upon by the Water Commissions of New South Wales and Victoria, can be assented to by them without any fear of the consequences. I think that we will be able to show that it is perfectly possible for us to unite with them in utilizing those waters on the basis of friendship and amity to the lasting advantage of all three colonies. When we convince them of that, I trust we shall be able, this Session, to introduce a Bill which will enable the waters of the Murray to be utilized, and that enormous wealth of water to be diverted on the land near the river to the great profit of all the colonies concerned. . . .

[Victoria] is certain to reap an enormous benefit, and in the future when this colony forms part, as I hope it will, of a federated Australia that will be renowned, I trust, all round the world for the richness of its soil, the enterprise of its people, and the freedom of its government. I believe that in those days this small Victoria will be in many senses a greater garden than it is now. I believe that if we are able to seize our unparalleled natural advantages, as compared with the rest of Australia, even our small territory might bear a population that will compare with some of even the greatest of our neighbours. I believe that our agricultural production, by utilizing the water supply available for irrigation, may be made to compare favorably with that of the colony most favoured by nature. We shall have a large and prosperous population obtaining its wealth from the surest possible means, that is from the soil, delivered from the risks of the natural rainfall, not dependent upon the chances of clouds, but able to secure a shower when it is needed, and to apply just the necessary quantity of water to bring their products to the highest state of perfection so as to obtain the highest yield. Then, I say, if irrigation proves the success which we have every reason to hope it will, we shall compare in population as in wealth—as I hope we shall always continue to do in energy and enterprise—with any colony of the group, or any country of the world; and those who visit us then will, like the explorer who first penetrated to the heart of our great plains and grassy hills 30 or 40 years ago, be led to confess that if there is a spot meriting the proud title of Australia Felix it is the colony of Victoria.

J. A. Froude, *Oceana: Travellers' Tales of Early Australia and New Zealand,* 1886, pp. 23–24.

J. A. Froude was one of many British travelers and writers who, in the second half of the nineteenth century, visited the Australian colonies and New Zealand before sailing

across the Pacific to the United States. He was impressed with the many flourishing public gardens that the colonists nurtured with exotic species.

Whether it be the genius of the country, or some development of the sense of beauty from the general easiness of life, or the readiness of soil and climate to respond to exertion, certain it is that the public gardens in the Australian towns are the loveliest in the world, and that no cost is spared in securing the services of the most eminent horticulturists. The custodian at Adelaide, Dr Schomberg, has a worldwide reputation, and he is allowed free scope for his art. Ornament is more considered than profit, and flowers and flowering shrubs than fruit trees. He follows Goethe's rule in taking care of the beautiful, and leaving the useful to take care of itself. I was sorry to miss Dr Schomberg; we looked for him at his house, but he was absent. The gardens not being open to the public on Sundays till the afternoon, we had them to ourselves, and could wander at leisure. Trees from all parts of the world are gathered together in that one spot, of the rarest kinds. The flowers with which we are familiar as exotics in our forcing-houses luxuriate as in their natural home. The oleander towers and spreads in pale pink glory. The crimson hibiscus glows among the bananas; passion-flowers—blue, purple, and scarlet—hang in careless festoons among the branches. The air is loaded with perfume from datura, orange-flowers, stephanotis, and endless varieties of jessamine. Araucarias, acacia-trees, Norfolk Island pines, tulip-trees, &c., are dispersed over the lawns, grouped, not as science would order them, but as they would be arranged by a landscape painter. Avenues of dense evergreens, the Moreton-bay fig-tree conspicuous among them, invite you under their shade.

J. A. Froude, *Oceana: Travellers' Tales of Early Australia and New Zealand,* 1886, p. 53.

Froude was also impressed with the combined utilitarian and aesthetic accomplishment of the authorities in Ballarat in Victoria, in regards to the construction and beautification of their domestic water reservoir.

Drought is the worst enemy in Australia, but rain falls sufficient for all necessities, and only asks to be taken care of. In a gorge among some high hills the Ballarat municipality have made a reservoir as big as a large lake. The embankment across the neck of the valley is a fine piece of engineering work, and on our way back we made a circuit to see it. . . . The useful has created the beautiful. There is a sheet of water produced by a mere desire to prevent Nature's best gift from running to waste, which, with the pine-groves planted round its shore, will look as well as any other inland lake in future water-colour art exhibitions. We stopped for a few minutes at a roadside hotel, near the end of the embankment, to rest our horses. It was tidily kept and picturesquely situated. The little wicket gate was open. I strayed in and found myself in the garden of an English cottage, among cabbage-roses, pinks, sweet-williams, white phlox, columbines, white lilies and orange, syringas, laburnums, lilac. Beneath the railings were beds of violet and periwinkle, and on the wall a monthly rose was intertwining with jessamine and honeysuckle. The emigrants who had made their home there had brought with them seeds and cuttings from the old home. They were "singing the Lord's song in a strange land.

J. A. Froude, *Oceana: Travellers' Tales of Early Australia and New Zealand,* 1886, pp. 133–134.

In New Zealand, Froude was disturbed by the state of the cleared land and the waste of timber.

A track had to be cut with the axe for the road on which we were travelling, permission being purchased from the Maoris to whom the wood belongs. Thirty feet or so had been cleared on either side of the carriage-way, to let in air and light. And the vast trunks lay stretched as they had fallen, one upon another, thousands and tens of thousands of tons of the finest timber left to rot. Nay, not even to rot, for they had set them on fire where they could, and the flames spreading to the forest had seized the trees which were nearest, and there they were standing scorched, blackened, and leafless. We went through absolutely twenty miles of this. Such wanton and lavish destruction I must have seen to have believed. . . . It was really painful to look at, and it was a relief when we emerged into open land and sunshine. There are unnumbered pheasants in these woods.

J. A. Froude, *Oceana: Travellers' Tales of Early Australia and New Zealand,* 1886, pp. 144ff.

Among the grandest sites in nineteenth century New Zealand were Lake Rotomahana and the sparkling pink and white terraces near Rotorua, strange and ancient geological formations associated with thermal water activity in the region. They were a great attraction for visitors, and one of the earliest sites to be reserved for their scenic beauty. They were destroyed in a cataclysmic volcanic explosion in June 1886, soon after Froude's visit.

We took off our boots and stockings, put on canvas shoes which a wetting would not spoil, and followed our two guides through the bush, waiting for what fate had in store for us. . . . After a winding walk of half a mile we came again on the river, which was rushing deep and swift through reeds and Ti-tree. A rickety canoe was waiting there, in which we crossed, climbed up a bank, and stretched before us we saw the White Terrace in all its strangeness; a crystal staircase, glittering and stainless as if it were ice, spreading out like an open fan from a point above us on the hillside, and projecting at the bottom into a lake, where it was perhaps two hundred yards wide. The summit was concealed behind the volumes of steam rising out of the boiling fountain, from which the siliceous stream proceeded. The stairs were about twenty in number, the height of each being six or seven feet. The floors dividing them were horizontal, as if laid out with a spirit-level. They were uneven breadth; twenty, thirty, fifty feet, or even more; each step down being always perpendicular, and all forming arcs or a circle of which the crater was the centre. On reaching the lake the silica flowed away into the water, where it lay in a sheet half-submerged, like ice at the beginning of a thaw. There was nothing in the fall of the ground to account for the regularity of shape. A crater has been opened through the rock a hundred and twenty feet above the lake. The water, which comes up boiling

The stunning pink terraces on Lake Rotomahana in New Zealand were one of the country's great tourist sites until destroyed by a massive volcanic explosion in 1886. (Alexander Turnbull Library)

from below, is charged as heavily as it will bear with silicic acid. The silica crystallises as it is exposed to the air. The water continued to flow over the hardened surface, continually adding a fresh coating to the deposits already laid down; and, for reasons which men of science can no doubt supply, the crystals take the form which I have described. The process is a rapid one; a piece of newspaper left behind by a recent visitor was already stiff as the starched collar of a shirt. Tourists ambitious of immortality had pencilled their names and the date of their visit on the white surface over which the stream was running. Some of these inscriptions were six and seven years old, yet the strokes were as fresh as on the day they were made, being protected by the film of glass which was instantly drawn over them. . . .

The Pink Terrace, the object of our voyage, opened out before us on the opposite shore. It was formed on the same lines as the other, save that it was narrower, and was flushed with pale-rose colour. Oxide of iron is said to be the cause, but there is probably something besides. The water has not, I believe, been completely analysed. . . . At the foot of each cascade the water lay in pools of ultra marine, their exquisite colour being due in part, I suppose, to the light of the sky refracted upwards from the bottom. In the deepest of these we were to bathe. . . . The crater at the White Terrace had been boiling; the steam rushing out from it had filled the air with cloud; and the scorching heat had kept us at a distance. Here the temperature was twenty degrees lower; there was still

vapour hovering over the surface, but it was lighter and more transparent, and a soft breeze now and then blew it completely aside. We could stand on the brim and gaze as through an opening in the earth into an azure infinity beyond. Down and down, and fainter and softer as they receded, the white crystals projected from the rocky walls over the abyss, till they seemed to dissolve not into darkness but into light. The hue of the water was something which I had never seen, and shall never again see on this side of eternity. Not the violet, not the hare-bell, nearest in its tint to heaven of all nature's flowers; not turquoise, not sapphire, not the unfathomable aether itself could convey to one who had not looked on it a sense of that supernatural loveliness. Comparison could only soil such inimitable purity. The only colour I ever saw in the sky or on the earth in the least resembling the aspect of this extraordinary pool was the flame of burning sulphur. Here was a bath, if mortal flesh could have borne to dive into it! It was a bath for the gods and not for man.

***Hobart Mercury,* 27 August 1887, cited in Robert Paddle, *The Last Tasmanian Tiger: The History and Extinction of the Thylacine,* Cambridge University Press, 2000, p. 160.**

John Lyne, a pastoralist and member of the Tasmanian parliament, conducted a campaign against the Tasmanian tiger or wolf (Thylacine), seeking to have a bounty placed on its head. As in this parliamentary debate, he greatly exaggerated the depredations of the animal, but so strong was the prejudice that he was successful, the bounty was imposed, and the extinction of the thylacine was probably only a matter of time.

Mr. LYNE said his patience had been sorely tried to sit and hear the remarks of hon. Members on the motion. He could state from his own experience what devastation tigers caused. He rented 2,000 acres of Crown lands upon which he had not been able to put one single sheep for the past five months in consequence of the ravages of the tigers. In his district the sheepowners paid £3 per head for all tigers that were killed there, and each of them had to keep a huntsman for the express purpose of killing these animals. On the Malahide estate Mr. Rigney had been paid 25s. a head for them during the last five years, and had paid for 50 of them. The fact remained that there were 700,000 sheep less in the colony than there should be, and the tigers had a great deal to do in causing this loss to the country. He had followed the matter up very consistently, and he hoped the House would grant him his committee.

William Allen, *The Centennial Cantata,* Melbourne, 1888, University of Melbourne Archives.

These lyrics were written for a cantata first performed at the inauguration of the Centennial International Exhibition in Melbourne. They contained expressions of faith in Australia's future now that British colonizers had arrived, shattered its solitude and wilderness, and were turning the land to production. The attitudes towards the Aborigines are a good example of the justification given by the British for occupying the land and displacing the indigenous people.

PART II—AUSTRALIA'S SOLITARY PAST

The reign of solitude; o'er vale and hill;
Broad-breasted lake; deep river; leaping rill
O'er stony wastes of stillness, seldom stirred
By whirr of wing, or note of passing bird;
Or speech barbaric; from whose face austere
The shudd'ring savage turns in speechless fear;
Where fainting nature sinks and swoons away,
Smit by the summer sun's unkindliest ray;
O'er ferny haunts, whose mossy hollows, deep,
The livelong year their fadeless beauty keep;
O'er the primeval forest depths profound,
Wherein is heard the wild-bird's joyous sound;
O'er leagues of wrathful waves, with sullen roar,
Tumultuous thundering on the rock-bound shore:
O'er all perpetual solitude doth brood,
Save where the savage stalks in search of food:
A land by civilization's step untrod-
Alone with Nature, and with Nature's God.

PART III—FIRST STAGE IN THE NATIONAL HISTORY: THE SOLITUDE INVADED BY THE PASTORAL PIONEERS

Honour the Pioneers.
Stout of heart and strong of frame,
Sturdy sons of Britain came;
Grappling hard with natural powers,
Turned the wilderness into flowers;
Taught the sometime barren field
Nature's kindly fruits to yield;
Now on lawny spaces green,
Chestnut-spotted kine are seen,
With the horse and patient ox,
And the fleecy-covered flocks.
Cheerful human speech is heard,
Mingling with the song of bird,
And the inharmonious call
Of the tameless warrigal.
Stout of heart and strong of frame,

Worthy of their British name;
These the men that set the tree
Of Australian liberty.
Honour the Pioneers.

PART V—THE PRESENT AND THE FUTURE

Where the warrigal whimpered and bayed,
Where the feet of the dark hunter strayed,
See the wealth of the world is arrayed.
Where the spotted snake crawled by the stream,
See the spires of a great city gleam.
Is it all but the dream of a dream?
And the halls of our domed palace fair,
And the wealth of the world that is there,
Are they nought? Are they fashioned of air?
Not a dream! For the night is away,
And we walk in the light of a day
That shall not be extinguished for aye.

D. W. Carnegie, *Spinifex and Sand,* London 1898, pp. 131–133.

Water shortage on Western Australian goldfields in the 1890s required unorthodox mining methods and ingenuity.

In countries blessed with abundant rainfall the nuggets can be separated from the dirt by a comparatively simple arrangement of sluices and cradles. In the drought-stricken west of Australia other means must be adopted, which I will endeavour to describe.

Having picked and dug out a certain amount of alluvial ground which, it is hoped, contains nuggets of various sizes, the digger then breaks up any lumps of clay or earth by means of a heavy billet of wood, or like implement, and this prepared dirt, as it is called, he treats in one of the following ways:

1. By means of two iron dishes, in diameter 15 to 18 inches, and in depth 4 to 5 inches.

One dish is placed empty on the ground, the other, filled with the prepared dirt, is held up at arm's length above the head, with the mouth of the dish turned to the wind; the earth is then allowed to fall gradually into the dish beneath, all light particles and dust being blown away by the wind. Exchange of dishes having been made, the same process is repeated again and again. When there is only a small amount of dust left, the full dish is held in both hands, and given a circular movement, which causes the larger stones and pebbles to come to the surface; these are cleared away with the left hand, and a sharp look is kept out for nuggets of quartz specimens. This is repeated until nothing is left in the dish but a small quantity of dust, ironstone-gravel, and possibly fine gold, or

On the arid Western Australian goldfields there was often no water for washing pay dirt, so various dry-blowing systems were devised. (E. J. Brady, Australia Unlimited, Melbourne, 1918, p. 730)

small nuggets. The dish is then held up at an angle, and shaken from side to side until a compact little heap remains, to the bottom of which the gold will have sunk. The next and final operation is to hold the dish up to the mouth nearly horizontally, and blow the little heap across the dish. Any fine gold will then be seen lying on the bottom just under the nose of the operator.

Given a good hot summer's day, flies as numerous as the water is scanty, clouds of dust, little or no breeze, and the same quantity of gold, and a few score of men working within an area of nine or ten acres, one is sometimes tempted to think that gold may be bought too dear. But the very lowest depths of despair, cannot compare with the heights of satisfaction, attained after a successful day's dry-blowing.

2. By means of two dishes, and a tripod stand and pulley.

A tripod, twelve or fifteen feet high, is set up over a hard and smooth piece of ground. By a rope and a pulley the full dish is hauled up as far as required; the rope is then made fast and a string, fixed to the edge of the dish, is pulled, and the dish tipped up allowing the dirt to fall on to the prepared surface below, where it is swept up and treated as in the first method described. With a fair breeze this is a very effectual way of getting rid of the fine dirt.

3. By means of a sieve.

This method is only suitable when the soil is wet and sticky, or when the nuggets are fairly large and are not too rare.

H. H. Scott, letter to Oldfield Thomas, British Museum (Natural History), 3 Aug 1901, cited in Robert Paddle, *The Last Tasmanian Tiger: The History and Extinction of the Thylacine,* Cambridge University Press, 2000, pp. 168–169.

By the start of the twentieth century, the Tasmanian tiger was already becoming rare and therefore increasingly valued by collectors and museums. However, the bounty on its head made it attractive to farmers who would kill any animals they found, and the Thylacine was all but extinct in the mid-1930s.

The Government years ago put a price upon their heads . . . this has thinned them down, & good specimens are rare and not easy to obtain. . . . If a man kills an animal in the back blocks he has only to chop its head off & claim 20/- reward, this does not spoil the skin for certain markets, & if he cares to bother with it he can get another 20/- that way, which is far more easy than lugging the animal for some miles to a railway station in the hope of sending it to a museum, & asking more.

Blanche Baughan, "A Bush Section," c. 1907.

Blanche Baughan was English-born and migrated to New Zealand in 1900 at the age of twenty. This poem is widely renowned for its sense of loss at the clearing and burning of vast areas of the New Zealand forest, but also the sense of pioneering hope of creating a better future out of the desolation. The following is only about a third of the poem.

Logs, at the door, by the fence; logs, broadcast over the paddock;
Sprawling in motionless thousands away down the green of the gully,
Logs, grey-black. And the opposite rampart of ridges
Bristles against the sky, all the tawny, tumultuous landscape
Is stuck, and prickled, and spiked with the standing black and grey splinters,
Strewn, all over its hollows and hills, with the long, prone, grey-black logs.
For along the paddock, and down the gully,
Over the multitudinous ridges,
Through valley and spur,
Fire has been!

Ay, the Fire went through and the Bush has departed,
The green Bush departed, green Clearing is not yet come.
'Tis a silent, skeleton world;
Dead, and not yet re-born,
Made, unmade, and scarcely as yet in the making;
Ruin'd, forlorn, and blank.
At the little raw farm on the edge of the desolate hillside,
Perch'd on the brink, overlooking the desolate valley,
To-night, now the milking is finish'd, and all the calves fed,
The kindling all split, and the dishes all wash'd after supper:
Thorold von Reeden, the last of a long line of nobles,
Little "Thor Rayden," the twice-orphan'd son of a drunkard,
Dependent on strangers, the taciturn, grave ten-year-old,
Stands and looks from the garden of cabbage and larkspur, looks over
The one little stump-spotted rye-patch, so gratefully green,
Out, on this desert of logs, on this dead disconsolate ocean
Of billows arrested, of currents stay'd, that never awake and flow.
Day after day,
The hills stand out on the sky,
The splinters stand on the hills,
In the paddock the logs lie prone.
The prone logs never arise,
The erect ones never grow green,
Leaves never rustle, the birds went away with the Bush,
There is no change, nothing stirs!
And to-night there is no change;
All is mute, monotonous, stark;
In the whole wide sweep round the low little hut of the settler
No life to be seen; nothing stirs.
Yet, see! Past the cow-bails,
Down, deep in the gully,
What glimmers? What silver
Streaks the grey dusk?
'Tis the River, the River!
Ah, gladly Thor thinks of the River,
His playmate, his comrade,
Down there all day, All the long day, betwixt lumber and cumber,
Sparkling and singing;
Lively glancing, adventurously speeding,
Busy and bright as a needle in knitting
Running in, running out, running over and under
The logs that bridge it, the logs that block it,

The logs that helplessly trail in its waters,
The jamm'd-up jetsam, the rooted snags . . .
Yea, spark of Life!
Begotten, begetter, of changes:
Yea, morn of man,
Creature design'd to create:
Offspring of elements all, appointed their captain and ruler:
Here dawning, here sent
To this thy disconsolate kingdom –
What change, O Changer! Wilt thou devise and decree?
Hail to they god-ship, O Thor! Good luck to the Arm with the Hammer!
Good luck to that little right arm!
Green bush to the Moa, Burnt Bush to the resolute Settler!
In strenuous years ahead,
Wilt thou wield the axe of the Fire?
Wilt thou harness the horse of the Wind?
Shall not the Sun with his strong hands serve thee, and the tender hands of the Rain?
Daytime and Night spring in turn to thy battle,
Time and Decay run in yoke to thy plough,
And Earth, from the sleep of her sorrow
Waked at thy will, with an eager delight rise, re-quicken'd, and heartily help thee?
—Till the charr'd logs vanish away;
Till the wounds of the land are whole;
Till the skeleton valleys and hills
With greenness and growing, with multiplied being and movement,
Changeful, living, rejoice!

T. Sedgwick, article in *Sydney Morning Herald,* cited in E. J. Brady, *Australia Unlimited,* Melbourne, 1918, p. 121.

E. J. Brady's book exhibited unbounded faith in Australia's future once its deserts were made productive by British/Australian ingenuity. Australians have a long history of deferring to the opinions of overseas visitors, and Brady was only too happy to cite T. Sedgwick.

Australia has been made what she is by a million immigrants and their descendants. The land was always here, but during the last century the presence of population has made her worth two thousand million pounds, whereas formerly she was worth nothing. Were the horizon clear we could afford to wait patiently until the present population had multiplied and covered her vast areas, but population elsewhere is moving and increasing at infinitely greater ratios than are the people of the Commonwealth.

Encouraging immigration from Great Britain would go far to helping the motherland and her people, who suffer from the effects of an overcrowded labour market, and all its attendant evils. Increased migration to Australia would increase the food supply at home, multiply the demand for her exports, even after allowing for the effects of the new Customs tariff, and reduce the number of workers. It would give older people a chance to get employment in situations now filled by boys and girls, and release to the great relief of the rates, some thousands of workers who are now kept in the workhouse because their proper situations are filled by better men and lads who would migrate if they could find the fare. There is work for all, and there are plenty of defenders when the population of the Empire is properly distributed.

E. J. Brady, *Australia Unlimited,* Melbourne, 1918, p. 37.

A critical element in Brady's thinking was that the sands and soils of Australia's arid regions were highly fertile and needed only the application of water, potentially from the Great Artesian Basin, to make the deserts bloom with fruit trees and other crops.

Very early in the country's history there grew up a stereotyped conception of the interior as a dry and waterless desert, composed for the most part of shifting sands, scorched by everlasting suns and swept by constant hot winds.

Book after book has been written perpetuating this fallacy, which has become so firmly rooted in people's minds that it will probably be another two or three generations before it is finally consigned to the limbo of ancient fallacies. It is doubtful that there are a hundred square miles of true desert within the whole area of the Australian Continent, and it is now an established fact that millions of acres, once regarded as useless for agricultural purposes, are among the most fertile and productive lands in the world.

Ignorance and prejudice, at home and abroad, have militated very greatly against settlement.

E. J. Brady, *Australia Unlimited,* Melbourne, 1918, p. 634.

Brady saw only "progress" in the clearance of the mallee country of South Australia and Victoria. He also had a capacity to read into the environment what he wanted to see, rather than what was there, as he demonstrated in this description of the soils and dust in the Pinnaroo area in South Australia.

The train moves on again in a leisurely way through more virgin Mallee and fresh clearing. The light-coloured soils have given place to red. At all the sidings there are trucks—full of knotted Mallee roots—waiting to be taken away. Thousands of tons of these roots have been removed from the wheat fields—after the cleaning and burning is finished—and sold. They have a high calorific value, and bring the settler locally 10/6 a ton. The clearing of the Mallee is a simple and inexpensive business. The scrub is first rolled down with a traction engine, hauling an old tubular boiler (for choice) behind it. This or some heavy object is used to iron the scrub out flat; after which it is burned off and the roots removed in time. . . .

The Mallee soil gets better and firmer after it has been worked. . . .

A fine red dust works its way into the railway carriages—the dust of the desert, rich with the fertility of untold ages . . . . The good old Australian "desert" only waited to be tickled and it laughed—into baker's loaves.

Herbert Guthrie-Smith, *Tutira: The Story of a New Zealand Sheep Station,* 1921, pp. 236, 239–240, and 361–362.

Herbert Guthrie-Smith's perceptive account of the environmental changes on his pastoral property, Tutira, in the Hawkes Bay region of New Zealand's North Island, has become recognized as a classic expression of sensitivity and understanding of the natural world and the changes brought by British occupation.

We think of the colonisation by England of the temperate regions of the globe as for the benefit of her citizens alone, their domesticated animals, their domesticated plants. The scores of tribes of smaller living things are overlooked by those whose desire to multiply, whose lust for land, is quite as keen as that of man himself. . . .

Tutira homestead, photographed in about 1939. (Making New Zealand Collection, Turnbull Library)

In the wake of our sailors, explorers, soldiers, and pioneers, they steal unnoticed, unobserved. The proverbial sun that never sets on the flag, never sets on the chickweed, groundsel, dandelion, and veronicas that grow in every British garden and on every British garden-path. . . .

Following its destruction through man's agency by fire and stock, a huge area of virgin soil was, to use a New Zealand political term, "thrown open to selection." Upon the decline of the tyranny of ubiquitous, a host of ancient and eager rivals rushed upon the soil. With the assistance and assent of stock the ground was seized, not only by indigenous plants, whom we may imagine to have been for centuries eagerly waiting for expansion and jealous of their hungry foe, but aliens brought from thousands of miles—from Europe, Asia, Australia and America; from, in fact, the four quarters of the globe.

The annals of Tutira can be read in its weeds. Each phase in the improvement, each stage in the development of the run, has been marked by the arrival and establishment of aliens particularly fitted for the particular condition. Each of the main periods in the history of the station has produced an especial flora.

In the sixties, when Maoris were still in occupation of the run, its acclimatised species consisted of a grass or two, such as rye (*Lolium perenne*), a few purposely planted edible fruits—cape gooseberry (*Physalis peruviana*), peach and potato—a few pot herbs, such as mint (*Mentha spicata*) and thyme (*Thymus vulgaris*).

In the seventies stocking was attempted. That period was marked by the establishment of plants carried up in the body of man, as blackberry; in the stomachs of stock, as members of the clover family; in the wool of sheep, as Australian bur (*Acaena ovina*).

During the eighties the house and wool-shed were built and a permanent homestead established. As if by magic, there appeared those plants which seem to be almost parasites to mankind—plantain (*Plantago major*), shepherd's purse (*Capsella bursa-pastoris*), annual meadow grass (*Poa annua*), chickweed (*Stellaria media*), groundsel (*Senecio vulgaris*), and others.

Later again, when surface-sowing commenced on a great scale, in the train of valuable fodder-plants purposely scattered abroad, numbers of weeds and inferior grasses, stowaways such as foxglove (*Digitalis purpurea*), vetch (*Vicia sativa*), hop-trefoil (*Trifolium campestre*), hair grass (*Aira caryophyllea*), and many more made their appearance.

When a greater degree of leisure made possible the care of a flower-garden, there reached Tutira one by one a multitude of those plants that seem habitually to consort with their more lovely relatives—white dead-nettle (*Lamium album*), common fumitory (*Fumara officinalis*), couch-grass (*Agropyron repens*), pimpernel (*Anagallis arvensis*), and a host of others. . . .

I verily believe that, were a menagerie to be established or a musical festival ordained on Tutira, plants corresponding to these forms of human activity and ingenuity would be forthcoming. Species possessing tastes in accord with the dust of cages, heaps of mixed dung, horse-flesh, and monkey-nuts, would follow the menagerie. Top-hats, violins, ground resin, old catgut, long hair, and broken piano-wire would doubtless likewise produce their specialised flora.

The policies of the Auckland Acclimatisation Society have been the chief centre of dispersion from which northern aliens have reached Tutira. . . .

In October of '82, a month, that is, after our arrival at Tutira, a small flight of sparrows rested for a brief space on the wood-heap, that inevitable adjunct of every primitive homestead in New Zealand. The species had reached the station neither by mountain-top, coast, or river-bed, but by road. They had followed—surely one of the most interesting treks in natural history—the highway of man through the very heart of the North Island.

Sparrows were imported and turned out by the Auckland Acclimatisation Society in '67. Two years later the Society reports: "Sparrows have increased largely, but seem reluctant to go far from home, though stragglers are occasionally met with." A few years later their migration must have begun, for in '76 they were suspected to be at Opepe on the Taupo road. In '77 we find the Hawke's Bay Acclimatisation Society requesting their Committee "to take any necessary steps for the destruction of sparrows said to be in the district," a request, by the way, about as futile as that of King Canute to the flowing tide . . . by '82 they were present at Tutira. In '84—that is only seven years after the Hawke's Bay Acclimatisation Society was dubious about the very presence of sparrows in the province—this same Society "viewed with considerable alarm the enormous spread of small birds, but took the opportunity of reminding the public that they were not responsible for the introduction of linnets, sparrows, and larks." In fifteen years, therefore, the sparrow had travelled nearly two hundred miles through an uninhabited waste, had invaded the settled portion of Hawke's Bay, and had even begun to follow up the tracks leading away from that district.

A chief reason for the choice of man's highway as his route of migration may be found in the sparrow's relation to and reliance on man. *Passer domesticus* is his name, and passer domesticus is his nature. Of all wild creatures that utilise our roads in New Zealand, none take advantage of them in so great a measure as the sparrow. He knows, perhaps instinctively, certainly through the experience of the older birds, that it is by the work of man's hands his race principally thrives; that it is man who provides for him shelter plantations, building sites, and food. The man-built road by which he moves is indeed in itself a provision house. There are to be found on its horse-droppings containing undigested oats, foodstuff thrown down by travellers, wheat, barley, and grass seed fallen from sacks. On either side of its white sinuous line, so conspicuous from above, so markedly dissimilar to surrounding surfaces, extend tilled earth and land in crop. Like the bee-bird, which guides the hunter to the hive, the sparrow in striking and following up a road foreknows the benefits that will accrue to him. Maybe in the neighbourhood of townships, between village and village, the sight of the travelling sparrows is too common to excite remark; they are merely specimens of the most common bird in the country. On the far inland up-country roads of New Zealand, however, where ten or fifteen miles may intervene between homestead and homestead, travelling parties cannot but excite attention.

Willis T. Pope, *Manual of Wayside Plants of Hawaii,* Advertiser Publishing Co., Ltd, Honolulu, 1929, pp. 3 and 5–6.

In his 1929 study of plant species in lowland Hawai'i, Willis T. Pope sought to define and understand the problem of weed species facing the islands. He was frustrated by the lack of effective control on the importation of weed species and the likelihood that more would be added to the list of 83 "weeds" that he had already found on the lower reaches of the islands.

It is interesting to note that very few of the wayside plants are endemic, the major portion having migrated from other countries. Many of these plants may have economic value for forage, medicinal, ornamental or other uses. On account of certain detrimental qualities, a considerable number are commonly called "weeds." These are not only serious enemies of tillers of the soil but are menaces to many of our other activities. Plant life in general has always been of immense importance to mankind as a source of food, medicine, building material, clothing, etc. . . .

It is rather difficult to decide just what determines a weed. A commonly accepted definition, given in a popular weed bulletin, is as follows: "A weed is a wild plant that has the habit of intruding where it is not wanted." Some very useful plants often become undesirable, for example, a well known garden flower, Gaillardia, has escaped from cultivation and has become a serious pest and pasture on windward O'ahu. A portion of the plants discussed herein are not pests, but their habit, their size, nature of growth, habitat, etc, indicate the importance of including them. . . .

Many of the chief weed-pests have followed the advance of agriculture from the time of early civilization. They have established astonishing habits of re-seeding and maintaining themselves. When they gain entrance into a new country, they increase rapidly and tend to exterminate many of the native plants. Quarantine against weeds gaining entrance into a locality, state or territory from some outside source, is important and has been made effective. The amount saved to agriculture, as valued in money, is almost inestimable compared with the losses where no quarantine regulations have existed. It has only been within very recent years that a plant quarantine in reference to weeds has been partially effective in the Territory of Hawaii, by authority of Pure Seed Law, Act 107, Session laws, 1911, Territory of Hawaii. It is a good law but at this time, 1929, there is no provision for its operation.

W. K. Hancock, *Australia,* London, 1930, p. 30.

Keith Hancock was the first Australian historian to bring to his account of the Australian relationship with the land some of the understandings and perspectives of an environmental historian. This remarkable passage is from the first chapter of his 1930 history, equally surprisingly entitled "The Invasion of Australia."

The very soil has suffered from the ruthlessness of the invaders. The most precious possessions of Australia are her rivers, whose even flow is protected by the forests which stand around their mountain sources and the trees which line their banks. The invaders

hated trees. The early Governors forbad them to clear the river banks, but these prohibitions were soon forgotten, and in the second half of the nineteenth century tree murder by ring-barking devastated the country on a gigantic scale. Provided that it is used with restraint, ring-barking is a useful method of clearing the land; but the greed of the pioneers caused them to devastate hundreds of thousands of acres of forest-land which they could not hope to till or to graze effectively. To punish their folly the land brought forth for them bracken and poor scrub and other rubbish. They ruined valuable timber to make a few wretched farms, but that was not the end of their folly. Placid low-banked rivers frequently gave place to water-channels which in rainy weather whirl along useless muddy waters threatening to ruin good alluvial lands, and which in time of drought parch into hard, cracked mud. . . .

The advent of the white man with his ready-made civilization has violently disturbed the delicate balance of nature established for centuries in the most isolated of continents.

***Northam Advertiser,* 5 January 1935.**

Rabbits did untold damage to land and ecosystems across Australia until myxomatosis at last brought them under some degree of control in the 1950s. A group of travelers near Northam in Western Australia in 1935 observed their vast numbers.

Rabbits we saw in thousands, in hundreds of thousands! We had got some distance beyond the Buckland homestead when their numerousness forced itself upon our attention. And for miles and miles . . . it was the same. At times there would be anything from 20 to 50 squatting in the road immediately ahead, and at our approach they would start up and dart about in aimless fashion. For a space, it was as though we were driving them as sheep along the road until they would scurry into the fields, there to join the thousands of their brothers and sisters that dotted the land on either side.

Francis Ratcliffe, *Flying Fox and Drifting Sand: The Adventures of a Biologist in Australia* (with an introduction by Julian Huxley), Angus and Robertson, 1938, pp. 189–190.

Francis Ratcliffe was an English biologist and ecologist who came to Australia to undertake work for Australian institutions, fell in love with the country, and stayed. In his writings and his work he was a conservationist, and he was a founding member of the Australian Conservation Foundation. He was shocked by the soil degradation he encountered during the dust bowl years of the 1930s.

It is strange how one can live in complete ignorance of certain major events and phenomena, even though they may receive their due share of publicity. I am ashamed to say that until that talk over luncheon in an Adelaide hotel I was unaware of the phenomenon of soil erosion. Yet during recent years, when drought has struck almost every continent of the world, the process, usually slow and insidious, has moved with a speed so terrifying, and has demonstrated in so spectacular a fashion its power to turn fertile lands into unprofitable wastes, that erosion has become front-page news and the subject

of learned leaders in *The Times.* To the various distressed areas of the earth has been added the Dust Bowl of the American Middle West; while other regions, less spectacular in their deterioration (red rolling dust-clouds have a grandeur of their own), are going the way of those barren and denuded Chinese hills which once were clothed with a fertile and cultivated soil.

The hillsides were killed for man by water erosion, the washing-away of the surface soil by heavy rains after clearing and injudicious cultivation had destroyed the cover of vegetation which had protected and bound it. Wind, and not water, has made the Dust Bowl; but the same factors have been the root cause of the trouble—clearing and injudicious cultivation. Here the cultivation was injudicious because the soil was of the type which lost its cohesion when, ploughed and fallowed, it gradually dried out under the burning sun as month after month passed and no rain fell. When the wind rose the soil broke down and began to move. The finer particles were blown away as far-travelling dust, while the heavier sand drifted over the surface of the ground. This loose drift gave to the wind a biting edge, turning it, so to speak, into sandpaper, and greatly increasing its erosive power. This the destruction of the surface soil increased more and more rapidly. With every blow the flying dust grew thicker, and the sand drift piled higher against the fences and farm-houses. The crops failed, naturally. Farmers and their families (unabashed by press photographers) knelt in rows outside their homes and prayed for rain, which they thought would give them back the kindly and bounteous world they used to know. But the experts noted the changes in the soil, and realized that none of the present generation of farmers, and possibly none of their descendants either, would ever see that land recover all of the fertility that had been blown away.

The drift in the Australian arid pastoral country is a by-product of wind erosion, which differs from that in the prairie States of North America only in that the destruction of the vegetation which paved the way for it was due to causes other than clearing for the plough. What these causes were, it was apparently my task to determine.

Carl Markwith, "Farewell to Bikini," *The National Geographic Magazine,* July 1946.

Carl Markwith was a member of a film crew that was employed to record the removal of the people of Bikini Atoll to Rongerik Atoll prior to the detonation of the first Pacific nuclear test in July 1946.

About the middle of February, 1946, modern civilization suddenly overtook the natives of Bikini Atoll in the Ralik Chain of the Marshall Islands. . . .

Then the U.S. Navy decided that Bikini was the place to test the atomic bomb, and almost overnight the natives found themselves in the Atomic Age.

The first inkling the Bikinians had of this was the arrival of Commodore Ben H. Wyatt and his staff to gain their consent to the test and to arrange for their evacuation to safety on another island in the Marshall group. After much discussion, Jud arose and spoke for his people. He signified they would be happy to cooperate.

The arrival of the navy Hydrographic Office survey ships Sumner and Bowditch in Bikini lagoon a few days later inaugurated what is known as Operation Crossroads. Their

crews of scientists, naturalists, and engineers began surveys of the lagoon, catalogued and classified animal and vegetable life, and started clearing a channel to the beach for the landing and evacuation craft.

LST 1108 arrived and took about twenty of the native men to Rongerik, their future home, about 125 miles to the east. This group was paid by the Navy to help a detachment of Seabees [to] erect temporary tent housing and provide a water supply for the main body which was to follow. . . .

Bikini, as I first saw it from the air, was something to remember. I'd been seeing South Sea islands as they looked after both we and the Japs had had our innings—hot, dirty heaps of coral overrun with military installations, roaring with gasoline engines, reeking of Diesel oil, and almost completely treeless.

Bikini Island was a long, narrow crescent of gleaming sand, well grown with palms and other vegetation and framing one side of a lagoon of incredibly blue and green water. . . .

Several loads of dried palm and pandanus leaves for home building on Rongerik were followed by a ton or so of palm matting and a whole load of corrugated sheet iron salvaged from the rain-catching racks to be reused for the same purpose.

Moving went on until almost dark without fill more than a small part of the cavernous tank deck or greatly reducing the piles on the beach. . . .

As the ship turned to head out into the lagoon, the natives lined the port rail and began to sing a song of farewell. Until now, none of them had shown much emotion over leaving, but as the island dropped on the horizon their faces became very solemn, and some of the women sniffled when they thought no one could see them.

Shortly after breakfast on March 8 a shout went up on the foredeck, and the natives all crowded the rails to get a look at an island off the bow. It was the first of many small islands and reefs we passed as we crossed the lagoon towards Rongerik Island itself.

There was much excited chatter as we headed in towards Rongerik's beach. . . .

A few yards inland from the beach were the first of the wood-framed, plywood-floored tents erected by the advance party of natives and Seabees. Much of the thick brush had been cleared away, but there was still an enormous amount of work to be done before the site would be as attractive as the one at Bikini. . . .

Jimmie, our interpreter, who was to leave with us, had spread the word that we were departing and a sizable group of Bikinians—now Rongerikans—stopped their home building to see us off.

As good-byes were being called back and forth, I found myself wishing that I could say, as I had each time before, *Kim naj drol ilju*—"We shall return tomorrow." I refrained, because there would be no returning for me—nor perhaps for them. Civilization and the Atomic Age had come to Bikini, and they had been in the way.

Melbourne *Age*, 28 October 1969.

This editorial in the Melbourne Age *was written at the time of the Little Desert controversy in Victoria, which resulted when the government proposed to clear and subdivide*

a large area of arid bushland. The article demonstrates the strength of public sentiment and protest which was generated by the issue, the first time in Victoria that a conservation matter had generated such heat and had intruded on the political scene. The government of Sir Henry Bolte was eventually forced to back down.

SAVING THE BUSH

One of Sir Henry Bolte's more distressing misreadings of the public mind was his statement earlier this year that conservation was a minor issue. Evidence that large numbers of Victorians disagree with the Premier's scale of values has been mounting for months. The latest came at the weekend when 1500 people packed a St. Kilda theatre to attend a meeting organised by the Save Our Bushlands Action Committee. That was an impressive turnout for any public meeting—and those who attended were only a small fraction of the growing number of Victorians who are deeply concerned about the Government's passion for alienating Crown land and its begrudging attitude to conservation.

Everyone who attended Sunday's meeting was handed a copy of a proposed Bushlands Magna Carta. It is a document which deserves the widest possible distribution. It contains a crushing indictment of the State Government's record on conservation and states, for example, that all of Victoria's national parks together are not as big as one national park in Tasmania. It claims that New South Wales spent more on national parks last year than Victoria has spent in 10 years. Even if such bald statistics are somewhat misleading, the overall picture presented is thoroughly disturbing. It puts into sorry perspective the Government's recent proud boast that its proposed additions to the State's national parks would bring the total area to more that 500,000 acres, an increase of about 50 per cent in the past 10 years.

The Save Our Bushlands Action Committee may be asking too much when it calls for the greater part of Victoria's nine million acres of uncommitted Crown land to be reserved as parks and wildlife reserves. It is one thing to say that the alienation should not be indiscriminate, quite another to assume that it is always a bad thing regardless of whether the area in question has demonstrable value for conservation purposes. But, in general, the suggestions contained in the committee's seven-point charter are sensible and responsible. It calls for the immediate freezing of all alienation projects until the conservation potential of the land can be properly assessed. It urges a strengthened national parks authority and a system for public notification for all proposed changes of land use on Crown land, with public inquiries where objections are raised.

It would be a pity if the Government dismissed these proposals out of hand—a reaction we have seen all too often from Sir Henry and some of his colleagues in the past year or so. The people who have put them forward, and the thousands who support them, are not "unbalanced fanatics." They represent a wide cross-section of the public and include men with the highest scientific and economic qualifications. Sir Henry would be wise to remember they are also voters.

David Johnston, *Lake Pedder, Why a National Park Must Be Saved,* Lake Pedder Action Committees of Victoria and Tasmania and the Australian Union of Students, 1972, pp. 92–93.

The Lake Pedder controversy in Tasmania in 1969 to 1972 had close parallels with the Lake Manapouri controversy in New Zealand, which took place at the same time. Both were responses to government plans to flood an existing natural lake to create a larger body of water for hydroelectricity generation. Both campaigns were based on a mixture of concern about the loss of an ecologically rich site as well as the loss of a place of great beauty—a mixture of ecocentric and anthropocentric utilitarian arguments. The Lake Pedder campaign was unsuccessful.

THE CASE TO SAVE LAKE PEDDER

1. In the recent history of industrial civilisation a large number of species have been destroyed through man's thoughtlessness. Anything which reduces diversity in the total environment reduces man's opportunity to solve his problems with the tools of nature and to learn more of his environment and its interactions through its studies. Therefore any action which reduces the diversity of the environment should be avoided. Insofar as Lake Pedder and its immediate environs contain unique species of plants and animals it should not be damaged in any way.

2. In a similar way, direct evidence of recent geological history (not found elsewhere in Australia) would be submerged below a permanent body of water fifty feet in depth. Insofar as this will eventually cause siltation and dispersion, thereby rendering the evidence inaccessible and unobtainable, and making much scientific study impossible, inundation should be prevented.

3. The area is a natural focus for bushwalkers and other adventurers in this unique wet wilderness area of Australia. Insofar as it represents an incomparable scenic resource and a source of inspiration to the spirit of man, its flooding must be prevented.

4. The area has been declared since 1955 a National Park. Lake Pedder itself was the focal point of the original 59,000 acre Park and the principal purpose for which it was reserved. The concept of a national park is to preserve the natural environment intact for the long-term benefit of man. Insofar as the Serpentine storage would destroy the ecosystem of Lake Pedder and its immediate environs, its inundation under any circumstances can NOT be tolerated.

5. There is still time to save Lake Pedder. Though there is the possibility that the Pedder beach and the button grass plains surrounding it may be inundated with winter rains, it is anticipated that little permanent damage will result to landforms, fauna, flora and endemic species if the lake is drained prior to the winter of 1973.

6. The Hydro-Electric Commission of Tasmania has deliberately withheld from the public information regarding alternative engineering layouts which it had studied, and

which would avoid the necessity for flooding Lake Pedder. It has avoided public discussion of an issue which it was well aware was a matter of great public concern. It even delayed the release of information to the Parliamentary Select Committee, information which was totally germane to its considerations. It has also more recently (when pressure for a review developed) deliberately twisted the sequence of events and quoted material out of context. It has attempted to influence the results of a democratic election by deliberate efforts to frighten electricity consumers with open threats of increased power charges. It has attempted to influence political action within the community by misstatements concerning the position of the Serpentine impoundment in relation to Lake Pedder. It has alienated itself from the public and has been criticised in a Parliamentary Report. Its policies are desperate and bankrupt.

8. The Lake Pedder National Park, if destroyed by the Houn-Serpentine impoundment, will exemplify the worst form of environmental law making. No open discussion or land-use tribunal to determine the best use of the land was held before the submission was presented to Parliament. There was no independent assessment of the environmental impact of the scheme on the area. There was only one study commissioned, but this was by the HEC, who were preparing the proposal to destroy Lake Pedder. At no stage were conservationists or environmentalists invited to assist the Commission in the early phases of planning for the scheme. The whole approach has been one of least direct financial costs. Social costs have not been taken into account. This is simply not good enough. The Age of the Environment has arrived.

13. The pattern that emerges from the above indicates hydropower to be a rather poor proposition. It begins to appear more like a self imposed deception. This makes it imperative to prevent the loss of Lake Pedder. It is bad enough to sell natural assets for a few dollars as profit, but infinitely worse to do so just to act out a myth that has been false for over twenty years.

14. If Australia is ever to permanently retain natural areas free from commercial exploitation damaging to national environmental principles, then it is imperative that its people make a stand and impress their point of view on legislators. Lake Pedder is an issue of national significance. It Lake Pedder is lost no national park, no wildlife sanctuary in Australia remains free from the danger of destruction.

LAKE PEDDER MUST BE SAVED!!

Plaque beside Lake Manapouri, South Island, New Zealand.

(See lake Pedder above) As the plaque indicates, the Manapouri campaign was successful.

MANAPOURI SAVED

THE SAVE MANAPOURI CAMPAIGN (1959–72) WAS NEW ZEALAND'S GREATEST ENVIRONMENTAL BATTLE. INVOLVING THOUSANDS OF NEW ZEALANDERS FROM

ALL WALKS OF LIFE, THE CAMPAIGN SAVED LAKES MANAPOURI AND TE ANAU FROM BEING RAISED FOR THE PURPOSE OF HYDRO-ELECTRIC GENERATION.

THIS MONUMENT IS A TRIBUTE TO THE CAMPAIGNERS. THEIR LOVE AND RESPECT FOR NATURAL BEAUTY, THEIR FORTITUDE, AND TENACITY TRIUMPHED OVER POLITICAL AND OFFICIAL INDIFFERENCE.

A TRIBUTE IS ALSO PAID TO THE GUARDIANS OF LAKES MANAPOURI AND TE ANAU WHOSE DEDICATED AND VIGILANT WORK SINCE 1973 HAS PRESERVED THE NATURAL BEAUTY AND ECOLOGICAL VALUES OF THE LAKES.

"SAVE MANAPOURI" WAS A CATCH CRY OF A GENERATION. IT ECHOES STILL

"IN WILDERNESS IS THE PRESERVATION OF THE WORLD"

HENRY DAVID THOREAU

Rosslyn Beeby, "A River of Innate Power and Beauty" Melbourne *Age*, 13 December 1982.

The campaign to prevent the damming of the Gordon River below its confluence with the Franklin River in western Tasmania began to come to a head in late 1982 when construction work commenced. By then, substantial public opinion across Australia was opposed to the dam, and some of the prominent newspapers, including the Melbourne Age, *were giving the issue considerable coverage.*

Australia's last great wild river, the Franklin, rises high in the Cheyne Range in Tasmania's central-west highlands.

It descends from the peaks of Mt Gell and Mt Rufus through alpine glacial lakes, forming numerous rapids and waterfalls before plunging through a series of spectacularly high gorges and cliffs to meet the waters of the Gordon River.

Ironically, it is this rugged topography that makes the river unique as a wild or unpolluted river of world status, as well as a valuable resource for the production of hydroelectric power.

The south-west wilderness, of which the Franklin River forms the core, was nominated last November by the federal Government for the World Heritage List.

The list is administered by UNESCO and includes more than 80 natural and manmade features considered worthy of international protection. It includes the Great Barrier Reef, the Pyramids and the Grand Canyon.

Although a recent National Parks survey ranked the Franklin River first among Australia's remaining wild rivers for its aesthetic and recreational merits, the Tasmanian Government has been reluctant to acknowledge the Franklin's importance as an environmental and cultural asset.

Before the declaration of the Wild Rivers National Park in 1979 Tasmania did not have one of its major river systems protected in its entirety as a national park. Of the State's 11 major rivers, only the Franklin and the smaller Davey are unpolluted or undammed and, therefore, able to be classified as wild rivers.

It is the untouched state of the Franklin River and the south-west rainforest wilderness that is crucial to acceptance of the World Heritage nomination. If the river is dammed, it will lose its "wild" status, and large tracts of the wilderness will be flooded

or scarred by roads, fire breaks and power lines. The concept of a wilderness is difficult to define. A report submitted to the Australian Heritage Commission by the University of Tasmania, defines it as both an environmental and cultural resource. A wilderness is an area where genetic diversity and natural cycles remain undisturbed, but it is also a place where nature can be experienced as a challenge.

Nomination of the south-west for World Heritage status centres on the preservation of caves containing evidence of Aboriginal occupation during the last ice age, the Franklin's unpolluted state and the diversity of native flora and fauna.

Archaeologists have discovered nine caves on the banks of the Franklin which contain evidence of Aboriginal occupation dating from 14,800 to 20,000 years ago when the rainforest bordering the river was glacial tundra. All the caves will be flooded by the Gordon-below-Franklin power scheme.

Little is known of the native fauna found in the area due to the rugged and inhospitable terrain. So far, 18 indigenous species have been recorded in the area to be flooded. Animals at risk include the Tasmanian devil, tiger cat, platypus, several species of marsupial mice and the pigmy possum. The last recorded sighting of the thylacine, or Tasmanian tiger, was also in the south-west.

Bird-life is particularly rich in the wilderness area, due to the absence of exotic predators. More than 49 species have been recorded by ornithologists, three of which are rare. The azure kingfisher, an uncommon bird in Tasmania, appears to be restricted to rainforest streams in the south-west. It is not an open-water bird, and its habitat and status will both be threatened if the river is flooded.

The orange bellied parrot, Australia's rarest and most endangered bird, breeds only in tree hollows in the south-west forest. Only 83 pairs of the birds are known to exist. The ground parrot, one of only three rare ground-living parrots in the world, is also native to the south-west.

A botanical survey of the area recorded 290 species of plants, 18 of which have been listed as rare, endangered or vulnerable. During his recent visit to Australia to campaign for the preservation of the wilderness Dr David Bellamy said he had seen mosses, bladderworts and other microplants which were still botanically unclassified. Some species indigenous to the south-west would be extinct before technically discovered.

"Why the Franklin should be saved," Melbourne *Age*, 7 January 1983.

As the controversy deepened in early 1983, and as volunteer protestors attempted to blockade the construction work, public and newspaper opinion hardened further.

If the Prime Minister, Mr Fraser, is back on his feet next week, there is one part of Australia he will be heading for. South-west Tasmania is occupying the thoughts of many Australians, not least the Prime Minister, and not only because of his desire to fish the Ouse River. The televised confrontations in the Lower Gordon River rainforests are giving Australians a nightly reminder of what is at stake in the dams issue. And few would have been struck by its growing importance so forcefully as the Prime Minister planning an election in which one of the issues looks like running strongly against him.

There are many dimensions to the dams issue. It is the most important clash between conservation and development values Australia has seen. The mountain rivers are among the gems of Australia's landscapes, while cheap hydroelectricity is the Holy grail in Tasmania's credo of economic development. The dams issue is now, with the economy, the most potent single issue in Australian politics and it is becoming more so every month. Even if the impressive muscle of the conservation movement could shift only 1 per cent of votes and preferences from Liberal to Labor, this might be enough to change the Government. The Fraser Government is in a dilemma. It will suffer in Tasmania if it intervenes to stop the dam; it will suffer in the rest of Australia if it doesn't intervene. And it has little time left to choose.

For three years we have argued against the dam, and called on the Fraser Government to intervene if necessary to stop it being built. We have taken this stand not because of any animosity to Tasmania or Tasmanians, or because we are indifferent to Tasmania's need for cheap electricity, or because we want to conserve everything, everywhere. The point of our opposition is that the country where the dam would be built is something magnificent. It is a land of grand river valleys as unspoilt as the first Eden, and still remote enough to evoke that sense of awe and wonder that the first explorers might have felt. That is an experience that few places on Earth can now offer, and one that is becoming more rare each year as Earth's remaining wilderness is destroyed for dollars. Whether you call it our national heritage, the world heritage, or, in Eric Reece's homely phrase, one of "the things you want to keep," it is too important for future generations to be thus destroyed. Mankind needs more than just cheap electricity.

It is said that there is no alternative to the proposed dam. That is palpably untrue. Tasmania has enough coal to fuel its own power station—relatively poor coal, admittedly, but then Victoria's brown coal was dismissed as too poor to use until we showed that it could be done. Tasmania could buy good quality coal from NSW, or build a cable link to Loy Yang, or even build smaller hydro stations in less controversial locations. It is a fact that Tasmania could build any one of these alternatives and still have the cheapest power in Australia.

It is said that the environment is purely a State issue, of no legitimate concern to the Federal Government. The Fraser Government's own past actions give lie to this view. The Government did not consider it a State issue in 1976 when it intervened to stop the export of mineral sands from Fraser Island, reversing a decision taken by the Whitlam Government, and acting in the face of strident opposition from the Bjelke-Petersen Government. From 1975 on, it has pledged to help in setting up a national park of world importance in south-west Tasmania, and has taken numerous actions towards this, culminating in the region being listed as a World Heritage area. It is signatory to the World Heritage Convention, and has legal obligations to protect the area under this and its own national heritage legislation. Certainly there is general support in Australia for the Federal Government to take the lead in preserving our natural heritage. Australians do care about their country.

Perhaps the saddest thing about this whole issue is that so few Tasmanians, and so

few of their leaders, have tried to see the issue from both sides. Hardly any Tasmanian politicians have been to see the river they are proposing to flood. The Premier, Mr Gray, who has never set foot in the area, has nonetheless dismissed this gorgeously scenic river as a "brown ditch, leech-ridden, unattractive to the majority of people." His Government is so bent on rejecting any alternative it has even reversed its predecessor's decision to require new homes to be insulated. It has stopped the HEC from converting the Bell Bay power station from oil to coal firing, lest this create the impression that coal could be an alternative to flooding the Franklin. If the States rights view is accepted, these are the men (for men they all are) who are the trustees of our national heritage, and whose decisions should not be challenged by the national Government.

Australia demands something better. One can sympathise with the Fraser Government over the political dilemma it faces, although the stakes seem clearer on the mainland than in Tasmania (after all, who else could Tasmanian pro-dams voters turn to—Labor? the Democrats? Both are opposed to the dam). But if it is concerned for something more than short-term internal harmony, it must intervene to stop the dam. In the beauty of those rainforests, in the grandeur of those mountain valleys, their haunting mists, their spectacular cliffs, rapids and beautiful vegetation, there is something Australia should preserve untouched for all time.

David Elias, "Warrior scuttled by experts in underwater war," Melbourne *Age,* 5 November 1985.

The events surrounding the sabotage of Rainbow Warrior *by French agents in Auckland in 1985 were neatly summarized during the court case.*

The Greenpeace ship *Rainbow Warrior* was scuttled by experts in underwater warfare helped by French secret service agents Major Alain Marfart and Captain Dominique Prieur, the District Court in Auckland was told today.

The couple, posing as husband and wife, acted purely in a support role, enabling judicial authorities to accept their guilty pleas on lesser charges of manslaughter and wilful damage.

New Zealand's Solicitor-General, Mr Paul Neazor, QC, said the Crown's evidence would not have established that the two agents were responsible for the placing of the explosive charges.

The evidence also would have failed to establish any intent to kill or injure or any knowledge by the agents that the placement of the explosives was likely to cause death, Mr Neazor said.

Summarising the Crown case, he said: "There is no doubt that the placing of the explosives and their detonating was carried out by persons trained and expert in underwater warfare. The Crown's investigations do not establish the defendant's role in this affair as other than in support of those who actually placed the explosives."

. . . His summary named the members of France's external secret service, the DGSE, known by police to have taken part in the action ordered by the French Government to stop the Rainbow Warrior's intended voyage to Mururoa Atoll.

One agent was Frederique Bonlieu, a French woman who infiltrated the Greenpeace protest movement earlier in the year to report on its activity to the four crew members of the yacht Ouvea, which they chartered in Noumea and scuttled after Australian police allowed them to sail from Norfolk Island.

These agents called themselves Raymond Velche, Jean Michel Berthelo, Eric Audrenc and Xavier Jean Maniguet. But the first three were later identified as DGSE agents Roland Verge, Jean Michel Barcelo and Gerald Andries. Maniguet was a doctor and reservist in the French navy.

Also named was another Frenchman, Jean Dormand, who liaised with Ouvea crew members and reported to Paris.

The story began on 23 April when Bonlieu arrived in NZ on a French passport in a false name.

The Greenpeace movement knew she was coming. She had been introduced by a letter from a friend of one of the group's members and was accepted by Greenpeace. She accepted the group's hospitality until her departure on 24 May.

Mr Neazor said Bonlieu was clearly sent ahead of the main party to gather intelligence.

Two days after Bonlieu's departure, French agents moved to arrange charter of the 12-metre sloop Ouvea.

On 29 May, five days after Bonlieu left NZ, Andries bought an inflatable dinghy and an outboard Motor from a marine supplier in London.

Arrangements for the charter of the Ouvea were completed at the end of May and on 13 June the ship left Noumea with the four men on board.

Mr Neazor said the Crown contended that the Ouvea was the means by which equipment and explosives were brought to NZ.

On 22 June the Ouvea arrived in Parengarenga, on the northern tip of NZ. Also on that day, Marfart and Prieur arrived in Auckland by plane, travelling on expertly forged Swiss passports in the name of Mr and Mrs Turenge.

After 22 June the Ouvea moved down the coast to Whangerei, where according to its log, it left NZ waters on 9 July.

Mr Neazor said the crew of the Ouvea met Marfart and Prieur. The "Turenges" took over the dinghy and the outboard and made frequent visits to Auckland's waterfront, in particular to Marsden wharf where the Rainbow Warrior was berthed and open to the public after its arrival on 7 July.

On the evening of 10 July a party was held aboard the rainbow Warrior to celebrate a birthday, and there was a meeting of Greenpeace skippers. Thirty people had been aboard but only 12 remained later in the evening.

About 11.50 pm, the first explosion damaged the rainbow Warrior's starboard side at engine-room level. Water flooded in and the skipper gave the order to abandon ship.

Everyone left except the photographer, Fernando Pereira, who went aft to his cabin to retrieve photographic equipment. There was a second explosion at the stern of the vessel and a perceptible but limited increase in the intake of water. Pereira was not injured by the blast but died from drowning.

Mr Neazor said that as part of their support role, Marfart and Prieur picked up one of the people responsible for placing the explosives. Those who placed and set the charges had not been identified, he said.

During the night of 10 July, Marfart and Prieur drove south to the town of Thames and then to Hamilton the next morning. In Hamilton they telephoned their contact in Paris and altered their plane reservations to get out of NZ as quickly as possible.

"They were, however, interviewed by the police on 12 July," Mr Neazor said.

Harry Djagamara in Colin Tatz (ed), *Black Viewpoints: The Aboriginal Experience,* Australia and New Zealand Book Company, 1975, pp. 72–73.

Australian Aborigines were the first humans to arrive in this part of the globe more than 50,000 years ago. Since European arrival in Australia just over 200 years ago, Aborigines have suffered profoundly from many injustices, including deprivation of their traditional land, which have deep spiritual as well as economic significance. They have also been forced to observe the landscape's desecration and degradation. Therefore, it is appropriate that an Aborigine has the final word in this collection. In the second half of the twentieth century, Aborigines became better organized and more assertive, mounting campaigns to demand civil and other rights, including the return of some of their land. Land rights were fought in the face of opposition from mining companies, pastoral interests, and entrenched white prejudice. Despite Harry Djagamara's pessimism in the 1970s, Aborigines have had some limited success in having their lands returned, partly because of a mounting awareness of past injustices and partly because of recognition by the Australian community and courts of the spiritual significance of the environment.

Then we talk about land rights. We don't want the land to build a big motel or hotel. We want it to be there without it being touched—for Aboriginal traditional culture, so that our children can go there and see the places the old men are talking about in the "Dreamtime." If we can take them out to sacred sites and show them what different things represent—it might be a ghost gum, a piece of rock, a rock pillar—if we can show them these things and tell them what they represent, it means a lot more to them. This is why we want the land.

One thing that the Aboriginal people of the Territory are not aware of is the fact that they are on Crown land, and they have no hope of getting it. We have been told. When they talk about land rights, they don't want it so they can work it and get wealth. Take uranium for example: We have a uranium deposit west of Yuendumu and our mining company—we have a mining company which produces copper ore which we send down to Adelaide—has the mining leases for this area. If a commercial mining company comes in to mine this uranium we make very sure that:

1. they pay royalties into our mining company, and
2. they don't go near our sacred areas and destroy out sacred sites.

One of the mining companies did go on to our sacred lands and there was a six month battle in the Alice Springs court, which we won.

BIBLIOGRAPHICAL ESSAY

To leave the environment out of history is, generally speaking, to create a distorted view of the past. Such basic aspects of everyday life as climate and weather, soils, and "natural resources" determine much of the nature of a society, its culture, its development, and its survival. In turn, the way a society treats its environment will, eventually, determine much of its future and, therefore, history. And yet, little of the history that was written prior to the 1970s gave the environment much of a role. At best it was a platform upon which history occurred, or the environment was granted occasional recognition as a bit player whose storms or droughts or shortages impinged sufficiently upon the main players to demand attention. That has changed dramatically in the last two or three decades, and environmental history is now not only a major show in its own right, but is also given at least a walk-on role in most general histories.

Environmental history emerged as an area of study in the United States from the early 1970s. In Australia, New Zealand, and the Pacific, while there were a few publications that dealt with "environmental" issues such as introduced species, it was not until the 1980s that the new discipline appeared as a recognizable approach to history. Its emergence everywhere was part of a wider historiographical "revolution" that, in the last three decades of the twentieth century, saw a broadening of historical studies and the development of new approaches to how history is conceptualized in such matters as gender and race. In most cases, it was mounting community interest in a contemporary issue that brought attention to bear on the historical antecedents, thereby generating a new area of historical study. In the case of the environment, it was the realization of the rapid degradation of many parts of the planet, together with concerns about overpopulation and food shortages, which stimulated a desire to understand the historical attitudes and actions that had created the contemporary situation. While environmental history and environmental awareness developed somewhat in tandem, it was environmentalism that occupied the front seat, a little in advance of environmental history and largely responsible for the direction the pair was taking.

One of the principal characteristics in the historiography of environmental history is the breadth of material it incorporates. Often it is a synthetic study that draws together the research, skills, and insights of a wide range of disciplines. There are many scholars whose work overlaps that of environmental historians who would not perceive that they are, at least to some degree, environmental historians themselves. Much of the basic conceptualization and research for this volume and other environmental history is drawn from such diverse areas as historical geography, biology, climatology, agricultural science, and anthropology, as well as more conventional history. The challenges of this interdisciplinary approach in the Australian and New Zealand context were discussed by Pawson and Dovers in the November 2003 issue of the international periodical *Environment and History.*

The following essay will give a broad introduction to the historiography of the environmental history of Australia and Oceania in four geographically oriented sections—broad regional overviews, and then studies within Australia, New Zealand, and Oceania. The works referred to are by no means a comprehensive coverage of Australian and Oceanic history and related disciplines but are a distillation of what are considered the main publications in environmental history and of main use for those reading into the subject. Publication details are found at the end of the essay. Postgraduate theses are not dealt with.

OVERVIEW

Despite their proximity and historical connection, there have been few historical studies that have looked broadly at Australia and Oceania, and no major environmental histories. A small number of environmental histories have encompassed more than one part of the region.

One of the most useful of the general histories that embrace Australia and Oceania is the innovative and perceptive, but now slightly dated, 1963 work by historical geographer A. Grenfell Price, *The Western Invasions of the Pacific and Its Continents* (1963). Price was one of the first scholars to examine in detail the impact of European diseases on indigenous people, together with the moving frontier of introduced species and changing landscapes. More recently, the comprehensive study of Australia, New Zealand, and the Pacific by Denoon, Mein-Smith, and Wyndham, published in 2000, is the only general history covering the same region as the current volume, but it is far broader in subject matter than an environmental history and touches only briefly on environmental issues. It can perhaps be seen as a companion, complementary work to this volume.

Studies with an environmental history orientation and covering large parts of the region have come mainly from the United States. The way was led in the 1980s by Alfred Crosby (1986) who took his concept of "ecological imperialism" and applied it to Australia and New Zealand as well as to North America, for the period up to 1900. A similar path was followed in the 1990s by Tom Dunlap (1999) who studied nature and the English diaspora in North America, New Zealand, and Australia and brought his valuable synthetic history through to the end of the twentieth century. J. R. McNeill (2001) has written an excellent synoptic chapter on the environmental history of the Pacific, while Australian Tim Flannery (1994) combined his broad range of interests to examine the impact of immigrant peoples on the environment in Australia, New Zealand, and Rapa Nui. Most recently, Jared Diamond has examined Australia and parts of Oceania in *Collapse,* his mammoth study of why societies "choose to fail or survive."

Many scholars have contributed to the great advances that have been made in recent decades in the study of Oceanic archaeology and ecological history. While it is risky to nominate individuals, Bellwood, Steadman, and Anderson are notable, and of particular value for environmental historians is Patrick Kirch, who has produced a wealth of articles on aspects of human occupation of the Pacific (See Bibliography, Chap. 2, for some). For the environmental historian, Kirch's synthetic monograph, *On the Road of the Winds* (2000), is a masterly ecological history overview of the pre-European Pacific, combining archaeology, anthropology, linguistics, and a range of other fields. The collection of essays he edited with Hunt (1997), and his history of the Lapita peoples (1997), are also necessary reading for Oceanic environmental history. Houghton's study of cultures, winds, and physiology (1996) is equally stimulating.

New Zealand historian Kerry Howe has also written broadly about the Pacific and New Zealand, generally from a somewhat more conventional historical perspective. *Where the Waves Fall* (1984) is still a most useful introduction to Pacific history and some of the issues that interest the environmental historian. *Tides of History* (1994), which he edited, contains a general overview of the Pacific in the twentieth century. Of more immediate interest to environmental historians are his reflections in *Nature, Culture, and History* (2000), a perceptive analysis of those three elements in the Pacific context. Howe's most recent publication, *The Quest for Origins* (2003), is an invaluable guide through some of the contentious and complex evidence about the original peopling of Oceania.

The *Pacific Islands Yearbook* and the various *Lonely Planet* guides and the *Lonely Planet* website provide a good, general introduction to the history, natural history, and understanding of many of the countries in Oceania.

AUSTRALIA

It is surprising that in a country in which the environment is such an ever-present factor, recognition of the influence of the environment in history was largely ignored until the 1980s. One notable exception to this occurred as long ago as 1930 when Keith Hancock "discovered" the environment, in the sense that he drew attention to some of the destructive elements of British occupation and factored aspects of the environment into his work. As a chapter title, he used what has now become something of a stereotypical view of the pioneers—"they hated trees." After a distinguished academic career in Britain and Canberra, Hancock turned to environmental history in his retirement and in 1972 published one of the earliest and best regional studies, *Discovering Monaro.*

Concern in the 1960s about environmental degradation stimulated a small body of environmental literature in Australia. Probably by chance, 1966 was an important year as it saw the publication of works by A. J. Marshall, Vincent Serventy, and Alan Moorehead that drew attention to aspects of the alarming degradation of the continent and, in Moorehead's case, the Pacific. The collection of articles edited by Marshall was a scathing indictment of Anglo-Australian "cupidity, wickedness and waste." Moorehead used the title "fatal impact" to capture the nature of British colonization in the Pacific and Australia. Serventy's study of the endangered state of the environment was complemented by his television series. These three helped to popularize interest in the environment and environmental history. None was an historian. Nor were botanist Leonard J. Webb or geographer Geoff Mosley, who from the 1960s were drawing attention to environmental degradation and the need for more and better administered national parks in Australia.

Arguably the first Australian environmental history was published in 1969 by farmer and environmental writer Eric Rolls. *They All Ran Wild* was a pioneering piece of research into introduced species in Australia, particularly rabbits. Rolls later wrote other environmental studies with an historical flavor, the most important of which was a perceptive and sensitive regional history, *A Million Wild Acres.*

These were part of a small body of literature that from the 1960s began to reassess the European occupation of Australia and its interaction with the natural environment. Since then, the flow has increased, and so has the proportion stemming from the academy and, to a lesser degree, from historians. In the academic sphere much of the early work that falls within the gambit of environmental history was undertaken by historical geographers. Of some significance were four imports, three of whom were transients who undertook research in

Australia before returning to their home countries—D. W. Meinig (a case study of failed settlement in northern South Australia), Michael Williams (the making of the landscape in southeastern South Australia), and R. L. Heathcote (regional studies and a particular interest in drought and aridity). Incidentally, they established a valuable tradition of visitors that was continued in the 1990s by Stephen J. Pyne who researched a fire history of Australia. The fourth imported geographer in the 1960s was Joe Powell who taught at Monash University until his retirement, and in numerous books, notably on water, has made an invaluable contribution to the study of Australian environmental history.

Polymath, George Seddon, was drawn into environmental studies in the 1970s and was influential in establishing it as a field of study at Melbourne University. He published many articles, particularly about landscape, which were gathered together in *Landprints.* His personal and historical view of the Snowy River, *Searching for the Snowy* (1994), is a model history of a water system.

The first academic historian to take up the new field of environmental history was Geoffrey Bolton who pioneered it in the early 1980s as an undergraduate subject at Murdoch University. From his lectures for that course came the first general environmental history, *Spoils and Spoilers,* published in 1981. There is one other general environmental history, *Taming the Great South Land,* which was published by William Lines in 1991. In 2005 Jared Diamond included a synthetic overview of the European occupation of Australia as a chapter in *Collapse,* and in which he presents an even more gloomy portrait of the relationship with the environment and the resulting degradation than I have in this volume.

Since the 1980s there has been a great increase in the number of local and regional histories being published, but only a few have been significantly influenced by the concerns and perceptions of environmental historians. Besides Rolls's *A Million Wild Acres* (1984), one of the earliest and best examples is Gammage's 1986 history of the Narrandera Shire (1986). More recently, Crawford and Crawford's 2003 history of the Northcliffe region in Western Australia is indicative of the advances in genre and exemplifies the wealth of insights that can be provided by well researched and written local environmental history.

The 1990s brought a small explosion in environmental history in various forms and a marked increase in the types of material from other disciplines that was available to be used by environmental and ecological historians. These can be broken down into a number of categories; the following list is by no means exhaustive.

There are several works that in the last decade or so of the twentieth century assessed and evaluated the changes in and the damage to the environment. Early in the decade there were two studies whose titles make clear their message—*The*

Vanishing Continent: Australia's Degraded Environment (Beale and Fray 1990) and *Saving a Continent: Towards a Sustainable Future* (Smith 1994). Powell's *An Historical Geography of Modern Australia,* first published in 1988, was a pioneer historical geography/environmental history text for tertiary students. Jeremy Smith (1992) and Ann Young (2000) included major aspects of environmental history in texts aimed at environmental studies and geography students. There is a very large body of scientific work on Australia's prehuman history, of which the most accessible for non-scientists are the two works by Mary E. White. She has also contributed valuable works on water manipulation and on the modern state of the environment, although the most extensive depictions of the latter issue were published by the Australian State of the Environment Committee in 1996 and 2001.

There are many accounts of the Australian conservation and environmental movements and of specific campaigns and issues. It is noticeable that the authors have tended to seek out and amplify those interested in conservation and their achievements, at times giving both people and events greater significance than may be deserved. The major general conservation histories are by Michael Hall (1992), Tim Bonyhady (1993), and Hutton and Connors (1999), with the last being the most recent and comprehensive. Among many accounts of specific campaigns are the book by Pybus and Flanagan (1990) on the Pedder and Franklin issues, and Libby Robin's excellent study of the Little Desert (1998). Amanda Lohrey has provided a valuable account of the rise of the Greens as a political force (2003), while in 2003 Flannery, always the iconoclast, stirred controversy with his ideas about population size and the directions being taken by the environmental movement. Timothy Doyle (2000) presents a sophisticated analysis of the politics of the environmental movement. Studies of people involved in conservation and environmental matters have been written by Graham Pizzey (1992), Peter Meredith (1999), and Mulligan and Hill (2001). In 1996, Tom Griffiths produced a prize-winning intellectual and cultural history about the hunters, collectors, natural historians, conservationists, and nature writers of the late nineteenth and early twentieth centuries.

Studies of introduced species have been popular, with the broadest and most thorough modern works being the two books about feral species by biologist Tim Low (1999). Weeds and vegetation have been examined by Jamie Kirkpatrick (1994) and W. T. Parsons (1981 and 2001), among others, while rabbits have attracted the attention of Rolls (mentioned previously), Stodart and Parer (1988), and were addressed in a comprehensive update in 1999 by Brian Coman.

The future of environmental history in Australia is very promising and, ironically, will presumably remain that way as long as the environment remains endangered. There are many possible directions that the study may take.

It is likely that the environmental significance of specific industries will be further studied, along the lines of Barr and Cary's history of the agricultural industry (1992), and John Dargavel's work on forest history (1988). Another fruitful direction is likely to be the study of geographical features and systems that are delineated by natural boundaries rather than human political or economic boundaries. Pioneering works of this type are Tom Griffiths's two works on the Victorian Ash Range (1993 and 2001), and Sinclair's study of the Murray. Sharon Morgan's history of the Tasmanian landscape (1992) can also be mentioned in this context. There is an impressive and growing body of postgraduate research and unpublished theses in environmental history as the new discipline establishes itself, and many of these will enhance the historiography once they are published.

The two volumes of environmental history essays edited by Stephen Dovers (1994 and 2000) give a good idea of the range of material and the discipline areas now being incorporated into environmental history in Australia.

NEW ZEALAND

The extent of clearing of New Zealand's indigenous landscape and the rapidity with which a bewildering diversity of introduced species occupied the created space led to several early expressions of environmental concern in that country, as outlined in Chapter 5. Among these were the history of W. Pember Reeves (1899), the poems of Baughan and Bathgate, the observations of sheep station owner Herbert Guthrie-Smith (1921), and the study of introduced species by Canadian historical geographer Andrew Hill Clark (1949).

However, New Zealand is a small country, and despite having an active group of environmental historians working in its universities (some of whom look outward into the Pacific), there is not yet a substantial body of identifiable environmental history. Nearly all that does exist has been published since the early 1990s. The most significant single volume is the collection of essays published in 2002 by Pawson and Brooking, *Environmental Histories of New Zealand.* The essays provide a broad coverage of many subjects ranging from Maori impacts, colonization, land clearing, and introduced species to modern concerns and environmental law. An area that is not covered as fully as it might be is the evolution of New Zealand's very significant environmental movement. Otherwise the volume comes close to providing a comprehensive outline of environmental history. The November 2003 edition of the international periodical *Environment and History* was devoted to New Zealand, and some of its articles help plug this gap by discussing aspects of conservation and environmentalism.

Indeed, this issue of *Environment and History* now forms the second most important collection of New Zealand environmental history writing and, with Pawson and Brooking, demonstrates the rapid expansion and the quality of the discipline in the country.

The other major work of environmental history in New Zealand is ecologist Geoff Park's *Ng¯a uruora (The Groves of Life): Ecology and History in a New Zealand Landscape* (1995), a very sensitive examination of the removal of trees and the transformation of landscape in a number of sites. Otherwise, New Zealand environmental history tends to be in journal articles, forms part of wider studies, or is drawn from the work of scholars in other disciplines.

Belich's masterly two-volume history of the New Zealand people (1996 and 2001) covers some relevant environmental issues, notably his discussion of Maori use of "resources" and impact on the landscape. He, like all scholars, is heavily dependent on the work of archaeologist Atholl Anderson whose examination of Maori sites, synthesized in *Prodigious Birds* (1989), has provided much of our fundamental understanding of the fate of the moa. The 2003 *Penguin History of New Zealand* by Michael King provides a brief but valuable coverage of environmental aspects of the country's history, such as the impact of European agriculture and some of the conservation campaigns. American fire historian Stephen J. Pyne includes a brief fire history of New Zealand in *Vestal Fire* (1997).

There is a large volume of other work on pre-European history, neatly summarized and evaluated by Howe in *The Quest for Origins* (2003). That subject, together with matters relating to forest clearance and introduced species, are, not unexpectedly, the main areas that have attracted attention. Introduced species are discussed in Ross Galbreath's history of the Wildlife Service (1993), Johns and MacGibbon's study of introduced animals (1986), and McDowell's history of the New Zealand acclimatization societies (1994). John Halkett's work on New Zealand's forests (1991) is useful on that subject.

There are two valuable works of reference that cover many issues of interest to the environmental historian, both published in 1997. *The State of New Zealand's Environment 1997,* by Taylor et al., is an extremely useful account of the environment at that time, but also contains substantial historical contextualization. The *New Zealand Historical Atlas,* edited by Malcolm McKinnon, provides a well illustrated and accessible overview of the creation of modern New Zealand, including a brief but very helpful outline of many environmental issues.

Books by Tong and Cox (2000), Scott McVarish (1992), and Neville Peat (ND) give useful introductions to aspects of the environmental movement, but a history of environmentalism remains an area in great need of further work.

THE PACIFIC

The Pacific has fascinated the European imagination and scientific mind since its ocean expanses, islands, and people were first encountered. For more than two centuries it has served as a laboratory for many areas of research and conjecture, a site for such diverse pioneering minds as Charles Darwin in the nineteenth century, and in the twentieth century the controversial anthropologist Margaret Mead, and the pioneering work of botanist Raymond Fosberg on island ecosystems. It continues to attract attention, and there is substantial historical and other research that is focused on the islands and their societies. Much of the research is based in the fringing Western countries—the United States, Australia, and New Zealand. However, there are major research centers in Hawai'i at the Bishop Museum and at the University of Hawai'i, and at the multi-campus University of the South Pacific with its main center in Fiji. These tend to be directed towards Pacific biology, archaeology, anthropology, politics, and economics.

The historiography of the Pacific is rich, with such noted authors as J. C. Beaglehole, Oskar Spate, Dorothy Shireberg, Norma McArthur, and Bernard Smith having written about aspects of its European past in the decades after World War II. General histories continue to be published, with the works written in 1984 and edited in 1994 by Kerry Howe providing good introductions, while J. C. Campbell's history of the Pacific (1990) is very accessible. There are large numbers of detailed studies of parts of the Pacific that can be found in secondhand bookshops, but for many, that is where they should stay. However, there are also many good historical accounts of European exploration, missionary work, the impact of European colonialism on island societies, and other aspects of post-European contact. Brij Lal's work on Fiji (1992) stands out, as does Judy Bennett on the Solomons (1987 and 2000). Lal and Fortune's *The Pacific Islands: An Encyclopedia* (2000) is a useful work of reference with some environmental history relevance. Gavan Daws is among many who have written about Hawaiian history (1968).

The position of Pacific environmental history is rather ambiguous. There is not a substantial amount of specific environmental history yet written and, apart from J. R. McNeill's chapter (2001), there has been no significant attempt at a general environmental history overview. Nevertheless, there is a great deal of relevant research that has been concentrated on two or three aspects.

One of these is what is often known as historical ecology or biogeography. In the late decades of the twentieth century there was a new flourish of archaeological, anthropological, and biological research, some of which is outlined by Patrick Kirch in *On the Road of the Winds* (2000). Kirch, together with Marshall Sahlins, David Steadman, and others, pushed back the frontier of knowledge of how Pacific peoples interacted with their environment. Gerard Ward's

1972 collection of essays on humans and geographical change in Pacific islands might be seen as a pioneer of this type of work. Two relatively recent texts with a scientific orientation that encompass ecological history and biogeography, are John Dodson's edited collection of broad essays on Australia and the southwest Pacific (1992), and Lobban and Schefter's introduction to Pacific tropical island environments (1997). Bahn and Flenley's account of the discovery of the "solutions" to the mystery of Rapa Nui (published in 1992 and second edition 2002) is an excellent example of this new approach to interdisciplinary synthetic work. Howe's *The Quest for Origins* (2003) neatly brings together a similar range of sources in his analysis of current understandings about the arrival and distribution of island people, and Jared Diamond uses the Pacific as a case study in *Guns, Germs and Steel* (1997) and *Collapse* (2005) to explain how environment and geography shaped the histories of island societies. This is a rich and expanding area of study.

The other principal aspect of environmental history that has received attention has been the introduction of alien species, most particularly into Hawai'i. This is discussed in a number of works, most of which are scientifically oriented but with a strong historical flavor. Some of the relevant books are those by Sherwin Carlquist (1980), Cuddihy and Stone (1990), David Eyre (2000), Juvik and Juvik (*The Atlas of Hawaii* 1998), and in the significant 2002 study by Alan Ziegeler that encompasses *Hawaiian Natural History, Ecology, and Evolution.*

There is a small but growing number of studies of aspects of environmental history in other societies. One of the best and most detailed is Judy Bennett's study of resource exploitation in the Solomons. Another work that is worthy of recognition is Mark Jaffe's (1994) account of the "detective" work that led to our understanding of the role of the brown tree snake in the disappearance of the birds on Guam.

I acknowledge my debt to all of these authors and to the many others who are listed in the bibliographies of the individual chapters. Without their research this book could not have been written.

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A TO Z

The aim of this section is principally to give a brief introductory outline of issues and places which are either not mentioned in the main text or are deserving of further development.

ALIEN OR EXOTIC SPECIES

Almost wherever humans have traveled in the last 10,000 years, they have taken with them a range of other species, both deliberately and accidentally. For much of this time these were economic species (food and utilitarian plants and animals), apart from a few uninvited companions such as vermin (body lice), pathogens (viruses and germs), and unintended migrants (insects or small fauna). The earliest humans in Australia and the western Pacific (the Australoids and their descendants) were seminomadic hunter-gatherers and carried few species with them on land. However, they would have helped a few passengers to travel across ocean distances in their vessels when they crossed into Australia and Near Oceania.

The Austronesian/Lapita migration and the subsequent Polynesian dispersal were very different. As agriculturalists, they carried a significant range of plant species across Oceania, and some or all of their four economic animal species—pigs, chickens, dogs, and the Pacific rat. Their large, ocean-going vessels often also carried a complement of uninvited insects, lizards, and perhaps some plant seeds. Some of these alien introductions became predators or were invasive, and played a role in the human-induced transformation of insular environments, notably the extinction of large numbers of flightless birds.

The main influx of alien or exotic species came with the European invasion, dating from the late decades of the eighteenth century. This was, in Alfred Crosby's phrase, "ecological imperialism" (*Ecological Imperialism: The*

Biological Expansion of Europe, 900–1900, 1986). Europeans not only carried economic species, but as they advanced across Australia and Oceania, increasingly brought together a vast assemblage of culturally valued species that were introduced for their aesthetic appeal in gardens, could be hunted, or were a nostalgic reminder of the lands they had left. The number of Europeans and their forms of transport meant that they also carried innumerable species accidentally and unconsciously, spreading weeds, vermin, and other problematic invaders. The diseases carried by Europeans also took a terrible toll on indigenous peoples.

The insular environments of the Pacific and the aged environments of Australia were fragile and vulnerable, and their indigenous species often lacked the strength or defenses to resist immigrant species. Many of these alien species, free of the restrictions of the predators, diseases, and climate extremes that controlled them in their native environment, became feral or invasive. Oceanic and Australian environments were transformed and degraded by this blending of the world's biota, the creation of these "hybrid landscapes." (See Chapter 7, Hawai'i)

AMERICAN SAMOA

Population: 70,000

Geography: American Samoa consists of seven scattered islands in the central South Pacific that lie east of Samoa (formerly Western Samoa) and west of the Cook Islands. The combined land area of the islands (Tutuila, Aunu'u, Ofu, Olosega, and Ya'u, which are volcanic; and Swains and Rose, which are atolls) is 199 square kilometers. Tutuila is by far the largest in the territory, occupying 145 square kilometers and rising to 966 meters. American Samoa is a territory of the United States, in effect still a colony, in which the indigenous people have not been given U. S. citizenship.

Environmental Issues: American Samoa has very limited natural resources or fresh water, and most of its arable land is already extensively cropped. Its population is growing, and the territory is heavily dependent upon imports of goods, energy sources, and capital, as well as on tourism. While there are still significant areas of indigenous vegetation on Tutuila, particularly on the rugged mountain slopes, urban development and environmental degradation around the capital, Pago Pago, is extensive. Logging and other clearing has degraded significant parts of the island. The smaller islands are generally undeveloped. Fresh water is limited. The only indigenous mammals are two species of flying fox and a species of bat, while the Pacific rat was introduced by Polynesians. (See also Samoa)

ATOLLS (see Darwin, Charles)

AUSTRALIA

Population: 20 million

Geography: The modern nation of Australia is made up of the world's smallest continent (Australia); the large island of Tasmania, which lies to the south of the south-eastern corner; and a number of smaller islands. Together these total 7.78 million square kilometers, making Australia the world's sixth largest country in area, although in terms of population it is quite small. The reasons for this contrast lie in the aged soils and often arid climate that dominate most of the continent. Only in the southwest corner and along the eastern coastal strip and southeast corner of the continent, and in Tasmania, is the soil more fertile and the rainfall more abundant. Most of the continent is relatively flat, the only significant mountains being found in the Great Dividing Range, which runs parallel to the east coast, and which rises to 2,229 meters at Mount Kosciusko.

The land is endowed with a variety of mineral resources that are central to Australia's modern economy, including black and brown coal, iron ore, bauxite, copper, tin, gold, silver, uranium, nickel, tungsten, mineral sands, lead, zinc, diamonds, substantial volumes of natural gas, and small quantities of petroleum.

Northern Australia was settled by Aborigines about 55,000 years B.P. They spread across the continent and then into Tasmania before it was cut off by rising seas following the last ice age. The British colonized Australia, commencing with the penal settlement at Sydney in 1788. Altogether, six colonies were founded by the 1830s, all of which were granted self-government in the second half of the nineteenth century. They federated as a single nation in 1901. It is now a prosperous Western country with a predominantly European population, although with increasing numbers of immigrants from around the world.

Environmental Issues: Australia faces a multitude of environmental problems, principally because of the way the country has been exploited since the arrival of British colonists. A significant proportion of the country is severely degraded, and many species are listed as having become extinct—more than 20 species of mammals, 25 species of birds (with 30 critically endangered), and more than 60 species of plants (over 1,100 under threat). Australia's islands, like those elsewhere in the Pacific, have proven particularly vulnerable to species extinction. The main reasons for environmental decline have been the introduction of alien species, excessive land and forest clearance, and bad farming practices.

Australia now suffers from extensive areas of eroded and degraded land, with increasing salinity the current most alarming problem. Virtually all water systems are truncated, diverted, polluted, and are experiencing decline in water flow and quality. Australia's urban areas, however, while experiencing low-grade air and pollution problems, are relatively healthy compared with other cities.

(See Great Artesian Basin and Great Barrier Reef as well as the discussions in Chapters 1, 3, 4, and 6.)

AUSTRALOIDS

This is the name now generally given to the first people who arrived from Southeast Asia about 55,000 years B.P. They were dark-skinned people who reached northern Australia and spread across the continent, to become known as Aborigines, and who also spread through New Guinea and the other islands of Near Oceania.

AUSTRONESIANS

The Austronesian people arrived from Southeast Asia in about 3500–4000 years B.P. and spread by sea through the islands of Near Oceania. Some migrated northward into Micronesia, while the main migration continued east and south to Vanuatu, New Caledonia, Fiji, Tonga, and Samoa, in the region known as Melanesia. The name Austronesian comes from the family of languages that these people spoke. The Melanesian Austronesians are also referred to as the Lapita people, after the distinctive pottery that they manufactured for many years. In turn, that name comes from the place in New Caledonia where Lapita pottery was first uncovered and identified by archaeologists.

BIKINI ATOLL (see Hydrogen Bomb Tests and Marshall Islands)

CHRISTMAS ISLAND (see Kiribati)

COOK ISLANDS

Population: 20,000 and in decline, with more than three times that number resident in New Zealand and Australia.

Geography: This small independent nation with strong historical links to New Zealand consists of fifteen islands divided into two groups totalling 240 square kilometers spread over about 2 million square kilometers of ocean. About 90 percent of the land mass and of the population are found in the volcanic islands of the southern group. These include the main island of Rarotonga, Aitutaki, Atiu, and Mangaia, all of which are of younger volcanic origin, are somewhat hilly, and have arable areas. The northern group consists of seven small and sparsely populated atolls.

Environmental Issues: The nation has limited natural resources apart from good agricultural land on some of the volcanic islands in the southern group, but this has led to excessive clearing. There is a heavy dependence on importation of energy sources and manufactured items, while overfishing, waste, and the threat of global warming to the low-lying atolls are becoming significant issues.

CORAL BLEACHING (see Global Warming and discussion in Chapter 6)

DARWIN, CHARLES

Since the 1760s, the Pacific has attracted the attention of the scientific world and has been something of a scientific laboratory, playing a role in many discoveries and new understandings. Charles Darwin (1809–1882) visited the Pacific as a member of the scientific team on the *Beagle,* which circumnavigated the globe in 1831 to 1836. Most of this time was spent in and around South America, and in September to October 1835, Darwin made his crucial visit to the Galapagos Islands, which lie on the Equator in the eastern Pacific. From there, the *Beagle* sailed to Tahiti in November, to the north island of New Zealand in December, and spent the first three months of 1836 in Australian waters before returning to Britain.

Darwin is best known for his publication of the theory of evolution, which he advanced in *On the Origin of Species* in 1859. His visit to the Galapagos

played a role in the gathering of evidence and the formation of the theory, although in recent times the significance of the Galapagos has been questioned. Darwin is reputed to have observed the subspecies of turtles found on the different islands, and he collected examples of the various subspecies of finches that inhabited the different islands and microenvironments on the islands. However, it is now questioned whether these played a major part in triggering his ideas about evolution. While he may have been puzzled by the similarities and differences in the finches, notably the variation of their beaks, it appears that it was not until well after his return to England that their significance became apparent. John Gould, the ornothologist, examined the finches and realized that they were, in effect, variations of the same species that had apparently evolved to suit their specific environments. Darwin absorbed the notion, which then played a part in supporting his understanding of the idea of natural selection—in this case, that the shape of their beaks was an adaptation by the birds to suit the food sources available to them. Those whose beaks were of the appropriate shape were the best fitted to survive and reproduce—that is the process of natural selection. We now understand that the finches had apparently bred from a tiny number (perhaps even a pair) that had been blown to the islands and had radiated and adapted over thousands of years.

Somewhat less known is Darwin's role in providing the explanation for the origin of coral islands and atolls, an issue that puzzled the scientific community in the eighteenth and nineteenth centuries. It was particularly mysterious because coral grows only in very specific conditions of light and temperature not far below the ocean surface. Yet there were large areas of dead coral far below the surface and, at times, on the surface of islands. Darwin puzzled over this issue on the *Beagle* voyage and on return to Britain read, he claimed, "every work on the islands of the Pacific" before he published his theory in 1842. He realized that the explanation lay in the movement upwards or downwards of the earth's surface. In the case of atolls, he realized that fringing coral reefs had formed around the steep sides of volcanic mountains which, as they sank slowly back under the surface, left an expanding lagoon within a coral fringe. If the pace of subsidence was appropriate, the coral continued to grow close to the surface, and in some places a ring of small islands or motu could be grounded on high parts of the reef. By contrast, if shifts in the earth's surface forced the islands upward, expanses of coral would be exposed on the surface, as with makatea islands. (See also the discussion of the formation of the Pacific islands in Chapter 2.)

Darwin's theory of coral islands was supported soon after publication by the independent work of an American geologist J. D. Dana, but many other scientists challenged the explanation. Scientific testing of the theory in the late nineteenth and early twentieth centuries failed to confirm Darwin's under-

standing fully. Deep bores on the island of Fanafuti in Tuvalu, on the Great Barrier Reef, and at Bikini Atoll reached great depths but did not find the volcanic core. Ironically, it was American boring in 1952 prior to nuclear testing on Eniwetok Atoll that confirmed Darwin's theory.

DROUGHT (see El Niño and La Niña)

EASTER ISLAND (see Rapa Nui)

EL NIÑO AND LA NIÑA

El Niño or the El Niño-Southern Oscillation, or ENSO, are the names given to what is now recognized to be a phenomenon that has a profound climatic impact across a wide band around the globe. It results from a complex of changes in ocean currents in the Pacific Ocean that are interrelated with changes in air pressures, which in turn impact upon climate, notably rainfall. The term *El Niño,* meaning boy child, was applied by Peruvian anchovy fishermen to the annual arrival at about Christmas of warm ocean currents moving south in the Pacific from tropical waters, running parallel to the coast of South America. They displace the colder Humboldt current from the south, which is rich in the nutrients upon which the anchovies feed. In some years, occurring erratically each three to seven years, the flow is stronger and warm water pushes further into the cold current regions, having a devastating effect on the fisheries. This is an El Niño episode and can last from one to three years.

However, the effects of El Niño are experienced far beyond coastal South America, although this connection was only realized in the twentieth century. Briefly, in a "normal" year the cold southern waters move north to the equator and then move westward across the Pacific, keeping the waters of the eastern Pacific relatively cool. However, in El Niño episodes the eastern Pacific remains warmer and this causes a change in air pressures and airflow, and a change or even reversal in prevailing wind patterns in a band around the globe stretching from the equator to beyond the Tropics. The effects vary widely. In an area from the southwestern United States through Central America and along the west coast of South America to Peru, the result is thunderstorms and high rainfall. In Australia, it is the reverse as rains fail and large areas of the country plunge into

drought. El Niño episodes have a similar effect on several Pacific countries, notably Fiji. In New Zealand the change of wind direction mixes up the normal rainfall patterns, with some drier areas receiving more rain and normally moister regions experiencing drier seasons. In Southeast Asia, Asia, equatorial Africa, and the eastern coast of South America (and sometimes North America, where the dust bowl of the 1930s is now attributed to El Niño), the failure of monsoon or other seasonal rains also brings drought and the loss of crops. A most disturbing depiction of late nineteenth century El Niño episodes is Mike Davis, *Late Victorian Holocaust: El Nino Famines and the Making of the Third World,* Verso, 2001. He provides a graphic account of the starvation of millions in India, China, Africa, and Brazil, while making the point that the intervention by colonial powers in local administrative systems and traditional forms of relief profoundly compounded the impacts of the droughts and, in effect, reduced those regions to "third world" status.

The fading of an El Niño episode is sometimes followed by the opposite phenomena, known as La Niña. A stronger flow of cool waters forces its way northward along the coast of South America and into the eastern equatorial Pacific. The consequent changes in air pressure and wind patterns result, for example, in periods of higher than average rainfall in Australia and Southeast Asia and drier periods in the western Americas.

The discovery of El Niño and La Niña is one of the great scientific sagas of the nineteenth and twentieth centuries. In the 1870s Henry Blanford, a meteorologist working for the Indian government, gathered atmospheric weather data from within the British Empire that showed that there were wider than previously known patterns in climate fluctuation across large areas of the globe. It was again in India that Sir Gilbert Walker, a British scientist who was head of the Indian Meteorological Service in the early twentieth century, observed in the 1920s that patterns in barometer pressures and rainfall across different parts of the globe, such as the concurrency of droughts in India, Southeast Asia, and Australia, were accompanied by patterns of changing ocean temperatures. He was the first to use the phrase Southern Oscillation to describe the "see-saw" of barometer pressures and rainfall on opposite sides of the Pacific. His name was used for the Walker Circulation, the wind patterns across the Pacific and Southeast Asia. Notably, he observed that the trade winds that blow from east to west along the equator in "normal" years, carrying moisture to Australia and Southeast Asia, weaken and even reverse in periods that we now recognize as El Niño episodes. They leave the western Pacific dry and instead drop their moisture in the eastern Pacific and along the west coast of the Americas.

It was not until the 1960s that Norwegian meteorologist Jacob Bjerknes identified the links between these phenomena and was able to explain the oc-

currence of El Niño and La Niña episodes. Since then, scientific study of the phenomena has advanced considerably, especially after attention was focused by the devastating El Niño of 1982 to 1983. It is now understood that the Southern Oscillation, the major shifts or a "see-saw" of air pressure between the eastern Pacific and Asia, is a "normal" event, but there are periodic extremes in the swing that are the El Niño and La Niña episodes. As these phenomena have come to be better understood, there has been an accompanying increase of interest among environmental historians who are now much better able to investigate how such climatic fluctuations have impacted upon natural and human history.

FEDERATED STATES OF MICRONESIA

Population: 108,000

Geography: The Federated States of Micronesia consists of 607 islands totalling 702 square kilometers, clustered in four major groups in the northern Pacific, part of the Carolina Islands within the area generally known as Micronesia. The groups are Pohnpei (Ponape), Chuuk (Truk) Islands, Yap Islands, and Kosrae (Kosaie). Most were originally "discovered" and claimed by the Spanish. Pohnpei is the largest of the groups, its name taken from the main island, a high volcanic island with a central rain forest and eight atolls besides twenty-five other small islands, half of which are volcanic. Chuuk has nineteen high islands and over seventy small coral islands and supports the largest population (56,000). Yap has two islands and nine atolls that are inhabited, as well as a number that are uninhabited. Kosrae is a single high volcanic island.

Environmental Issues: Apart from U.S. aid, the principal source of income is the licensing of Asian nations to fish within the Federated States of Micronesia exclusive economic zone, particularly for tuna. The future is uncertain as the region is under threat of overfishing, while global warming may swamp the low-lying atolls and islands. Land and forest clearing are also taking their toll.

FIJI

Population: 868,000

Geography: With more than 18,000 square kilometers contained in its 332 islands in the central Pacific, 110 of which are inhabited, Fiji is among the largest as well as the most populous of the nations of Oceania. Viti Levu (10,390 square kilometers and site of the capitol, Suva), Vanua Levu (over 5,538 square

kilometers), Taveuni, and Kadavu, are the largest of the high volcanic islands. Far more numerous are the many small islands and atolls that are mainly part of the Lomaiviti, Lau, Moala, Yasawa, Mamanuca, and Rotuma groups. The larger islands tend to be well-forested and well-watered, although Fiji suffers from periods of drought associated with El Niño episodes. The highest peak is Mount Tomanivi, on Viti Levu, at 1,323 meters.

The first human residents were Austronesian Melanesians who arrived about 3,000 years ago. European exploitation commenced early in the nineteenth century with whaling, sandalwood cutting, and bêche-de-mer fishing. British missionaries and interests dominated the islands and in 1873, the British government formally annexed Fiji. From the 1860s, cotton and sugar plantations were established and from the 1870s, large numbers of Indians were imported to labor on the plantation, coming to form a substantial proportion of the population and of business owners. Fiji gained independence in 1970, but its subsequent history has been marked by tension between the indigenous Fijians and the later immigrant Indian community.

Environmental Issues: Fiji has more extensive indigenous biota and "natural resources" than most nations in Oceania, a reflection in part of the extent of its land masses. About 3,000 species of flora are found, of which about one-third are endemic, and prior to human occupation Fiji possessed approximately 100 species of birds, 20 species of reptiles, and 1 indigenous land mammal—a bat. Three of the bird species are believed to have become extinct soon after the arrival of the Austronesians with their pigs and the Pacific rat. Europeans contributed to the decline by introducing goats, rats, dogs, and cats, and then the Indian mongoose to control rats in sugar plantations. In the last 150 years, land clearance for sugar and cotton plantations and timber cutting of forests (around 15 percent of the country's forests have been cleared since the 1960s) have been major sources of income but have contributed to soil erosion and the degradation of the water systems. Gold and copper mining causes localized degradation and pollution, while urban and tourist impacts on land and adjacent waters and corals reefs, and overfishing of offshore waters, loom as problems. A number of conservation groups are based or represented in Suva, including the South Pacific Action Committee for Human Ecology and Environment, the World Wildlife Fund, and Greenpeace.

FRANKLIN RIVER (see Gordon-Below-Franklin Campaign)

FRENCH POLYNESIA

Population: 262,000

Geography: French Polynesia, as its name suggests, was colonized by the French, who still maintain an essentially colonial regime under the guise of being a part of France. The territory consists of five main archipelagos in the eastern part of Polynesia. These contain 118 islands and atolls with a land area of 3,660 square kilometers, a mixture of rugged high islands and low islands, atolls, and reefs. Four of the archipelagos consist largely of high volcanic islands and are mountainous: the Society Islands (subdivided into the Windward and Leeward Islands), the Austral Islands, the rugged and high Marquesas, and the Gambier Islands, which contain a mixture of high islands and small islands within an encircling reef. The Tuamotu Archipelago consists of low-lying coral atolls apart from Makatea Island, which was one of the major Oceanic phosphate islands. The phosphate was exhausted in the 1960s. Tahiti, the main island, is in the Society Islands. It was one of the early Pacific sites visited by British and French explorers in the eighteenth century. Their accounts of the Tahitian environment and people were major factors in fixing the Pacific in the European imagination as an earthly paradise. Tahiti now possesses most of the territory's population and the capital, Papeete.

Environmental Issues: French Polynesia was the site of extensive French nuclear testing over three decades beginning from 1966. The long-term impacts of these tests are the gravest environmental problem facing the region, especially around Mururoa and Fangataufa atolls. Reportedly high rates of cancer and birth defects, and the apparent leakage of plutonium into the sea near Mururoa, are sources of concern, but the secrecy of the French government has prevented full public disclosure. The usual problems associated with urban development, tourism, land clearing, and extensive fishing are also to be found.

GALAPAGOS ISLANDS (see Darwin, Charles)

GLOBAL WARMING

While there are still a few people who deny the likelihood of global warming or the degree to which it is attributable to human activities, at the start of the twenty-first century, there is substantial understanding among scientists and wider communities that the world has been warming since the industrial

revolution in the eighteenth century, and that this threatens the future of life on the planet as we know it. Current estimates are that the temperature of the planet has risen by 1°F, or .6°C, in the last century, much of it in the late twentieth century. Current predictions (not universally accepted) are that the average surface temperature could rise in the next fifty years by up to 4.5°F, or 2.5°C, and in the next century by up to 10°F, or 5.8°C.

The Earth's atmosphere naturally contains a number of so-called greenhouse gases, which trap the Sun's warmth, maintain the earth's temperature and climate, and create the conditions for life on this planet. However, human activities are changing the contents of the atmosphere. Most significant is the increasing release of disproportionate levels of greenhouse gases, particularly carbon dioxide, methane, and nitrous oxide. The increase of carbon dioxide is associated with the vast consumption of fossil fuels as the principal source of energy in modern societies. The United States is estimated to contribute about 20 percent of global greenhouse gases. The problem is made worse by continued land clearing and the decline of the planet's forests, thereby reducing the floral species that normally remove carbon dioxide from the atmosphere by photosynthesis. The presence of such high levels of greenhouse gases reduces normal levels of heat escape and the planet is becoming warmer. The ice caps at the poles and in mountainous regions are melting, causing a rise in sea levels. The earth's climate is also changing, with the likelihood of more extreme storms or extended droughts in many areas.

Among other expected changes are rises in sea levels by up to a meter in the next century, which could swamp many low islands in the Pacific, or pollute their freshwater supplies. In addition, because tropical corals grow best in water from 21°C to 28°C, a rise in ocean temperatures will bleach many of the planet's coral reefs by killing the colored algae that live in the corals and upon which the coral polyps depend. The reefs will then die and decay. (See also discussion in Chapter 6.)

GONDWANA

Gondwana was the southern megacontinent that hundreds of millions of years ago contained the land masses that have now broken into Australia, New Zealand, New Guinea, and some of the western Pacific islands as well as South America, Africa, Antarctica, and India. It is named after geological features found in the Gondwana region of India. Although the continent began breaking up about 130 million years ago, the regions still share some Gondwana inheri-

tance in their biota. About 45 to 80 million years ago, the section containing Australasia known as Sahul broke away and began drifting north. (See Sahul and discussion in Chapter 1.)

GORDON-BELOW-FRANKLIN RIVER CAMPAIGN

Despite widespread public opposition to the damming of Lake Pedder in the early 1970s, the Tasmanian government and the Tasmanian Hydro-Electricity Commission continued to foster plans to establish new bodies of water for hydroelectricity generation. In the late 1970s, they proposed the creation of a large new reservoir by damming the Gordon River below its confluence with the Franklin River on the west coast. It was an area of great natural beauty and high biodiversity, and the dam would have flooded a large reach of the superb, wild Franklin River and its catchment. The Tasmanian Wilderness Society, which had been formed in 1976, organized opposition but the HEC proceeded with its plans and the resulting campaign was one of the most significant in Australian history.

The Tasmanian government went through the farce of holding a referendum in December 1981 in which electors were given the choice of the Franklin dam or a compromise proposal, which was little better. The Wilderness Society argued that voters should write "No Dams" on the ballot paper, which 45 percent of them did. The Society had learned the lessons of its earlier loss with Lake Pedder and, realizing that this was an issue with wider implications than just Tasmania or even Australia, was very successful in building a campaign that had a wide impact. In particular, they used superb photographs by Peter Dombrovskis to create beautiful posters. Film and television was also very successfully incorporated into a campaign aimed at impressing the public with the beauty and the ecological significance of the region.

A major victory for the campaigners seemed within reach when they convinced the conservative Liberal federal government to nominate a large area of southwest Tasmania for World Heritage listing as a way of protecting the Gordon and Franklin Rivers. However, this simply caused the Tasmanian authorities to speed the work before the listing could be made. (Constitutional relationships and environment are discussed in Chapter 7.) The issue came to a head late in 1982 when the HEC began to transport bulldozers up the Gordon River to commence road building and earth works. The Wilderness Society quickly organized a blockade, which began in mid-December and continued into the new year. Over 2,000 people came from all parts of Australia, and even

from other countries, to resist and disrupt. In the face of local hostility and a determined police force, about 1,500 protesters were arrested.

Coincidentally, a surprise federal election was called for March 1983, and the new Labor Party leader, Bob Hawke, announced that if elected, he would stop the dam. With the help of the environmental vote, Hawke won, and he announced on election night that the dam would not be built. The Tasmanian government fought the decision in the courts but finally had to admit defeat, although it has continued to approve the damming of other areas and the clear felling of native forests.

GREAT ARTESIAN BASIN

The Great Artesian Basin is a vast area of permeable sandstone aquifers that lie under significant parts of Queensland, New South Wales, South Australia, and the Northern Territory in central Australia, at depths of from a few hundred to up to 2,000 meters. The Basin has an area of over 1,711,000 square kilometers and the estimated water storage capacity of its the aquifers—which accumulated over a period of perhaps 2 million years—was 8,700 million megaliters.

Aborigines and wildlife gained access to the water through mound springs or bubblers, natural springs scattered irregularly across parts of central Australia. The bubblers also attracted European explorers and stockholders, and became an integral part of the pastoral industry as it spread across the region. From the 1870s, pastoralists began to sink bores to tap into the artesian water, and by World War I, there were about 1,500 bores in operation. Most were uncapped and the water was allowed simply to overflow into the desert or was distributed by open bore drains. Most evaporated or drained into the soil.

Government concern about this waste of water and the impact on the Basin has yet to result in effective cooperation or action. While there have been some controls gradually applied, the use of the water has been widened to include other industries including mining and natural gas. More than 4,700 artesian bores and more than 2,400 subartesian bores have been drilled. There are still about 3,700 uncapped and free-flowing bores from which it is calculated that 570,000 megalitres of water flow each year. About 500,000 megalitres is produced for the pastoral industry, but most is wasted by free-flowing bores and over 40,000 kilometers of bore drains, which lose 90 percent of the water that enters them. The quantity of water stored in the Great Artesian Basin has dropped severely and artesian pressure and water discharge rates have declined. Most of the natural springs are now dry.

GREAT BARRIER REEF

The Great Barrier Reef is a combination of 3,400 coral reefs, 300 coral cays, and 618 islands that stretch parallel to the Queensland coast for more than 2,000 kilometers from near the Tropic of Capricorn to the north of Cape York Peninsula. It is the largest coral reef system in the world and is often proclaimed as the only natural feature large enough to be seen from space. As well as being superbly beautiful, it is immensely biologically rich, being inhabited by more than 1,500 species of fish, 400 species of coral, 4,000 species of mollusk, 242 species of birds, dugongs, and a number of species of whales, dolphins, and turtles, besides many sponges, anemones, and crustaceans.

Human action apart from fishing, shipping, and some land runoff offered little threat to the Reef prior to World War II. Since then it has come under increasing pressure from many directions. Oil drilling and sand mining in the 1960s and 1970s were ended in the 1970s, and much of the reef was incorporated into a national park. In 1981, the Great Barrier Reef was given World Heritage listing, and an area of nearly 35 million hectares is now covered by that protection. However, there are still major threats from land pollution from agricultural and urban runoff, plagues of the crown of thorns starfish, and overfishing. More than 3 million tourists visit the Reef each year, adding significantly to human utilization and environmental pressures. However, the major threat in the coming century is from global warming and coral bleaching. If sea temperatures and levels rise to the extent that some scientists are predicting, most of the Reef and its inhabitants will perish.

GUAM

Population: 164,000, including 13,000 American military and associated personnel.

Geography: Guam is an American territory consisting of a single island of 550 square kilometers in the northern Pacific, the most southerly of the Mariana Islands.

Environmental Issues: Guam has lost most of its birdlife through the depredations of the alien brown tree snake. There is considerable environmental pressure from the U. S. military base, rising population, and tourist development.

(For a more detailed discussion of Guam, see Chapter 5.)

HAWAI'I

Population: 1,245,000

Geography: Hawai'i is the only state of the United States not situated on the North American mainland, but it lies more than 4,000 kilometers to the west in the north Pacific. The state occupies an archipelago of about 130 islands with a land area of about 16,700 square kilometers, of which six major and two lesser islands are inhabited. These are all at the southeastern end of a long chain of underwater volcanoes that stretch from near Midway atoll in the northwest, some 2,500 kilometers away. The volcanoes and the islands are the result of movement of the Pacific Plate over a stationary hot spot, a weak point in the earth's mantle through which lava is forced. (See Chapter 2, and Pacific Ocean).

The largest of the islands, Hawai'i or the Big Island, is still situated over the hot spot and has been formed by five volcanoes, three of which are considered active: Kilauea, which has been putting on spectacular shows since the 1950s; Mauna Kea, which has been dormant since 1984 and at 4,205 meters is the highest peak in the archipelago—and taller than Mount Everest if one measures it from the ocean floor; and Hualalai, which rises over the city of Kona and has been dormant for two centuries but whose lava and ash are very apparent in the landscape.

The other main islands, from the southeast, are Maui, Lana'i, Moloka'i, O'ahu, and Kaua'. Maui, formed by two high volcanoes with a low plain or isthmus connecting them, is the second-largest of the islands. Lana'i, considerably smaller and formed by a single volcano, lies in the rainshadow of Maui and is fairly arid. Moloka'i was formed by three volcanoes and is divided into three main areas—the rugged mountains, canyons, and cliffs of the eastern half; the dry rolling hills and some sandy beaches in the western half; and the Kalaupapa Peninsula, which juts into the ocean below the cliffs of the exposed northern shore. O'ahu, the site of the capital, Honolulu, is dominated by two mountain ranges, the Koolau Range in the east and the Waianae Range in the west, with a fertile valley plain between them. Kaua'i, slightly separated from the main group and somewhat older, is notable for its dramatic mountains (claiming the most rainfall on the planet), canyons, and cliffs, which dominate its north-western two-thirds, and the green hills and plains skirted by sandy beaches that occupy the rest. The other two substantial islands in the group are Kaho'olawe, which is south of Maui, and Ni'ihau west of Kaua'i, both of which were produced by smaller volcanoes.

Generally speaking, the further west the islands, the older and more weathered they are, while their reefs are more established and boast richer marine

life. The flora and fauna that reached these remote islands and evolved on them was remarkable, with about 95 percent of species being endemic. The Hawaiian Islands were particularly notable for their unique species of birds, especially the 40 species of honeycreepers, and more than 750 land and freshwater snails. (See Chapters 2 and 7.)

The islands were first settled by Polynesians in about 400 A.D., and over the next 1,300 years, the Hawaiians developed a sophisticated society notable for its complex agricultural and fishing systems. The first known European encounter was the arrival in 1778 of Captain James Cook who named the archipelago the Sandwich Islands. Cook was stabbed to death in February 1779 at Kealakekau Bay near the modern site of Kona on the Big Island. During the nineteenth century, American sandalwood merchants, whalers, cattlemen, sugar plantation owners, and missionaries acted as the forerunners and subsequently the agents of United States influence. Hawai'i became a U.S. Territory in 1900 and the site of a major naval base, at Pearl Harbor. After the Japanese attack on Pearl Harbor on 7 December 1941, Hawai'i played a major role in the Pacific war and has continued to have a large military presence and significance. Hawai'i became the fiftieth state of the United States on 21 August 1959. It has become a magnet for tourists, welcoming about 7 million each year.

Environmental Issues: Sandalwood cutting and the convenience of the islands for whalers brought substantial numbers of Europeans to the Hawaiian Islands from early in the nineteenth century, with considerable localized environmental impacts on regions where sandalwood was cut and where ships landed. The extent and fertility of the islands brought extensive European settlement in the nineteenth century and large areas were converted to agricultural and pastoral production, notably cattle grazing and sugar plantations. Both resulted in the clearance of large areas of lowland vegetation, and the onset of problems associated with soil erosion and invasive species. These problems continued throughout the twentieth century, with periodic and geographical variations such as the conversion of most of Lana'i to pineapple growing and the increasing military presence.

At the start of the twenty-first century, Hawai'i faces a significant number of environmental problems associated with the increasing size of its population, the level of development on most of the main islands, and the pressures from the huge tourist industry. However, arguably even worse, Hawai'i has come to epitomize one of the most dire examples on the planet of the repercussions of the introduction of alien species into a fragile insular ecosystem. The indigenous biota had evolved in long isolation and has proved particularly vulnerable to the huge range of introduced species. Extinctions have been numerous and about half of the remaining species of flora are considered endangered. Hawai'i's

spectacular honeycreepers and snails are in steep decline. (For a more detailed discussion of alien species in Hawai'i, see Chapter 7.)

HOWLAND ISLAND

Howland Island is a small, uninhabited island of only 1.6 square kilometers in the northern Pacific, west of Kiribati. It was claimed by the United States in 1857 for phosphate mining and its deposits were exhausted by the end of the nineteenth century. The island is hot and windy with only low vegetation apart from a small group of trees in the center, and no supply of fresh water. It is protected by the United States as a wildlife refuge for birds and for aquatic species on its fringing reef.

HYDROGEN BOMB TESTS

In the nuclear arms race after World War II, both the United States and the Soviet Union tested and developed nuclear fission bombs. However, by the early 1950s these were already being partly superseded in the pursuit of the superbomb—a so-called hydrogen bomb that used a fusion process. The United States tested its first hydrogen bomb, code named "Mike" on Elugelab Island in the Enewetak Atoll in November 1952. It produced a huge fireball that rose 5 kilometers into the air, an enormous mushroom cloud, and obliterated Elugelab, leaving a large underwater crater in the atoll where the island had been.

The second hydrogen bomb, code named "Bravo," was exploded over Nam Island at Bikini Atoll on 1 March 1954. Because of a miscalculation of the forces unleashed by the fusion reaction, the explosion turned out to be much greater than anticipated, and the resulting radiation made it the dirtiest bomb exploded in the atmosphere—at 15 megatons, it was more than 1,000 times bigger than the bomb dropped on Hiroshima and the largest bomb tested by the Americans. It blew a crater about 2 kilometers wide and 80 meters deep in the reef, lifting vast quantities of radioactive powdered coral into the atmosphere. The coral fallout and radiation fell over hundreds of square kilometers and many people, including United States personnel and Marshall Islanders on Rongerik, Rongelap, Ailinginae, and Utirik atolls. The Americans were generally protected, but many of the Islanders were exposed to radiation and suffered various contamination symptoms. The crew of a Japanese fishing vessel 130 kilometers away contracted radiation sickness and one died. In 1955 the Japanese, and then in 1997 the Marshall Islanders, were granted some compensation.

JARVIS ISLAND

Jarvis Island is a small uninhabited island of 4.5 square kilometers on the equator, north of the Cook Islands, which in the nineteenth century was mined by U.S. interests for guano. In 1974, it was declared a National Wildlife Refuge administered by the U.S. Department of the Interior. It is a sandy coral island with fringing reef, low rainfall, constant wind, and very hot sun.

JOHNSTON ATOLL

Johnston Atoll is an isolated dot of 2.8 square kilometeres in a remote part of the north Pacific, 1,300 kilometers southwest of Hawai'i. It was mined by U.S. interests for guano in the nineteenth century. In the 1950s and 1960s, it was used for high-altitude nuclear tests and then until the year 2000 as a disposal site for chemical weapons. The atoll has been considerably altered by the dredging of coral sand to create further land areas. The islands are very low, have little vegetation, and are very hot and dry. Ironically, the atoll is also a wildlife refuge.

KIRIBATI

Population: 98,000

Geography: Kiribati is an independent republic made up of thirty-three coral atolls and low-lying islands (twenty-one inhabited), with a land area of a mere 811 square kilometers. These are gathered in three main groups that are scattered across nearly 4,000 kilometers along the equator. The groups, from the west, are: the Gilbert Islands (sixteen atolls), the Phoenix Islands (eight atolls, mainly uninhabited), and the Line Islands (only three inhabited). The capital is Tarawa, in the Gilbert Islands, where about a third of the population reside. Kiritimati, also known as Christmas Island and located in the Line Islands, is the world's largest coral atoll and at 388 square kilometers, contains 48 percent of Kiribati's total land area. Banaba, also known as Ocean Island, is a raised coral island that lies 400 kilometers west of the Gilbert Islands and was a major source of guano-phosphate in the twentieth century until its deposits were exhausted in the 1970s. The Japanese removed or killed virtually all of Banaba's indigenous inhabitants in World War II.

Environmental Issues: The major issue facing Kiribati is that being so low-lying, the highest point being a mere 81-meter hillock on Banaba Island, it is

one of the nations most vulnerable to global warming and rising sea levels. However, the small nation has a number of other environmental issues in its past and present. The islands have very limited resources, consisting essentially of a base of coral rock thinly coated with an infertile sandy soil that supports only limited vegetation. There are no significant bodies of fresh water. Japanese occupation and American liberation in World War II left several islands environmentally devastated, notably Tarawa. Subsequently, Christmas Island was also used by the British for nuclear testing. The country experiences frequent typhoons, and the area around Tarawa and its lagoon is infamous for the rubbish and pollution from urban and human waste. Despite all this, the accessible parts of Kiribati are very attractive to tourists because of their birdlife, fishing, and diving on reefs and World War II wrecks. Apart from tourism, copra exports and licences to fish in the Exclusive Economic Zone are the main sources of income.

LAKE MANAPOURI CAMPAIGN

The campaign in the late 1960s and early 1970s to prevent a substantial increase in the water level of Lake Manapouri in the fjordland region on the South Island in order to provide more water for hydroelectric generation was one of the earliest and most significant environmental protest movements in New Zealand. Manapouri and adjacent Lake Te Anau are large and beautiful lakes that had considerable significance for Maori and had also become major tourist attractions. The campaign to preserve them united a number of environmental, wildlife, and indigenous interest groups that won sufficient public support for the new Labor government that was elected in 1972 to announce that it would not proceed with the plan.

LAKE PEDDER CAMPAIGN

Until 1972, Lake Pedder was an amazingly beautiful, small-to-medium lake surrounded by mountains, high in alpine Tasmania. When the Tasmanian Hydro-Electric Commission proposed in 1967 to dam the outlet and flood the lake, creating a much larger body of water for hydroelectric generation, there was widespread protest in Tasmania and other parts of Australia. It became one of the earliest and most important environmental campaigns in Australia, but as both major political parties were committed to the project, the Tasmanian government was able to overwhelm the opposition. Flooding of the lake com-

menced in 1972, and it has since become one of the great environmental landmarks and memories. The ongoing symbolic and ecological importance of Lake Pedder was demonstrated by a failed proposal in 2002 to release the waters and to restore the lake to its original levels.

LEEWARD ISLANDS (see French Polynesia)

LITTLE DESERT CAMPAIGN

The Little Desert Campaign was one of the first environmental campaigns in Australia to involve the general public and to have political repercussions. The Little Desert is an area of sandy mallee country in far western Victoria. In the 1950s, it was still government land that had been partly grazed but had not been cleared for agriculture because it had been considered too infertile. After World War II, new land clearing technology, trace elements, and superphosphate made it potentially more viable to bring such marginal land into production. Proposals in the late 1950s and early 1960s to develop the Little Desert lapsed, at least partly because of ongoing questions about the financial viability of the schemes and the agricultural value of the land.

In 1967, the Victorian Minister for Lands revived the idea, proposing the clearing of 80,000 hectares and the reservation of a smaller section as a national park. A significant opposition campaign was mounted, both locally and in Melbourne, in which a combination of experts (naturalists, scientists, and conservationists) played a major role. Members of the broader public also became involved in the protest, attending public meetings, joining a campaign organization, and writing letters to newspapers and politicians. The Melbourne *Age* took a strong opposing stand in its editorials. For the first time in Victoria, arguments grounded in ecological environmentalism rather than anthropological utilitarianism were widely presented.

Also for the first time, an environmental question became a political issue, and when in 1970, the Victorian government lost a bye-election, partly on the Little Desert matter, the scheme was abandoned. Instead, a new national park of 132,000 hectares was declared.

MARQUESAS (see French Polynesia)

MARSHALL ISLANDS

Population: 56,000

Geography: The Republic of the Marshall Islands was until recently under the control of the United States and there is still a significant American influence and military presence. The country is made up of a myriad of over 1,200 tiny islets formed by 29 atolls, with a total land area of 720 square kilometers. Most of these atolls are situated in two roughly parallel archipelagic chains that run northwest from the northern border of the Gilbert Islands into the northern Pacific. Majuro Atoll, the capitol, supports about half the population, while the other main center is around the American military base at Kwajelein Atoll.

Environmental Issues: The Marshall Islands can lay claim to being one of the world's lowest nations, its highest point being only 10 meters above sea-level. This makes the islands particularly vulnerable to threatened rises in ocean levels. Some of the atolls also suffered severely from military activity during World War II and from the sixty-seven American nuclear tests held on Bikini and Enewetok Atolls after the War. The inhabitants of those atolls were moved, and attempts to resettle them have been frustrated by continuing radiation pollution, especially from the danger of eating locally grown food. There are particular health concerns on the island of Rongelap, which was covered in fallout from the 1954 hydrogen bomb test on Bikini. The Marshall Islands have few natural resources apart from marine products and are heavily dependent on foreign aid and imports.

MELANESIA

In 1832, French explorer Dumont d'Urville suggested that the Pacific was divided into three geographical regions occupied by people of different ethnic and cultural characteristics—Melanesia, Micronesia, and Polynesia. While still widely used, these terms are now seen as being rather problematic.

Melanesia, meaning black islands, was named because of the generally dark-skinned people who inhabit the region, which is now made up of the nations of Papua New Guinea, Solomon Islands, Vanuatu, New Caledonia, and Fiji. The region possesses some sense of geographical unity from the fact that it is substantially made up of relatively large volcanic and uplifted islands in the west of the Pacific. However, despite a tendency to a shared dark skin color, the human history is very complex. The first people arrived in the New Guinea region in about 55,000 years B.P., and over the next 25,000 years or so moved on through New Britain, New Ireland, Bougainville, and the Solomon Islands. This

region is now known as Near Oceania. A further group of people known as Austronesians moved out of Southeast Asia in about 3,500–4,000 years B.P. and followed this same path, although much more quickly, mixing their culture and genes with the previous inhabitants before sailing further into the Pacific over the next thousand years to settle Vanuatu, New Caledonia, and parts of Fiji, Tonga, and Samoa. (See Chapter 2 for further discussion.)

MICRONESIA

In 1832, French explorer Dumont d'Urville suggested that the Pacific was divided into three geographical regions occupied by people of different ethnic and cultural characteristics—Micronesia, Melanesia, and Polynesia. While still widely used, these terms are now seen as being rather problematic.

Micronesia, meaning small islands, is aptly named because it consists of thousands of tiny atolls and other small islands in the northwestern Pacific. It contains the modern nations and regions of the Marshall Islands, Federated States of Micronesia, Republic of Palau, Guam, and the Northern Marianas. While sharing the habitation of tiny islands and a propensity for sailing, the people of Micronesia are too genetically diverse to be seen as an ethnic entity. There appear to have been at least four main shipborne migrations into the region from both Asia and elsewhere in the Pacific. There are two main language groups and several sublanguages. (See Chapter 2 for further discussion.)

NAURU

Population: 12,570

Geography: Nauru is an independent republic occupying a single island of only 21 square kilometers, situated 42 kilometers south of the equator and north of the Solomon Islands. It has a central plateau that rises to 61 meters.

Environmental Issues: Nauru consisted essentially of a large body of bird guano (phosphate) deposited over millennia on a base of rock and coral. The phosphate was of immense value as fertilizer for poor soils and has been mined since the beginning of the twentieth century by German and then British and Australian interests. Most was exported to Australia and New Zealand. To mine it, vegetation was removed and the phosphate was dug down to the coral bedrock, leaving a landscape of shimmering wasteland. At the start of the twenty-first century, the phosphate deposits were almost exhausted and the people were facing a bleak future on an island with little income, potable water,

or vegetation and a near-bankrupt government. There were ongoing discussions about repatriation of the Nauruans to Australia once mining ceased.

NEW CALEDONIA

Population: 211,000

Geography: New Caledonia is based upon a group of twelve islands lying in the western part of the South Pacific, some 1,200 kilometers from the Australian coast, and with a land area of 19,103 square kilometers. It is dominated by the large Gondwana remnant that forms the island of Grande Terre (16,350 square kilometers), on which Noumea, the capital, is situated. Grande Terre has been substantially modified by subsequent volcanic and geological activity, but retains a significant complex of Gondwana vegetation as well as later arrivals of flora and fauna. It is a rugged, mountainous island that rises to 1,628 meters and is large and high enough to have distinct climatic and vegetation regions. The east coast faces the prevailing winds and receives much more rain than the west coast, which lies in the rain shadow of the central mountain range. The east coast and the mountains have areas of dense tropical rain forests. The other main islands in the group are Ile des Pins (152 square kilometers) at the southern foot of Grand Terre, and the Loyalty Islands to the east. Around 80 percent of flora and 30 percent of fauna are endemic.

New Caledonia was first occupied by the Austronesian/Melanesian or Lapita people in about 2800 B.P. The first European visit was by Captain Cook's second voyage in 1774. British traders and missionaries became established on the islands in the first half of the nineteenth century, but French interests and missionaries were also present; in 1853, the French government annexed the islands and in 1864, they established a notorious penal settlement. France has suppressed attempts by the local people to gain independence since World War II, and New Caledonia remains a French territory, in effect still a colony

Environmental Issues: Because of its Gondwana origin and size, Grand Terre has greater mineral wealth than most parts of Oceania, including nickel, chrome, iron, cobalt, manganese, silver, gold, lead, and copper. Mining of these minerals is a principal source of environmental damage, with nickel mining causing deforestation, erosion, and river pollution on Grande Terre, while the nickel smelter near Noumea causes serious air, ocean, and coral pollution. About 80 percent of New Caledonia has been cleared for grazing, mining, and intensive commercial agriculture of export crops like oranges, pineapples, avocadoes, and rice.

NEW GUINEA (see Papua New Guinea)

NEW ZEALAND

Population: 3,951,000

Geography: The New Zealand archipelago contains the largest land masses in the Pacific Islands, stretches the furthest south of any part of Oceania, has the coldest climate, and, not coincidentally, was the last to be settled by humans. The land area of the archipelago is about 270,500 square kilometers including the North Island, South Island, Antipodes Islands, Auckland Islands, Bounty Islands, Campbell Island, Chatham Islands, Kermadec Islands, and numerous other small islands scattered around the coast. The largest land masses are the South Island (151,000 square kilometers) and the North Island (115,000 square kilometers and site of the capitol, Wellington). Originally these were Gondwana fragments, but they have been greatly changed by volcanic action and uplift caused by their positioning in a region where the Pacific Plate is sliding underneath the Indo-Australian Plate. The South Island is particularly mountainous with substantial alpine regions and many glaciers. The highest point is Aoraki-Mount Cook at 3,754 meters. Because of its size, New Zealand developed a richness of biota including large numbers of endemic species, perhaps most notably its flightless birds.

Environmental Issues: More than 70 percent of New Zealand has been cleared for agriculture, forestry, and urban settlement, and more than 20,000 alien species have been introduced. As a result, much of the New Zealand landscape and its biota have been transformed, and the country suffers many environmental problems among which soil erosion and the threatened extinction of indigenous species are prominent.

(New Zealand's environmental history is outlined in the relevant sections of Chapters 2, 5, and 6.)

NIUE

Population: 1,600

Geography: Despite its minute population, Niue is a self-governing country, the smallest in the world, although with close ties and considerable support from New Zealand. It consists of a single makatea or uplifted coral island, with

a land area of 260 square kilometers, making it one of the largest coral islands in the Pacific. It is situated south of American Samoa, between the Cook Islands and Tonga. It has steep limestone cliffs along the coast and a central plateau that rises at its peak to 68 meters.

Environmental Issues: The arable areas of Niue suffer from infertility due to centuries of slash and burn agriculture. While the sustainable population capacity of the island is unclear, there is a great deal of concern about the decline of the population, which has shrunk steadily in recent decades. There are far more Nieuans living overseas than at home, notably about 17,000 in New Zealand and 3,000 in Australia. Negotiations have been conducted with the government of Tuvalu about encouraging people from Tuvalu, which is considered overpopulated, to migrate to Niue. In addition to population concerns, feral cats have had a considerable impact on the local fauna. However, the gravest threat to Niue may be global warming, and an unprecedented cyclone in January 2004 did such damage that there was doubt that the nation could recover and rebuild. There was speculation that the cyclone might be connected to changing weather patterns and more extreme weather events that are associated with global warming.

NORFOLK ISLAND

Population: 2,000

Geography: Norfolk Island is a self-governing external Australian territory 1,600 kilometers northeast of Sydney. It is of volcanic origin, rising to 319 meters with an area of 35 square kilometers. Most of the coastline consists of inaccessible cliffs, but there is a small bay where the capital, Kingston, is situated and where ships are able to land. The island had 178 species of indigenous flora, 40 of which are endemic, 15 species of land birds, no amphibians, and 2 species of lizard. Norfolk Island, then uninhabited, was encountered and named by James Cook on his first voyage in 1770. His party was particularly impressed by two species of flora, the now widely emigrated Norfolk Island Pine (*Araucaria heterophylla*) and the Flax (*Phormium tenax*). Their potential for shipping materials—the pines for masts and the flax for sailcloth—was one of the justifications for the decision to establish a convict settlement in New South Wales. A settlement was established at Norfolk Island within weeks of the arrival of the First Fleet in Sydney Harbor. The two plants proved unsuited for naval purposes, and the settlement was withdrawn in 1814. However, from 1825 to 1854, Norfolk Island was again the site of a particularly brutal penal settlement. In 1856, the de-

scendants of the *Bounty* mutineers were resettled from Pitcairn Island to Norfolk Island, and their descendants still make up about half of the population.

Environmental Issues: Hundreds of thousands of Norfolk Island Petrels were killed to supply the early convict settlement with food, and their numbers declined further as land was cleared and pigs and other alien species were introduced. The species became extinct, as did the Norfolk Island Ground Dove and the Norfolk Island Kaka (a parrot). In all, eight of Norfolk Island's sixteen endemic bird species became extinct within the first century of settlement. By the end of the twentieth century, most of Norfolk Island had been cleared for agriculture and urban settlement, leaving indigenous vegetation confined to the island's national park and botanic gardens. About eighteen of the endemic species of flora are considered endangered or vulnerable.

THE NORTHERN MARIANA ISLANDS

Population: 80,000

Geography: The Northern Mariana Islands form a quasi-independent Commonwealth territory in union with the United States. The territory contains fourteen islands with a total of 477 square kilometers that stretch in an arc from north of Guam (the most southerly of the chain but a separate state) into the north Pacific. The capital, Garapan, is on the island of Saipan, the largest of the islands and home to 90 percent of the population. The Marianas are formed by the peaks of an enormous volcanic mountain range that rise nearly 10 kilometers from the ocean floor. As a result, the islands are generally mountainous, with the highest point (965 meters) found on the island of Agrihan which, together with Pagan Island, has an active volcano.

Environmental Issues: Some of the islands were extensively cleared for sugar plantations by the Japanese who took over the Northern Marianas as a Protectorate after World War I. Large areas were devastated in 1944 in some of the fiercest fighting in the Pacific when U.S. forces invaded, using napalm to clear vegetation. Serious erosion resulted and revegetation with alien species compounded the difficulties for local ecosystems. A heavy American military presence has continued to cause problems of urban pollution and waste.

NUCLEAR TESTS (see Hydrogen Bomb Tests and discussion in Chapter 5)

PACIFIC OCEAN

Depending on where one draws its borders, the Pacific Ocean covers an area of around 162 million square kilometers, making it not only the largest of the world's five oceans, but larger than all the others combined. It covers nearly a third of the globe, which is more than the total area covered by land. At the equator, the Pacific is 16,700 kilometers wide, and at its widest more than 19,000 kilometers, stretching across about 45 percent of the globe. It is also the deepest ocean, and at its lowest point, the Challenger Deep in the Mariana Trench, is 10,924 meters. The Pacific also has more than 25,000 islands, most of which are in the form of tiny atolls and other coral islands. However, a small number of islands, fragments of Gondwana or the product of uplift of the earth's crust or recent volcanic action, are quite large. These are mainly in New Zealand, Hawai'i, Fiji, New Caledonia, Vanuatu, and the Solomon Islands.

It is now generally although not universally accepted that the earth's crust is made up of several semirigid and irregularly shaped tectonic plates that are in a constant state of motion over a more fluid layer of underlying material. Where these plates abut, move apart, or collide and grind into each other, they generate immense pressures, which cause earthquakes and volcanic eruptions. The floor of the Pacific is divided into four main tectonic plates. The largest, the Pacific Plate, occupies the vast majority of the central and northern Pacific and rotates in an counterclockwise or essentially northwesterly direction. Its circumference is marked by the "ring of fire," the volcanic activity that accompanies its movement against the other plates. For example, the border where the Indo-Australian Plate (which lies beneath Australia and southern Asia) is slowly forcing its way over the Pacific Plate can be traced by the line of volcanic activity running through New Zealand, Vanuatu, and the Solomons. The other two smaller plates are the Cocos Plate off the west coast of Central America and the Nazca Plate which lies off the coast of South America.

The Pacific floor is marked by thousands of enormous volcanoes that have erupted over millions of years. Some have reached thousands of meters to break the surface and form islands, but most have become guyots, extinct peaks that either never made it to the surface or have sunk back below. Many Pacific volcanoes, volcanic islands, and guyots are the product of hot spots in the ocean floor, or points where volcanic pressures have broken through the slowly moving Pacific Plate. The best example of such a hot spot is the Hawaiian archipelago. (See Chapter 2.)

The Pacific Ocean is such a large body of water that it influences the planet well beyond its shorelines, perhaps most notably in its impact on climate. The El Niño and La Niña phenomena are among the most apparent examples, but

there are many more subtle but equally significant influences on weather and climate patterns. These affect not only the land masses that occupy and border the Pacific but impact upon ocean currents, wind patterns, and weather, and therefore also biota and human history, both in the Pacific and across large areas of the globe. Geoffrey Irwin, *The Prehistoric Exploration and Colonisation of the Pacific* (1992), discusses the influence of wind, weather, and currents on sailing and colonization in the Pacific.

Human use of the Pacific Ocean, especially since the 1770s, has placed great stress on its health and biodiversity. Millions of seals and whales had been taken from its waters by the 1840s, causing unknown disruption to its ecosystems. World War II caused considerable local damage to reefs and coastal systems that had been caught up in the fighting. From the 1950s to the 1990s, the Pacific was the main site for nuclear tests, which has left areas in the Marshall Islands and French Polynesia badly damaged and contaminated. Fishing has become a major industry since World War II, with 96 percent of the world's fish catch coming from the Pacific in 1996. Fish stocks have been rapidly reduced, and marine birds and other species have suffered directly from fishing practices or indirectly through disruption to food supplies. Land clearance and other human activities have caused siltation and pollution of coastal regions, while climate change and global warming threaten the future of coral reefs and low-lying islands. The offshore drilling for oil and gas is locally destructive and has the potential for major environmental damage if accidents occur. Many marine species are endangered, including the dugong, sea lion, sea otter, seals, turtles, and whales.

PALAU

Population: 19,700

Geography: The Republic of Palau gained its independence in 1994 after many years as a Protectorate, first under the Japanese trusteeship after World War I and then under U.S. control after World War II. It is the furthest west of the Pacific states, lying north of New Guinea and east of the Philippines and consists of 6 island groups of more than 300 islands with a land area of 458 square kilometers. The largest island, Babeldaob, is the second largest Micronesian island after Guam. It is a high volcanic island, as are the other substantial southern islands including Koror (the capital), Peleliu, and Angaur. The islands in the north are smaller coral islands. There are also major reefs and many small limestone islands.

Environmental Issues: Because of their proximity to Asia and their volcanic fertility, Palau's high islands possess substantial ecological diversity, a biotic

richness also found in its reefs and coastal waters. Some of the islands were badly damaged in World War II. Erosion from forestry and land clearance is a problem in some areas, while the usual Pacific problems of waste and overfishing are becoming apparent.

PAPUA NEW GUINEA

Population: 5.3 million

Geography: Papua New Guinea is an independent nation lying between Australia and the equator, east of Indonesia. It is made up principally of the eastern half of the world's second largest island, New Guinea, on which the capitol, Port Moresby, is situated. (The western half of New Guinea, Irian Jaya, is occupied by Indonesia.) Papua New Guinea also includes many smaller islands and atolls to the northeast and east including the Bismarck Archipelago, which is dominated by New Britain and New Ireland, and Bougainville, a total of 462,840 square kilometers. New Guinea and some of the smaller islands are Gondwana fragments that, with Australia, formed the ancient continent of Sahul and were separated by rising seas between 11,000 and 8,000 years B.P., following the last ice age. The region is situated upon the Pacific "Ring of Fire," as a result of which it has many volcanoes and experiences earthquakes, mud slides, and tsunamis. Most of the islands are "high islands" shaped by uplift and volcanic activity. New Guinea is dominated by a wide, rugged, and densely vegetated mountain range, the Highlands, which occupy the center of the island, the highest point of which is Mount Wilhelm, 4,509 meters. Coastal regions include many wetlands, while offshore are typical Oceanic coral reefs.

The biota of Papua New Guinea is rich and complex, made up of Gondwana species shared with Australia, later immigrants from Asia, and locally evolved endemic species. Like Australia, a number of species of megafauna became extinct, most likely because of human activities. The region possesses more than 200 species of mammals (many of which are very rare), about 900 bird species (including the remarkable birds of paradise), and a great diversity of reptiles, insects, and other forms of fauna, besides a complex diversity of flora ranging from the coastal wetlands to snow-topped highlands.

New Guinea was the first part of Oceania to be occupied by humans when the Australoid people arrived by sea from Southeast Asia between 50,000 and 60,000 years B.P. They settled the coastal fringe and moved slowly southeast through the other islands of Papua New Guinea and Near Oceania. They also penetrated deep into the valleys of the almost inaccessible central mountain ranges of New Guinea, establishing isolated communities that often developed

their own tribal cultures and languages—about 800 languages were spoken in the region occupied by the modern nation. Such was their isolation that the tribes had little contact with each other and in some cases were not exposed to the outside world until well into the twentieth century. There is also evidence that the New Guineans were among the earliest of human communities to evolve from hunter-gatherers to early agriculturalists who burned and otherwise cleared land on which to grow some of their favored food plants. From perhaps 10,000 years B.P., their agriculture became more complex and they developed sedentary agriculturally based societies.

There were various other human arrivals and visitors from Southeast Asia, and the second principal wave of migrants, the Austronesians, arrived between 4,000 and 3,000 years B.P. They possibly introduced pigs, dogs, chickens, and food plants which were incorporated into the local economies. Some Austronesians mixed with the local people, contributing to the disparate ethnic identity known as Melanesian, and the Austronesian migration also moved further into the Pacific occupying the region later known as Melanesia. They developed societies that were generally based upon a mixture of hunting, gathering, and agriculture.

The first European sighting of New Guinea was by Portuguese explorer Jorge de Meneses in 1526. He gave it the name Ilhas dos Papuas (Land of the Fuzzy-Haired People). Dutch contacts occurred in the seventeenth century after they removed the Portuguese from the Spice Islands and established control of the Dutch East Indies, now Indonesia. The Dutch added Irian Jaya to their possessions in 1828. There were British and Australian contacts, exploration, and attempts at trade during the first half of the nineteenth century, but because the land was so rugged and inhospitable and offered few commercial opportunities, most European activity involved little more than coastal contacts. From the mid-nineteenth century, missionary work commenced and small-scale trading bases and plantations were established, together with gold mining.

Interest in New Guinea was stimulated by the scramble for colonies in the late nineteenth century, culminating in 1884 in German annexation of the northeastern section and Britain annexation of the southeastern, known as Papua. Britain gave Australia administrative responsibility for Papua in 1902. Following World War I, Australia was granted a League of Nations Mandate over the former German territory. Papua New Guinea gained independence in 1975, but has been deeply troubled by economic difficulties and by the centrifugal tendencies of its diverse peoples. The attempt by the people of Bougainville to gain independence contributed significantly to instability and economic problems in the late twentieth century.

The rugged terrain and the high cost of developing infrastructure have hampered development in Papua New Guinea, and subsistence agriculture is still

the principal livelihood for 85 percent of the population. Because of its size and Gondwana inheritance, Papua New Guinea is richly endowed with natural resources including gold, copper, and silver mining; natural gas and oil; timber; fisheries; and copra.

Environmental Issues: Large areas of Papua New Guinea are so rugged and so difficult to penetrate that human impact has been relatively limited. While the indigenous people contributed to the extinction of some species through hunting, clearing, and later the introduction of pigs and dogs, they did relatively little to change most of the environment. European colonization was also less dramatic in its effect than in most places in Oceania for similar reasons, although plantations, timber cutting, and gold mining degraded some regions. The islanders of Papua New Guinea saw long and highly destructive fighting in World War II and were left an inheritance of badly damaged landscapes and large volumes of military junk.

Because of the unsettled political situation since independence, poor law and order, and the uncertain economy, Papua New Guinea has not been as exposed to Western capitalist development as much as otherwise would have occurred. Tourism has been deterred, and while mining and other enterprises have been established, they have not grown significantly. The large and polluting Panguna mine in central Bougainville was forced to close by civil disturbance over Bougainville independence. Exploitation of tropical timber has been largely uncontrolled because of the corruption and weakness of the central government, and large areas of forest have been cleared.

Ironically perhaps, the human problems of Papua New Guinea have left large areas of the country in a relatively undeveloped state and with their high biodiversity largely intact.

PITCAIRN ISLANDS

Population: less than 50

Geography: The Pitcairn group of four islands lies east of French Polynesia in the South Pacific, with a land area of 47 square kilometers. Pitcairn Island, the only inhabited island, was occupied in 1790 by *Bounty* mutineers and their Tahitian companions, and subsequently became a British colony. The Pitcairn Islands are the only remaining British colony in Oceania. The other islands in the group are Henderson Island, a makatea island, and Oenao and Ducie Islands, which are atolls.

Environmental Issues: As it is a relatively pristine example of a makatea island formation, and with four endemic bird species, Henderson Island was

given World Heritage listing in 1988. By contrast, much of Pitcairn Island has been deforested by clearing.

POLYNESIA

In 1832, French explorer Dumont d'Urville suggested that the Pacific was divided into three geographical regions occupied by people of different ethnic and cultural characteristics—Polynesia, Micronesia, and Melanesia. While still widely used, these terms are now seen as being rather problematic.

Polynesia (many islands) refers to the multitude of far-flung islands that lie scattered across the Pacific beyond Melanesia and Micronesia, and the term therefore lacks a real sense of geographic unity. In human terms, however, it has greater coherence than Melanesia or Micronesia because of the shared physiological, language, and cultural elements of most of the Polynesian people who inhabited the region between about 2500 B.P. and 1300 A.D. The islands settled by Polynesians contain the modern nations and regions of New Zealand, Cook Islands, Niue, Tonga, Samoa, Western Samoa, Tuvalu, French Polynesia, Rapa Nui (Easter Island), and Hawai'i. (See Chapter 2 for further discussion.)

An interesting theory about the physiology of Polynesians has been advanced by Philip Houghton, *People of the Great Ocean: Aspects of the Human Biology of the Early Pacific* (1996), to explain their generally large physique. He asserts that their bulk was a response to the Pacific climate, but not, as might be expected in the Pacific, to the warmth. Travelers in Oceania soon discover that once away from the hottest near-equatorial regions, especially in winter months when the sky is cloudy, rain is falling, and winds are blowing (which, in fact, they do nearly all the time), the Pacific can be wet and cold. The wind chill, in particular, is surprisingly severe. Unlike peoples who lived in cold climate regions and who had access to animal skins, Houghton points out, Polynesians had little to protect them from cold and winds apart from bark cloth. On long ocean voyages, particularly as they moved further from the equator into colder seas, and as they settled cooler islands, the cold, damp winds must have caused considerable physical discomfort and even danger. Houghton postulated that their bodies responded by a selective adaptation for a large, muscular, cold-tolerant physique. A person with large body mass was more likely to survive because thick, muscular limbs and large muscle masses, particularly skeletal muscle, produce more body heat. Houghton argued that in the oceanic environment, "a larger-bodied muscular individual is at a quantifiable and crucial advantage in maintaining body temperature." As a result, Polynesians became one the largest and most muscular of humans groups. It is part of the

explanation for modern Polynesian and Maori excellence in playing the sport of rugby.

POPULATION DEBATE (PACIFIC)

There is an ongoing and highly sensitive debate over the size of Pacific island populations prior to European arrival, a controversy made more contentious by the fact that reliable figures are almost impossible to establish. For many years it was held that most islands had substantial populations, which crashed with fatal impact when they were overwhelmed by European cultural disruption accompanied by new diseases, alcohol, forced labor, and kidnapping. To a degree, such views were grounded in Social Darwinist perspectives, which saw indigenous people as doomed to disappear when confronted by "superior" European cultures and peoples. In the second half of the twentieth century, there was a reaction against such beliefs, and estimates of high precontact populations and profound postcontact crashes were challenged, especially by the 1967 work of Norma McArthur, *Island Populations of the Pacific*; she argued that pre-European populations were considerably lower than had been previously calculated and therefore the European impact much less. In part, such views were centered in a cultural and historiographical trend that sought to give agency to indigenous peoples and to downplay their previous depiction as mere victims of European colonization.

In the last two decades of the twentieth century, fresh studies revised some precontact population estimates upward again, especially on those islands with environmental resources capable of sustaining large and sophisticated societies. For example, D. E. Stannard, *Before the Horror: the Population of Hawaii on the Eve of Western Contact* (1989), asserted a very high population on the rich islands of Hawai'i. Current scholarship now depicts a mixed picture, with both island populations and postcontact death rates being seen as diverse and varied according to local factors.

RAINBOW WARRIOR

In July 1985, the Greenpeace vessel *Rainbow Warrior* was on its way to disrupt and to protest against French nuclear testing at Mururoa Atoll in French Polynesia. On the night of 10 July, the ship was docked in Auckland Harbour. At about 11:50 p.m., an explosion blew a large hole in the hull. As the ship began to fill

with water and tilt, all the crew managed to escape except for photographer Fernando Pereira who went below for his cameras. He was in his cabin when there was a second blast, which trapped him and resulted in his drowning.

The news spread rapidly around the world causing shock and revulsion as it became clear that the vessel had been bombed as a response to Greenpeace activities, particularly its antinuclear campaign. Suspicions were inevitably directed toward the French, partly because the expertise involved in the bombing showed military capacity. The French government denied any responsibility but the suspicions were confirmed a few days later when New Zealand police arrested two French secret service agents, Alain Mafart and Dominique Prieur. Attention also turned to a the chartered yacht, the *Ouvea,* which had sailed out of New Zealand waters soon after the sabotage, briefly visited Norfolk Island, and then disappeared. It was later concluded that the yacht carried another group of French agents who had been involved in the bombing. It is believed that they were picked up by a French nuclear submarine that was in the Pacific at the time, and the yacht was sunk.

While international condemnation grew, the French government coolly continued to deny any involvement but, finally, public disclosures caused some token sackings and resignations in France. Meanwhile, the two captured agents went on trial for manslaughter in November, pleading guilty after having escaped more serious murder charges because they had not been involved in the actual planting of the bombs. They were sentenced to ten years in jail, but within a few months were released back into the hands of French authorities after the French government placed considerable economic pressure on New Zealand's European trade. New Zealand was paid some token compensation, and the French authorities set the two prisoners free in May 1988.

RAPA NUI (EASTER ISLAND)

Population: 2,800

Geography: Rapa Nui, or Easter Island, contains 180 square kilometers, and since the 1880s, has been controlled by Chile. It can claim to be the most isolated piece of land on the planet, lying 1,900 kilometers east of Pitcairn Island, the closest piece of land, and 3,700 kilometers west of the coast of South America. Its capital is Hanga Roga. Rapa Nui is the tip of a huge volcano that reaches from the ocean floor; the island has many volcanic craters and a generally steep and rocky coastline. Rapa Nui has long fascinated Europeans because of the large statues or *moia* which are scattered across the island. It was a great

mystery how the islanders could have carved, moved, and erected these enormous sculptures.

Environmental Issues: Rapa Nui has come to represent one of the most important messages about the possible future of humans on the planet if we do not learn to live sustainably within our environments. Modern research has led to an understanding that the people denuded their island of its trees, and that these trees were such a crucial material that their loss brought about the destruction of the islanders' culture. The absence of timber not only prevented them from moving and erecting statues, but caused an ecological crash that devastated the human population and society.

Furthermore, since European colonization, extensive grazing and the introduction of alien species have continued to degrade the environment. (See Chapter 7 for a more detailed discussion of Rapa Nui.)

SAHUL

The land mass known as Sahul is believed to have broken away from the megacontinent of Gondwana about 45 to 80 million years ago, drifting north until it now is pushing against the southern regions of Southeast Asia. The area of Sahul expanded and contracted according to sea levels, but within the last 14,000 years, the sea has risen to cover large areas of the land, leaving the main islands of Australia, Tasmania, and Papua-New Guinea and many smaller islands above sea level. (See also Gondwana and discussion in Chapter 1.)

SAMOA (FORMERLY WESTERN SAMOA)

Population: 178,000

Geography: Samoa is an independent state in the central South Pacific with close ties to New Zealand, its former Protectorate administrator. The nation consists of two substantial islands of volcanic origin and seven smaller islands, with a total land area of 2,934 square kilometers. The two main islands have narrow coastal plains and rugged mountainous interiors rising to a peak of 1,857 meters on Savai'i, the largest island (1,700 square kilometers). The capital, Apia, is located on Upolu (1,115 square kilometers), the second island.

Environmental Issues: As relatively large and fertile land masses, the two large islands have substantial biodiversity, particularly of flora and birds. However, continuing deforestation of the hardwood forests for agriculture and log-

ging is causing erosion and threatening some areas and species. Alien species, overfishing, waste, and a dependence on imports of energy and commodities are also degrading the environment.

SANDALWOOD

Sandalwood is a small tree whose wood was sought after in China for an oil in the timber that emits a perfume when burned. The tree was found to be widely dispersed in the Pacific, but particularly on the larger islands of Melanesia and in Hawai'i. In the first half of the nineteenth century, it became one of the early extractive products that attracted European and American traders to the Pacific. Sandalwood merchants traded with local people to cut out the trees in Fiji, the Marquesas, Hawai'i, Vanuatu, New Caledonia, and the Solomons. Most of the valuable oil in the tree was found in the heartwood at the base of the tree, near the roots. To gain access to it, a tree was grubbed out and its branches and outer timber cut off and thrown away. This process destroyed the trees and any chance of regeneration. The principal study of the sandalwood trade is Dorothy Shineberg, *They Came for Sandalwood: A Study of the Sandalwood Trade in the South-west Pacific 1830–1865* (1967).

SOCIETY ISLANDS (see French Polynesia)

SOLOMON ISLANDS

Population: 509,000

Geography: The Solomon Islands make up an independent republic consisting of an extensive archipelago containing a mixture of large and mountainous volcanic and uplift islands rising to a peak of 2,447 meters, and smaller coral atolls and raised coral reefs, situated to the east of New Guinea. There are more than 990 islands occupying a land area of 29,785 square kilometers, of which about a third are inhabited. The capital, Honiara, is located on the island of Guadalcanal. The Solomons possess deposits of gold, bauxite, phosphates, lead, zinc, and nickel.

Environmental Issues: Whereas nature has been kinder to the Solomon Islands than many other parts of Oceania, creating large, fertile, well-watered

land masses with rich biodiversity and fertile soils, the human history has been sad and environmentally destructive. In the nineteenth century, sandalwood cutting and labor recruiting or kidnapping took a toll on the societies, while later plantation agriculture and forestry saw significant areas of land clearance. The Solomons, notably Guadalcanal, was one of the most fiercely contested Pacific theatres during World War II, causing a great deal of destruction. In recent decades, civil disturbance and civil war have made government difficult, and control of exploitative industries almost impossible. Large areas of forest have been cleared at levels well beyond sustainability. Soil erosion and severe damage to surrounding coral reefs have resulted.

SPAIN IN THE PACIFIC

Spain was the first European nation to establish a substantial presence in the Pacific following Magellan's crossing from Cape Horn to the Spice Islands (Indonesia) in 1520 to 1521. The establishment of Spanish colonies in the Philippines (1565) and Guam (1668) was accompanied by perhaps 450 Spanish voyages of trade and discovery in the Pacific. One of many reminders of Spanish activities is found in the name of Esperitu Santo in Vanuatu.

Some of the more interesting theories about Spanish impact in the Pacific have been put forward by Robert Langdon in a number of books and articles, but most notably *The Lost Caravel* (1975) and the *Lost Caravel Re-Explored* (1988). He argued that there were hundreds of European castaways from many lost ships in the Pacific, and that they had a major genetic and technological impact on Pacific culture and development. In particular, Langdon emphasized the Spanish caravel *San Lesmes,* which disappeared in 1526, and he made a strong case for the vessel having run aground on Amanu Island in the Tuamotu Archipelago, east of Tahiti. Langdon used a mixture of logic, conjecture, and diverse fragmented evidence to argue that survivors from the vessel had a considerable impact across that region of the Pacific, genetically through interbreeding and technologically through the introduction of European knowledge. Langdon argued that through subsequent voyaging, the descendants of the Spanish spread their genetic, cultural, and technological influence across much of the Pacific, even as far as New Zealand. These views have been dismissed by opponents who believe that Langdon does little more than perpetuate the notion that only European influence can explain the technological capacities of the Pacific islanders. Pacific scholars have largely ignored or dismissed Langdon's theories for a lack of supporting and plausible evidence. Kerry Howe gives a brief evaluation and bibliography of Langdon's work in *The Quest for Origins* (2003).

TOKELAU

Population: 1,400

Geography: Tokelau is a tiny isolated group of three atolls (Atafu, Fakaofo, and Nukunonu) north of Samoa in the central South Pacific, with a land area of only 10 square kilometers. The region is administered by New Zealand.

Environmental Issues: Tokelau is so low lying, no more than 5 meters above sea level, that it is threatened by rise in ocean levels. Although the population is small, it places considerable pressure on the limited resources of the atolls, which emigration to New Zealand has alleviated.

TONGA (FORMERLY THE FRIENDLY ISLANDS)

Population: 108,000

Geography: Tonga lies east of Fiji in the central South Pacific, a constitutional monarchy and the only Oceanic territory that did not come under control of a colonial power. Tonga consists essentially of four island groups (Tongatapu, Ha'apai, Vava'u, and Niua), mostly uplifted coral islands although there are also some of more recent volcanic origin, especially in the west. The groups contain about 170 islands, with a land area of 718 square kilometers, of which about 40 are inhabited. About two-thirds of the population live on Tongatapu, a flat island that, at 260 square kilometers, is by far the largest island and is the site of the capital city, Nuku'alofa.

Environmental Issues: While Tonga can boast that in 1977 it became the first Pacific Island nation to commence reserving marine parks and sanctuaries to protect its ecological riches, and it has large areas that have not been overexploited or degraded, it faces similar problems to most of the other nations—the threat of rising seas, dependence on imported energy and commodities, waste, tourist pressures, and deforestation. Overhunting threatens sea turtle populations. Tonga has a unique species of fruit bat (*Peteropus tonganus*) whose wingspan reaches up to 2 meters.

TUVALU (FORMERLY ELLICE ISLANDS)

Population: 11,300

Geography: Tuvalu, an independent constitutional monarchy, was formerly part of the British Protectorate of Gilbert and Ellice Islands. It is one of the world's smallest nations in land area (26 square kilometers) and population, but

its archipelago of nine coral atolls sits in national boundaries containing 1.3 million square kilometers of ocean situated east of the Solomon Islands. As the highest point in the kingdom is 5 meters above sea level, it also has a claim to be the world's lowest nation. The capital is Funafuti, situated on Fongafale Islet, which is inhabited by nearly half of its population.

Environmental Issues: Tuvalu is profoundly threatened by rising ocean levels, and increasing king tides and salinity of soil and water degradation are already threatening to make the atolls uninhabitable. This is aggravating the problem of overpopulation and the country's meager natural resources. The atolls can support only a small population at little more than a subsistence level of farming and fishing, and most other commodities are imported. Significant numbers of the people have migrated to Australia, New Zealand, Kiribati, and other Oceanic nations, or have undertaken overseas work. There is a move to transfer some of the population to a privately acquired island in Fiji, and negotiations have also taken place with the government of Niue where the exodus of people to New Zealand and Australia has left that country with a declining population. The provision of potable water, disposal of waste, deforestation, and erosion are problems facing the tiny nation. Additionally, the spread of the crown of thorns starfish threatens coral reefs.

VANUATU (FORMERLY NEW HEBRIDES)

Population: 199,000

Geography: Vanuatu is an independent republic occupying a Y-shaped archipelago of about eighty islands lying between the Solomon Islands, New Caledonia, and Fiji. It is a region in which the earth's crust is still active, situated on the line where the Pacific tectonic plate is being forced up and over the Indo-Australian plate. The country contains a mixture of large islands created by uplift and volcanic action (there are a number of live volcanoes) and a few smaller coral islands, with a total land area of 12,200 square kilometes. The capital, Port Vila, is located on the island of Efate while Espiritu Santo, at 3,947 square kilometers, is the largest island. Some of the islands are quite mountainous, with the highest peak 1,877 meters. The geologically recent volcanic activity on many islands has given Vanuatu fertile soils, but the relatively recent creation of the islands also means that they do not have the same biodiversity as older islands in the western Pacific. However, the biota is notable for the number of subspecies that have evolved on the different islands and in the localized climatic and other environmental conditions.

During the nineteenth century, both French and British missionaries, traders, and settlers came to the islands, and neither nation established a clear predominance. The population of the region dropped dramatically as a result of disease, forced and contract emigration of workers, and social disruption. In 1906, France and Britain agreed to establish a Condominium to govern the New Hebrides, a unique and not very successful form of shared administration. In 1980, the new, self-governing nation of Vanuatu was established.

Environmental Issues: Vanuatu was extensively exploited in the nineteenth century for sandalwood and labor, leaving parts of the country somewhat degraded and depopulated. Population levels grew again during the twentieth century, but generally not, it seems, to pre-European levels. On the larger volcanic islands most people live in the fertile fringing lowlands, rather than the generally more mountainous interiors. There, land clearance for logging, grazing, and agriculture (both local and export markets) has been extensive, degrading soils and streams and threatening biodiversity. Invasive alien species, inappropriate burning regimes, and pollution of marine environments have also emerged as environmental issues. The rugged interiors of the islands are generally less exploited and degraded. Vanuatu shares with many Pacific nations an economic dependence on tourism, which in itself can be environmentally problematic. There have been significant efforts to encourage and educate local populations in environmental care.

WALLIS AND FUTUNA

Population: 15,700

Geography: Wallis and Futuna is a French overseas territory consisting of the volcanic islands of Ile Uvea (Wallis Island), Ile Futuna (Futuna Island), Ile Alofi, and twenty islets, a land area of 274 square kilometers. They lie on the northeastern border of Fiji, west of Samoa. Slightly more than half the population live on Uvea, and a number greater than the resident population have migrated to New Caledonia.

Environmental Issues: A large proportion of the main islands has been cleared of vegetation for timber and agriculture, as a result of which Futuna has experienced considerable erosion.

WINDWARD ISLANDS (see French Polynesia)

WAKE ATOLL

Wake Atoll is a U.S. territory consisting of three small islets, Wake, Peale, and Wikes, with a land area of 6.5 square kilometers, situated in the north Pacific Ocean, north of the Marshall Islands. It has no indigenous population, but since World War II has served as a U.S. military base. It was occupied by the Japanese from 1941 to 1945 and subsequently used as a refueling depot for military and civil aircraft. Since the 1970s, it has been maintained mainly as a military and emergency landing strip. It is also used as a facility for the U.S. National Oceanographic and Atmospheric Administration.

WORLD HERITAGE

In 1972, a UNESCO conference drew up the "Convention for the Protection of the World Cultural and Natural Heritage," an international agreement that established a body and a mechanism to identify, list, and provide some supervision of areas of outstanding cultural heritage significance and "outstanding universal value from the point of science, conservation or natural beauty." National governments could nominate sites within their boundaries that, after approval by a rigorous vetting process, could be listed as having World Heritage significance. The listing of a site imposes certain responsibilities on the government for the "protection, conservation and preservation."

There are twenty-two World Heritage sites in Australia and Oceania, all but three of which (Rapa Nui, the Melbourne Exhibition Building, and—in part—Willandra Lakes in Australia) are sites of natural rather than cultural heritage. The Pacific sites are East Rennell Islands in the Solomon Islands, Henderson Island in the Pitcairn Island Group, and part of Rapa Nui. New Zealand has three sites—Tongariro National Park in the central North Island, Te Wahipounamu in southwest New Zealand, and New Zealand Sub-Antarctic Islands. Australia has fifteen sites—Shark Bay and Purnululu in Western Australia; Uluru-Kata Tjuta and Kakadu in the Northern Territory; Australian Fossil Mammal Site, Riversleigh (linked with Naracoorte), Wet Tropics, Lord Howe Island Group, Fraser Island the Great Barrier Reef in Queensland; Greater Blue Mountains area, Willandra Lakes, and the Central Eastern Australian Rainforest Reserves in New South Wales; Australian Fossil Mammal Site, Naracoorte in South Australia (linked with Riversleigh); the Tasmanian Wilderness region; and the Heard and McDonald Islands and Macquarie Island in Australian Antarctica.

TIME LINE

80 million–50 million years B.P. Break up of Gondwana and northward movement of large land mass containing Australia, New Guinea known as Sahul. Other fragments that would form the basis for New Zealand, New Caledonia, and Vanuatu also broke free and moved northward into the Pacific.

56,000 years B.P. plus or minus 4,000 years Arrival by sea of Australoid or Aboriginal peoples from Southeast Asia into Australia and the islands to the north of the continent. Aborigines spread across Australia as far as Tasmania, while other Australoid people migrated into New Guinea and into Near Oceania over the next 20,000 years.

30,000 years B.P. Onset of last Ice Age.

30,000–25,000 years B.P. Spread of first humans as far as the Solomon Islands.

18,000 years B.P. Last Glacial Maximum.

14,000 years B.P. Beginning of the end of the Last Ice Age.

10,000 years B.P. Development of plant cultivation and animal domestication by humans.

10,000–8,000 years B.P. Rise of sea levels and separation of Australian mainland from New Guinea and Tasmania.

9,000 years B.P. Adoption of plant cultivation in New Guinea and Near Oceania.

4,000 B.P. Introduction of dingo to Australia from Southeast Asia.

4000–3500 years B.P. Arrival of Austronesians in the western Pacific.

3200–3100 years B.P. Settlement of Vanuatu.

3000 years B.P. Settlement of Fiji.

2800 years B.P. Settlement of New Caledonia.

2700–2600 years B.P. Settlement of Tonga and Samoa, believed to be followed by development of Polynesian culture and physiological characteristics, and followed in subsequent centuries by further voyaging and settlement across the Pacific in such places as the Cook Islands, Society Islands, and the Marquesas.

BEGINNING OF CHRISTIAN CALENDAR

300–400 Arrival of Polynesians in Rapa Nui and Hawai'i.

1100–1300 Arrival of Polynesians in New Zealand.

1450–1500 Probable extinction of the moa in New Zealand.

1520–1521 Spaniard Ferdinand Magellan entered and named the Pacific Ocean and sailed from Cape Horn northwest to Guam and the Philippines.

1564–1565 Foundation of a Spanish colony in the Philippines—followed by extensive Spanish voyaging and exploration in the northern Pacific over the next 250 years.

1577–1580 Briton Francis Drake explored the western coast of the Americas and crossed the northern Pacific.

1606 Dutchman Willem Janszoon made the first Dutch contact with Australia, exploring the western coast of Cape York Peninsula.

1606 Spanish expedition led by Pedro Ferdinand De Quiros visited some of Cook Islands and landed at and named Esperitu Santo in Vanuatu. The party subsequently sailed between New Guinea and Australia through the strait that bears the name of its navigator, Luis Vaez de Torres.

1616 Dutchmen Willem Cornelisz Schouten and Jacob Le Maire crossed the Pacific from Cape Horn, sighting Tonga, Futuna, and Alofi.

1616 Dutchman Dirk Hartog explored part of the northwestern coast of Australia and landed on Dirk Hartog Island. Many other Dutch landings and sightings, and some shipwrecks, occurred in following decades.

1642–1643 Dutchman Abel Tasman sighted and sailed partly around Tasmania, New Zealand, Tonga, Fiji, and New Ireland and New Britain in Near Oceania.

1668 Jesuit missionaries commenced Spanish settlement of Guam.

1688 and 1699 British seaman William Dampier made two visits to the west coast of Australia. In 1688, he was a crewman on the *Cygnet,* which spent three months in the region of King Sound. His account was published in 1697, the first British observations of Australia. In 1699, he returned as Captain of HMS *Roebuck,* which visited Shark Bay and spent several weeks in Roebuck Bay near the present town of Broome.

1733 Dutchman Jacob Roggeveen was the first known European to visit Rapa Nui (arriving on Easter Day and naming it Easter Island) and Samoa.

1765 Invention of the steam engine by James Watt, one of the critical factors in the start of the Industrial Revolution. The use of coal to fire most steam engines marked the transition from dependence on concurrent photosynthesis (trees) to prehistoric photosynthesis (carbon trapped in fossil fuels).

1767 Briton Samuel Wallis visited several South Pacific islands, including Tahiti.

1768 Frenchman Louis de Bougainville visited Tahiti, Samoa, and western Pacific islands including Aoba, Pentecost, and Maewo in Vanuatu.

1768–1771 Briton James Cook's first voyage. Visited Tahiti, Society Islands (French Polynesia), and New Zealand, and in April 1770 made the first British sighting of the eastern coast of Australia. In August 1770, Cook claimed British possession of the east coast of Australia.

1769 First Maori shot dead by a member of Cook's crew. Introduction of first European species of flora and fauna into New Zealand.

1769 Frenchman Jean de Surville visited the North Island of New Zealand.

1772 Visit to New Zealand by Frenchman Marion du Fresne. He and twenty-five members of his crew were killed by Maori at the Bay of Islands. After vengeance, the survivors departed, leaving behind a number of pigs and European food plants.

1772–1775 Cook's second voyage in which he visited Cook Islands, Niue, Tonga, Norfolk Island, Vanuatu, New Caledonia, Rapa Nui, and the Marquesas Islands. Cook distributed pigs, goats, and various other species of flora and fauna across the Pacific in order to broaden the range of foods available to locals and to European visitors.

1773 Ten members of Cook's party killed and eaten by Maori.

1776–1779 Cook's third voyage in which he visited Tasmania and many parts of the Pacific including the Cook Islands. He was the first European to visit Hawai'i in November 1778, and on a return visit in February 1779, he was stabbed to death.

1785–1788 Frenchman Jean-Francois de Galaup de La Perouse spent four years exploring and mapping the Pacific and its rim. He visited Rapa Nui, Hawai'i (twice), Fiji, and the eastern coast of Australia. (See 1788)

1788, January Arrival of First Fleet at Botany Bay in New South Wales, and then establishment of settlement at Sydney Cove on 26 January.

1788, January Five days after the arrival of the First Fleet, La Perouse arrived in Botany Bay. Soon after, his expedition was lost at sea in the Santa Cruz group near the Solomon Islands.

1788, March Governor Phillip issued the first government conservation order in Australia, that no trees be cut within 50 feet of the stream near the settlement in Sydney Cove. It was ignored.

1788 The first cattle escaped into the bush of New South Wales.

1789 Mutiny on the *Bounty* against William Bligh. The purpose of his expedition was to take breadfruit from the Pacific to the West Indies in order to

grow as food for slaves. The mutiny occurred after breadfruit had been picked up in Tahiti. Bligh and his party were cast adrift in small boats by the mutineers but managed to sail through the Fiji and Cook Islands and across the Pacific to Timor.

1789 Establishment of settlement on Norfolk Island as an offshoot of the Sydney penal settlement. In 1793, two Maori men were kidnapped and brought to the island to give instructions on the processing of flax—but were then returned when it was found that they could not assist as flax processing was women's work.

1791 First whales killed off Sydney by ships of the Third Fleet.

1791–1793 Briton George Vancouver visited King George Sound in Western Australia and crossed the Pacific visiting New Zealand, the Chatham Islands, Tahiti, and Hawai'i before exploring the Pacific coast of northern North America. He introduced cattle and pigs to Hawai'i.

1791–1793 Frenchman Bruni d'Entrecasteaux was sent to search for La Perouse. His expedition visited and mapped much of southern Australia, New Zealand, Tonga, New Caledonia, and the Solomon Islands.

1792 First party sent from Sydney to kill seals on the New Zealand coast, slaughtering 4,500 in a season.

1793 First export shipment of pigs from Tahiti to Sydney.

1793 Englishman William Brown commenced settlement and trading at Honolulu on O'ahu in Hawai'i. This can be seen as the effective start of European exploitation and settlement of the islands.

1794 First shiploads of timber taken from New Zealand.

1795 First export of timber from Sydney to India.

1797 London Missionary Society commenced missionary work in the Pacific at Tahiti and Tongatapu.

1797–1798 George Bass led an expedition from Sydney in a whaleboat that effectively demonstrated the existence of the strait that bears his name, lying between the Australian continent and Tasmania.

1800–1803 French scientific expedition led by Nicholas Baudin and Louis-Claude de Freycinet mapped and examined much of the Australian coast.

1801–1803 Matthew Flinders led a major scientific and cartographic expedition that circumnavigated Australia.

1803 Foundation of British settlement at Hobart in Van Diemen's Land (Tasmania).

1805 80,000 seal skins taken from the Foveaux Strait in New Zealand.

1809 Up to seventy Europeans killed by Maori and their ship burned in Whangaroa Harbour.

1813 Pineapples introduced into Hawai'i.

1814 George Stephenson built first steam locomotive in Britain, a major advance in the transport revolution.

1814 Arrival of the first Christian mission in New Zealand, at the Bay of Islands.

1814 Landing by Sydney trading vessel *Cumberland* in the Cook Islands seeking sandalwood. Violence occurred and Ann Butchers was captured and eaten by islanders. Reputedly, she was the only European woman to have met this fate.

1817 Coffee introduced into Hawai'i.

1820 Arrival of first American Protestant missionaries in Hawai'i from New England.

1821 Arrival of first Christian missionary in the Cook Islands, at Aitutaki—John Williams from the London Missionary Society.

1824 Formation of a convict settlement at Moreton Bay, which was the first settlement in Brisbane and Queensland.

1826 Whalers brought the first mosquitoes to Hawai'i in water casks.

1827 Formation of a convict station at Albany on southwest coast of the Australian continent, the first settlement in Western Australia.

1829 Establishment of the Swan River Colony, the first British settlement on the west coast of Australia.

1832 Publication by French explorer Dumont d'Urville of an article in which he proposed that the Pacific Islands were divided into Polynesia, Micronesia, and Melanesia. D'Urville made three voyages into the Pacific, 1822 to 1825, 1826 to 1829, and 1837 to 1840. He touched upon many parts of Australia, circumnavigated New Zealand, and visited Tonga, Fiji, Vanuatu, New Britain, the Solomons, Guam, and French Polynesia.

1833 Appointment of the first British Resident in New Zealand, based at the Bay of Islands.

1834 Henty family made the first, illegal, settlement on south coast of eastern Australia, at Portland.

1835 First, illegal, settlement at the site of Melbourne, by pastoralists from Van Diemen's Land (Tasmania).

1836 Foundation of the colony of South Australia with settlement near Adelaide.

1838 First recorded importation of rabbits into New Zealand. Possums were also introduced at about the same time. Both became major pests, with possums reputedly numbering 70 million in the 1990s.

1840 Signing of Treaty of Waitangi between Maori and British at the Bay of Islands in New Zealand, effectively British annexation. Establishment of settlements at Auckland and Wellington.

1841 Establishment of settlements at Nelson and New Plymouth in New Zealand.

1841 Declaration of French protectorate over Tahiti. Subsequently armed French forces took over the Society Islands, establishing what became French Polynesia.

1842 Discovery of first copper deposit in Australia at Kapunda in South Australia. The first mine opened in 1844.

1848 Establishment of settlement at Dunedin in New Zealand.

1850 Establishment of settlement at Christchurch in New Zealand.

1851, 6 February Black Thursday bushfire swept across large areas of Victoria and into South Australia.

1851 Discovery of gold in New South Wales and Victoria stimulated gold rushes, population influx, and major long-term economic and environmental impacts on the Australian colonies.

1851 South Australia enacted legislation to endeavor to control thistles—the first such legislation in Australia.

1851 First liberation of red deer in New Zealand.

1853 Smallpox epidemic in Hawai'i killed about 5,000 people.

1854 Publication of *Walden* by American nature writer Henry David Thoreau, one of the major pieces of nature writing. It was widely read in Australia and New Zealand.

1854 Opening of first steam passenger railway in Australia, between Melbourne and Port Melbourne.

1855 Major earthquake raised the height of the Wellington shoreline by up to 2 meters.

1859 Successful introduction of rabbits into the wild by Thomas Austin, near Geelong, Victoria.

1859 Taranaki and Nelson provinces in New Zealand prohibited the continued planting of gorse.

1860 Tasmanian government introduced the first legislation in Australia to protect native game birds with a closed season.

1861 Gold discovered in the Otago region of South Island of New Zealand, commencing a gold rush. Later in the decade, gold was found in several places on both islands.

1861 Establishment of the Victorian Acclimatisation Society, an offshoot of the Zoological Society of Australia, which had been founded in 1857.

1862 Victorian Game Preservation Act, to control hunting of some alien and indigenous game bird species, passed.

1862 Establishment of acclimatization societies in South Australia and Queensland.

1863 South Australia granted control of the Northern Territory.

1863 Arrival of first Pacific Island laborers in Queensland to work on sugar plantations.

1863 Opening of first steam railway in New Zealand, from Christchurch to Ferrymead.

1863 The Nelson Acclimatisation Society incorporated, the first active acclimatization society in New Zealand

1864 Publication of *Man and Nature or Physical Geography as Modified by Human Action* by American George Perkins Marsh.

1864 First sheep introduced into Rapa Nui.

1864 Otago and Canterbury Acclimatisation Societies incorporated in New Zealand.

1864 First liberation of fallow deer in New Zealand.

1865 Identification by the Surveyor-General G. W. Goyder of the effective limit of agrarian expansion in South Australia.

1866 Declaration of first landscape preservation reservation in Australia, at the Jenolan Caves in the Blue Mountains in New South Wales.

1867 Arrival of the first axis deer in Hawai'i.

1867 Formation of the Auckland Acclimatisation Society.

1872 Opening of the telegraph link between Australia and Britain via a line from Darwin through Alice Springs to Adelaide. Building the telegraph helped to open up central Australia and the Northern Territory to European settlement and economic exploitation.

1873 Introduction of the mongoose into Fiji to control rats in cane plantations.

1875 New Zealand had about 255,000 people and 13 million sheep.

1875 First liberation of sambar deer in New Zealand.

1876 Rabbit Nuisance Act introduced in New Zealand.

1879 Formation of the Zoological Society of New South Wales, an acclimatization society.

1879 Declaration of Australia's first specifically named national park, the Royal National Park south of Sydney.

1879 Commencement of the pastoral occupation of the Kimberley region of northwest Western Australia.

1879 Export by Thomas Mort of the first shipload of frozen meat from Australia to Britain.

1879 Indentured Indian laborers arrived in Fiji to work on sugar plantations.

1880 Foundation of the Field Naturalists Club of Victoria, an important conservation as well as scientific organization. Other colonies also established such groups.

1882 German Gottlieb Daimler developed the first petrol-driven engine, marking the birth of the motor car.

1882 Reservation of area at Ferntree Gully, Victoria's first scenic preservation reserve.

1882 First export of refrigerated meat from New Zealand. Exports of meat, butter, and cheese to Britain would become a major sector of the economy.

1884 Stoats and weasels introduced into New Zealand to control rabbits.

1885 First New Zealand scenery preservation legislation to protect the Rotorua hot springs area.

1885 First liberation of sika deer in New Zealand.

1886 Massive volcanic eruption at Mount Tarawera near Rotorua covered 1,500 square kilometers in ash, destroying the large and dazzling pink and white terrace formations that had become a tourist attraction, and killing over 150 people.

1888 Tasmanian government placed a bounty on the thylacine.

1891 First fauna preservation reserve in New Zealand.

1891 Declaration of first South Australian national park at Belair.

1892 Discovery of gold at Coolgardie in Western Australia.

1892 Commencement of copper smelting at Mt Lyell near Queenstown in Tasmania. The sulphur from the process subsequently killed all vegetation for miles around leaving bald, eroded hills.

1892 Establishment of Victoria's first specifically named national park, Tower Hill National Park.

1892 New Zealand legislation introduced to enable more efficient declaration of scenic preservation reserves.

1893 Discovery of gold at Kalgoorlie in Western Australia.

1894 Establishment of first New Zealand national park, Tongariro National Park.

1895 Establishment of an acclimatization society in Tasmania.

1895–1903 Great drought in southeastern Australia, an El Niño event.

1898, 1 February Red Tuesday bushfires in Victoria.

1898 Publication by New Zealand author and politician William Pember Reeves of *The Long White Cloud,* his history of New Zealand, which drew attention to the destructive impact of colonizing the land.

1898 U.S. victory in the Spanish-American War, gaining control of Guam and Hawai'i.

1900 First national park in Western Australia, John Forrest National Park.

1900 Declaration of Egmont National Park in New Zealand.

1901 Federation of the Australian colonies and foundation of the Commonwealth of Australia.

1901 Donation by U.S. president Theodore Roosevelt of moose for release in New Zealand. This attempt failed but another in 1910 was more successful.

1902, November Huge dust storms in southeastern Australia, with dust blowing as far as New Zealand.

1903 Opening of the Mundaring scheme, which piped water from the Darling Range near Perth to the Coolgardie and Kalgoorlie goldfields in Western Australia.

1903 Visit to Australia by American conservationist John Muir.

1903 Enactment in New Zealand of the Scenery Preservation Act.

1904 First section of Fiordland National Park declared. Full national park area reserved 1952, and Southwest New Zealand World Heritage Area in 1990.

1905 There were 415 timber mills operating in the New Zealand forests.

1905 Wilson's Promontory, Victoria, declared Victoria's second national park.

1905 Liberation of wapati or North American elk by the New Zealand Tourist Department.

1907 Liberation of chamois in New Zealand, donated by the Emperor of Austria-Hungary.

1908 Publication of "My Country" by Australian poet Dorothea Mackellar.

1908 Queensland's first national park, Mount Tambourine National Park.

1908 First tractor manufactured in Australia, the Imperial Oil Tractor EA. A few tractors had been imported since 1903.

1912 Native Flora Protection Act in Western Australia, the first serious attempt in that state to protect indigenous flora on crown land.

1914 German colonies occupied by Allied countries which subsequently were given control of them as League of Nations–mandated territories—Australia in New Guinea, Australia-New Zealand-Britain in Nauru, New Zealand in Western Samoa, and Japan in the Caroline, Marshall, and Mariana Islands.

1914 Opening of the Panama Canal facilitated access to Pacific from the east coast of the Americas.

1915 Proclamation of first Tasmanian national park, Russell Falls-Mount Field National Park.

1916 Arrival of the brush-tailed rock wallaby in Hawai'i.

1918 Publication of *Australia Unlimited* by Australian author E. J. Brady.

1920 First long-distance passenger flight in New Zealand, Invercargill to Auckland.

1921 Publication of *Tutira the story of a New Zealand sheep station* by New Zealand station owner, Herbert Guthrie-Smith.

1921 Commencement of Group Settlement in southwest Western Australia.

1924 More than 2 million koala skins exported from eastern Australia.

1925 Introduction of *Cactoblastis cactorum,* a moth, to attack prickly pear, which had infested millions of hectares in Queensland and New South Wales. A successful example of biological control.

1927 Queensland government declared an open season on possums and koalas, which is believed to have resulted in the death of a million possums and 600,000 koalas, almost causing the extinction of the latter in Queensland.

1927 First non-stop aircraft flight between the United States mainland and Hawai'i.

1928, May–June First trans-Pacific flight by Charles Kingsford-Smith and others, from Oakland, California, to Brisbane, via Honolulu and Suva.

1928, September First trans-Tasman flight by Sir Charles Kingsford-Smith and Charles Ulm from Sydney to Christchurch.

1929 Declaration of Arthur's Pass National Park in New Zealand.

1930 Publication of *Australia* by Keith Hancock, containing one of the earliest expressions of concern about the devastation of the Australian landscape caused by the British "invaders."

1931 New Zealand's worst recorded earthquake in the Hawke's Bay region. It caused great damage to natural systems and to human structures, particularly in Napier, which was largely destroyed by the earthquake and a following fire.

1932 Introduction of the cane toad into Hawai'i.

1934 Native Plants Protection Act passed in New Zealand.

1935 Introduction of the cane toad into Queensland.

1936 Last known thylacine died of neglect in the Hobart zoo, Tasmania.

1937 Commencement of flying boat services, which subsequently developed to link New Zealand, Fiji, Honolulu, Tahiti, and other Pacific islands to Australia and mainland United States.

1938 Publication by British biologist Francis Ratcliffe of *Flying Fox and Drifting Sand,* a perceptive observation of nature in Australia.

1939, 13 January "Black Friday" bushfires devastated large areas of Victoria.

1941, 7 December Japanese attack on Pearl Harbor precipitated Pacific into a major theater of hostilities in World War II. Many islands in the northwestern quadrant were occupied by the Japanese, and subsequently devastated by the fighting.

1944 Commencement of the first stage of uranium mining in Australia, which operated at Mary Kathleen in Queensland and Rum Jungle in the Northern Territory until the early 1960s.

1945 Establishment of the New Zealand Wildlife Service.

1946 Detonation of the first atomic tests by the United States at Bikini Atoll in the Marshall Islands.

1946 Major tsunami devastated Hilo on the Big Island in Hawai'i.

c1946 Arrival of the brown tree snake on Guam.

1946 Bulldozers, an application of tank technology, began to be used for land clearing.

1947 South Pacific Commission created.

1947 Passing of the New Zealand Rabbit Nuisance Act whose purpose was the futile dream of rabbit eradication.

1949 Snowy Mountain Commission established to undertake Australia's largest water system manipulation and hydroelectricity scheme.

1950 First release of myxomatosis, a rabbit disease, into the wild in Australia, on the Murray River.

1952 First test of a hydrogen bomb by the United States on Eniwetak Atoll in the Marshall Islands.

1952 Last known moose shot in New Zealand.

1953 Commencement of British atomic bomb tests in South Australia. Altogether, nine explosions occurred from 1953 to 1957.

1954 Detonation at Bikini Atoll of the "Bravo" bomb by the United States, the first hydrogen bomb and the largest and dirtiest test in the atmosphere.

1955 Completion of first works in the Snowy Mountain Scheme, New South Wales.

1955 Introduction of the cannibal snail, *Euglandia rosea,* into Hawai'i from Florida.

1956 Western Australian government transferred 607,000 hectares near Esperance to an American syndicate to develop and subdivide.

1956 Detonation by the British of their first atomic test at Maralinga in South Australia.

1957 British tested their first hydrogen bomb in the Gilbert Islands.

1959 Hawai'i became the fiftieth state of the United States of America.

1962 Publication by American biologist Rachel Carson of *Silent Spring,* a book often attributed with promoting the foundation of the modern environmental movement.

1963 Establishment of the Wildlife Preservation Society of Queensland, which was largely devoted to prevention of damage to the Great Barrier Reef.

1963 Signing of the Partial Test Ban Treaty by the United States, Britain, and the Soviet Union, to stop atmospheric and underwater nuclear testing.

1964 Establishment of the Australian Conservation Foundation.

1966 French commence twelve years of aboveground nuclear tests at Mururoa and Fangataufa Atolls.

1966 Publication of three significant works dealing with environmental issues and their history in Australia and the Pacific A. J. Marshall (ed), *The Great Extermination: A Guide to Anglo-Australian Cupidity Wickedness and Waste;* Vincent Serventy, *A Continent in Danger;* and Alan Moorehead, *The Fatal Impact: The Invasion of the South Pacific 1767–1840.*

1967 Devastating fires in the Hobart region of southern Tasmania.

1967 First oil drilling on the Great Barrier Reef. Public protests led to cessation in the early 1970s.

1967 Victorian government announced its plan to subdivide the Little Desert. Protests over the next three years led to the scheme being dropped in 1970.

1968 Commencement of major works on the Ord River Scheme in northern Western Australia. Lake Argyle opened in 1972.

1969 Publication by Eric Rolls, *They All Ran Wild: The Animals and Plants That Plague Australia,* a significant early work in environmental history.

1969–1972 Controversy in New Zealand over government proposal to lift the water levels in Lakes Manapouri and Te Anau for hydroelectricity generation. The project was abandoned after the election of a Labor government in 1972.

1969–1972 Controversy in Tasmania over government proposal to flood Lake Pedder for hydroelectricity generation. The protests failed and the lake was flooded in 1972.

1970 First logging of an old growth forest for export of wood chips to Japan, at Eden in New South Wales.

1971 Controversy over a plan to develop Kelly's Bush, an area in suburban Sydney at Hunters Hill, which resulted in the Builders Labourers Federation imposing the first "Green Ban" to stop the project.

1971 Leases to undertake sand mining on Fraser Island in Queensland led to public protests. In 1976, the federal government prevented further exports and the mining ceased.

1972 Establishment by UNESCO of World Heritage system.

1972 Stockholm Conference on the Human Environment, the first global environmental meeting.

1974, 24/25 December Cyclone Tracy devastated Darwin.

1974 Recommencement of uranium mining in Australia at Mary Kathleen.

1975 The French moved their nuclear tests underground at Mururoa Atoll and continued testing in the face of international protests until 1992.

1976 Foundation of the Tasmanian Wilderness Society, which subsequently became an Australian national body, the Wilderness Society.

1979 Major protest action against clearfell logging at Terania Creek in New South Wales.

1980 After years of environmental protest, commencement of the Ranger uranium mine within the boundaries of the Kakadu National Park in the Northern Territory.

1981–1983 Height of controversy over proposal by Tasmanian government to dam the Gordon River below its confluence with the Franklin River. Protestors blockaded the work from December 1982. The March 1983 federal election was won by the Labor Party after it pledged to stop the dam. The dam did not proceed.

1982–1983 Severe El Niño event in southeast Australia.

1983, 16 February "Ash Wednesday" bushfires killed seventy-one people and devastated large areas of Victoria and South Australia.

1983–1984 Road built through Daintree rain forest despite intense protests.

1985 French agents blew up the Greenpeace vessel *Rainbow Warrior* while berthed in Auckland.

1987 The World Commission on Environment and Development issued the Brundtland Declaration promoting the critical need for development to be sustainable.

1988–1989 Controversy in Tasmania over government agreement to establishment of a paper pulp mill at Wesley Vale. As a result, at the Tasmanian elections in 1989, the Greens won the balance of power in the Tasmanian parliament.

1991 Passing of Resource Management Act in New Zealand and establishment of the New Zealand Department of Conservation.

1992 Earth Summit Conference at Rio de Janeiro, Brazil, resulted in five major international environmental agreements. These included the Framework Convention on Climate Change, which contained agreement to reduce greenhouse gases, an issue taken forward at Kyoto in 1996.

1994 Serious bushfires around Sydney which seriously damaged the Royal National Park.

1995 Rabbit calicivirus escaped from an island off the South Australian coast and spread rapidly on the mainland.

1995–1996 French undertook another six underground nuclear tests around Muraroa Atoll in French Polynesia.

1996 Kyoto Protocol agreed to at United Nations Framework Convention on Climate Change in Kyoto, Japan. Under the Kyoto Protocol, most developed countries committed themselves to reduce their greenhouse emissions by at least 5 percent below 1990 levels by 2008 to 2012. Australia refused to accept and was granted an increase. The United States subsequently refused to ratify the Protocol and the Australian government followed.

1997 Illegal release of rabbit calicivirus in New Zealand.

2002 Cane toads commenced the invasion of Kakadu National Park in the Northern Territory of Australia.

2003, January Severe bushfires in the Australian capitol Territory, New South Wales, and Victoria.

2004, January Major cyclone hit Niue and destroyed much of the island.

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