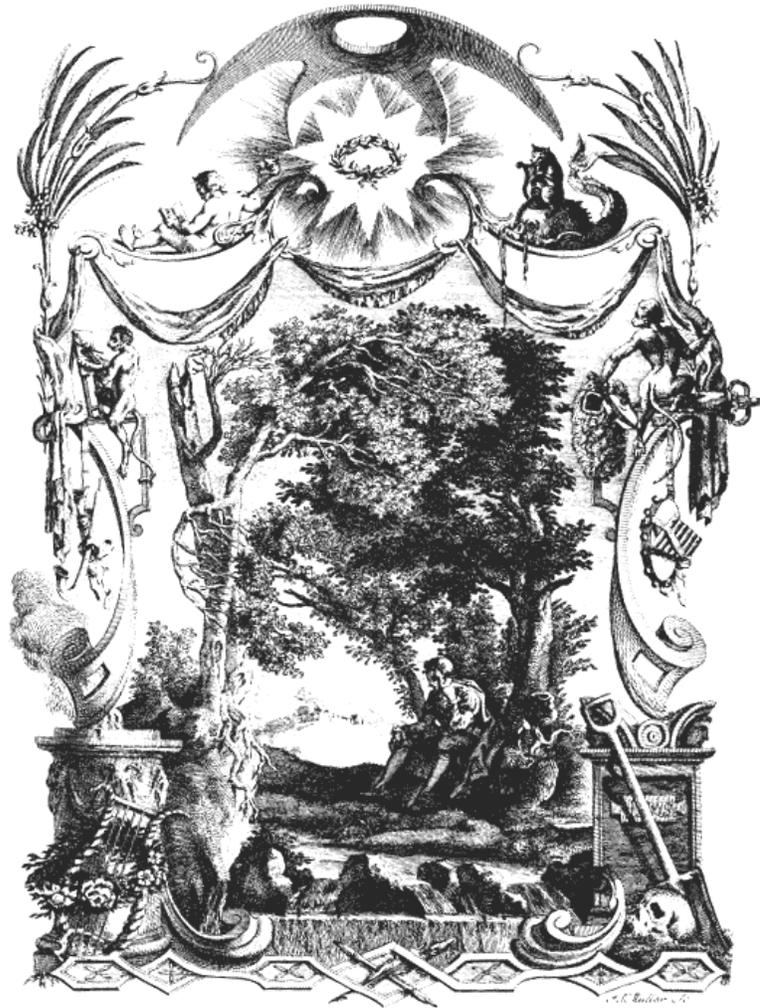


# THE MISUNDERSTOOD FOREST



GENE NAMKOONG

**Publication**

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# FOREWORD

THE CONTINUING STORY of human conflict over forest use and preservation is complex and bewildering, spanning thousands of years. However, since the early 1990's, a widespread concern has emerged over the fate of the world's forests. Over the past decade or so, this has led to several international conferences and agreements, as well as dozens of books published on the general topic of man's generally destructive relationship with the earth's forests and wilderness<sup>1</sup>. Many of these books provide a thorough analysis and describe local issues - from the historical events to the consequences in society and across the landscape. Among them, a substantial number focus on forestry in the controversial Pacific Northwest of North America.

In the "Misunderstood Forest", Gene Namkoong set out to dig deeper in a quest to identify the fundamental problem that continues to drive the conflict. He highlights many of our major historical conflicts, from recent events to very long ago, and suggests that the crux in our conflict is a misunderstanding of what forests are, a misunderstanding that is as complex as the history. Many writers over the few decades have expounded on various themes related to the 'complexity' of forests. They have achieved some success in convincing people that there is, in fact, no "balance of nature," or natural equilibrium of ecology. Unfortunately, this has sometimes justified more atomistic or engineered approaches for managing forests, largely to generate revenues with very short-term land management policies. Proponents of the other side of the argument assert that forests are so complex that we cannot possibly understand or know what we are doing, and any intervention into the forest must be focused with the aim of preserving or managing forests for 'the way they are.' This duality, which is evident in the earliest known records, has sadly featured in virtually every event of human colonization.

Gene, in his career as a forest scientist, became interested and impressed with the magnitude of the problem forests have faced and are facing. He reflected on this topic over many years, and particularly so with his time at the University of British Columbia, but he also had a life-long association with many individuals and national and international forestry agencies that were enmeshed in the conflict themselves. Yet, with all his experience, and exhaustive reading on the issues, he was still left with a feeling that the fundamental problem had not been identified. The conflict would continue, the writing would continue, but the debate would not move forward, and we would remain trapped in various types of circular arguments. Moreover, the political and social mechanisms would not evolve without a breakthrough in the dialogue between the two mindsets that permeate most of past and current thinking regarding forests. Gene believed we desperately need a new reference point for the debate to move to the next necessary level.

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1. A few key books that we would like to specifically point out are:  
Oelshlager, M. 1991. *The Ideal of Wilderness: From Prehistory to the Age of Ecology*. Yale University Press, New Haven, CT  
Chase, A. 2001. *In a Dark Wood: The Fight over Forests and the Myths of Nature*. Transaction Publishers, New Brunswick, NJ  
Mitchell, J.G. 1991. *Dispatches from the Deep Woods*. University of Nebraska Press, Lincoln, NB.  
Harrison, R.P. 1992. *Forests: The Shadow of Civilization*. University of Chicago Press, Chicago, IL.  
Satterfield, T. 2003. *Anatomy of a Conflict: Identity, Knowledge, and Emotion of Old-Growth Forests*. University of British Columbia Press, Vancouver, BC.  
Williams, M. 2003. *Deforesting the Earth: from prehistory to global crisis*. University of Chicago Press, Chicago, IL.

"The Misunderstood Forest" argues that the duality in the human understanding of forests has, over the centuries, led to this stalemate. Contributing to this stalemate is widespread popular misunderstanding of the biology driving the evolution and development of organisms, systems, and processes within forests. Very few people thought more about forests in this context, or were more qualified to describe this complexity, than was Gene.

Many of us in forest genetics thought of Gene as one of the most influential forest geneticists of our time. In 1994 he was awarded the prestigious Marcus Wallenberg prize for his "path breaking contributions to quantitative population genetics, tree breeding and management of genetic resources which form a solid scientific basis for the maintenance of biological diversity in forests all over the world." But he was also a man who reached a deep understanding of how and why people perceive forests the way they do. Although his research in the fields of population genetics, bio-mathematics, plant breeding theory and plant genetic resource management allowed him to gather a unique understanding of the development of forests, more importantly he believed the ethical and human element was as critical as the underlying biology of forest ecosystems.

He began his career with the United States Forest Service (USFS) as a plant quantitative geneticist. Quite early, by 1972, he became one of a very few Pioneer Research Scientists in the USFS, as well as being appointed Professor of Genetics and Forestry at North Carolina State University (NCSU). Initially focusing on statistical methodology for more efficient tree breeding, he branched out into population genetics carried out leading research on genetic processes that affect the development and evolution of forests and forest organisms. He was keenly aware of international developments in forestry and forest conservation. He saw early in his career that the problems of forestry in North America, while interesting, were not as imperative and as complex as the problems elsewhere in the world. He became more active in international forestry matters, and was recruited and served as a board member and a scientific advisor on organizations such as the International Plant Genetic Research Institute and the Food and Agricultural Organization of the United Nations.

As you will see, this book is the product of the many questions that Gene wrestled with throughout his career and that many of us still have, on why humans have not been able to come to grips with some of the inherent contradictions between use and preservation of forests. Forest decline has been the net result of this problem, but of course much of it can be attributed to same basic social problems and short-term political and economic ambitions that lead to wars, inappropriate land conversion policies, stock trading in futures, etc. However, the dichotomy of forest use versus preservation should not and cannot continue to be embraced by either of the polarized parties in the debate. In order to make this point, "The Misunderstood Forest" takes a different approach than previous books. Gene first searches through human history for examples of forest destruction, as others have, but he explores the mind sets and belief systems of those who were making the decisions, determining whether forests were utilitarian objects to be exploited, or viewed as entities that required very limited interference, if any. The reader will see how the historic thinking of mankind led us to this duality, and how it trapped both ancient and modern civilizations. Near the end of the book, he presents the most important biological principles that we now need to help guide new thinking in developing management in new directions. Few, if any, of the many other writings addressing the complex interactions of humans with forests, from the physical to the spiritual, make this next important leap.

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Gene retired from the USFS and NCSU in 1992, and moved to the University of British Columbia (UBC) to become the Department Head in Forest Sciences. He started to write this book during his last few years at UBC, close to the time when he learned that he had melanoma. Those of us close to Gene were incredibly humbled with the exceptional dignity with which he fought this cancer. Although the book progressed, so did the disease, and he was still working on the last few chapters before the physical toll of the cancer and his fight against it limited his ability to continue working. Bringing great sadness to those who knew him, he passed away on March 3, 2002.

We know chapters 7, 8, and particularly 9, were not completed to his liking. Still, most of what he was attempting to provide the reader was, we believe, captured in his latest drafts. Several of us have attempted to pull and put together the various chapters that Gene had completed, and finalize the manuscript with largely editorial contributions. A few publishers looked at this manuscript but declined to publish it due to concerns over the audience to which this was directed, and that the last few chapters do not carry the sharpness that clearly bring the message home for the popular reading audience. We did make some attempts to add some further thoughts or ideas we thought Gene would have included, based on the publishers comments, but we were left perplexed over how to incorporate them easily, and whether we could actually make any serious improvements. We were also concerned about “putting our words into Gene's mouth” and then thought it best to leave the manuscript more or less as is and let the reader enjoy what Gene managed to write. Most of us who knew Gene well will see with relative ease where he was going and what the key messages are. This was not an uncommon experience for anyone who worked with Gene — even a scribble on a napkin during a coffee break, at a conference, or at dinner was usually enough of a new idea, a fresh perspective, or an answer to some question that had no other real source. So what the reader will see is more or less Gene's text and all we have done is provide some structuring to the manuscript (i.e., section headings, Chapter titles and organization) with some re-writing and editing for clarity.

Of course one book, manuscript or writing cannot revolutionize the mentality and general knowledge of the human population, or the social mechanisms needed to start such changes in our thinking on such a complex topic. But Gene does provide a rich panoramic synthesis of how forests develop, why they are not “perfect” entities, describes what they are and are not, what they can and cannot do, and the biological principles behind the assemblages of species that make up forests. We will never understand the virtually infinite forest-level processes that can occur, but we do know enough, and can infer enough, to make well-reasoned choices. Gene argues that the understanding, the knowledge and management tools are largely in place to create a greater overall forest diversity. A hands-off approach cannot accomplish this, nor can the equally dangerous “engineering” of future forests, or some delusion of being able to maintain forests exactly the way they are or were. This has been our major obstacle for the last several decades, but we at last can say we have a general goal of creating more options for natural processes and humans, without staying trapped in the dichotomy of duality described in this book. We believe this was Gene's one hope for the book — namely, that people see there are, in fact, options and we can do something about it.

Gene never got around to titling the book himself, as he was more concerned with getting down what he could, with whatever time was left for him. “The Misunderstood Forest” appealed to us after several iterations of many themes on phrases such as the “the longest conflict” or the “humans and the forest precipice”, etc., as being more simple, yet

more descriptive of what the problem has been. We hope the reader will agree, by the end of the book, that this misunderstanding has been the fundamental issue.

We want to thank many of Gene's other friends and colleagues who have helped out in many ways in finalizing the book. Drs. Harvey Gold and John Bishir, long-time friends and colleagues of Gene's at NCSU, read earlier drafts and provided many useful comments and questions to both Gene and to us. We also have to thank many of Gene's colleagues at UBC who helped Gene out early on in the development of the book, and with their continued support in the later stages of publishing it. In particular we express our appreciation to Dr. Mathew Koshy who assisted Gene with researching many ideas on many topics. Gene's daughter, Barbara, also helped with editing some of the initial chapters. Finally, we express our appreciation to Bob Biesterfeldt who edited Gene's scientific work over his years in the USFS, and was the primary editor of the first major draft we pulled together. Bob's initial comments back to us on the book were very revealing with respect to some first impressions of what effect the book might have on people, and we would like to close with those...

“.....it means to me that deeply held current views are, in essence, incorrect. I think it means that people ought to ease up on their advocacy. I think it could be argued that if there was a Golden Age in American conservation it was when Pinchot and Muir were allies. I think Gene also makes it obvious that the people who want forests for their products and people who want forests for their inspirations must learn to be allies. When the two types of people are divided, forests suffer badly. To me, that is the point of the book - maybe Gene was being too humble to point that out in the Conclusions.”

**Alvin Yanchuk**, Victoria, British Columbia, Canada,

**Rowland Burdon**, Rotorua, New Zealand; February 2005

Gene's many friends are one of his greatest legacies. Their willingness to help in any way was amazing. I want to thank all of them for that, and for their concern for me. Above all, the great act of love for Gene shown by Alvin Yanchuk, in taking the time and effort to see this book to completion, requires recognition. It is impossible to put my gratitude into words. Rowland Burdon has also been an invaluable help and support, and many thanks go to him as well.

Gene was always happiest in a forest, none more so than the one we have here on Early's Mountain. He was passionate about the survival of the forests and wrote this book to convey his thoughts and hopes for the future of the world's forests, and to leave a record of some of his concerns. My hope is that it will be of some help in resolving the dichotomy toward forests which he revealed here and in forwarding our thinking on some of the issues involved.

**Carol Namkoong**, Asheville, North Carolina, April 2005

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## PREFACE

IN THE SOUTHERN APPALACHIAN WOODLANDS there is a pervasive aura of quiet and peace. There is space to enjoy an unforced life, and time for people, and for the trees to live out the rhythms of their lives. There is a calm that invites acceptance and inspection of the surrounding forms of life. If you chance to walk through these forests, the patterns change from closed canopies to open crowns. The contrasts of sunlight and shadow seems to invite further exploration. There is an alluring romance to these forests that is especially intriguing in the mid-elevations between the peaks of the mountains and the fecund river valleys.

On Early's Mountain where I am buried, a poplar cove lies hidden below the eastern crest of the ridge. There, between the windy ridges and the river valley, a medley of life seems to harmonize. It is cool in summer and golden in autumn, when the open crowns of the tulip poplar let the sun sink into the forest floor. The cove faces a mountain called High Knob, but if you walk a bit south through an oak and hickory stand then turn east again, there is an opening where North Turkey Creek, near Asheville, can be seen flowing into the valley of the French Broad River. To the south is a ridge with a dry patch of pine. Directly below our mountain is moist pasture, and along the edges of the woods and in openings among the trees is a profusion of blackberries, raspberries, wild grapes, blueberries, and wild roses.

Last year a doe gave birth here. On a trail you might be lucky to see the grown-up fawn by the edge of an opening as it emerges from the heavy undergrowth. You can often hear, but can rarely see, a resident flock of wild turkeys that forages through the cove and over the slopes of the ridge. Many other bird species spend winters here, and migrants join them in the spring and fall each year. Some, like the pileated woodpecker, prefer the deep forest cover. Others, like the bluebird, prefer the edges of open fields. Lizards and small mammals appear in abundance through the summer. Some, like the skinks, prefer the drier sites, while others, like the box turtle, live most easily where the soil is moist.

Brief visits reveal only momentary slices of time, and the forest's topographic patterns of life. Longer visits can reveal some temporal patterns. Below the poplar canopy, oaks and hickories are already crowding into the lower crowns of the forest. In a few decades it will be too dark on the forest floor to support the abundance of life that now proliferates in this cove. Unless a new opening occurs, the poplar will lose out to more shade-tolerant species. On the north side of the ridge, a dense canopy of hickory has already closed over the forest floor, and the crowns of oak and hickory now dominate. In an occasional gap, a patch of rhododendron survives around a remnant patriarch from a former open stand of poplar and locust. From there, deeper forests predominate on the mountains as they climb further to the north and west in a series of ridges toward the peaks of the Great Smoky Mountains National Park. To the east the Black Mountains and the Blue Ridge Mountains rise and sandwich our transverse ridges between their dominating peaks. It is a complex topography, which is rich in biotic diversity. This forest has housed a broad diversity of life for thousands of years. Most of the forests in the Southern Appalachians have been well used by humans. Within the last century the area was logged, but there are patches of old growth with stately patriarchs that remind us of what the forest could be like if a different path had been followed.

Over the years, as the old openings close and new openings are created by cutting, fire, disease or decay, new patterns emerge. As one patch gives way to another and the

poplar cedes ground to the oak, the longer rhythms of forest life become evident. Over the centuries, climates change; chance events, fires, and windstorms take out trees, and the local competition drives one species out as another enters. And overlaid on long-term patterns of change, shorter-term cycles of events disrupt any regularity in either spatial or temporal pattern. Within a human lifetime, the forest changes. Within shorter intervals, the harmonics of seasonal cycles are also revealed. The contrast between the spring burst of growth and autumn leaf fall is as beautiful as it is dramatic.

In any single year the changing patterns invite inspection. I have especially enjoyed the autumn mornings when the vapors lift through the tree crowns and the sun glows through the gold and scarlet leaves. On such mornings, the contrast between the oak and hickory, maple and hemlock, pine and sourwood, give sharp relief in contrasting yellow, red, and green: a medley of texture, shape, and form. The fruits of summer are both the dying leaves and the seeds of autumn. The small mammals are active as they prepare for winter, and all of life shows the contrast between the decay of last summer and the promise of next spring. The last moths are dying as they lay their eggs for next year's larvae to feed on the emerging spring growth.

As inviting, and as rich and complex as life is in these forests, other forests are equally intriguing, even overwhelming, in their own ways. Whether it is in autumn on a hill in New England, in spring meadows at the edge of the subalpine fir in the Canadian Rockies, or in gallery rainforests of the Amazon, forests can saturate all of the senses. Regardless of the forest type or where in the world it grows, whether in temperate, boreal or tropical climates in the Americas, Eurasia, Africa, and Oceania the complexity of life within every forest can be overwhelming.

While most of the estimated 25,000 tree species in the world occur in the tropics, even a few tens of species in a temperate forest can generate a system of discomfiting complexity. It would be impossible — but fascinating — to understand the nature of this complexity, and the passing patterns of change. It seems that unless I turn away from that richness and focus on a single species, or an individual tree, or consider an individual bird or insect species, the forest is too difficult for me to begin to understand.

In general, forest scientists consider each system in its parts, and as each part becomes more comprehensible luck may allow them to find beauty in the complexity revealed when the pieces are reassembled. There is the challenge to both reduce the complexity and to understand the dynamics of forest change. We often assume that science progresses through repeated cycles of analysis and synthesis, but we also enjoy the paradigm shifts that reveal new ways of seeing. We hope to find an aesthetic dimension to the beauty of the micro- and macro-levels of observation as integral parts of the study of forests. I am aware of the danger that I may mistake the way that I construct a picture of Nature for the actual structure of Nature. But without such an approach to understanding, I cannot see the trees for the forest.

I am also aware that to understand forests, neither an atomistic nor a holistic approach alone is sufficient. Generally, forest scientists study subsystems rather than trying to understand the whole. In contrast, the forest manager tries to predict how the whole forest will behave but usually must simplify the biology of forests to approximate a mechanical system. Both approaches are never complete and there are always large errors of prediction, much of which can never be reduced. In managing for either production or for conservation, managing for uncertainty is as important as managing for any particular objective.

For those who have been privileged to study or visit many forests, the experience includes a more global perspective of variations. But the experience may also include his-

torical dimensions of continuity. The maple that I see now, and the spruce that can no longer endure here, responded to forces that also affected human migrations. The history of forests is contiguous with a past that connects us with our own deeper roots. Beyond the beauty and the intricacies of whole ecosystems, it is the size, complexity and the multiple time scales of the entire forest that lend an unprecedented richness to the concept of a "forest". There is a deep, atavistic response to forests. They evoke basic emotions as well as complex rational processes and involve our whole being. Understanding forests requires us to use all of our capacities as human beings. We must examine more than their physical presence, and more than our aesthetic and intellectual responses. Forests also evoke a sense of a world before humans existed, uncultivated and unconstrained by social purpose. They are a metaphor of age-old stability; they summon up the myth of the "natural person" and they connect us to a primeval world before humans. They represent a world that is outside the one that we can only physically experience.

The forest is a powerful metaphor for free and natural forces that we admire in the wild and enjoy in ourselves. For most, there is another metaphor of forests that implies a darker place — a jungle full of fearsome animals and other spirits that are foreign, incomprehensible, and beyond our control. The same forest that is beautiful can be suffocatingly close in twisted trees and thorny thickets that hide poisonous plants, venomous snakes, and wild predators. This forest stands in sharp contrast to all that is safe, orderly, and familiar in our urban landscapes and pastoral fields. It is a metaphor for everything that civilization is not. Here we can project all of our childhood fears and perhaps our atavistic visions of falling into a chaotic abyss. Here life is unstable and we fear the foreign forces that lie on the other side of our secure home. For some the deep forest challenges explorers to survive in hostile environments, to regenerate themselves before returning to civilization. Forests may then be seen as arenas for re-creation, or even entertainment. From this wild concept of forests, it follows that one function of civilization is to tame the wild and turn wasteland into a productive resource. Within this culture, the human endeavor is to civilize the world and to use technology to convert the forest into a harvested crop. The goal that arises from these thoughts is to mine the resource where it is accessible and to cultivate a tree crop as we would any other agricultural commodity. By this reasoning, unmanaged forests are unproductive wastelands that provide little of use to humans who must struggle in a world of limited resources. For many people around the world, there is an understood human obligation to make the wasteland useful. They argue that forests should be converted by agriculture or by silviculture into a productive system.

The two concepts of a forest imply two very different consequences for living, one conveying a sense of the sublime, and the other a sense of risk and fear. The first implies that interference is a sacrilege and the second that forests can and ought to be conquered and made productive. Throughout human history, the forest has served as a confusing metaphor for both concepts. Perhaps many of us share and suffer the consequences of mixing our metaphors.

The two concepts generate different visions for what we would like forests to be and how we should interact with them. They also reflect a duality in how we react to the world at large. Do we fit into a dynamic world and live with evolving forests that obey their own laws, or must we conquer them, control the wild, and pacify their inhuman evils by engineering forests to fit our technology? The differences have a significance that goes well beyond forests and into our basic concepts of how humans fit into the world. We consider that the world outside of ourselves is to be either loved or feared. Our lives are permeated by the differences between our senses of beauty and fear, and love and hate. Forests bring these contrasts into sharp focus.

For many, forests are considered to be vital for our spiritual, rather than our material well-being, and are best if left with little disturbance. For others, forests are a wasteland that should be removed or should at least be engineered to become economically useful. For the latter, converting forests to a useful commodity and trees to an economic crop is but one step in the further advance of civilization and agriculture. We have, in fact, two cultures divided by their understanding of forests. They are as deeply divided about their understanding of what forests are as they are about their understanding of what science is, as defined by Snow (1959). The dichotomy between them is reflected in differing attitudes towards how forests must be either preserved or used as tools for economic development. Within many nations commercial and environmental interests are at odds over whether to use or to preserve forests. And even within most individuals we often demand wood and paper products, but simultaneously feel benignly towards forests and appreciate that they provide more than commodity values. We sometimes feel that wild forests need protection. At other times we want protection from their wildness and would be happy to see them converted to productive use. We are at war among social groups and even within ourselves about what forests mean in our lives.

The dichotomy cuts across time and national boundaries, and is carried within each of us. There is certainly a duality in my response to forests. I confess to a romantic as well as a scientific interest whenever I visit a forest. There are economic benefits for local residents, and there is a profound pleasure in entering a beautiful and complex forest, and a sense of foreboding about the dangers that may exist. I have experienced these feelings in the boreal forests of Canada, the tropics of the Amazon and West Africa, the mangroves of Malaysia and the temperate hills of Korea. At home in the Southern Appalachians I see both, and wonder if there is room for both.

The great contemporary problem is that while it is possible to contemplate the beauties of forests, and to wonder at dual visions of what they might be like, the world is being deforested. It is more than an interesting academic problem. This split produces conflicts that only result in the further loss of forests. While arguments rage around the world about the appropriate view of forests, the actual rate of decline of natural forests is around 16 million hectares per year, mostly in the tropics. Forests have declined from a potential of over 50% of the land area to 30% today. And as human populations rise, we demand more goods and services from a smaller land base. It seems obvious that one of our common human concerns should be the demise of forests, but there has never seemed to be sufficient cause for long-term solutions to be forged. From the perspective of threats to forests, it might seem petty to argue about how forests are viewed and valued. It might seem that the conflicting and dual views that we hold could be easily resolved. As shall be seen, however, arguments over forests have been persistent for millennia and have never been resolved. In this book, I argue that the duality itself is the foundation for our inability to halt forest decline.

This book attempts to trace the roots of our conflicts over forests, and to suggest a route to resolution for humans to coexist with forests and for forests to evolve in a human-dominated, unstable world.

It is a complex story, for it touches on all aspects of the history of human existence, from our basic needs for food, fuel, and shelter for security and for aesthetic and religious experiences. It is a story of despair as we continue to lose forests around the world, but it is also a story of hope for a mutually beneficial coexistence between forests and humans that can support all of our conflicting needs.

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# CHAPTER 1. WAR IN THE WOODS

IN MIDSUMMER OF 1993, in a remote forest on the west coast of Vancouver Island, one of the critical battles in the war for the woods was fought. The Island, outside of a few urban areas, is lightly populated, heavily forested, and generally serene. Vancouver Island is on the other side of the North American continent from my home on Early's Mountain, but the issues of clear cutting are similar, and invoke the same strong feelings around the impacts of logging practices. Before 1993, industrial logging had not intruded into some of the watersheds in this region of British Columbia - some of the old-growth forests are truly stunning. Some trees have grown huge over the centuries, and the very age of the trees is cause for intense conflict and confrontation. As virgin timber, they are highly prized both as a significant historic and natural relic and as a valuable resource. On the one hand, they were understood to be noble patriarchs standing tall through the trials of time. On the other hand, they contained valuable logs, perceived as stagnating if left in the forest; that is, producing no net growth on fertile land. The values to both sides were high, and conditions were ripe for conflict.

## **Protest in Clayoquot**

About halfway up the west side of Vancouver Island, the quiet coves and ridges above Clayoquot Sound became the chosen field of battle. There, the moist Pacific winds form heavy clouds as they are blown over the coastal mountains. As they rise, they drop their nurturing rains onto magnificent forests of fir, hemlock and red cedar. The steep mountains along the valleys form long picturesque fjords. Continuous forests of Douglas-fir, true fir, hemlock and Sitka spruce cover the hills from the alpine tree line down to the water's edge. And where the valley coves have accumulated deep soils for centuries, the trees of the old-growth forests now reach over 200 feet high. They are as large as legend pictures the virgin forests of a primeval world to have been. They thrive in a climatically benign strip along the coast where the Japan Current moderates the arctic cold in winter, and the winds from the Pacific moisten and cool the valleys in summer. Lying across both the northern temperate and the southern boreal vegetation zones, the forest supports many plants and animals typical of both zones. In this rare temperate rainforest, the biological diversity ranks among the highest in the world.

The summer mornings are usually cool and moist, and it takes a few hours for the sun to lift the fog from the valleys. But on one morning in August 1993, the usual quiet in the remote Clayoquot Sound was shattered by fierce protests. When the morning fog lifted, hundreds of protesters rose from an encampment as if at a religious revival and blocked a logging road with their bodies. The demonstrations had been mounting for weeks to reach a new peak of intensity. While the conflict over clear cutting was not new, startling televised pictures of silver-haired grandmothers marching into police wagons gave this demonstration unparalleled impact. They sang protest songs against the destruction of the old-growth rain forests and were arrested for obstructing the legally sanctioned logging by MacMillan-Bloedel, at that time the largest timber company in British Columbia. At that moment, the "Raging Grannies" captured, as no others had been able to, the instantaneous sympathy of a broad audience, including me, as they demonstrated their willingness to put their fragile bodies on the line to preserve old-growth forests. They lost the battle on the logging road, but shifted the war to another plane.

It was easy to dismiss the Raging Grannies as a frivolous protest group, as many did, but to do so would have missed the potential impact that apparently minor social movements can have on political processes. This protest fit well into the history of English and American protest movements and gave the legitimacy of tradition to their actions. The Raging Grannies' actions fitted a general reform tradition with social and political strength beyond that called forth by the immediate issues. They echoed the feminist and reform movements of two centuries ago led by Mary Wollstonecraft, whose seminal work for women's rights in England came at a time of political revolution. It formed the basis for the feminist movement of the mid-19<sup>th</sup> century and, in the United States, Margaret Fuller's movement for political equality for women. Fuller received encouragement from her circle of friends, which included Ralph Waldo Emerson, the early American environmental philosopher. The women's suffrage movement and demonstrations, sometimes against the law of the time, became part of the folklore of protest movements. The Grannies were aware of that history, and an informal group of women in Vancouver started in 1987 to form around issues of war and nuclear power.

As a scientist working in British Columbia during the 1990's, I had opportunities to meet many people involved in the conflicts. One of the founding Grannies, Doris McNab, told me that there wasn't any shortage of issues that begged for attention, once they found that women's groups could be as effective today as they were a century ago. The Grannies' protests resounded among modern reformers and focused other local protests against uranium mining and environmental pollution. Their general concern for the planet and for the sanctity of life led the Grannies to finally address forestry issues in 1993. They joined an ethos of social reform and social action in forestry.

The highly dramatic pictures of their arrest signaled a decisive turning point in the battle over clear cutting on Vancouver Island. The Raging Grannies had joined a growing protest movement against logging (what seemed to be) the last "virgin" forests of North America. Troops of younger protesters had already been in the front lines of action, and they helped form a large coalition of environmental interest groups that carried protests across Canada. The young people lived with fewer social constraints than their elders, and were freer to question practices that traditionally had been accepted. The groups, though disparate in age, shared a common belief that forests are a natural endowment to maintain and to protect. Together, they developed a ground swell of political support in North America and Europe and began having an economic impact in the marketplace for timber and paper products. It was largely a youthful movement, led and carried on by people of the post-hippie generation that had already attracted celebrities like Robert Kennedy Jr., and had begun to capture broad attention. But a new dimension was added by the arrests of the Raging Grannies.

When the grandmothers marched into the trenches of the battle it was a statement that they felt imminent threats to deeply held, traditional and long-term interests of future generations. They feared that their grandchildren would be denied the benefits of the forests that they had enjoyed, and that their children, grandchildren and generations hence would instead witness the destruction of a vital part of their lives. When they joined the more youthful chorus, they brought a deeper tone of moral concern and religious fervor to the cause. Fundamental, vital and broadly held public values were being so threatened that grandmothers were willing to go to jail along with the young for their beliefs. They felt morally compelled to preserve the sanctity of life as found in natural forests, and by join-

ing the younger protesters they acknowledged a vision, or a mythos, of protecting a benign state of Nature.

It was a compelling vision that combined this ecological mythos with social history. Logging became a moral issue and clear cutting a forest became the moral equivalent of desecrating a cathedral. The televised arrests recalled newscasts of the civil rights demonstrators of 25 years earlier, and invoked visions of suffragettes of 75 years earlier, both of which raised a ground swell of overwhelming public opinion against moral wrongs. The mixture of moral and religious motivations sent clear, immediate and irresistible signals to the world.

In many ways, I feel a deep empathy for the protesters and can easily understand the threat posed by massive clear cuts. These forests are unique and create a sense of enchantment for anyone entering them. The dynamics of the soil and climate on the species growing on Vancouver Island are certainly different from those on the East Coast of North America, or anywhere else in the world. The forest is incomparably beautiful. The forest grows in a unique biome, and as one of the last temperate rainforests, contains biological interactions that may not exist elsewhere. The forest is also the home for an Aboriginal culture, for which the forest is significant in present religious practice and embodies respect for the past.

But if I can empathize with the anti-logging protesters, I can also understand that humans have interacted with forests over thousands of years. The history of interactions between forests and humans interactions is at least as complex as the history of social movements. As in most boreal forests, the retreat of the last glaciers, the establishment of forests at that edge, and occupation by humans occurred almost simultaneously, so humans have always interacted with and affected these forests. In the past century, the practice of industrial forestry has changed from being solely concerned with harvesting timber to managing forests for a broad spectrum of values. In modern times, forestry has become a complex integration of humans and forest ecosystems. This cultural understanding of forests is another side to the story of human-forest interactions. And there is another segment of society, with a different history regarding forest practices and a different social agenda that matched the protesters in the fervor of their beliefs.

## **The Loggers**

In the opposing trenches were troops of woods workers, their families, and officials of local communities, who depended on the forest economy and who had an opposing set of values and priorities. To them, logging and milling were traditional and well-respected jobs that had sustained woods workers for generations. During the latter half of the 20<sup>th</sup> century, they and their predecessors had begun cutting into the reserves of old-growth timber that were a primary resource for their jobs and for the economic development of the province. The economy of British Columbia was and still is based largely on natural resources, though it is in a transition towards a more sophisticated industrial and service-based economy. For the workers, timber was a natural endowment that they were using in time-honored ways for human development. Moreover, the forests were now being managed under a sustained-yield plan for forest renewal administered by the provincial government's Ministry of Forests: if old trees were cut, enough young trees were established to replenish the forests. Forest workers, therefore, saw that the protesters were threatening their livelihoods, and they were angry and frightened at the implications for their future imposed on them by intrusive outsiders.

The Forest Alliance, a provincial association of the local forest industries and forest workers' unions, supported the workers. Since almost all of the forestland in British Columbia belongs to and is regulated by the Province, and the law requires that sufficient tree regeneration follow any cutting, the Forest Alliance's own self-interest lies in practicing sustainable forestry. The Alliance is comprised of many rational and dedicated conservationists themselves. They truly are not the "land rapists" of past generations, who destroyed the eastern forests of North America. They are dedicated to using forests as a renewable resource, and they apply the techniques of modern scientific forestry as well as they can. Their economic objective is to extract and regrow wood as efficiently as possible. In effect, forest management is seen as another form of agriculture - instead of harvesting grain, woods workers harvest wood. In their view, forestry is as natural as farming. Once the old growth is harvested, they look forward to planting a new crop of selected trees and harvesting those stems in a silvi-cultural - instead of an agri-cultural - system. Both farming and forestry are perceived as morally positive ways to make the wilderness more productive. The Alliance works with a technology that can sustain forests and produce a flow of wood products as well as jobs and income. But now, in the conflict over clear cutting, their way of life was being threatened.

The employment of woods workers clearly has a long and respected history that stems from the drive to make the wild productive. In fact, for centuries forests have been viewed solely as a resource available for economic benefit. Forests are an endowment that human technology can turn into products of value. Left alone, forests will not provide agricultural or industrial employment for workers, nor will they house or feed their people. Unmanaged forests themselves limit the well being and safety of agrarian peasants, as well as their social and political systems. Before the advent of scientific forestry in the 18<sup>th</sup> century, the forest was seen at best as a primeval resource. At worst, it was thought to be a dark and dangerous place that needed to be cleared and settled by hard work. Similar to the ancient woodcutters of ages past in Europe and the loggers symbolized by Paul Bunyan in the American tradition, the loggers in Clayoquot Sound were at the forefront of clearing dark places that lay just beyond the edge of civilization.

For many years, European settlers saw the forest as a wasteland and believed that a primary role of civilization was to conquer wastelands and bring order by making Nature productive. These settlers developed techniques to control forests, harvest the useful, manage crops, and tame the wild. Westerners see technology not only as a means to convert materials into resources, but also as a distinction between human civilization and sub-human savagery. We seem bound by our human nature to remove the wild and, encouraged by modern technology, to engineer the forest to provide useful materials. Forestry is part of the civilizing conquest of humans and technology over wildness and mysticism. Modern scientific research now underpins the technology, but, fundamentally, forestry is the human effort to conquer the wild. Using our human capacities to control and use Nature is part of the Promethean struggle for fundamental power. From this perspective, we are most human when we use our intelligence to conquer and control Nature with our technology. While few foresters may see themselves in such heroic roles, the drive to manage forests is part of the fundamental drive to manage Nature. Part of the mythos of forest management is this drive, and the scientific positivism that we can know and control forests.

In addition to lacking commercial productivity, an unmanaged forest also harbors an aura of danger. When entering a dark forest from the outside, it is easy to feel a sense of disorientation. In deep forests your vision is limited ahead and to the sides, as well as above by the overstory of tree crowns. Trees confine the limits of view, instead of lifting one's vision beyond the immediate. And in the deep forest, primary productivity is shifted above our reach to the treetops, so we cannot readily cultivate or control it. We feel exposed to the chaotic forces in such a forest.

In allegories and fables, through centuries of story telling, forests have been used to evoke our fears of losing the security of home, domestic order, and familiar surroundings. Where some people may see a forest as a sanctuary, at least as many see an equally compelling dark side of wild woods. Folklore is filled with images of wild animals and of the danger that lurks in untamed wild areas. Wild forests have come to symbolize the chaotic and dangerous side of uncivilized nature. From this view, it followed that the secular duty of ecclesiastical bodies was to eliminate the paganism that found refuge in the wild, and to foster agriculture and grazing to clear the wilderness. Little Red Riding Hood and Hansel and Gretel are among the more famous stories that instill a lasting fear about the hidden dangers in forests. In the lore of many societies, there is a "wild woman" who lures children into the forest, never again to be seen by their parents or their tribe. Those stories are quite powerful and give form to primal fears that mold even our adult views of a dark world out of our control, and channel how we see and respond to forests. It may even be necessary for the human psyche to construct a clash between a well-ordered culture and a savage Nature in order for humans to define themselves. The forest easily fills the role of the savage with which to contrast human culture.

The forests therefore lie beyond the kind of control we can exercise in cultivated fields or within city walls. Instead, they seem to generate unpredictable chaos. Whether forests appear threatening and we then create stories about them to guide children away from danger, or our fears of chaos precede the stories and we cast those fears in terms of forest images, we associate dread with forests. Around the world and across centuries and cultures, we have carried these shadowed fears of forests. Even in modern times when people experience most forests only indirectly, the stories persist and remain as formative images of our world. The forest remains a powerful metaphor of the foreign. The words in English (forest and foreign) and their meanings share a common root and form part of this alternate mythos of forests that reaches deeply into our modern psyche.

When the loggers and the protesters met in Clayoquot, it was a battle between the two different meanings of forests that carry the weight of historic social and economic conflict. Hence, it is fair to say that the conflict had mythic proportions.

## **The Forest Crisis**

Superimposed on the conflict over the nature of forests is a crisis of frightening proportions. From the world beyond Vancouver comes a muted but steady drumbeat of news that warns of the impending forest crisis. Reports of uncontrolled logging and wild forest fires only occasionally draw the public's attention to the worldwide scope of forest loss. As scientific studies and international surveys accumulate (FAO 2001), the growing magnitude of forest destruction has begun to arouse global concern. The loss of forests is most apparent in the tropics but is occurring on all the continents outside of Antarctica. The net losses of forest lands are small in Europe and North America. If we accept the replacement of old growth with successful regeneration and plantation forestry, forest area is

increasing in parts of these continents. The magnitude of forest loss in many areas, however, is so great that it poses an immediate as well as a long-term threat to the health of the planet.

When public interest has been piqued by some catastrophic event, friends have asked me about the forests that were being damaged. My professional colleagues would be amused by my attempts to describe simply the biology and evolution of the Amazonian forests, or those of West Africa, Thailand, East Asia, or Europe. The biological issues are far too complex for social discussion and I always stumble in trying to describe the catastrophe as a biological problem. I try to describe the kinds of ecosystems, the types of species, and the conditions before and after the events. After several discussions about such incidents it dawned on me that there was a common pattern to our discussions. We might start by discussing forests, but the focus inevitably turned to the human conflicts that gave rise to or resulted from the incidents. At first I thought that I bored my friends so much that they turned their attention to more familiar social issues. Upon reflection, however, I also realized that the news reports primarily focused on the social conflict, usually between environmentalists and industrial interests. The more contentious the confrontation was, the more attention the media paid, but with no mention of the biology of the forest and of how humans actually interacted with the forest. When such reports are followed up by analysis, the conflicts are usually couched only in terms of the perceived environmental problems, and the possible resolutions in terms of social balances. The media, for the most part, ignore the underlying biological context of the problem. In modern liberal democracies, we assume such resolutions require balancing the relative values of the two opposing factions. By socializing the forestry problem in this manner, any solution has to subsume a single scale of value along which the balance is to be struck.

So, we seem to have evolved a classical good/evil, either/or structure to our contentions over forests. That structure assures us that we will find a stable solution to our uses of forests and forest land. It has allowed the problem of forests to be reduced to a political question that then seems amenable to solution by compromise. In 1992, at the Earth Summit conference in Rio de Janeiro, 172 countries were represented by official delegations charged to address the global scale of environmental destruction. The Conference focused global attention on many aspects of environmental degradation and, in follow-up activities, progress has been made on several fronts. However, the loss of natural tropical forests largely continues unabated.

In the decade of the 1990's, the net reduction of forest land around the world amounted to around 94 million hectares. That is an area slightly larger than Germany and France combined. Conversion has been a problem for centuries but has been exacerbated in recent decades. The total loss of natural forests is over 4% per decade. The net difference between conversion and loss lies in the shift of abandoned agricultural fields to forests in Europe and the United States. As mentioned previously, it is the establishment of plantation forests that masks the loss in the net change (FAO 2001). Similar levels of cumulative loss can be expected to continue into the foreseeable future, and in 50 years would amount to an additional 20% loss of natural forests worldwide - an area about the size of Australia.

Obviously, the reduction of the problem to a political one fails to recognize the biological, social, and historical context of the conflicts, and the long-term commitment needed to secure future forests. Unless these other factors are included in our thinking,

efforts to design sustainable forests are bound to fail. Conflicts will continue, and forests will continue to decline beyond what is ideal for either production or conservation purposes. To find our way out of this seemingly intractable problem, it would be useful to ask why we are so ambivalent about forests. The next questions might then be how to find alternatives to conflict, and whether possible solutions for sustaining forests exist.

In our complacency we might consider that some trees grow for centuries, that forests have endured many trials, and that conflicts over forests are as old as the proverbial hills. Unfortunately, unlike most hills that erode with time, these conflicts seem to grow, take on new meaning, and become even more contentious as the forests diminish. We might also think that the direct use of forests is primarily by more primitive societies, and that wood use would decline as they industrialize. It might therefore come as a surprise that the *per-capita* consumption of wood products is higher in industrialized societies than in non-industrialized ones. Currently, the *per-capita* U.S. wood consumption, for example, is four times the average of the rest of the world. Non-industrialized nations use more non-timber forest products for fuel and domestic purposes, but as they become industrialized, consumption increases (Sutton 1999), even as use of wood fuel declines.

All societies need standing forests to control soil erosion, regulate water runoff, and for carbon and oxygen cycling through the atmosphere. This need grows as the human population increases. For our material survival we must struggle to conserve forests. Instead, we struggle to harvest them with greater urgency across a smaller resource base. For most of recorded human history, local shortages of wood have occurred, even when there have been ample forests on a global basis to support human needs. For most of the time humans were evolving, forests occupied over half of the land area of the world and humans were a minor presence. The reverse is now true. Human-dominated landscapes, including farms, pasture, and urban areas, now occupy around 36% of the land area of the world, and forests only 30%. With a fifth of those forest lands in a severely degraded state (FAO, 1999), only about half of the forests are in as good a condition as they were two millennia ago. Yet our agricultural and industrial production systems have never been more dependent on forests than they are now. In an energy-critical world, trees supply a far more energy-efficient material for construction and paper products than any substitute metals, concrete, or plastics. Also, since forests contain most of the earth's plant and land animal diversity, the loss of forests threatens the main source of biodiversity for the entire globe.

To visualize our use of the globe, suppose that all of the dry land area was gathered into a single 64-acre plot of land — that is 26 hectares (ha), a little over 500 by 500 meters, or a tenth of a square mile. (One acre is about the size of an American football field.) On this land, the present human population would be represented by 13 people; their fields, grazing areas and living area would occupy 31 acres (12 ha); forest and woodland would occupy 20 acres (8 ha); and the rest is mostly rocks, desert, ice, and a little grassland. Forests once occupied over 30 acres (12 ha) of our example parcel of land. The woodlands are growing at a rate just a little more than needed, but with the projected human population of 20 people by the middle of the 21<sup>st</sup> century, there is not enough growth to match even current consumption rates, let alone any increases. At current rates of forest loss, we will lose nearly 5 of the remaining 20 acres (or 2 of the 8 hectares) of forest.

The pressure we have placed on this shrinking resource is apparent in the amount of forest land available to each person. That *per-capita* ratio has eroded in the last two millen-

nia from around 100 acres of forest per person to a mere 1.5 acres per person today. That will not be enough unmanaged forest land on a global average to produce wood at present consumption rates of industrialized societies. Nor would it be enough at low consumption rates for the projected human population of 10 billion people by mid-century. This reduction in forest land will also not allow for parks or reserves. Unless the erosion of forest land is reversed and more lands are managed for high wood production, all the other values produced in standing forests will be lost in the scramble to produce consumption goods.

This crisis is below most people's horizon of awareness. Since forests take a long time to grow, the solution will require long-term commitments that are difficult to support politically. There is a long lag-time between initiating forest remedies and growing a mature forest. Programs designed to prevent forest loss, therefore, have rarely had enduring effects. Over the last millennium, successful forest conservation programs have only been promulgated by royal or other authoritarian decree. The problem of losing forests is not new, but has repeatedly emerged throughout recorded time. And when the problem has been recognized, it has usually been in retrospect. Over 2,500 years ago Plato in Greece and Mencius in China recorded regrets over the loss of forests, as have innumerable observers since then. But these observations usually were made only after the forests had already disappeared. The rise of human populations and economies has been at the expense of forests, and only such great human disasters as the Black Death and global famines have given temporary pause to the persistent increase of human populations and the decline of forests.

## **Foundations of Conflict**

Over recent centuries, as forests shrank and human populations grew, forests have become the center of controversies. Conflicts have erupted over logging and fire control. Conflicts over the uses of forestland have emerged in developed and developing countries alike around the world.

Despite the long history of conflict, solutions remain rare and seem to be unstable. How is it that we have come to this path of destruction and irresolution? Why does it remain such a low priority? Obviously, there is a limit to how far we can degrade forests before catastrophes to our global ecosystem result. Local catastrophes have occurred in the past and continue to affect some areas today. There are global limits to forest resilience, so that even local losses can affect distant ecosystems. By failing to resolve our conflicts now, we continue to test those limits. Some argue that we have already passed the threshold of disaster, at least spiritually, if not materially and ecologically.

The relationship between humans and forests has largely comprised displacing forest ecosystems by human systems. While that displacement is a defining feature of the interaction between humans and forests, at least recently the displacement has been associated with conflicts among segments of human society. Since humans cause most of the destruction of forests and yet also depend on them, continuing human conflicts stand to generate catastrophes for both.

In human conflicts, the cultural war for the woods is a war of opposing visions of what forests ought to be. This war has never been satisfactorily resolved, but it must be if the catastrophe is to be avoided. Unfortunately, the human conflicts are based on deeply held but rarely examined beliefs and thus are not subject to easy solutions.

In Clayoquot Sound, the conflict was physically demarcated by people chained together who blockaded the logging road. The language of "us versus them" was accompanied by a demonizing of the other side as befitting enemies in a war. It was a conflict of cultures filled with physical and verbal reinforcement. It was going to be difficult for any arbitrator to find common ground for discussion among the warring camps and to avoid further conflict. Yet I certainly felt ambiguity, or rather duality, in my view of the forest and how the contrasting views could be integrated into a single forest plan for the province. While I felt that both sides had merit, I also wondered whether and how much the general public also felt this duality, and if even the staunchest supporter of either side did as well.

The human blockade on the logging road defined the line of opposition between two ideas of mythic dimensions. The forests of Clayoquot would be either a reserve for old-growth patriarchs or a timber resource for economic development. The "realists" on both sides knew that they might have to accept a compromise on what percentage of the forest would be dedicated to their goal. They also knew that their struggle would set precedents for future conflicts in other forests. The forest was the material basis for the conflict. Members on each side considered the resource an endowment from ages past that was theirs to protect or to develop, and each saw the forest as a passive resource in a pristine state except for very minor influences of human culture. Since the conflicts were primarily social and political in nature, the biological nature of the forest was of minor concern to the human participants. Forest biology would contribute only minor details to understanding any options for resolution and only minor adjustments to any agreements.

**Some  
Biological  
Principles**

As biological entities, forests have dynamics of their own that alter and constrain opportunities for human influence. A forest is not like a metal resource that lies dormant and needs only extraction to be of value: it grows according to its own dynamics, where its inherent growth processes produce value. Its growth is both its virtue and its curse, as considerable value emerges when it is harvested.

The growth of individual trees, like that of many other organisms, follows a path that begins with youthful vigor, when a large ratio of leaves and roots to trunk provides an excess of energy intake relative to expenditure for structure and support. As the tree's production and support systems grow, the leaves and root tips, which are the production units, require proportionately more support and defense, and also must eventually bear the reproductive organs. The vascular system carries water and nutrients. It elongates, but since it is often only a thin zone outside the heartwood, it requires an increasing amount of circumferential growth to maintain the transport of materials throughout the tree. There is an inevitable decline in production of net energy for growth of any organ, and with competition from neighbors or any other limitations on external resources, the decline may be precipitous as with poplars, or gradual as with redwoods. But decline there is. Depending on which organ is measured, there is an increase during youth and decline through maturity, and there must be at least one maximum somewhere between. In an oversimplification, the practice of forestry can be viewed as the cultivation and harvesting of that biological excess relative to its costs and benefits. If the production of game mammals and birds are also considered, these species often are at maximum density in transition zones or forest edges. Hence, for the production of many values of interest, nature forces us to harvest long before decline due to old age sets in. For some values associated with large

old trees, and for structural diversity, which are required by some animals, however, biological richness or productivity does not decrease with physiological senescence.

**Some  
Management  
Principles**

There are many scientific and technical questions involved in understanding the genetics and developmental physiology of trees, and of their associated organisms (including the insects and fungi above and below ground). It is also difficult to relate that knowledge to the effects of past or future environments, and to design appropriate management systems. In forests, with their usual complement of species in several layers of energy productivity, consumption and cycling, we must integrate mixtures of age classes and time scales in order to understand a particular forest ecosystem. Each species has its own requirements for space and resources over its lifetime. These needs may be correlated with the requirements of some other species in chains of partial causality. The design of a landscape for one species may be antagonistic to another, and one set of species may require a different design and management regime than another. That is, the state of the resource and its internal dynamics will often be a mixture of many types of individual conditions. Thus, no single pattern of landscape design can be optimal for all parts of a forest. Compromises must be reached in any mixed resource management solution. This is the central problem of silviculture and forest management, and its allure as well as its curse. Furthermore, each part of the forest can be expected to respond differently to any management prescription. Hence, no single system of treatment can be optimal for all parts of the forest. Technical solutions can only describe feasible alternatives for management. The problem of what and how to compromise on different objectives remains beyond the scope of what science can provide.

Currently, forest treatments of various kinds are theoretically capable of producing very different forest stand conditions, depending on the current state and past history of the forest. Many techniques have been developed under the general rubric of "ecosystem management." They include what is called "variable retention logging," which has been considered as an alternative to clear cutting in very large blocks (see e.g., Kohm and Franklin 1997, Vogt et al. 1997). But as techniques are being developed, cultural conflicts override the trial and application of technically feasible alternatives. The availability of alternative treatment methods has not allayed the conflicts generated in the public in Canada or elsewhere. As suggested by Jack Ward Thomas (1997), "The greatest challenge that foresters and other natural resource management professionals face in the practice of their professions may not be the technical aspects of forest management, but the public acceptance of those practices."

**Conflicting  
Visions**

Confrontation between these opposing positions is difficult to avoid, especially if its roots are unacknowledged. In Clayoquot Sound, a clash could not be avoided as forest-dependent families mounted protests to counter the anti-logging protests. Their underlying world views conflicted, and there was no room for compromise between what the loggers needed for economically efficient forestry operations and what the protesters considered to be well beyond the limits of acceptable environmental degradation and loss. In addition to the recognized economic issues, the situation took on a strongly moral and even religious tone as feelings deepened and personal levels of commitment became exposed. As deeply as these were felt, there were even larger economic and social forces moving into antagonistic positions around larger issues than the battles between conservationists and loggers.

Conflicts have arisen over forests and logging in many areas. For example, in Eastern North America one can see the same conflicts over previously cut stands. Old-growth in the East represents the residual stands that were logged a hundred or so years ago but have been left with little deliberate management. They may have been grazed, and a few trees taken for special purposes, but have otherwise been untended and now have a mixture of species and age classes of both commercial and noncommercial trees. Nevertheless, the urban pressures on these forests is at least as great as on Vancouver Island. The logging industry is weaker, but the same contentiousness exists over cutting and managing these forests. The same national and international environmental organizations support one side and the same industry groups support the other. Similarly, in Western Europe and Japan, where the ages and conditions of the forests, as well as the political and economic constraints are vastly different, there is a continuing struggle between proponents of Nature preservation and of logging. The emerging global economy forces these disparate struggles to play out on the same global stage.

Global trade is now forcing even larger issues onto the stage. In the global economy of the late 20<sup>th</sup> century, resource-based economies suffered from unstable prices and unfavorable balances of trade, and British Columbia became an economy in transition (Marchak 1983). It had a large timber resource to use but was moving towards a broadly based industrial and post-industrial society. Timber would no longer play the dominating role it once had there, but it could continue to be an important segment of the economy (Marchak 1995). In socio-economic terms, the struggle on one side was for immediate conversion to a non-commodity-based economy, and the other side was for maintaining flows of resource commodities. Between the two, the provincial government tried to develop community consultation programs to create consensus on locally based forest plans. The process, called "CORE," (Commission on Resources and Environment) would moderate uses, logging, and road building practices.

In addition to eastern Russia, the Amazon, and parts of central Africa, British Columbia was one of the few places left in the world where large expanses of virgin forest remained. There was opportunity both to sustain a wild estate and to maintain a prosperous society based on forest resources. It was felt that the province lay "on the cusp of an irreversible slide into the established historical pattern of resource depletion and attendant social disruption" (Binkley 1997). It was hoped that the province could find a path to development that did not follow the pattern of forest depletion of Eastern North America or of other colonized areas of the world.

From the perspective of professional forestry, the evolution of forest usage had long since passed the primitive stage of unregulated and destructive logging; it was confronting the problems of defining and balancing multiple ecological and social values (Kimmins 1991). The province commissioned a "scientific panel report" for Clayoquot Sound, and practices were described indicating that a range of biologically feasible steps could be taken to accommodate most, if not all, of the goals of users and conservationists (Bunnell and Johnson 1998). It was hoped that different visions for the future of the province's forests could be reconciled by a series of local agreements. At the provincial level, it was proposed that compromises could be reached by allocating large segregated areas for different classes of forest activities (Binkley 1997). But the issues involved were too large to be resolved by technical guidelines, and larger than just two views of the economy, or styles of

forest practices. They also involved fundamentally different views of both forests and of humans.

### **Obstacles to Resolutions**

The first solution, finding a series of local agreements, proved problematic due to the different scales at which some logging and conservation practices had to operate. The second solution, developing large segregated land-use agreements, required stability in agreements by all parties for long-term allocation of resources. Similar experiences of the past century and in other parts of the world did not portend well, either for finding common grounds for agreement or for the stability of any agreements the participants might reach.

A current panacea called "ecosystem management" raises as many questions as it answers. It has become apparent that there are so many difficulties in defining concepts that it is nearly impossible to implement programs based on these concepts. While there are indeed several examples of the positive effects of designating and managing various types of "forest reserves" (Bawa et al. 1990), the difficulties only point to the need for substantial redundancy among reserves. External threats to sustaining forests that may have originally motivated the need for the reserve usually persist at least in the surrounding area. Funding is often unsustainable and the infrastructure and internal organization needed to sustain a program have proven difficult (van Shaik et al. 1997). Among the difficulties is that any such program must be based on time- and space-bounded domains, but the definition of boundaries has remained elusive. Goals for "protected areas" were difficult to define and the selection of areas to include in the provincial protected area strategy were hotly debated (Soulé and Sanjayan 1998). As is true for other large global forest reserve plans, the selection of areas is always incomplete and their management is typically not sufficient to retain even minimal goals of conservation. For example, in a study of forest reserves in 10 countries, only 1% was found to be in a secure condition, while 22% were suffering severe degradation. Surprisingly, the trends existed in developed as well as developing countries (Dudley and Stolton 1999).

Similarly, the concepts of ecosystem health and integrity are so indefinite that they provide few guidelines for management. "Sustainability" requires an undefined selection of what is to be sustained and at what levels of input and output. None of these difficulties are insurmountable, but all point to the need for more consultation and sustained effort to make even apparently simple programs work. Success requires a long-term commitment to an evolving program, the use of several approaches to forest reserve management, and a strategy that can adapt to changing biological and social conditions. Initially, few participants in the Clayoquot conflict anticipated such needs.

Two other obstacles to finding enduring compromise solutions existed. The first was fear. Both sides feared not only unsatisfactory management of the currently contested areas, but also starting down a slippery slope to losing control over all of the remaining forests. Each side accused the other of having a hidden political agenda. Both feared that an adverse settlement would set dangerous precedents that would be detrimental in future struggles for control of other forested areas. The second obstacle was that conflicts arose from often unacknowledged moral values. The issues were actually about ethical values that were difficult to discuss directly or, when they were acknowledged, left no room for consensus or compromise. Participants phrased their values in terms of "desecrating a forest cathedral" on the one side, or "foregoing the benefits of jobs and production" on the other. It was considered to be a moral wrong whether it was 10%, 20%, 50%, or any other

amount that was saved - or cut. While in a specific situation each side might agree to put a given percentage of land into reserves as a politically expedient tactic, any amount would still be cause for future conflict. In such a politicized atmosphere, the provincial government could only act as a mediator for temporary solutions.

In one case, the concept of "variable retention logging" was accepted by leading environmental groups and by a leading company. Other than banning very large clear cuts, however, the agreement left all other practices more or less the same and open to debate and criticism. An illusion of victory for both sides was created, but it could only partially obscure a future of continuing conflict.

When planners tried to make specific decisions about which forests to manage and how to manage them for either conservation or utilization objectives, it was hard for them to put the general goals into practice. For example, the concept of a "production forest" proved more difficult to define than expected. Various "products" were being drawn from the forests, and far more than timber values had to be considered. If water and recreation values were considered in estimates of productivity, mixed methods of evaluation were required, and results were not easily reconciled. Possibilities for continuing conflict arose over calculating and achieving optimum productivity.

Similarly, the problem of defining clear objectives for what constitutes successful "Nature preservation" proved difficult in forests that are undergoing continual change. Trying to define particular age class, size, or even species representations in stands as being ideal in any sense has proven to be impossible, even on a very small scale. On a larger scale, the definitions approach vacuity and invite further controversy when specific objectives are not met. Attempts to apply ecosystem management that emphasizes maintaining ecosystem processes also prove difficult to implement, as they rely on various cutting or other techniques to mimic "natural disturbances." While the concept of natural disturbance seems obvious, natural disturbance effects are complex and of little-known or unpredictable benefit. Thus, the imposition of a disturbance entails two major sources of uncertainty. If forests have evolved over centuries of both climate change and human impact, then what particular condition a forest should be in becomes impossible to describe, much less to achieve. While broad goals could be stated, the effects of forest practices, including non-intervention, remained ambiguous. Added to this, the absence of scales for weighing different values on common grounds and the lack of mechanisms for achieving long-term agreements condemned the efforts for conflict resolution to futility.

The conflicts in British Columbia would be an interesting footnote to history were it not for the fact that they are symptomatic of struggles occurring around the world, none of which are reaching stable resolutions. There has been no long-term resolution to the conflicts over forests or to the decline of forests around the world. The reasons for our failure lie both in the failure of practical implementation of conservation plans and in fundamental conflicts over goals. The difficulties of applying conservation and use objectives become apparent when specific decisions have to be made about how to manage forests for either conservation or utilization objectives. Yet, these decisions must be made to formulate any specific plans of action.

With a biologically complex and dynamic system like a forest, the precise state of the system at any one time and its rates and directions of change are known roughly at best. The effects of any management intervention are also only crudely known. Hence, predict-

ing what changes will occur and what can be managed cannot be exact sciences. In addition, with a complex resource, multiple management goals require compromises among achievable outcomes. With uncertain, multiple objectives, and with several possible effects of each feasible practice, no one solution can be expected to be optimal in any but the most restricted way. To approach a solution, we need to examine what we want and need from forests, and to look among the feasible solutions for any options that may still exist for saving our forests.

It is clear that the conflict over logging evokes deep and powerful emotions. We rarely explicitly face these emotions, which form our perspective of the conflict. In fact, the conflicts we have over forests are based on mythic concepts of forests. I use the term "myth" in a non-pejorative sense, as an over-arching concept that gives coherence to propositions about the world. It is a world view of how basic forces shape our histories and our possible futures. We hold creation myths as ways to understand our origins, and we often base them on deductions from our experiences. We hold ecology myths about how the world fits together and how humans fit into the world. At their deepest levels, neither is scientifically testable, but both are plausible formulations of deeply held beliefs that guide our behavior.

When applied to forests, we have the concept that a pristine, ideal forest existed, and can exist again if we leave it alone. We also have the concept of a forest that can be understood as a deterministic production system, much like any other manufacturing system. Both concepts are held so deeply, have such long histories, and draw on so many other beliefs that they assume mythic status. If myths are in conflict, then to resolve the conflict we require a theory or a myth of resolution that overrides the conflict - or that allows for coexistence. While we argue over techniques to resolve our differences, the myths that are in conflict also need to be addressed. The resolutions offered may be means for achieving some agreements, but if they do not address the conflicting myths, they will not offer a resolution. In this book, I will examine the history of the conflicting myths in order to see their origins. I will only sketch the technical aspects of forestry in order to give substance to the concepts and myths that sustain the conflict, and to suggest routes to resolution.

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## CHAPTER 2. GLOBALIZING THE CONFLICT

### **The Microcosm at Clayoquot Sound**

WHAT SEEMED TO BE a local skirmish between woods workers and environmentalists favoring old-growth stands, turned out to have deep roots in opposing visions of what forests ought to be. Superficially, the conflict was over cutting rights in a previously unlogged valley on Vancouver Island. But the intense feelings that were evoked, and the social history supporting the opposing views, revealed that much deeper currents were present. A host of issues had coalesced into a powerful but unstated mythos on each side.

As the demonstrations and counter-demonstrations escalated through the last decade of the 20<sup>th</sup> century, the feelings that were expressed resonated in the broader public. In other parts of the world, similar, seemingly local, issues began to induce a global response — a common concern for forest conservation was developing around the world.

The outcome of the battle in Clayoquot Sound was anticlimactic. Four years after the confrontations on the logging road, MacMillan-Bloedel agreed to change its logging practices. There are grounds to argue that the changes were cosmetic, but the company's acquiescence can be attributed largely to market and political pressures. Globally, consumers and voters were responding to the appeals of the environmental coalition. The conflict had raised social and moral issues that had large impact on global business decisions.

Due at least partially to the higher costs of timber extraction in the province (the highest in the world), as well as to other economic forces and falling log prices, several thousand woods workers jobs were cut and many communities suffered severe economic hardship. But conflict did not end. The battleground shifted from the Clayoquot to other areas and to other kinds of forest practices. A few years after MacMillan-Bloedel agreed to modify some of its logging practices, the company was sold to Weyerhaeuser Corporation, which is based in the United States and holds global forest and forest product interests.

### **Global Issues**

In both the supply of trees and the market for products, the interests of the forest industries were becoming increasingly global. Social activism remained largely localized, but the protesters were quickly mobilized at many sites and against many forest companies. In British Columbia, an uneasy truce prevails in some areas, but new confrontations continue to arise elsewhere. On the west coast and in the northeastern United States, even in central Europe, the same struggle over the old-growth forests is being fought. The fact that these forests have previously been logged does not change the struggle, which is about survivorship of a more natural world. These struggles portend a repetition of this cycle throughout the world.

The global effects of forest conflicts also have implications for forest conservation. If conservation implies a change in management practices and logging in one part of the world, there are effects on the pressures for logging elsewhere. Reduced logging in British Columbia ultimately leads to increased use of substitutes, such as tropical species in Southeast Asia and petroleum-based plastics or metals in North America. The lines of cause and effect are not direct or simple, but simple solutions to local issues involve many causes and effects. As described by Binkley (1997), if the demand for wood remains, then a decrease of supply increases prices or pressure for cutting elsewhere. If the trade-off for large timbers is between British Columbia and a tropical country, then the difference in the distri-

bution of harvested trees and in logging practices increases the area of logging impact by a factor of four. The concomitant loss of associated biodiversity is also greater, so that much greater investment in management control of logging is called for. Alternatively, if the demand for wood is decreased by increased use of substitute materials such as concrete, steel, or plastics, the energy cost is increased by a factor of eight or more (Sutton 1999).

The basic conflict has remained unresolved and it is clear that the issue is now global. While the public focus may be on a Canadian forest, impacts resound in forests around the world. However, unless resolved, the material welfare of the world's people is seriously threatened. Aside from the injustices of the present inequities of consumption, the future promises more severe reductions in the total material resources available. We might first consider that the net rates of forest loss that I have cited are less than the rate of loss of naturally regenerated forests. In the 1990's, natural forests declined by an estimated 161 million hectares: a 3.4% loss in one decade, slightly higher than for the previous decade (FAO 2001). This loss was offset by reforestation with tree plantations and by the reversion of agricultural land to forests in North America and Europe. The net loss was 94 million ha. In the future, if losses to urbanization increase and forest incursions into former agricultural lands ceases, the net loss rate will rise, approaching the rate for natural forests.

If we consider forests only as a wood producing resource, the current global rate of wood consumption is supportable, as a global average, by the current growth of wood in natural and plantation forests. While only 5% of the land area of forests is in plantations, they account for 15% of the industrial wood produced. But if we use the projected growth of the human population to 10 billion people by the middle of this century, present consumption rates of wood will outstrip current production rates. Making certain conservative assumptions, such as no change in the global *per-capita* consumption, Sutton (1999) estimates a huge shortfall in wood production that could possibly be bridged by expanding plantations and managing them intensively for wood production. However, he also assumes that there will be continuing production out of the remaining natural forests at the same wood growth rates as today. His hopeful projections imply a continuation of current conflicts over the use of the remaining non-industrial forests.

The problem touches on burgeoning common concerns in Central and South America, Africa, and Asia, as well as in Europe (Marchak 1995). The conflict is global and is emerging everywhere that forests are being cut. One side contends that the local, national, or even global forest treasure is threatened with desecration. The other side sees that a valuable commodity is going to waste if not harvested. While the battles outside of North America are not as well publicized, there are commonly and broadly shared feelings of threat to either the environmental foundation for peoples' lives, or their economic well-being. In the recent history of the battles, local issues have often sparked conflicts. However, international organizations have also often joined in contesting the immediate use and future prospects for the land and forests. In those battles, the use of the forest was related to jobs and the economy, and the demise of forests is often tied to losses of biodiversity and long-term ecological and economic instability. Local economic and social issues vary. While neither the protesters nor the forests are similar, the same controversy is being played out. In country after country in recent years, the battle is engaged in much the same terms of environmental concerns versus economic utilization, and proposed solutions always seem to involve mutually exclusive practices.

While forest conservation is acknowledged to be important to contenders on all sides of the controversy, it is clear that the costs and benefits of any forest policy are often not equitably balanced among different segments of society and conservation efforts usually eventually fail. This issue is particularly critical in countries with emerging economies, but similar issues are shared around the world. The conflicts involve different social and economic segments of society, local versus global values, present and future generations, and international differences in resource trade that now include trade in pollution and carbon rights. Conflict between the extremes of preservation and abuse is our common way of dealing with forest policy in industrialized and non-industrialized nations.

The West African forests in Cameroon and the tropical forests of Colombia and Malaysia, whose forests were once inaccessible, now serve as timber basins for the world. Industrial logging for export to Europe has developed into a serious threat. Concern for these forests has led to efforts to conserve some endangered tree species and the remaining rainforests. Some efforts were intended to, and have successfully led to reductions in forest cutting rates. In one project in Cameroon, I participated with a team of forest scientists, sponsored by the Center for International Forestry Research, to design criteria and indicators for a system of sustainable harvesting. We worked on the area of a forest concession and could recommend a system with spaced cuttings to avoid totally destructive logging. For the local inhabitants, there was a lower harvest, and whether we were successful in providing some income now and maintaining a viable forest or not, it was quite clear that outside of the concession, no controls at all existed. Since the total trade in wood out of Cameroon did not diminish, transportation lines were simply extended and there was a shift of logging to other areas. The reductions have also led to lower local export rates as well as to loss of forest related jobs. In these countries, where levels of rural poverty and unemployment rates are high, the effects of forest conservation may be impoverishment of local communities and disruption of rural peoples' lives when their industries are lost or undeveloped. Here, conservation issues lead to sharp conflicts between segments of a national economy. Since forests provide much more than jobs to rural people, substituting conservation values for lost income is a significant net loss for many.

Expansion of agriculture and horticulture also threatens forests. In Chile, the peaks of the Andes run along the eastern border of the country and the Pacific Ocean delineates the western border. In the central latitudes, forests dominated by ancient *Nothofagus* trees grow into the mountain valleys and down the water courses to the Pacific. But these forests are disappearing as they are burned and cut for agriculture, horticulture, and grazing. There I have seen the new plantations of pine and Eucalyptus grown by foreign owned corporations in areas that had been stripped of their native forests and wondered about the costs and benefits. In Brazil, modern incursions into the Amazon basin are perhaps better known because of the massive amounts of forestland that has been burned and converted for purposes of population relocation. But less widely known is the fact that the Atlantic coastal forests have already been reduced to less than 5% of their former extent. In these cases, agricultural expansion is the direct cause of forest removal. Government efforts to remove forests are intended to accommodate rapid population growth. Colleagues there assure me that much more benign practices can provide economic benefit and long term sustainable forests, but the international public issue allows only the choice of preserving or logging the rainforest.

The local issues in Thailand are again different. I was brought directly into contact with the public issue when a flood brought all of central Chiang Mai to a standstill. That year, the flooding of the Chao Phraya River was a national disaster that led to the banning of teak logging in Thailand's national forests. This was little noticed outside of Thailand because it led only to slightly higher prices for illegal teak. It resulted in no reduction in harvest or in flood damage, but did cause a loss of revenue for forestry programs that had promoted sustainable forestry. The public issue was flooding that could be partly attributed to deforestation of the watershed. The ban on logging, therefore, was logical. The problem was that the over-harvesting that contributed to the flooding was largely illegal logging, which the Thai Forest Service was trying to control. One of its programs was the plantation management of teak that could bring substitute income to the hill people and could help stabilize their society and the forests. The ban on all logging cut off funding for this program.

In two timber-poor countries, Denmark and Korea, plans once emphasized the desirability of supplying a certain percentage of domestic needs. Under public pressure, national forest goals changed from only economic productivity to primarily nature preservation. The forests of both of these countries have been heavily cut and used for many generations and have recently suffered major devastation. In both countries there is a high demand for timber. As a result, the changes in forest policy have increased importation of foreign wood for domestic industries. Logging of wood from foreign sources is often more destructive to more delicate forests than logging the managed forests of either Denmark or Korea.

Regardless of the subtleties and variations of the local issues that surround forest cutting and conservation and the possibilities for locally adapted solutions, the contending sides are reduced to opposition. In addition, for the most part, deforestation continues apace. As described by Marchak (1995), "Deforestation is a central problem of our time: it impoverishes the earth, threatens the survival of all species, reduces biodiversity, destroys subsistence cultures and humans, as well as other creature-habitat, and robs humanity of a spiritual home." But the issues are not simple, and as she also points out, "Swiddeners, farmers, ranchers, miners, builders, warriors, and generals; the impossibly poor, the implausibly rich, — these are the deforesters of record." In study after study around the world, she found that the natural forests are disappearing. She also found that the usual losers in the conflicts over land use are the local landless inhabitants, who are marginalized. There are indeed complicating issues and often tree planting programs exist to assuage the problem, but these programs seem not to eliminate the problems anywhere.

With continual pressures for forest removal and with the failure of countervailing pressures, the long-term trends for forest removal can only continue. The pressure for jobs to feed an impoverished world is more persistent than pressures to conserve forests for future benefit.

Contrary to popular opinion, it seems clear that local solutions to this global problem do not translate into an effective global program. Instead, local solutions produce counterproductive and counter-intuitive global consequences. For British Columbia, for example, the effect of reduced logging on Vancouver Island was to raise prices of other wood supplies and wood substitutes. The increase in prices for tropical woods made it more profitable to build roads into tropical forests. It has been argued that the current state of forest management in British Columbia far exceeds that of most tropical countries, and that far

less ecological damage follows from logging there than in the tropical forests. There may also be fewer side effects on other forest-dependent species. In any global evaluation of conservation, temperate-zone forests are more resilient and can be managed for conservation values more easily than can tropical forests. Global considerations, therefore, require global resolutions of conflicts that occur at both local and global levels.

**What is  
 Being Lost**

While the conflicts rage, resolutions fail and forests fall, it would seem useful to consider just what it is that we are actually losing. For those who are not directly concerned with forests, it is fair to ask if our only concern is about losing a picturesque or theoretical resource. As a thought experiment, it may be useful to consider how human life might be in a world without forests. While we have developed the technology to expand human populations, have we, in the last millennium, developed sufficient new technologies and products to replace forests? Have we learned how to live without forests?

While the prospects of actually forcing forests to total extinction may seem remote, the record over the last millennium indicates that we are driving forests in that direction at an accelerating pace. The industrialized nations of Europe, eastern North America, and Asia destroyed much of their forests over the last millennium, in some cases leaving less than 5% of their original cover. Some of these forests are recovering but not nearly enough to offset the loss of other, especially tropical, forests around the world. Currently, forests are being destroyed at a net rate of over 24 million acres per year (FAO 2001). This is equivalent to losing an area the size of Portugal every year, or slightly more than the area of France and Germany together every decade. Of greater significance than just the area is that the forests of greatest diversity, those that lie in the tropics, are being lost at a greater rate than in any other region of the world. In the last decade, about 4% of South American forests and 12% of Central American forests have been lost. In Africa forests have decreased by over 8% and species-rich tropical forests of Southeastern Asia have decreased about 10% in the last decade of the 20<sup>th</sup> century.

Obviously, we cannot endure such losses in the next century, but some pressures are inexorable. In some parts of the world the squeezing of forests can be clearly observed. In a drive northward from Delhi to Mussoorie, India, I recall the feeling of relief as we climbed from the dry and dusty agricultural plateau that surrounds Delhi into the green foothills of the Himalayas. Below lay the densely inhabited plains, where thousands of years of agriculture have gradually removed the native forests. The air there was hot, and there was a pervasive fetid odor. As we climbed into the higher elevations, small trees began to appear and gradually more and larger trees formed a forest. The air cooled and felt refreshing. But as we climbed higher still, rocks became more obvious on the hillsides, soils got thinner, and the trees were stunted. When I reached Mussoorie and I could wander on foot a bit higher, I came to the elevation where trees could no longer grow and I could look across the valley to where the Himalayan Mountains loomed even higher above. As dramatic as the scenery was, what impressed me most was that the once luxurious and extensive forest that covered northern India was reduced to an elevation band of only a few hundred feet. Squeezed between the upper elevation limit to growth and the pressures of human civilization below, forests could only cling to a precarious strip of existence.

I also recall seeing how far up the hillsides the poor farmers built terraced fields for meager crops of wheat. They needed land and fuel for their subsistence and could not be

faulted for clearing trees for those purposes. So while the necessity to conserve forests seems obvious, the inherent contradictions of conservation and use seem so strong as to condemn us to failure in many localities.

If continued into the next century, current rates of loss in critical areas would translate, by the middle of the next century, to losses of two-thirds of all plant species and forest-dependent animal species. This is a biological catastrophe as great as any of the geological extinctions of the past, but with a concentration on plants that are keystone supports for whole ecosystems. With a continuation of both population growth and forest destruction, we can expect that within our lifetime we will have halved what remains of the world's forests. Where forests once surrounded human habitations, humans have now surrounded forests. Our contemporary perspective is not from the forest edge, but from the outside looking into shrinking forests.

An obvious metaphor for forest loss is that of a pond with an open water ecosystem. If the open water is threatened by a noxious weed that can double its size every year, or half the open water is closed every year, at what point is it too late to control the weed? At first, a single plant may not occupy much of the pond, and for many years the loss may seem insignificant, but after a while it begins to be noticeable and soon may occupy a quarter of the pond's surface. In the next year it would occupy one-half of this. At that point, only half of the free surface would remain and in one more step there would be no more open water left.

Having already lost more than one-fourth of the world's forests, the threat is that at current rates of net forest loss we will lose another fourth in just 50 years, before losing the last half. It seems improbable that we would lose all of the remaining natural forests around the world. There are, after all, limits to human rapacity, and other feedback mechanisms may reduce the rate of loss. But the feedback may be too slow, and human history is replete with ancient and continuing examples of the removal of forests. At the current rate of loss we not only directly threaten the immediate sustainability of many forests and human societies, we also threaten their renewability by the permanent conversion of forests to other land uses.

If all or most of the forests were destroyed by a natural calamity or by human actions, what would the world be like? We can predict some economic consequences such as the skyrocketing of building and housing costs, since the energy used to produce wood substitutes for construction would be several hundred times greater than at present. For billions of people, oil or other fuels would have to be produced and traded at unimaginable levels, and forest foods and medicines would require replacement by man-made processes, if they could be replaced at all. In addition, as a functioning ecosystem standing forests supply ecological life support for the human ecosystem. These values may exceed the economic value of all human manufacturing (Pearce 1993). Estimates of the value of all the ecosystem services derived from today's forests come to around \$US 33 trillion per year, which is around twice the annual global gross national product of all traded goods and services (Costanza et al. 1997). Without forests, the remaining agricultural fields would require much higher inputs for soil and water.

If human life could go on, it would be in a severely degraded ecosystem, and even if we could avoid our own extinction, the great majority of the higher plants and animals

would not. The changes in the earth's climate, fresh water, and agricultural systems would be catastrophic to all forms of life and to all ecosystems.

### **Intangible Losses**

Beyond the material loss, we would lose the major biologically complex ecosystem existing independently of human activity. We would lose a source of knowledge of alternative life forms and ways of life. Study of wildlife forms helps define what is not human and, therefore, what it is to be human. There are both aesthetic and scientific values that may ultimately be more important for human existence than material sustenance.

Even if we could somehow grow plastic trees and engineer all of the ecological and material resources that forests supply, we would miss something vital to human interests in that manufactured world. We would be poorer in such a sterile world that merely reflects our own technology and past imagination. Would we find that we have conquered Nature but limited our world to a mere mechanism? Do we need to think about and examine things that are not human artifacts in order to dream of what else we can do and be? Would we find that we need the nonhuman forested world to be human?

For much of the history of humanity, we have commonly sought the refuge of a tree or forest. In our poems and stories, we have sought the protection of a spreading shade tree and the respite of a quiet forest, away from the noises and pressures of daily life. Forests give us a calming sense of relief from social stresses and a palpable physical sense of returning to what is solid and enduring. The demanding presence of intruding people and the accouterments of modern life create insistent pressures for attention to ephemeral fashions. In forests these pressures are less demanding and less disruptive. If ordinary people are affected, how much more profound must the effects be on the great prophets of history? Buddha sat beneath the Bo tree to seek enlightenment. Abraham entertained God in an oak grove, and Zoroaster wandered in the wilderness. The need for forests when we are seeking eternal verities and moral clarity is strong and nearly universal. Forests manifest forces that are fundamental to life. By experiencing in them what is not human, we may come to understand better what it means to be human.

We might also ask why forests in particular are sought for renewal and inspiration. Is this only an escape from immediate human social problems, or is there an association between forests and human origins that is a remembered connection between our natures? Do we appreciate forests because they predate humans, and because they carry less of the trappings of civilization? While forests are undoubtedly viewed through the filter of our culture (Soulé and Lease 1995), they are more than cultural constructs. They are ecosystems that have helped shape the human system. Since human society emerged from forested environments and has been continually associated with forests, we seem to find in them reflections of our own basic nature. There is an inherent sense of a heritage in which forests form an intrinsic part of our own evolution and hence can enrich our lives. When the Psalmist says, "I will lift mine eyes unto the hills from whence cometh my salvation" (Psalm 121), the wilderness is acknowledged to be a source of inspiration from a God who lives in humans and in nature. Through the ages, forests have been much more than a resource or even a beautiful refuge. When forests are encountered apart from the confines of civilization, the limitations of civilization become apparent. Our human nature is enriched when we encounter wilderness without design. Life for humans without forests is a barren prospect, even for those who live their whole lives outside of them. For those of

us who enjoy forests on a daily basis or simply take satisfaction in their existence, their inexorable loss is a threat of immeasurable magnitude.

## Solutions

The worldwide similarity of the issues indicates that a broadly based and fundamental conflict exists for which neither local nor global solutions have emerged. Continuing conflict seems inevitable between opposing forces. No compromises seem stable between reserve forests and production forests. Marchak (1995) suggests that some specific conditions are necessary for approaching general solutions. Political solutions may offer some hope of stabilizing forest boundaries, such as government policies in land reform and community forestry. Other programs may segregate areas of core reserves as proposed by UNESCO (2002), designating some areas for production forests and investment, and allowing the remaining areas for mixed production and other activities. On the basis of a global average growth rate, it may be possible to double the area devoted to intensively managed plantations to fulfill the needs for industrial wood supply. Plantations would have to exhibit very high growth rates on land that would compete with agriculture and would not be too remote from processing plants. This approach, therefore, would generate the same kinds of conflicts as we see now.

Other solutions for land-use allocation that take many factors into account in addition to economics to create mixed-management solutions may also offer some reprieve for areas where mixed land use is possible. Ecosystem management for multiple economic and ecological values promises to provide methods for mixed land uses (Kohm and Franklin 1997, Vogt et al. 1997). The problem with mixed use is to define what kinds of activities are permitted such that the values of reserves are maintained while some forms of production are permitted. There will always be controversy over where to permit what kinds of activities, but economic valuations could be broadly based on several products and uses. Agreements could then be forged and global agencies such as the Forest Stewardship Council could certify that forestry practices can be expected to indefinitely sustain forests. Markets would also have to be restricted to certified wood products.

Both types of solutions would also depend on political and economic stability, which may not exist. Both also depend on an agreed-upon framework for resolving value conflicts and determining mutually acceptable trade-offs. Unfortunately, we currently lack such frameworks to reach agreement on a commonly accepted scale of values.

The difficulties presently encountered in finding balance may indicate that no common scales exist on which to seek this balance. Trying to save forests and biodiversity by adjudicating ecological or economic values may ultimately fail because the scales for balancing the conflicting values do not exist. The very act of seeking a balance between divergent ends may limit the scope of our understanding of the problem and our ability to find possible solutions. Thus, requiring forests to satisfy both goals may never be possible, and forcing a dichotomy of goals onto forests may render the search for stable solutions impossible. Such solutions require a continuing commitment to political and economic mechanisms for their adjudication.

In addition to countervailing policy debates, practical difficulties have arisen in designing the management of reserves or of production forests. There are substantial errors in estimating future effects of any forest practice. Hence, to ensure a minimum performance level, larger-than-minimum sizes or replicates of management units are needed. For example, errors in establishing and maintaining forest reserves suggest that even larger

investments in conservation are needed than those presently considered. While reserves clearly have a positive effect on reducing forest destruction and fragmentation (Bawa 1994), the efficacy of establishing reserves has come into serious question. Practical experience indicates that maintenance is far more difficult than originally thought (van Shaik et al. 1997, Dudley and Stolton 1999, Laurance et al. 2001).

Environmental effects of forest practices that spill over national boundaries and linkages between one nation's supply of wood products and the "Nature" of another nation create global political issues. The possibility of pollution and carbon allocation further complicates the situation. Plans must accommodate variations in the value of different forest products. Plans also must accommodate biological variability for a future that will be affected by changes in global climate and other environmental factors. The optimal location of reserves and production areas for different products will inevitably change and call for greater flexibility in planning.

Faced with such substantial, but perhaps not insurmountable, difficulties for managing forests, one solution proposed is to not manage at all. To preserve an unspoiled Nature, it seems fitting to not intervene. The conflict with management has persistently been cast in terms of irreconcilable values involving sacred beliefs. In these terms, a little desecration of a holy place is as bad as a lot of desecration. The battle for control of the forests may not be a matter of balancing or trading values as one would trade commodities, but one of resolving fundamental moral conflicts. There is a broad segment of the global public that recognizes these conflicts and responds to appeals against the immorality of forest destruction (Callicott 1996, 2000, Careless 1997, Leopold 1949).

At the forefront of action, "eco-warriors" see fundamental moral values being trampled by blatant, short-term economic interests (Scarce 1990). They find any compromise difficult to accept. They fundamentally oppose what they see as the Cartesian view of a mechanistic world and consider forest management to be a materialistic reduction of a complex and integrated ecosystem. They believe that the short-term and narrow self-interest of business destroys long-term and broad public interests before the public can become aware of the dangers. The judgment of the immorality of forest destruction is based partly on the intrinsic value attributed to undisturbed Nature and partly on a precautionary approach to threats to vital ecosystems. The latter position can allow for human uses of forests but often assesses most forest management plans as imprudent.

Drawn in these terms, any local or international political or economic compromise can only be a temporary tactic. Ultimately, only one side can win, while the other side must sacrifice vital interests and fundamental values in the contested areas. Any political or economic solution would also require political and economic stability for extraordinarily long periods — periods that extend beyond the generation times of forests. In a typical interaction, "environmentalists" fear that industrial interests will inevitably destroy forests unless continually met with resolute public resistance (Tokar 1992). However, even the threat of restrictions to future access causes uncertainty for the logging industries and forces them to forego long term planning for sustainable forestry in favor of liquidating forests that they own or lease. Even if there are industry victories, investors remain uncertain about future logging and are likely to favor liquidating standing forests. Thus, environmentalists face a "Catch-22" situation: they feel they must raise their issues or face losing forests by default to unopposed logging interests. However, if they raise issues they then exacerbate forest removal in much of the area they do not control. Thus, a perpetual struggle seems

inevitable. There seems to be no stable solution to the conflicts — only a continuation of less-than-ideal harvesting practices and less-than-satisfying reserve area policy and management. For any political or economic solution to offer long-term hope for the future of forests we must address the underlying reasons for the existence of the conflict.

**The  
Unresolved  
Dichotomy**

The scope and durability of the conflict and the continuous decline of forests force us to systematically look at the sources of conflict. Since humans are the active agents in most of the destruction of forests, we must look at the way humans interact with forests. We must discover why humans destroy forests while professing to want them. In the history of these interactions with forests, we may discover keys to how we may conserve them more effectively.

One target of inquiry is the dichotomy of views of forests that seems so embedded in our thinking. It seems that the divergence in the ways that we have considered forests is deep and persistent, and that we have never resolved the contradictions forced by that construction. Ever since prehistoric times, we may have needed both the material and the spiritual values of forests. It may not have been difficult to have both in early societies that were composed of small family groups. Their direct dependence on forests for food and fuel would have modified, but would not have been a major influence on forest development. But with a thousand-fold increase in the size of the human population and greater demands on the shrinking forest resource, the need for both forest products and for ecosystem attributes to the human society becomes evident. While we are no longer totally dependent on forests for fuel, we still need their timber, fiber, and food products. We have come to recognize our dependence on forests for their global functions in air and water circulation, soil restoration, and climate moderation. We are also dependent on forests as a source of spiritual sustenance, and as a reservoir of biodiversity. Nevertheless, by our actions we have lost a third of the forests that once stood, and we continue to lose forests to agricultural and urban encroachment. We are now critically aware of the dichotomy between the necessity to change our environment by using and overusing forests, and the necessity to stabilize the relationship between humans and forest ecosystems.

In cases of fundamentally opposing views, compromise solutions satisfy neither party and can lead only to continual conflict with one side then the other "winning." Any compromise solution is temporary and unstable. The management of forests and their conservation is then a perpetual struggle to balance inherently opposing forces, neither of which can afford to lose. Unfortunately, forest cycles take much longer than cycles generated by human-scale social, economic, and political activities. And since forests are more easily destroyed than they are recreated, the result is a continual decline of forests. With increasing human needs and the consequent increase in pressures to use forests and forest land for other purposes, the pressures on a shrinking forest land base can only intensify. Our history of resolving this conflict can only predict a continuing loss of forest lands.

This losing conflict seems to be the inevitable result of each side seeking stability in alternate sets of conditions. One side may focus on maintaining permanent production forests, the other may focus on permanent parks. We seem to be locked into a conflict of mythic dimensions with benign naturalism pitted against civilizing technology. The contrasting views hold two things in common: both developed from perspectives outside of the forest and both seek stability. The stability they seek, however, has different foundations. While our evolutionary origins may have been strongly rooted in the forest edge,

where neither forest nor prairie was foreign, we seem to have developed our conflicting views from the perspective of encountering forests from the outside. Perhaps our duality is the result of our starting from outside, where we consider forests as places upon which we can project our civilization's fears and dreams. Perhaps if we can trace the roots of our dual visions of forests we might come to a place where the duality dissolves and a new approach is possible in which a higher order of global stability may exist.

In the modern world, the destruction of forests is rarely a capricious act. Rather it is the result of many social, economic, and political factors that have no direct concern for forests or for their influences on human societies. It is a result of war, population pressures, industrialization, and agricultural encroachment. For poor people, especially those who do not have arable land, forests represent new lands and sources of fuel. It is inevitable that forests are destroyed, where that destruction permits farmers and their families to survive. The problem lies in the policy decisions that often consider forests as wastelands or wild lands of little or no value. From that perspective, the merits of forest removal for the sake of feeding a hungry constituency are overwhelmingly attractive.

To professional foresters and conservationists alike the disregard for forests is not a new issue; what is new is its magnitude and global scale. Indeed, the loss of forests was apparent long before the 20<sup>th</sup> century and even before the environmental awakening of the 19<sup>th</sup> and even 18<sup>th</sup> centuries. It occurred for millennia before the Enlightenment. Observers of human behavior have decried the deforestation of the world around them since the invention of written language. The puzzling feature of this behavior is why we have continued to destroy forests when we need them both as standing forests and for their harvestable products. It would seem reasonable to expect that the professional foresters and conservationists would be natural allies against forest destruction. This does not seem to be the case.

The interaction between human societies and forest ecosystems that started at the margins of forests was for humans to first live in, and to maintain themselves along, forest edges and to have little effect on forest interiors. In the Paleolithic and Mesolithic, humans had relatively little effect on forests, and vice versa. In the Neolithic, however, humans began to use the forest edge more intensively. By cultivation they reduced the margins and areas of benign coexistence. The human home was no longer in the forest edge but in areas of cultivation that were separated from the forest. Humans then primarily encountered forests from agricultural and urban environments. From that alienated perspective, a dichotomy of perceptions about forests was created. There was no inhibition to further loss of forest at the margins or core areas. That difference in perspective generated a deep hostility between those who would use forests and those who would conserve them. I would argue that the dichotomy generates modern-day confrontations, in which both sides seem willing to witness the decline of forests.

But if we recognize that forests are so essential for our material and spiritual well being, why have we tolerated such a continual decline? Certainly the problem has been recognized and struggles have been mounted to maintain forests in many places over the years, but the long-term trend continues. There are mounting conflicts over forest conservation, but so far few instances of stable resolution. It seems obvious that to have forests to use in the future, we must conserve them now, but in order to conserve them their conservation values must be made apparent. Where there should be a natural alliance, there is a long history of conflict that prevents the formation of a common agenda for forest con-

ervation. It seems that in our desire to both use and conserve forests we generate insoluble conflicts that only result in further loss of forested lands.

There seems to be no way out of the dilemma of use or abuse. Combatants have never compromised, and nations have exported their problem by importing wood. When forced to either log forests or conserve them for the future, we have logged them. In more recent times, controversy has erupted either before or after logging, characterized by vacillation between seemingly irreconcilable opposites.

At the personal level, when dichotomies are not resolved, a duality is forced in which contrasting views can be simultaneously held. This duality may be felt by contrasting a view of a forest as an enchanting experience to study and enjoy, against a view of the same forest as a wild place that could produce harvestable goods if tamed. To resolve the duality, we vacillate between the polar opposites with remarkable ease.

There may be a necessary and universal binary opposition between the primitive and the rational human, between the savage and the civilized. The difference between the wild and the cultivated forests may then serve as a strong metaphor for a human conflict that is perpetual and universal. In seeking an understanding of our forestry problem, we must recognize the influence of these human mental constructs on how we understand forests. But we must not confuse them with an understanding of how forests develop.

At a national policy level, we resolve the divergence by preserving some forests or clearing others for productive purposes. The result, a net loss of forests, could be attributed to indifference. In this book, however, I argue that far from indifference, there is a widespread, though latent, passion about forests and what they represent. I argue that the problem is that we are split as a society and as individuals. This is particularly evident in the way that forests have been used as metaphors for deep human conflicts and tragedies. Forests or those who dwell in them, are assumed to be either gods or saints living as nature intended, or devils and wild men living in depraved and chaotic conditions.

## **The Global Forest Problem**

To resolve the global forest problem, we must return to the general problem of how forest and human ecosystems have interacted in the past, and how they may benignly coexist in the future. Forests were first, humans were born on their fringes, and we depend on them for our very lives. If there is continuity to forest and human interactions, there is also continuity to our conflicts of enchantment with forests and of our destructive use of them. In former times, we always had resort to wild lands and foreign lands for resources. We could export our problems of overuse. From the Levant to Greece and Rome, and from there to Europe and the Caucasus, and from Europe to the Americas, Asia, and Africa, we could always go elsewhere for exotic forests and for timber and other biological resources. But now there are no forest frontiers left in the world. We live mainly in agricultural and urban ecosystems, and the remaining forest ecosystems must share a closed and finite world.

If forest and land-use policies are determined from either a perspective of preserving the values of the wild, or of taming and cultivating forests, the contradictory policies that come from conflicting understandings will lead to continued forest destruction. But if forests commonly elicit contradictory primal responses, the bases for the contradictions are rarely examined. It is clear that forests may simultaneously be a source of inspiration and a threat to orderly existence, and that such polar extremes are difficult to resolve.

The duality in our modern concepts of forests creates not only personal conflicts, but also social, economic and political conflicts. Until we examine the fundamental basis of the conflicts, we will find it difficult to constructively address solutions at either a personal or a societal level. Some would prefer that no human intervention be allowed to despoil wilderness. Others would prefer wider and more intensive exploitation of forest resources. And most would seek some mutual accommodation that respects both forest and human societies at one time or another. But if forests are to be pure sources of inspiration, uncontaminated by human impacts, then any interventions must be opposed. On the other hand, if forests are to be used for economic production, then to satisfy increasing demands more forest land and more intensive management must be used. We commonly address the problem in political terms as finding the best compromise between opposing parties. Seemingly, only two solutions exist and we must choose between them.

There are actually many conflicts invoked by forests that seem to be polar opposites. There is a conflict between diversity and uniformity, or its modern equivalent of monoculture. There are conflicts between maximum productivity and security. We contrast holism with fragmentation and Nature with culture. These are indeed opposites. Often, however, we assume that sets of these opposites form a coherent concept. They rarely do. It is often assumed, for example, that old-growth forests are maximally diverse, rich in species, and form stable communities. But if old-growth means that a stand has endured for many years without catastrophe by human or other agents, and old trees remain to attest to that history, then that stand may not be very stable or diverse. The magnificent stands of old redwoods in the Muir Woods of Marin County, California are dense in large trees of revered age. They are cool and shaded, and the public can walk about enjoying them. But where the tall trees are dense and shade the ground, they do not permit ground vegetation to grow. The stands are actually low in diversity of vascular plants and animals. Only when canopy trees die can a diversity of species invade the openings. If there is a correlation between age and diversity at all, it is more likely to be negative than positive. In addition, it is often found that diversity is highest in areas where there is a high number of transient species. This implies that diversity and stability are not causally related. Notwithstanding recent arguments that diversity depends on some degree of functional stability (Doak et al. 1998, Frank and McNaughton 1991), there is no simple correlation between the features of diversity and stability.

In like manner, many of the virtues of forest attributes that we use as surrogates for human values turn out to be independent features. Some exist in one forest, some exist in others. The biology is complex but allows us to draw two implications. The first is that there is no single ideal forest that can possibly combine all of the virtues implicit in such ideals as "old-growth." The second is that there are opportunities for obtaining most, if not all of the ideal features of forests, but not in the same package. These opportunities are addressed in later chapters.

If the various features of forests are not tightly bound into strong causative relationships, then there is no set of features that can be combined into a syndrome of opposites. Most of the opposites are features that live at the extreme ends of age, size diversity and other continuums, and many options exist for finding or forming forests of non-extreme types.

If all of the conflicting opposites could be combined onto a single scale, such that all merit was on one side and all evil on the other side, then the conflicts would indeed be

insoluble because no single solution would exist for the different problems. But if different combinations of kinds of diversity or stability, for example, can exist, then solutions may be found to be less monolithic. If the seemingly monolithic struggle can be deconstructed, then what seems insoluble today may yet yield satisfactory solutions.

The analogy of war for the conflict over forests is apt. Opinions are deeply felt and broadly supported, and the perspectives of opponents are largely unexamined. On each side there is a personal commitment to an ethos. Great sacrifices are willingly made to causes, and appeals to religious authority are invoked. We can begin to understand the nature of the conflict by first examining modern confrontations and then seeking their historical roots to learn of the development of the conflict. Only then may we seek possible resolutions.

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## CHAPTER 3. A HISTORY OF CONFLICT

BREACHING THE LAST FOREST FRONTIERS in the Amazon, Southeast Asia, and Central Africa, Siberia, and British Columbia brings a sense of imminence. Unlike breaching frontiers of space or of the mind, there is no sense of opening new realms of adventure, only a sense of loss as industrial logging enters regions previously beyond the hunt for profitable logs. But as the global economy reaches these last domains of the wild, the forces that drive the logging seem to be narrowly focused on short-term profits. There is a feeling of foreboding that we are losing more than we bargained for and the closing of these last forest frontiers engenders a sense of urgency to halt destructive logging.

The nature and causes of our present conflicts over forests are not new. As we shall see, they have been met in similar terms in the not-too-distant past. There is a recurring motif of conflict that is fought again and again in different times and places but never reaches a final settlement. There are philosophical differences about the place of humans in the world, different economic perspectives, and different social movements that are expressed in religious and political differences. As we shall also see, some of the heroes of those past struggles still serve as standard bearers for modern ideals, but they also serve as notice that their basic issues were never resolved. The conflicts emerged under different social and economic conditions, indicating a historical dimension to the present conflicts. The issues clearly go beyond our current emotions and sense of urgency. We start by examining the human history of conflict. We will later also examine the development of forests to comprehend their joint evolution.

### **Old Battlegrounds**

In the last decade of the 19<sup>th</sup> century two friends and colleagues, John Muir and Gifford Pinchot, were instrumental in establishing a large system of National Forest Reserves. They had fought for decades against rampant plundering of forests through public campaigns. They brought the issue of conservation to a level of national priority not previously seen. Their common enemy was the quickening pace of destructive logging that had decimated the forests of the Eastern United States and threatened the rest of the country. A vital natural resource was at risk and it was feared that it would not survive the next century. They were comrades in arms and through their complementary efforts they sought to build a national consensus to establish publicly owned lands for forest conservation. They were different in background and temperament, but seemed to enjoy each others' respective abilities and interests. One was a graduate of the University of Wisconsin who had roamed throughout America, the other was a graduate of Yale University who had training in forestry in Europe. They shared an abhorrence of the unfettered business of industrial logging. After years of struggle on many fronts, they successfully mobilized professional biologists and foresters, and publicized and politicized conservation. They were able to convince members of the U.S. Congress, and just before Grover Cleveland left the Presidency they convinced him to vastly expand the forest reserves in the West. They also later found a ready ally in President Theodore Roosevelt to establish federal protection for additional forests in a new system of National Forest Reserves. Largely on the basis of their efforts, a national campaign for forest preservation was mounted against the common practices of the day of clear cutting, burning, and land abandonment.

The victory, however, yielded only a short-lived peace. They soon found that they had mutually incompatible ideas about how to treat these forests. What seemed to be complementary differences in emphasis turned out to be substantive differences in goals. It wasn't a matter of both having a prior notion that the other possessed significantly different ideas, and sublimating the differences, for the greater concern over rampant and destructive logging. They thought that they were in agreement about their goals. The difference between joining in opposition to forest destruction and sharing a common vision for forests was not obvious to those warriors when they were fighting a greater common enemy. It wasn't until they were faced with decisions on the treatment of specific tracts of land that they could see that they actually held highly significant and directly conflicting views. The opposition that arose between them and their hostile camps of followers carried the bitterness of betrayed trust. But their confrontation was more than personal animosity. It was the result of a basic conflict between visions and philosophies of what forests could and should mean, and each held to beliefs that had grown with the development of America during the 19<sup>th</sup> century. What had been cooperation turned into opposition as their differing visions of what forests ought to be led to differences in how forests should be managed.

The differences between the two protagonists epitomize the modern differences between those who would preserve and those who would manage forests for production. For Muir, the standing forest in a pristine state was the optimum condition from which the benefits of wilderness were derived. For Pinchot, the pristine forest represented standing capital that could be converted to use and could then be regenerated to continually produce a net growth for human use. A pristine forest might just balance growth and mortality but a managed forest could be made to approach maximum productivity if it were periodically harvested for its net growth before net productivity declined in late succession. For both, the goals were obviously well justified. They could find no room for compromise. Muir led a national movement to preserve wilderness in a system of National Parks. Pinchot rose to leadership of a system of National Forests that took most of the land initially designated for the forest reserve, and made plans to convert this to sustained production and "wise use". Their conflict developed into a *de facto* segregated land-use policy.

**The  
American  
Environmental  
Movement**

The conflict between these two men was also forced by the simultaneous growth of a forest industry, and by the emergence of an awareness of an American "Nature". The industrial and agricultural expansion of the 19<sup>th</sup> century was an inherent part of American "Manifest Destiny". But the wild frontier was a defining feature of the American experience — of what it meant to be "American". The two forms of the American ethos developed independently through the century until they met on specific forest grounds.

In the century after the War of Independence, the idea of an American Destiny took a few decades to form and begin growing. The idea was nurtured in the early decades of the century by Jefferson's Louisiana Purchase and the expeditions of Lewis and Clark (Ambrose 1996). With the westward territorial expansion and the population explosion of settlers in the decades after the American Civil War, the social and political structure of the country was revolutionized. The natural resources of the Western United States were opened for rapid development and their exploitation became both cause and effect of a vast expansion of industrial production. Before that expansion, from the early colonial period onward, and outside of a log export industry limited to the East Coast, logging in

most of the country had been mainly an adjunct of agricultural clearing. By 1840, however, timber had become an important commodity and logging had developed as a growing and independent industry. At that time, the center of logging activity had begun moving from the New England States where it had been an important source of trade goods since the 17<sup>th</sup> century. With this emerging industrialization, the center of logging moved to New York, which provided convenient means of log transportation to the then new and growing industrial centers. But western sources of logs also became accessible. Within 20 years the center of logging activity moved westward to the Lake States, where the strong and easily worked white pine grew within easy access of rail and water transport.

New logging, milling, and transportation technologies developed for markets both to the east and abroad, and to the newly settled western areas that demanded more and more lumber for domestic consumption. The industrial revolution in the East led to a rapid conversion of the standing forest capital in the Lake States. No need for reinvestment in forest growth was recognized since other timberlands were still available for further cutting. The population of the United States, recorded as 4 million in 1790, doubled every 20 years, and reached 50 million by 1880. The demand for timber was insatiable, the supply seemed infinite, and for nearly a half century the production of lumber also doubled every 20 years. Clear cutting and fires destroyed millions of acres of forest through Michigan, Minnesota, and Wisconsin. Lumber production eventually peaked around 1892 in the Lake States but then crashed, leaving a legacy of biological and economic ruin. Logging, which had been moving to the Southeastern States, then centered in the southern pine forests, moving from Pennsylvania and Virginia to the Atlantic Coast and the Carolinas, eventually reaching Louisiana and Eastern Texas. With the threat of further movement of destructive logging westward, and the feeling that there was a limit to the resource, the concept of investing in forests to ensure future productivity grew more strongly in the Department of Agriculture.

The threat of forest destruction had a different impact on John Muir than on Gifford Pinchot. Muir was an American-trained biologist, who was born in Scotland in 1838 and was raised in the strict Calvinist tradition of his father. The family immigrated to America in 1849 and lived on a farm near Portage, Wisconsin, which lay in the white pine belt. It was upriver from Prairie du Chien and near the Chippewa River, which was a major route for lumber from upper Wisconsin. From boyhood on, Muir came to love anything wild and saw the forests as "God's first temples." He saw that the heritage of wilderness was being despoiled by human materialism and assumed as his life's mission the saving of the remnants of what was once an ideal state of nature. He was a moralist, who subscribed to a school of thought that was gaining popularity in North America and in Europe. These people saw humans as inevitably destructive of God's Nature. For them, the Golden Age lay in the past when the world was young and wild. They were pessimistic that any human intervention could ever do anything but harm.

When Muir traveled to California and lived in the Yosemite Valley, the contrast between his experience of the Hell of destruction in the Wisconsin forests and the Heaven of the wonders of the Yosemite Valley gave a physical reality to his view of what American forests ought to be. One consequence of his views about the effect of humans on the natural world is that he seemed to have had no qualms about removing the indigenous people of the Yosemite Valley from the new National Park. It was not unusual at the time to consider the indigenous people to be unconscious parts of nature, as were the trees. Appar-

ently, Muir could justify removing the Yosemite dwellers as threats rather than as parts of the ecosystem. Apparently he could not conceive of them as being part of the reason that the park was in the state in which he found it.

So sure was he of the righteousness of his mission that Muir marshaled sufficient public support and political pressure that the U.S. Congress established and then greatly expanded the park system between 1890 and 1910. The Forest Reserve Act in 1891 gave the President the power to set aside reserves out of public forest land. Muir continued to advocate for the preservation of wilderness. Part of his success was due to the support of Theodore Roosevelt, with whom he went camping in Yosemite, but he was also well known and respected in his own right. He established the Sierra Club in 1892, and steadily fought for a system of parks and wilderness for another 22 years.

Observing the same rate of forest destruction as did Muir, but with a different social, educational, and economic background, Gifford Pinchot saw a different forest and a different future. What horrified him about the destruction was that a great natural resource was being lost to the growing nation. He saw the forest as a natural resource that needed protection. He believed that protected forests could be developed as a renewable resource. He had well established European precedents for the manageability of forests to provide a supply of timber in perpetuity, and he saw that those precedents could be applied to American forests. European views of forests and forest conservation were based on European conditions, but he understood that most American forests, particularly the western ones, grew out of a different biotic history and in a different political climate. Nineteenth century America was seeking its Manifest Destiny through westward expansion. At the beginning of the century, prior to industrialization, the Jeffersonian concept of a nation of independent farmers was emerging as the national ideal. The Louisiana Purchase of 1803 opened former Spanish and French Territories, and the Lewis and Clark expedition was commissioned to ensure that the West was under American control. Britain, which was seeking trade with China, was another threat to that control. In the unmarked territory of western Canada and the United States, Britain and the United States were competing for overland routes to the Columbia River and to the Pacific Coast, using Shoshoni and Nez Perce horse routes. In 1805, the preliminary reports by Lewis and Clark stirred tremendous interest in the new territories, and the availability of free land was an irresistible draw for land hungry easterners. Free land was seen as the gift of the New World to the old, and was a dream come true for the European peasants, who would soon swarm into the West.

Agriculture was still the basis for the national economy and was to be the foundation for the expansion. Forests were largely considered to be a useful adjunct of farms and land-use policies were designed to manage the agricultural estate. In Jefferson's vision, the small and independent farmer was the paradigm, and the forest was an accessory of small-scale agriculture. The emergence of logging as a national industry in its own right did not become apparent until after 1840, when it had already passed its peak of operations in New York and New England and had moved to the Lake States. The changes that had occurred in the amount and purpose of logging had a large impact on the speed and scope of logging, but very little impact on the organization of the forest investigations in the Federal Government.

**The U.S.  
Forest Service  
and European  
Forestry**

In hindsight, placing the Forest Service in the U.S. Department of Agriculture might seem peculiar. As the stewards of vast areas which provided environmental, spiritual, and timber values, the placement in the Department of the Interior, or establishment as an independent agency might have been more logical. But during the last half of the 19<sup>th</sup> century when decisions had to be made about the use and conservation of forests, few could foresee that future. The government officials charged with deciding the future of forests could not see that this new industry would have a dynamic of its own that responded to non-agricultural forces. Forests could not be considered as needing an administration outside of what had been established in the Department of Agriculture. The disposition and use of forest land was a matter of supporting agriculture and resource development and not one of administering public lands for their ecosystem. As westward expansion continued and logging became a more obvious segment of the economy, it was recognized that forests needed policy direction. In 1880, as a result of reports by Franklin Hough, the U.S. Congress passed a bill to make forestry investigations a branch of the Department of Agriculture. The political struggles within the government as the Forest Service developed and evolved are well described by Clepper (1975) as a continuing crusade to institutionalize conservation.

The appointment of Franklin Hough as the first forestry agent of the Federal Government required him to issue reports on the condition of the forests of the United States and to make recommendations on their management. Until then, forestry was a minor addendum to agriculture and was not seen as worthy of independent study in its own right. There were no precedents in the United States, so Hough could do no better than to travel to Europe to study the more advanced systems of forest management in the Old World. Hough's actions established the precedent of looking to Europe for concepts of forests and their management, which was to remain unbroken for many years. Nathaniel Egleston succeeded him as Chief Forester and Bernhard Fernow, a German born and trained forester who had immigrated to America in 1876, succeeded him in 1886. Gifford Pinchot, who was then a young Yale graduate, had also gone to Europe to study forest management, and since his return to America in 1891 had sought to instill scientific forestry into American forest practices. In Europe, he visited the French forestry training faculty at Nancy, which had been established 50 years before. Nancy based its teachings on experience with French forestry regulations which had existed for more than two centuries.

Pinchot also met the internationally influential Dietrich Brandis, who had built up forestry for the British in India. Brandis was a German botanist who had gone to India to develop the teak forests for trade. He began work armed with German texts and concepts of forestry. The German methods of measurement and management suited the needs of colonial management. He also brought other German foresters, Schlick and Ribbentrop, to India and upon their return to England helped to revive British forestry (James 1981). The German view of forest management as an economic endeavor fitted in perfectly with the American government's notion of forestry as a means for developing the resource. The European experience with its forests and other natural resources was the product of the European Enlightenment. This movement allowed human reason to exercise power through analyzing the world and manipulating nature to yield benefits for civilization. After a harvest cutting, the land could be prepared and planted to a more useful species, spaced and tended for growth. Rotations of harvesting could then be sustained in perpetuity. With the support of royal or wealthy landowners, wood could be produced for construction, shipbuilding and fuel. For these purposes, European forestry had solid political,

economic, and biological foundations. The future of American forests was seen as stabilizing the yield of every forest in perpetuity by practicing silviculture to provide regular cycles of harvest, regeneration, tending, and repeated harvesting. In contrast to Muir's vision in which the Golden Age lay in the past before human intervention, Pinchot's Golden Age lay in a future replete with scientific management.

The challenge for Pinchot was that the European experience was with forests that had already been obviously and substantially altered by human activities, while many American forests were considered to be pristine. Without independent experience with the forests of the New World, it had to be assumed that the types and growth of the trees they found were the ideal condition that would arise when growing these tree species in any location. Pinchot had to apply the measurements and practices that were developed in Europe. Difficulties arose because different species were growing in environments that were changing in ways beyond his capacity to understand or observe.

When he went to Europe, Pinchot readily absorbed various aspects of the French, English, and German methods of forest management. He tried to choose among those methods when planning for American forests. He was also politically effective and forcefully advocated the withdrawal of lands for his kind of forest conservation from the prevalent practices of cutting and land abandonment. Exercising his personal charisma, he found support for scientific and economic approaches to forestry. A broad coalition which included such logging industry leaders as Weyerhaeuser joined forces in advocating forest management for sustained productivity.

While Pinchot advocated the commercial use of forests he was not an advocate for uninhibited industrial access to timber. Rather, he sought partnerships with industry leaders to advance the development of Forest Reserves. He was a follower of George Perkins Marsh in believing that human ignorance threatened the ecological balance (Marsh 1864) and that unfettered business interests were often guilty of flagrant disregard for Nature. In accord with his experiences in Europe, Pinchot believed that the land could be observed to indicate what tree species and characteristics should exist on a given forest. Once that choice was made, a system of silviculture and harvesting could be prescribed for optimal productivity of the land. The ecological balance could be maintained by bringing the forest to its original condition, and harvesting it as it reached maturity. By maturity, he meant the period of a tree's or a stand's life when its growth slows down and is overtaken either by disease or net negative growth, or by the economics of capital investment. In practice, as applied in the newly opened western forests, this approach required making forest surveys, harvesting the original timber, and ensuring regeneration of the same species for the cycle to be repeated *ad infinitum*. The biology was simple and the new scientific forestry seemed to be practical.

Most significantly, Pinchot's political instincts for a broad democracy led him to support the concept that the Forest Reserves ought to serve broad public needs rather than commercial interests. Conservation was an effort to support fundamental democratic values by protecting the resource from the abuses of corporate self-interest (Taylor 1992). He felt that scientific and technical solutions were available to protect ecological and political values, and that his form of conservation was morally upright (White 1957).

When Pinchot gained a position of influence, his predecessors had already firmly established the Forestry Division in the Department of Agriculture. Along with other lead-

ers of forest management, they began training young men in the new profession of forestry. They felt that they were saving the forests of the New World from wanton destruction such as they had seen in Europe, and they believed that they could raise a new generation of foresters who could consolidate forestry as a professional discipline through example and by education. A new school of forestry was begun in 1898 at the Biltmore Estate in North Carolina by C. A. Schenk, another German-trained forester. When Fernow retired from the government in 1898, he became Dean of Forestry at Cornell University. He strongly influenced forestry education through his relationships at Yale University, University of Toronto, Michigan State University, and Pennsylvania State University. These institutions taught the following generation, and generations of students since, that conservation could sustain a perpetual use of forests and advocated a national program based on economic productivity. They established university level forestry education in the German model and advocated rational planning for the highest end uses of forests.

They also formed a direct line of descent in the development of U.S. government policy. In 1898, Pinchot replaced Fernow as Chief of the Division of Forestry and promoted a policy of "wise use," which put primacy on economic over aesthetic evaluations of the forests. Conservation could then be justified as simply being "good business." He cultivated his former friendship with a like-minded Teddy Roosevelt and the two formed a strong alliance for promoting a national consciousness for the values of conservation. The phrase "the greatest good for the greatest number [of people] in the long run" was adopted as the motto of the U.S. Forest Service, and Roosevelt succeeded in making conservation an expression of American democratic patriotism. To Roosevelt, conservation of America's natural resources was an extension of his belief in the invigorating effects that Nature, especially the Nature of America, could have on western civilization, as distinct from European decay. He was at the political forefront of progressive conservation. He never publicly declared full support for Muir or Pinchot, though he finally did settle on the Pinchot model for National Forests.

Thus the Forest Service in the Department of Agriculture was built on the foundation of European, and more specifically, German practices. It would introduce a uniquely American form of forest conservation for the use and development of civilization. The Department of the Interior was also committed to managing National Parks for the good of the people, but not in the mold of resource production.

## Separate Camps

Both Muir and Pinchot enjoyed the friendship and support of Roosevelt in establishing the Forest Reserve, and neither was publicly rejected by Roosevelt. On the famous Muir-Roosevelt camping trip in Yosemite, Roosevelt found Muir to be rather too talkative but thoroughly enjoyed waking up in the valley's snows. Muir won some immediate concessions on extending the parks, but Roosevelt remained generally and strongly supportive of Pinchot's policies (Morris 2001). Roosevelt's personal position on preservation or use of the native forests was ambiguous. His policies supported Pinchot but he was careful to not alienate Muir.

The fundamental difference between Muir and Pinchot was never resolved in public policy or in personal relationships. From the earlier camaraderie between Muir and Pinchot against a common enemy, their differences in perspective sharpened with Muir's emphasis that wilderness had to be preserved for its own sake and that human utility was at best a transient value. Pinchot's emphasis instead was on utility as both an ideal and a

political expediency of joining enlightened self-interest to long-term conservation. They both started from an identical concern that the native forests were disappearing and had to be saved, but one looked to the past for a Golden Age to recover, while the other looked to the future to stabilize forest production. Both sought stability, but they had different models for the stable ideal.

The subsequent struggles for control of the Forest Reserves and the administration of the National Parks were institutionalized in the separation of objectives of the Department of the Interior and the Department of Agriculture. Since the Department of the Interior had the mandate to administer public lands and already administered Yosemite and Yellowstone National Parks (established in 1864 and in 1872 respectively), the National Park System was placed in the Interior Department. The goals of economic productivity were advanced under the Forestry Division in the Department of Agriculture, largely using the Forest Reserves established in 1891 and 1897. The status of forestry in the Department of Agriculture was advanced to the level of a Bureau in 1901 and the Forest Reserves, which eventually became the National Forests, were transferred to that Bureau in 1905. The differences in concept were institutionalized in the two Departments, as a national policy of segregated land use.

The development of the separate agencies responsible for the National Parks and National Forests was the result of over 30 years of intense political struggle. At first, efforts were made to organize a single policy and strategy for conservation. When this failed, the forest reserve was divided between the two jurisdictions. Legislators from the Western States largely opposed establishing forest reserves and favored the economic development and use of the timber resource. The political support for wilderness was largely based in the Northeastern States. With the movement of destructive logging from the Lake States to the Southeast, a wider public interest in forest conservation was again engendered. A broader set of objectives, including water and wildlife conservation, was then included in the Weeks Act of 1911 which expanded the Federal and State systems that were served by the Forest Service. Over subsequent decades, additions to the original National Forests have accumulated a total of approximately 190 million acres in the National Forests out of a total of nearly 750 million acres of forest land in the United States. In comparison, the National Parks now cover around 80 million acres, and the Department of the Interior administers additional areas in National Monuments, preserves, natural areas, seashores, lakeshores, and parkways, some of which are in forests.

Intense public interest in forestry issues grew during the first decades of the 20<sup>th</sup> century and reached great national intensity during the Hetch-Hetchy controversy culminating in 1913. A proposal to dam the Tuolumne River in Yosemite to provide water for San Francisco and for agriculture and grazing purposes generated national interest in preserving the proposed flood zone. Pinchot could argue that the "highest end use" could justify the dam and that this sacrifice could be used to gain a stronger national forest system. Muir, of course, felt that the desecration was inexcusable. The proposal was eventually passed and the dam was built, but the national debate marked the emergence of a strong national constituency for wilderness preservation. At the beginning of the 21<sup>st</sup> century, public debate is again raging over the removal of the dam, even as California goes through another energy crisis.

In the early 20<sup>th</sup> century, the wildlife biologist Aldo Leopold started his professional career in game management, very much within the spirit of management for the utilitar-

ian objectives of the Forest Service. Unlike Muir, he was a trained forester. A major effect of his efforts was to add Transcendentalism and Romanticism to ecology and to bring philosophical ideas into land management issues. As he developed his ideas about the ethical status of non-human life and of the ecosystem as a whole, he came to support the inclusion of a much wider sense of intrinsic value, in which humans were only one part of the world for which moral concern existed. He could be considered as supporting the Muir school of thought when he sought to protect wilderness in the National Forests. His "Land Ethic," as expressed in "The Sand County Almanac" (Leopold 1949) translated ethical concepts into guidelines for land management that emphasized ecological stability. For him, the ecosystem was at the center of moral consideration. He saw all parts of the ecosystem functioning as a whole. He idealized East Asian philosophies that believed in understanding and considering the environment in order to understand and to fully value humanity. But he displaced humans from the center of concern to the periphery, where they were merely one part of a whole. Leopold summarized his philosophy as, "A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise" (Leopold 1949). This approach places primary value on the whole over its parts, including the part that is human. It became the principal ethical guideline for conservation management in North America late in the 20<sup>th</sup> century. It also has helped to formalize the ethics of conservation and to establish the place of humans in Nature (Taylor 1992). Leopold legitimized ecological integrity as a higher principle than timber production in forest management.

Nevertheless, the two schools of thought and action existed as two camps, exemplified by the separation of lands and powers between two Departments. Within each Department a clear policy could give consistent direction to forest management. The hope then in the United States, as it is in British Columbia today, was that segregated land use could achieve a national peace by allowing each philosophy its own piece of land.

Nevertheless, the arguments over policy and management techniques either for preservation or for production did not stop in either agency. Converting goals into actions proved difficult in both agencies. As it turns out, neither the concept of wilderness nor of economic efficiency is sufficiently clear to effectively guide policies on the ground. There is continuing debate within the Parks Service and between the Department of the Interior and the Congress over the extent to which cost and benefit considerations should enter decisions about what to preserve, and whether to control such "natural" forces as fire. The ideal of excluding human intervention proved impossible to enforce. Some interventions have always been required to moderate "natural" calamities or to prevent incursion by newly invasive plants or animals.

The guidelines that Leopold tried to establish turned out to be too ambiguous for action plans. Debate continues to flare over the definitions of integrity, stability, and beauty of the biotic communities. The ecological systems themselves were complex and evolving prior to human intervention. The "natural" state, presumed the ideal condition to return to, could not be defined, and the success or failure of a program of conservation management or of benign neglect could not be known. Questions also arose about whether most biotic communities were stable in any measurable sense.

In fact, there has been a growing ecological awareness that communities rarely achieve a stable, diverse, and productive condition at the end of some progressive order. Succession and replacement are the predominant orders of nature and they are characterized by

impermanence. As a result, defining the integrity, stability, and even the beauty of a biotic community is difficult. The objectives of management or of neglect, therefore, generate policy conflicts. As the necessity for managing fire and wildlife is imposed on the Parks Service by public pressure, conflicts are fought within the agency over what to manage and how much intervention is required.

There is also continuing debate within the Forest Service over the unpredictability of ecosystem dynamics and of management impacts on them. For any biological system, and for forests in particular, human control can never be as precise as on a factory floor. There is always a degree of unpredictability about the system and uncontrolled environmental effects can be large. While most forest prescriptions can have predictable average expectations, actual responses are influenced by unpredicted extraneous events and the inherent variability in any specific forest stand. At the beginning of the 20<sup>th</sup> century, unpredictability was thought to be a sign of poor science, and was therefore rarely mentioned or included in management plans. Now we know that unpredictability is inherent in the system.

There is also debate over the extent to which forests that had been designated for production should be managed for scenic and recreation values and for nontimber products such as water and wildlife. The concept of productivity has broadened to include many of these nontimber values and has proven to be elusive for providing management guidelines. Most of the 190 million acres in the National Forests are now managed primarily for water, recreation and nontimber objectives.

Bob Marshall was instrumental in having areas of the National Forests designated as wilderness, wild, or roadless (Glover 1986). Many of those areas now are parts of the National Wilderness Preservation System, which includes around 28 million acres, or 19% of the land base of the National Forests.

Managing forests for multiple objectives involves complex and often biologically contradictory prescriptions. Public debate has arisen over the use of harvesting methods, particularly clear cutting. Since many plant and wildlife species require large openings for regeneration, especially those that occur in early successional stages of forest development, clear cutting is a useful management technique. It can, on occasion, be both ecologically sound and economically efficient. At this time, it is clear that even for the U.S. Forest Service, with its mandate to provide productive forests, economic efficiency for timber production alone is not sufficient to guide policies or practices (Greeley 1951). Today, the decline of emphasis on timbering and the rise of wildlife and watershed protection in the Forest Service do more than blur the distinction between Forest Service and Parks Service policies. The Forest Service is being battered internally by its conflicting policies and objectives.

The separation of the two land philosophies into two agencies with different land bases did not resolve the conflict as much as shift the arena. Each agency continues to carry conflicts within its own mandates. The apparently different goals of management do not provide sufficiently clear foundations on which to base management plans. The wilderness environment turns out to be an evolving and multi-faceted mixture of dynamically changing ecosystems that cannot be preserved in any stable state by any one level of intervention, or even by the withdrawal of management. The production of multiple-objective values from forest stands involves an unpredictable and variable nature that cannot be managed as a mechanical, nonbiological system. In addition to the political problems of

adjudicating compromises between different constituencies, there are biological problems in defining achievable objectives. The failure to establish consistent policies within each agency and the continuing conflicts among supporters are not attributable to a lack of effort or of good conscience. They are inherent in the situations each agency must address.

### **The Philosophical Roots**

The similarity of the conflicts around the globe during the last century is striking for its broad durability. We might blame Muir and Pinchot for creating a persistent controversy, but it existed long before they came to the forefront. In the century before 1890, the conflict was latent among opposing sectors of the general public. It only came to heated confrontation when the protagonists had to address problems in specific forests. The conceptual conflict had been simmering since at least the beginning of the 19<sup>th</sup> century. In fact, the protagonists couldn't have been as politically successful as they were without a wide pre-existing pool of support for the contending sides within the general culture. The social and philosophical basis for the conflict is partly revealed by the differences between the core beliefs of the leading protagonists. We might better understand the roots of the enduring conflict and the failure of each side to win agreement for their vision by looking at the development of these protagonists.

The Forest Service's land-use philosophy of production, as executed by Gifford Pinchot, was an outgrowth of the American Enlightenment. The ideas of the founding fathers of the United States, as exemplified by Franklin and Jefferson, were clearly drawn from the French and English Enlightenment and its faith in science and progress. Agricultural production was the basis for any growth of the national economy, and the settlement of the West was driven by a belief that America could take the European experience and avoid its problems by developing the new territories. The Department of Agriculture promoted the settlement of the Western States. The Forest Service, which was shaped by that mold, also benefited from the German adaptation of the Enlightenment in its scientific forestry.

The Enlightenment was a broad development in philosophy, science, and the arts. It was a rational approach to understanding Man and Nature and rejected ecclesiastical monopoly on the truth. It developed with the 17<sup>th</sup> century's discoveries and inventions, particularly those of Newton and Descartes. It did not reject God as much as it emphasized human intellect in understanding Nature and implementing God's will. The supremacy of rationality was advanced, in particular by Voltaire, and was communicated to the New World by 18<sup>th</sup> century political leaders.

To the colonists, the forests were at once a vast resource that God had intended for human development and a pristine state of Nature in which God's design could be discerned. To settlers along the Eastern Seaboard, the West presented opportunities for economic advancement and spiritual salvation. Fur trappers, traders, missionaries, and explorers joined in a great wave of internal migration. The westward advance of civilization was fueled by trade and characterized by the export of natural resources. While the wilderness frontier was considered to be in a pristine state with an inherent wild beauty, the natural resources were there to be exploited and humans were there to be enlightened. The early fur traders may have appreciated that beauty and may have had no great desire to change the landscape, but by the 19<sup>th</sup> century the pressures for land had pushed pioneers into the timbered areas of the West.

John Muir's strict Calvinist heritage and his direct exposure to the destructive logging near his home in the Lake States led him into a crusade to save what to him was God's

unspoiled wilderness. He was educated as a biologist and could therefore see the effects of the prevalent practice of clear cutting and burning. His convictions and his expressive certitude undoubtedly deepened when he became familiar with the philosophy of Ralph Waldo Emerson. It was Emerson's transcendentalism that gave logical form to Muir's feelings that there were values in wilderness that went beyond economic measures. When applied to the natural world, transcendentalism led to the belief that there is a divinity in the natural world that becomes clouded in cities but remains clearest in the wilderness. Because Muir's field experience lent substance to Emerson's more abstract concepts, the two came to share similar interests in conservation and they eventually became personally acquainted. For Muir, Emerson's transcendentalism gave a logical form to his own ideas of the wilderness. He likened the towering stature of Emerson and his concepts to the sequoias. They once met in Yosemite when Emerson, though already quite elderly, took a western tour. However, Muir was to be disappointed when Emerson declined his invitation to directly experience the western wilderness by going camping. Nevertheless, they admired and supported each other.

## Emerson

Emerson had developed his form of transcendentalism based on 18<sup>th</sup> century European Romanticism, which was a reaction against the Enlightenment. To Emerson, the strict emphasis on rationality constrained the quest for knowledge. Romanticists also rejected the Enlightenment view that humans required the behavioral constraints and disciplines imposed by rationality in order to achieve full potential. Instead they considered that humans were naturally and intuitively good, but were corrupted by society. Emerson agreed with the Romanticists' rejection of strict rationalism as too limited for understanding man and Nature. He based his own philosophy more on the writings on the empirical English philosopher John Hume, and on the Romantic philosophers, Swedenborg, and most notably, Jean-Jacques Rousseau (Mason 1979).

Rousseau's thoughts on nature and wilderness were harbingers of those later stated by Emerson and Muir. He stated that "Everything is perfect coming from the hands of the Creator; everything degenerates in the hands of man" (Masters and Kelly 1995). In a very similar vein, Emerson considered the wilderness to be an original state of nature. He thought that the American wilderness made it possible for all humans to recover the lost Golden Age which had existed before corruption by society and which contained a transcendent reality that was beyond understanding.

The explorations of Alexander von Humboldt expanded European understanding of the large scope of the New World and the unknown aspects of Nature. His understanding of different kinds of forests seems to have had relatively little influence on German forestry, but through Emerson he had a substantial direct effect on American forestry. Both he and Rousseau shared the Romanticists' faith in the individual. Understanding the "over soul" that existed in natural things didn't require the formal conceptual structures required by strict rationalists or the religious structures that required priests. Understanding could be achieved by individual human effort and insight. A direct connection between humans and God was available, and was aided by going directly to Nature.

Emerson sought an intuitive understanding of the material world, one in which the things and organisms that we can observe have a transcendent essence that we cannot observe or understand by reason alone. The wilderness could serve as a transformative influence for human understanding of the transcendence of natural objects. Specifically,

the American wilderness could be a means for achieving human transformation. These ideas injected a unique American expression into European Romanticism and lent support to feelings that the American wilderness held special significance for all people. For Emerson, Rousseau's idealization of wild Nature and his liberalizing of political thought, eventually expressed in the French Revolution, were a perfect fit for the politics of American democracy and for the rural environment of mid-19<sup>th</sup> century America.

## Thoreau

While developing his philosophy and teaching at Harvard, Emerson had a strong influence on a young student, Henry David Thoreau. Through the mid-19<sup>th</sup> century the two of them formulated the intellectual basis for considering the forest wilderness as an entity worthy of consideration. He took Thoreau into his home and the two advanced the primacy of emotion over reason as a source of knowledge. They asserted that the reality of the spirit transcended that of matter. However, while Emerson was a Boston Brahmin who taught at Harvard and was not one to get his hands or feet too dirty in directly experiencing wilderness, Thoreau was anxious to engage in the physical acts of a simple and self-sufficient life. The two personalities provided a strong foundation for a widening public support for maintaining forests at a time that logging operations had largely moved from the Northeastern States to the Lake States.

Thoreau did not advocate an uninhabited wilderness as much as he advanced the uses of forests for spiritual sustenance. The three acres on Walden Pond that Emerson gave to Thoreau were not in a virgin forest but in a cutover secondary forest. Nevertheless, Thoreau could escape the distractions of New England life. There, Thoreau could hunt, fish, gather wild fruits and plant beans. He could even listen to the lonely music of the wind in the telegraph wires. He could be considered to be one of the first Americans to advocate preservation of a pastoral ideal.

However, he was not an abstract idealist. He was a keen observer of natural phenomena. At Walden Pond, he noted the ways that the succession of plant species occurred over time as fields first recovered from clearing with grasses and low shrubs, which were replaced by certain tree species, and these, by other species of trees (Thoreau 1854). By those observations, he began to question the existence of the natural order of organisms that his whole intellectual milieu had led him to assume (Barbick 1987).

Thoreau was also puzzled by his conflicting feelings about wilderness. When he went into areas far beyond the urban and bucolic worlds of Massachusetts and hiked in the untracked and untamed backwoods of Maine, he experienced both the uplift of a wilder Nature and the threat of an inchoate world (Sherman 1958). He was disturbed by feelings of wild savagery as if he were reverting to become an atavistic wild man. He feared aspects of his own fierceness and animal instincts, and he also feared the repression of society on the human spirit (Schama 1995). Nevertheless, he advanced the idea, "in wilderness is the preservation of the world" (Thoreau 1851), which was later rephrased by Muir, "The clearest way into the Universe is through a forest wilderness" (Muir 1938).

While Emerson and Thoreau were rooted in European Romanticism, they awakened the American public to their forests and laid the basis for Muir and Pinchot to make forestry an American political issue. While Thoreau himself had come to accept a pastoral, not a wilderness, ideal for the future of America, his compromise has apparently not been accepted by his more recent supporters (Careless 1997).

As conservation and forestry came to involve national political interests, the issues were drawn in terms that were uniquely American. Here, a democratic, individualistic frontier spirit defined the national character. The independent and self-reliant individual symbolized the frontier ideal, and a national ethos was defined by the transforming influence of the wilderness. A new nation grew out of the European culture that had been transplanted to the New World. That culture was transformed by the combination of free land and the freedom of the wilderness for land hungry people. In 1893, Fredrick Jackson Turner gave a landmark paper to the American Historical Association entitled "The Significance of the Frontier in American History" (Turner 1893). Roosevelt and key legislators were quick to see historical and political significance in that paper. They concluded that the stultifying influence of European culture and the spirit of decline in Western civilization could be countered through reinvention of America.

The large political and social forces that defined America's character also led to the growth of conservation. Many Americans were eager to accept the concept that their untamed environment created a unique American character and destiny. To some, particularly in the East, the situation implied a necessity to maintain forests as they were, or as they had been, in order to maintain that American character. But to most westerners, for whom the Romantic Movement was foreign, the American Destiny was to develop the land for use and profit. Turner wrote at a time when the frontier had already closed, but he felt that the frontier experience assured the country's interior would be filled out in a spirit of democracy and freedom.

### **American Arts**

While the leaders of the movement may have been motivated by moral philosophy, popular movements are seldom based on esoteric philosophical arguments. In the absence of compelling economic arguments, a broader cultural foundation is needed to achieve political awareness. The role of wilderness in developing a unique form of American nationalism was probably pivotal in popularizing the conservation of wilderness. At the same time that Emerson was developing transcendentalism, there were other cultural expressions of European Romanticism in American literature and painting. The New World forests appeared to the Europeans as an untamed wilderness, but Americans saw these forests as a spiritual as well as physical frontier that was theirs to explore. The social and political convulsions in Europe after the Napoleonic Wars led to a decline in faith in the classical order, and to the elevation of individual freedom as a central goal of political and social organization. The social and intellectual freedom of the individual, and the release from the constraints of traditional forms of the Enlightenment, were central themes of European Romanticism. In the early 19<sup>th</sup> century, American forests came to symbolize those themes. In politics, literature, and painting, both in Europe and in America, freedom and the American wilderness were symbolically bound together. In this cultural atmosphere, it became important to protect the threatened wilderness resource from the inroads of industrial civilization and from the stultifying influence of classical European thought and society.

Political, philosophical, and historical factors came together to focus on the American forests as a symbol for the emerging nation. The artists of the time lent their very strong influence to the glorification of the American wilderness. They had a broad cultural effect on concepts of wilderness and the western frontier. Like the photographers and cinematographers of today, artists had an inordinate influence in determining what was seen and how it was seen. Though their influence on public opinion often is indirect, their vision

often is assumed by the public and becomes the common perception of things not directly seen. In 1841, at the same time that industrial logging swept into New York and up the Hudson River, Thomas Cole, Fredrick Church, Asher Durand, and Albert Bierstadt were developing what was later to be become known as the Hudson River School of painting (Howat 1987).

Cole was born in England but moved to America in his teens and developed his painting under the influence of both English and American ideas. He was a follower of William Gilpin, an English artist-philosopher who advanced the school of "naturalism" in landscapes. But he was also strongly influenced by concepts of Nature as a primordial wilderness that could be found in America and preserved in his paintings. Church studied with Cole and extended his travels to South America, where he was also influenced by Alexander von Humboldt, the German scientist-romantic. Asher Durand was one of the first to develop the outdoor techniques of painting. A painting of his two friends Cole and William Cullen Bryant standing over the Catskill forest is perhaps his best known. Albert Bierstadt was German born but painted the widely reproduced pictures of the Grand Canyon, the Rocky Mountains (Lander's Peak), and Yosemite Valley which are still well known for their grandeur.

The paintings of the Hudson River School depicted distant perspectives that highlighted the grandeur of the country's forests. The paintings were hugely popular and helped to create the frontier myth. Some were also physically large, covering whole walls, and filled with details of individual trees and plants drawn with fine strokes in small scale in several vignettes scattered through the landscape. The cumulative effect of the detail only amplifies the grandeur of the whole composition in which humans often are minor details. These works gained great popularity for their idealized pictures of forests. They brought a glow to the beauties of wilderness by their use of luminescent techniques in which the land itself became a source of light. They inspired William Cullen Bryant to write that they had caught the essence of the "wild grandeur peculiar to our country which once were wild and picturesque haunts of the Red Man but were now being lost to commerce and manufacture" (cited in Howat 1987). However, these American expressions of Nature had so recently grown out of their European roots that Bryant wrote a poem for Cole, on the occasion of a visit by Cole to Europe, reminding him that:

... thy heart shall bear to Europe's strand,  
A living image of our own bright land,  
Such as upon thy glorious canvas lies;  
Lone lakes - savannas where the bison roves –  
Rocks rich with summer garlands – solemn streams –  
Skies, where the desert eagle wheels and screams –  
Spring bloom and autumn blaze of boundless groves.  
Fair scenes shall greet thee where thou goest – fair,  
But different – everywhere the trace of men,  
Paths, homes, graves, ruins, from the lowest glen  
To where life shrinks from the fierce Alpine air.  
Gaze on them, till the tears shall dim thy sight,  
But keep that earlier, wilder image bright.  
(Bryant 1933)

While most of the paintings from this school were focused on a landscape without human intervention, and some pictured an indigenous person within a benign "Nature," they also pictured an idealized future in a pastoral setting. There was nostalgia for the wild but an acceptance of the idea of "progress" to civilization. The artists were conflicted in their feelings about the forest, and in the early 19<sup>th</sup> century there were divisions in American society about whether the despoilment of their paradise was a sin or a symbol of progress.

Writers also contributed to the culture of wilderness. In New York, the Knickerbocker school of writers sought to define an American spirit that was independent of the Old World. They achieved some success, especially with the poetry of Bryant and the novels of James Fenimore Cooper. Bryant's poem, "A Forest Hymn", opens with:

The groves were God's first temples  
...holy men who hid themselves  
Deep in the woody wilderness,  
And gave their lives to thought and prayer ...

and closed with:

... Be it ours to meditate,  
In these calm shades, thy milder majesty,  
And to the beautiful order of thy works  
Learn to conform the order of our lives.  
(Bryant 1933)

In the 1820's Cooper first published his *Leatherstocking Tales* (Cooper 1823) from his home in Cooperstown, N.Y. He mentions the passing of "God's Wilderness" and the loss of the "American Eden," as forests were removed for the expansion of trade and agriculture following the European model. Much of the story in "The Pathfinder" (Cooper 1840), "The Deerslayer" (Cooper 1826), and "The Last of the Mohicans" (Cooper 1841) is concerned with the wilderness way of life in upper New York State, and Cooper occasionally contrasts the indigenous with the European concepts of life. The hero, Nathaniel Bumppo, readily passed between the two worlds and at times behaved in savage and wild ways that horrified his own European sense of propriety. In the last of the *Leatherstocking Tales* (Cooper 1823), which takes place in the Mid-western plains, he mourns the loss of the Aboriginal forest and its way of life but comes to accept the inexorable progress of civilization and grudgingly accedes to the advance of agriculture. So Cooper, like Thoreau, accepted a pastoral compromise, but that compromise view is seldom associated with his legacy as a champion of wilderness. There is also a degree of ambiguity about the view that Cooper had of the Aboriginal people. Barker and Sabin (1995) argued that Cooper actually had to assume a natural superiority of the European over the indigenous and see the loss of the savage as the inevitable consequence of progress, but that he felt an obligation to apologize.

Similar tales of failure to achieve a compromise between alien ways of living have been a staple of English literature and often echo themes of forests and days of past glory. One of the strong literary influences on Cooper was Sir Walter Scott, whose "Ivanhoe" had been published only a decade or so before the first of the *Leatherstocking Tales*. The

story told of the Age of Chivalry, when the Norman invaders usurped the traditional land claims and uses of forests by the English peasants. They too were rapidly losing their original forests and their old way of life and their tragedy lay in seeing the Golden Age slip away.

Populist ideals merged with the westward expansion and the Tales were an instant best seller. They gave a positive image for unsettled easterners and for immigrants who could escape urban centers to conquer a new land with their democratic, frontier individualism. Cooper and other artists, including Asher Durand, formed "The Bread and Cheese Club," and promoted the Romantic vision of America that glorified wilderness and gave support to Andrew Jackson's westward expansion. The power of the myth endures today, as attested to by the repeated telling of the story in film and even in modern comic books (Barker and Sabin 1995). The concept of the "natural man" as epitomized in the Leatherstocking Tales and the liberating effect that forests could have, strongly influenced D. H. Lawrence, who extended their effects to the erotic side of the human psyche in his 20<sup>th</sup> century English novels.

Thus, artists and writers advanced the vision of wilderness as an ideal state, but acquiesced to a pastoral realization of that vision. The pastoral view, however, was of an ancient Eden. There was a grudging acceptance that the boundaries of wilderness must recede, and agreement that the Golden Age lay in the past at a time before human exploitation. Their form of compromise, however, is not currently popular and is generally ignored by supporters of wilderness (see e.g. Careless 1997). The pastoralization of nature and, by extension, the use of land for productive farms and forests, was seen as an inevitable consequence of human progress. Writers' and painters' perceptions formed the basis not only for the Muir wilderness movement but also for Pinchot's progressive forest management.

In any case, American philosophers, poets, painters and novelists in the 19<sup>th</sup> century portrayed wilderness or its pastoral version as a paradise. The power of their visions, and the rich diversity of images that they could conjure, became embedded in the common culture and had enduring profound political and social influence. John Muir and his followers could claim a philosophical and cultural heritage that was broadly and deeply based in Europe that found unique expression in the development of America and in the American experience. In the untamed West, Muir could retain a purer, more Rousseauesque vision of wilderness and could build on an ethos that the American wilderness could transform European civilization and recreate a wild Eden. An American alternative to rampant plundering of the forest was the establishment of pristine forest reserves, an alternative that was not available to the English and German foresters of the time. The ideal of preserving the pristine forest was seen as defending the sublime. Although compromises might have to be made, the polar position of preservation was firmly established. Muir understood that the dichotomy of forces for wilderness preservation and for its taming had come face to face in America. He took the position that the mental duality could be best resolved by keeping national forests in a state of wilderness.

Pinchot's ideas also had European foundations, but they were directed to the cultivation of forests for perpetual productivity to serve people. Muir's position was heavily influenced by Rousseau, while Pinchot's arose indirectly from the positivism of Comte and Spencer. Those thinkers assumed that as history unfolds, it reveals an inevitable progressive evolution. It was human destiny to advance. One of the implicit assumptions of

progress that was considered characteristic of an American pioneer spirit was that the wilderness had to be tamed.

Progress meant conquering the frontier, and the "American Destiny" was a godly endeavor to make the land fruitful. The Golden Age of America lay not in the past, but in the future when technology and the American spirit would bring bounty to all. The American Destiny was to fulfill the progressive human destiny. Gifford Pinchot and his followers derived their programs from a philosophical and cultural heritage that was deeply and broadly based in its Progressivism. They envisioned American forestry creating a new Eden. The settling of the West arose from these origins, and not from the ideals of forest preservation.

By assuming the goals of economic productivity and a stable Nature, the foresters who were penetrating into the Western United States were committed to actions that had profound effects on the forests and the continuing controversies. They assumed that the forests they observed before logging were the original forests in a pristine state. Their tasks were: (1) to determine what that original forest condition was, (2) to devise ways to harvest logs, and (3) to regenerate the original composition for perpetual harvest. In the Northwest for example, large, dense, even-aged stands of Douglas-fir stood in coastal forests, and mixed stands of open pine and fir grew in the interior. Each forest had to be surveyed and harvested with the intention of restoring its composition and productivity. With some modification for an expanded set of "production" goals that include water, wildlife, and other ecological products, this paradigm of management is pursued to this day.

What was not understood was that the existing forests were far from stable and were far from being free of human influence. Environmental changes had occurred and the indigenous people had certainly had a large influence on plants and animals of the region. The forest ecosystem and the human ecosystem of the time were in intimate contact and had profoundly influenced one another long before the 19<sup>th</sup> century. One of the ways in which the contact between human society and forest ecosystems was played out was in religious activities.

## **Religious Movements**

In the 19<sup>th</sup> century, other social forces with the power of mythic proportions were operating in America. Among them were the religious movements that began the American Age of Reform, which had impacts on the forests and had roots in Europe. In the early 19<sup>th</sup> century, evangelicalism, spiritual revivalism, and populism arose. The Protestant Evangelical movement in America grew out of the same rejection of the Enlightenment that gave rise to Romanticism. The reform religions that blossomed in America emphasized nonauthoritarian structures and favored individual sources of inspiration. The Evangelical and Reformed Churches, and especially the Methodist Church, were based on reform movements in Europe that emphasized individual paths to religious experience devoid of the hierarchical structure of official religions. They supported the revival of spirituality through a second crisis of evangelical faith that followed an initial conversion. This process resulted in a consecration of an individual to God. An individual's faith was revived and the person was willing to do whatever was seen as God's will.

In 19<sup>th</sup> century America, this fervor met with the western expansionist movement and resulted in an American Protestant missionary program that went West with the early explorers and traders. These missionaries rejected the established and official churches of Europe. They believed their mission was to transform, civilize and Christianize the indige-

nous people. They may have had no original desire to physically transform the wild lands, but by Christianizing the people, they were instrumental in the cultivation of the wilderness. They did not go to tame the land. They intended to materially change the Native peoples, and they brought along the concepts of the Enlightenment. While they originated largely from a rejection of the Enlightenment and Modernism, they accepted the mission of transforming the wilderness in forests as well as the wilderness in people. They carried with them a vision of a pastoral home - an Eden that was a result of human cultivation. In this approach they were following an old religious tradition. The monks in Medieval Europe were successful in founding outliers of civilization through much of Western Europe by clearing wastelands and cultivating fields. Simultaneously, they converted the heathen to civilization and to allegiance to the Church.

As the physical frontier was also a religious frontier for the burgeoning Protestant Evangelical movement, their vision of the indigenous people was one of ignorant heathens who needed Christianity. In contrast to Cooper's Natty Bumppo, for whom the Indians had a different culture that was inherently difficult to understand by the European, missionaries' perspective was much simpler. Indian culture was not worthy of understanding. They were uninformed heathens who needed to be saved by missionary effort (Drury 1897). In advancing progress, the missionaries were just behind the trappers and explorers in carrying out the American Destiny. The missionaries and the pioneering land settlers who invaded the West, like the foresters and conservationists, thought that they were entering a system that had had no previous dynamic changes and only awaited their intervention.

### **Missionaries and the West**

The pioneers of the 19<sup>th</sup> century largely came from a land-hungry culture: either from the Eastern Seaboard or directly from Europe, where the poor could never dream of owning land of their own. The combination of nostalgia for a 'past Golden Age' and the availability of open land was an irresistible attraction (Nugent 1999). Railroads, which were given huge land grants to lay track, provided land to encourage settlement along their routes. Advocates like Horace Greeley urged people to settle the West (Cross 1995). Europeans were induced to emigrate and the trade in supplies for the settlers proved to be a boon for the northern tier of territories (Mickelson 1993). The more of the forest and prairie that could be brought under agriculture, the better their condition would be, and the more prosperous America would be.

Since European Romanticism didn't have much impact in North America until the mid-19<sup>th</sup> century, all of the European and American pioneers of the 18<sup>th</sup> and even into the early 19<sup>th</sup> centuries were embedded in a culture that was intellectually formed by the European Enlightenment. Prominent leaders like Ben Franklin and Thomas Jefferson advocated faith in reason and technology. That faith was combined with a democratic political ideal in which the common man could generate and share in the benefits of progress. The discoveries of Lewis and Clark (Ambrose 1996) stimulated a huge migration from the Eastern Seaboard to the newly purchased western territories. The faith in technology and science was joined with a democratic spirit in Andrew Jackson's expansionist movement. For forests, the process culminated in Theodore Roosevelt and Gifford Pinchot's ideas of conservation and wise use for the greater good.

In the 19<sup>th</sup> century, America was an industrializing country. Its agriculture and its population expanded to the west and south. Settlers, fur traders, and loggers came to the wil-

derness to tame it. However, many settlers and explorers harbored the idea that the pristine forests were God's expression and should not be destroyed. For most settlers forests were idealized both as untouched expressions of a long-lost Eden and as a source of wealth.

At the beginning of the 19<sup>th</sup> century following the lead of the Lewis and Clark expedition, trappers and traders tried to beat the British to the lucrative supply of furs that existed in the Pacific Northwest. A few prospered for a while, but many got lost, killed, or otherwise were thwarted in their efforts to establish a trading center. For the most part, the Hudson's Bay Company won the race for furs. The Oregon Territory, however, was dually administered by both England and the United States, and the American Fur Company made effective inroads into the trade there, forging overland links to compete with the sea trade. Nancy Langston (1995) reports that the first explorers and traders to enter the Blue Mountains of eastern Oregon in 1811 were met with a bewildering landscape, and many died in those first attempts at establishing the overland route. But by 1825 there was sufficient commerce in fur and enough connections among trappers and traders to have "Rendezvous," which were trade fairs of a sort. At these annual events, set up as focal points for trade, large numbers of beaver trappers could gather and sell to traders. Traders would then carry furs to the eastern markets.

Traders and settlers often found areas where the trees were large and well-spaced with lush grass under them. Horses could be ridden there. These open areas, which were maintained by Indian burning practices, resembled English country estates on a large scale and were assumed to be God's gift of wild trees in a bucolic setting. The "pristine" wilderness was idyllic for emigrants from the East and from Europe. Indeed, for subsequent generations, those forests would naturally be a dominant vision of what God had made ready before civilization. In 1836, the pristine and forested world of the Northwest also became accessible to missionaries from New York and New England. Some, like Narcissa Whitman, were motivated by a Christianizing zeal (Drury 1897). Her devotion was so unquestioning that even the eight-month journey from New York to Oregon was no deterrent.

She had been born and raised in rural New York State and, like many young women of the time, had been strongly influenced as a young teenager by religious revivals that regularly toured smaller communities. Narcissa was among those affected; she had a religious experience at one of the summer revival meetings when she was but 16 years old. At age 25, she applied to the American Board of Commissioners for Foreign Missions, "... to go to the heathen" (Drury 1897). A year later, after becoming engaged to Marcus Whitman, both were accepted for a mission to Oregon. They married on February 18, 1836, and left on their journey by wagon the next day. They had to do their courting along the way, and "had to make love abruptly" (Drury 1897).

Marcus had practiced medicine in New York and Canada before applying to the Board of Missions for service. In 1835 he was commissioned to look into the possibility of establishing missions in the Oregon territory. He and another missionary, Samuel Parker, first joined a caravan from St. Louis, then continuing on alone by canoe and horseback, they finally reached Wyoming. There, they were welcomed by bands of the Flathead and Nez Perce, who may have been members of the same bands who had welcomed the Lewis and Clark expedition 30 years before. Among the early converts to Christianity was a man called Tuekakas, known as Old Joseph by the white men. Encouraged by their welcome, Parker continued westward while Whitman reported back to the Board of Missions in

New York, which then authorized additional recruiting efforts for missions to the area. In the few months before leaving again for Oregon, he organized the equipment and supplies for a permanent mission and married Narcissa.

The trip was long and difficult in some places. Initially they used an established trail that took them by wagon from Ithaca to Pittsburgh, to St. Louis, and to Fort Laramie. From there, they crossed the continental divide by horse or mule. Four missionary families traveled as part of a much larger caravan of traders and fur trappers to the Rendezvous in Wyoming. From there on, Nez Perces guided the Whitmans and their companions the Spaldings, whose party included the first white women to travel overland into Oregon. They passed through the Grand Ronde Valley, which the Lewis and Clark expedition used and where the Oregon Trail would later be located. To the east lay the Wallowa Mountains and valley where a band of the friendly Nez Perce lived. In the Blue Mountains of Oregon, Narcissa found the beauties of the landscape deeply affecting. They reminded her of the hills back in her native Steuben County in Upstate New York, and the singing of the birds recalled bygone days of peace and ease. Descending from the Blue Mountains heading westward, they came to a panorama of the Columbia River Valley and saw the sun setting behind Mt. Hood and Mt. St. Helens, and were enchanted by visions of God's bounty. They saw a parkland of open forests surrounding lush valleys. Like visitors to the valley have felt since then, they were enamored by this pristine sanctuary. It was an idyllic setting that reassured her they could recreate an Eden in this wilderness. Upon reaching the area of their new mission, Narcissa felt stronger than the fatigue of the voyage would have warranted, and she rejoiced in God's strength and presence. She was thankful for the energy she had for the mission before her. The Whitmans would recreate a Garden of Eden in the pleasant valleys of a New World. They settled into Waiilatpu, just west of present day Walla-Walla, Washington, while the Spaldings set up a mission at Lapwai to the northeast in Idaho.

The work of setting up a home to their liking, however, was considerable. First they built a simple one-room house in the middle of a fertile valley near the Walla-Walla River. Next they erected a house that contained a small meeting room in addition to their living space. They cleared fields and cut the lumber they needed from the adjacent stands of tall, straight trees. They also developed contacts with the local Cayuse band that had previously shown interest in them and their religion. The routine of Narcissa's busy life was briefly interrupted by the birth on March 14, 1837 of Alice Clarissa who had been conceived on the voyage. The addition of a baby girl was a bright spot in an otherwise difficult life for Narcissa. Marcus and Narcissa were fully challenged by the work required to survive far from home with only occasional contact with other missionary families. Marcus worked with the Cayuse and preached in this outpost of Christian civilization. Narcissa, who had strong ideas about appropriate conduct, had to deal with people whose mannerisms were foreign to her, and who often invaded her sense of privacy. But each had their duties in life and for the next twelve years they created a life as they understood God intended for them, preaching daily, raising some crops, herding their cattle, and teaching the heathen about God and cattle husbandry. The only great tragedy they suffered was the accidental drowning of Alice Clarissa in the summer of 1839. But even that failed to cause more than a brief pause in their mission.

Neither Narcissa nor her party were prepared for an indigenous society that had a complex social economy and religious life of its own. They could not understand that such

a society would not uniformly and eagerly follow their prescriptions for a bountiful and holy life. To the missionaries, the Cayuse were in a primeval state that was waiting to be, and would presumably want to be, Christianized and civilized. They assumed that the Cayuse did not possess a culture worth the name, and certainly could not conceive that the Cayuse society was undergoing revolutionary change. In fact, all the indigenous societies that lay in the plateau between the plains and the coastal societies were being buffeted by changes in their social structure and in the military and economic power around them. They were related to the Nez Perce, who were the richest of the plateau tribes. With others of the plateau, they shared the influences of both coastal and plains tribes. At least since the 13<sup>th</sup> century, the plateau cultures had plank houses and carvings similar to those of the coastal cultures. By the 18<sup>th</sup> century they had acquired horses and used teepees in the fashion of the plains cultures. The Cayuse society was not culturally stable and often was at war with the Shoshoni groups in Idaho and eastward. The Cayuse had a complex life based on utilizing different resources at locations that shifted with the seasonal availability of resources, and competition among groups. It was a highly mobile but regulated society that had been undergoing shifts for centuries. The revolutionary influence of the horse and the fur trade further changed their social, political, and economic structures. With upheavals in all aspects of their lives, it would be extraordinary if their spiritual and religious beliefs were not also in flux. They therefore would have been open to examining the religion of the traders. It was a society that must have been in a very rapid state of evolution, but to the missionaries, the Cayuse tribe was much like any other "Indian" tribe — in a state of nature waiting for Christianity and civilization.

While the societies of the Cayuse and the missionaries both were evolving, they had different foundations. At first, the relationship between them was complementary and mutually beneficial, but it soon deteriorated. The missionaries thought that there was but one civilization, to which the other society must adapt. From different but unexamined assumptions, conflict would eventually emerge. Eventually, assumptions and expectations were violated, and tragedy followed. While the Cayuse were adopting some of the missionaries' customs, they were also following their own. The missionaries could not perceive that resistance or disagreement with their teaching could be due to anything other than intransigence. For example, to the Evangelicals, a second crisis of faith was required to belong to the church. Childhood baptism couldn't carry the same mature commitment to Christ that an adult rebirth could. But since the Cayuse had no concept of rebirth, none could become full members. While this thinking seemed logical to the Whitmans, it was an egregious insult to the Cayuse.

Although the schools and the churches continued to function, the mission seemed to bog down and few new converts could be counted. Some important conversions were achieved, but it is not clear that there was a strategy to develop the mission by converting the leadership of the tribes. In effect, inroads were being developed that could have affected the eventual debacle. In 1840 in the Wallowa Valley, a son was born to Old Joseph, named Heinmot Tooyalaket, also known as Young Joseph. His father was to put the boy into a mission school (Brown 1971), but the missionaries and their eastern supporters failed to see the opportunity. The small number of students was taken to mean that the missions were ineffective.

Back in the East the decision was made to shut down the missions. Faced with disappointment in his work with the Cayuse, Marcus shifted the function of the mission to

aiding settlers. In 1842, he returned by horseback to the Board of Missions to argue for the survival of the mission. In Washington he argued that settlers would find it hospitable in the Oregon Territory. On his return to Oregon, he joined with 1,000 immigrants in what was later called the "great migration." Narcissa was not as ready to turn the mission to the service of the settlers, but she did find working with the Cayuse to be full of annoyances and difficulties.

A few years later, when a measles epidemic broke out and the medicines of the missionaries seemed to preferentially allow the missionaries to survive, deep hostilities were generated that the missionaries did not perceive. A party of the same band of the Cayuse that they had been working to convert came to the mission, killed the Whitmans in 1847 and wiped out the mission. This act led the Congress to pass a bill to organize the Oregon Territory and wage larger scale warfare. The Cayuse War ended in 1850 and the United States government started to push the whole of the Nez Perce out of Washington and Oregon and onto a reservation in Northern Idaho. The reservation was at the Lapwai mission that the Spaldings had set up 15 years previously. In 1855 a treaty was presented to the Nez Perce. Some accepted the treaty but Old Joseph did not. In 1863, another treaty was presented leaving only the Lapwai reservation in Idaho to the whole tribe, but Old Joseph remained in the Wallowa Valley. In 1871, Old Joseph died, but Young Joseph took up the struggle and successfully petitioned President Ulysses Grant to withdraw the Wallowa Valley from white settlement. But gold was found nearby and as settlers crowded in, pressure for removal mounted. Settlers took the Wallowa Valley and the government tried to force Young Joseph onto the reserve at Lapwai. The events of the heroic war and flight, and the eventual removal of the Nez Perce are well known. They stand as an example of the tragic and unnecessary exclusion of one society by another (Brown 1971, Jackson 1993).

The good intentions of the missionaries to bring Christianity and the benefits of the Enlightenment to the natural world of God, and to recreate an Eden in the wilderness, utterly failed. The mission failed to recreate their vision of a pastoral home, and they carried their assumptions to their graves. They thought that there was only one social order and they could not see that there was another - that an ancient and dynamic society was rapidly evolving in its own way. That failure cost the Whitmans their lives but it cost the Nez Perce their world.

### **The Modern Forester**

Foresters in the newly formed Bureau of Forestry came to the Blue Mountains in 1900 to survey for the federal forest reserve system. This project was part of Gifford Pinchot's effort to bring productive forests under some form of management system. But managing these forests proved no easier for the foresters than managing the people had been for the missionaries. According to Langston (1995), the forests that the settlers found had already long been significantly altered and managed by the indigenous people. They had periodically burned the undergrowth, harvested the plants and animals, and allowed the beaver to alter the waterways. Driven by a highly variable climate, the system was in a continual state of flux.

The region of northeastern Oregon that includes the Blue Mountains never was a stable or pristine ecosystem. Frequent, light fires kept cycling the soil nutrients, providing grazing for game animals while keeping fuel loads low and preventing hot conflagrations that would favor the fire-dependent lodgepole pine. Once the indigenous system of periodic fires was lost, the traditional sequence of species replacements was disrupted, and the

tree composition changed. The beavers provided watered ponds and edges for aquatic vegetation, and the periodic climate changes moved the ranges of species into and out of areas that were limited by soil depth and exposure. Once the beavers were trapped out, the system of waterways changed drastically, altering plant and animal communities both near and far from their immediate borders.

The trees that grew after logging often were not the same species as had previously grown on the sites. What was thought to be a single region for management purposes was a complex of plateaus and ridges that rose above the sagebrush steppes and grasslands. South- and north-facing slopes had very different microclimates. Wind patterns differed between the northern and southern parts of the region, affecting the pattern of winter snows and their spring melting, and pockets of ancient volcanic ash created a mosaic of soil types. Soil moisture is a strongly limiting factor for plant life in the Blue Mountains, and the amount and frequency of flooding affects the downstream ecology. The ecologically complex area provided sufficient sustenance for different tree species, but only marginally so for many of them. Each species was stressed in different ways. As the climate changed over time, the species shifted their zones of occupation.

The problem that was beyond the comprehension of either settler or forester was that the "pristine" pine forests were actually in a perpetual state of change because environmental factors were variable and the human effects were also changing. Before those attempts to manage the forests, the Blue Mountains had long been a nexus of trade between the original inhabitants of the Plateau, Great Plains, and Pacific Coast. The dynamic ranges of tree species and the shifting composition of stands could be easily accommodated by adapting patterns of use and management. When the settlers eliminated the indigenous people, trapped the beaver to local extinction, and tried to suppress fire, they couldn't understand why the forest did not return to its presumed, ideal state. If left alone the forests changed in complex ways, and if foresters tried to manage the reproduction to favor commercially valuable species, less desirable species always seemed to invade.

The new Forest Service met with a complex biological system that was responding to factors that lay beyond their abilities to detect. The forest was driven by environmental factors that varied over short distances and over short periods of time, but were managed assuming an average uniformity and a fixed state of nature. Parks Service managers would not have fared better. Neither Service was prepared to deal with the system in transition.

Indeed, in the Yosemite Valley where John Muir saw the lush valley floor as a natural grazing ground for wildlife, the native people had also managed the vegetation with a burning system that provided plant and animal foods. Both the forests and the people that they met were assumed to be in an original state of nature, and neither their status nor the effects of the settlers on them were understood. What Muir found as wilderness in the Yosemite was actually a highly cultivated home landscape for the Ahwahneechee, who were removed from the Valley in 1851. Some years after their removal, a band member visited the valley and found that it had become brushy and "dirty" (Olwig 1996). The tribe had worked hard to make it a productive home and found it changed from its ideal condition. Similarly, in the Yellowstone Valley where the Nez Perce and other tribes of the plateau had been living, the removal of the indigenous people and the establishment of a park changed the composition and the dynamics of the forest. The continuing problems of fire management, which were so disastrous in 1988, indicate that we still have failed to adjust

to the unstable conditions of these forests. We still cannot restore an ideal and stable ecosystem, possibly because one may never have existed.

Regardless of whether the settlers of the Blue Mountains were motivated by visions of a pristine world, or by a management philosophy of taming the wilderness for use, their efforts came to grief when confronted with the complexity of real forests. The failure of the paradigms, however, did not lead to a re-examination of either side's belief. Rather, failure was taken as proof that the other side was wrong. When the Romantic and the Puritan views came into confrontation in this part of the New World, as they have to this day, each side finds comfort in the sure knowledge that the other side is wrong. The conflict, then as now, has never been resolved. From the perspective of those who found wilderness to be God's endowment to preserve in its pristine state, the rapacity of trappers and loggers and the intrusion of the Forest Service were to blame for the changed forests. From the perspective of those who considered God's endowment to be a resource to exploit, the forests had to be used and harvested in order to achieve a stable future, and to maintain forests that would otherwise be lost.

The concept of wilderness as God's endowment was the common foundation for both John Muir and Gifford Pinchot. The difference that the two symbolized, and that their followers continue to espouse, is whether that endowment is itself a goal to preserve, or is instead a resource to use and develop. Was God's intention most purely expressed in a past Golden Age? Or did God want to use human effort to fulfill the destiny of a future Golden Age? The differences carried strong moral messages for each side.

The deep differences between the dual visions of forests carry the same overtones of morality that were established in 18<sup>th</sup>- and 19<sup>th</sup>-century Europe and expressed in 19<sup>th</sup>-century America. As noted earlier, the U.S. Forest Service took its model of development directly from France and Germany, and its ethos from the traditions of the Enlightenment. The missionaries took their model from church doctrine, which saw forests and people as objects for conversion. The conflicts over forests took on specific political and religious overtones, with artistic and literary support. But the divergence of views of what forests should be were based on European thought. Branches of the same conflicts also existed in Asia, Africa, and Oceania. They were latent in Europe in previous centuries, though they did not involve the direct confrontation that has marked those of the last hundred years in North America. Europe had long since lost almost all of its original forest cover, and protagonists could not confront a recognizable "pristine" forest. They could, nevertheless, have a vision of forests that had existed at some time in the past, and could hold that vision in contrast with the unstable and chaotic times of industrialization. They could also see forests as raw materials and an impediment to agriculture.

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## CHAPTER 4. FORESTS IN THE AGE OF EMPIRE

THE CONTRASTING CONCEPTS of forests that were formed in Europe grew from two largely independent roots. The desire for a return to Eden was powerful enough in much of Europe to maintain a perpetual nostalgia for a past Golden Age. From that perspective, the appearance of what was a virgin wilderness in the New World became the foundation for the American wilderness movement. The concept that values were to be found in wild Nature did not take explicit form until long after European forests had been largely tamed. These were values that could not be readily realized in the Old World forests, and certainly not on the continental scale of the New. By the time the conflicting concepts of forests took solid form, there were no specific forests left in Europe in which opposing views could be set in physical opposition. The battles over the divisive perceptions of forests could be fought elsewhere.

In the centuries leading up to the confrontations in America, wood was the critical resource for economic development, equivalent in strategic importance to the role now played by mineral and energy resources. Wood was a primary resource of economic life, second in importance only to food. It was the primary domestic fuel, the choice for construction material, shipping and shipbuilding, and the energy source for smelting iron and other metals. Wood shortages were one of the driving forces behind the European Age of Exploration in the 16<sup>th</sup> through the 19<sup>th</sup> centuries. The need for wood preempted any other consideration of forests. The global reach of exploration and the critical needs for timber created the first global forestry issues.

### **Forests in the New World Colonies**

Before the 19<sup>th</sup> century, the forests of the New World were strongly affected by European interests. These interests, however, were dominated by intra-European political and economic forces, in many ways similar to the management of colonies in the 20<sup>th</sup> century. They had huge impacts in North America, where forest policies were driven by Old World concerns. The economic development of the North American colonies in the 17<sup>th</sup> century was partly generated by the European demand for their timber (Carroll 1973). New England Puritans in particular profited from the timber trade with Portugal for wine, and with England for manufactured goods. With large timbers of fine quality free for the taking without counterclaim from any international power, they could profit on trade with English merchants. The Puritans found, however, that large profits could be made within the Western Hemisphere by trade with the West Indies for the slaves, staves, and timber needed to construct their sugar and rum industries.

The trans-Atlantic sugar trade had already been initiated in the 14<sup>th</sup> century by Portuguese explorers, who colonized the Island of Madeira and established sugar cane plantations. While the world to the west was unknown and possibly terminated somewhere out there, Madeira was close enough and warm enough that the dangers of travel were worth the risk. It then became possible to think of establishing vineyards on cleared land, but wine made there could not be carried to Europe without damage. However, in the 15<sup>th</sup> century, a new type of wine – sweet Madeira was developed. It could be carried on long voyages. Soon both wine and sugar became important items of trade between the two worlds. Inevitably, land clearing and fuel harvesting for the mills and distilleries eradicated all of the island's forests in one century.

By this time, cross-Atlantic voyages were well established, and an international market for wood for fuel and construction was readily extended across the Atlantic. Wood supply from the West Indies was developed but, in the face of voracious demand, the forests were destructively overharvested. Explorations of the coast of South America revealed some new sources of timber, but the readily accessible supplies were soon exhausted and any richer sources involved excessively long lines of transportation. By the early 17<sup>th</sup> century, interest turned northward. Pilgrim merchants found that they could profitably trade their North American timber in Madeira. From there, rum and sugar could be taken to Africa, where slaves could be bought for the West Indies and America. It was a highly profitable, if immoral, trading loop which generated income at every port: timber in Madeira, rum in Africa, and slaves in America. Manufactured goods from England and timber from South America were also traded (Perlin 1993).

Another profitable trade loop existed between the West Indies and America. American traders could exchange timber for the West Indies' rum. The rum was exchanged for animal pelts trapped by American Indians. The pelts would then be traded for European manufactured goods. The American forests fueled profits all the way along multiple lines of trade. They were rich resources that helped to advance the European Age of Exploration, and later became critical for naval construction in the colonial wars for European conquest and expansion.

By the 18<sup>th</sup> century, conflicts arose in Europe over the natural resources of North America. The Hudson's Bay Company was seeking control not only of trade in the Americas but also of the routes for the China trade. Captain Cook's voyages to the Pacific took him up the west coast of America, where he found Douglas-fir trees in Nootka Sound that could supply him with masts made of a single tree stem. Tall masts that required no splicing gave an important advantage in strength and height for the weight carried. White pine in North America had previously been found that could also provide the navy with stems 40 inches diameter, over 120 feet in length, and sufficiently straight to similarly provide single stem masts, not available elsewhere. The British still preferred the Scots pine that used to be available from the Baltic States. They complained about the rate at which white pine masts rotted, but they came to accept the new material. When access to Baltic sources of Scots pine was threatened by the Dutch and the French, the British replaced their worn and rotted masts with North American pine or spruce. They sent crews into the forests to mark selected trees with a broad arrow as property of the Royal Navy (Applebaum 1993, Lind 1978, Drushka and Kunttinen 1997). Thus, through the 18<sup>th</sup> and into the early 19<sup>th</sup> century, American forests provided a critical supply of timber for the Royal Navy.

Prices for ship timber varied widely according to European events that determined supply and demand. Especially during the wars with Napoleon, when France cut off the Baltic routes, prices rose and cutting intensified in America. Soon after the American and French Revolutions, North American manufacturers drew more heavily on native supplies, and the European trade dwindled during the latter part of the 19<sup>th</sup> century (Aird 1985).

In eastern Canada, as a part of the British Empire, the fate of the forests was even more strongly driven by European wars and concerns than in the United States. In the late 18<sup>th</sup> century, when France ceded Canada to Great Britain, prices for its forest resources fluctuated with the access that Great Britain had to Baltic forests. The economic development of Canada depended on its physical environment since natural resources were the source of its wealth. It too bartered its furs for rum and brandy from the West Indies.

When dealing with the indigenous people, traders often offered a watered down wine. They offered a diluted brandy mix when something stronger was required. By 1670, on Prince Edward Island, however, they were using full strength brandy in trade with the Mic-Mac (Harvey 1955). As agricultural settlements made incursions into the fully wooded island, they felled and burned the trees not used for trade. Repeatedly burning the logs and stems provided some fertility for grain and forage crops. But crops were poor and even though fish were abundant they were slow to develop as an economic factor.

The forests provided an important export crop. The white pines, which grew up to 5 feet in diameter, were so tall that a single stem could form a main spar. However, such trees were sparsely distributed and other timber products provided some income through the 1840's (Stewart 1967). Ship building as an earner of foreign exchange peaked in the mid-1860's. The price of wood declined when iron ships came into dominance (Rankin 1965). Nevertheless, trading of timber products continued for some time, and timber accounted for nearly one-quarter of all of the exports of Prince Edward Island in 1891. By 1900, however, it accounted for less than 1% and forests then covered only 30% of the Island's land area. The fisheries that had developed during the latter half of the century went through a similar boom and bust cycle, and the Island had to return to a low level of economic productivity based on agriculture. With the passage of another half-century, however, the forests recovered to half of the land area, albeit with less valuable species and smaller trees. In the 1990's, with a revival of prices in the pulp and paper market, another cycle of cutting ensued. This time, the cutting was protested.

## European Forests

The declining condition of forests in Europe since the 16<sup>th</sup> century was both a cause and an effect of the great European economic expansion. Increases in manufacturing demanded more wood for construction and for fuel. Iron and glass smelting consumed charcoal, and mineral extraction and new transportation technologies required timber. As populations grew, harvesting outgrew the capacity of local farms and woodlots to produce wood.

By the early 19<sup>th</sup> century, the greatly expanded uses of wood had already decimated most of the native forests in Europe. To meet European demands, timber was extracted from wherever transportation capacities allowed, in the Americas, Asia, and Africa. Despite having very little of its native forests left, England could still support a huge navy and iron production on the basis of its global hegemony. Its relatively secure industrial dominance was based on being the first to industrialize in the preceding century, and until 1830 it could prevent the export of its technologies. But France and then some of the German States developed their own industrial bases, and competition for a new economic order was quickly established. The accumulation of power and wealth, through industrial organization and technological innovation, was turned to securing the resources necessary to maintain Britain's dominance. The rising dominance of the industrializing world made all the world's resources available and held the promise of a Golden Age of technology.

Empire grew out of a Western European economic, political, and military dominance that was based on controlling critical resources, including wood. To a degree not previously achieved, these empires could smelt huge amounts of iron and steel, construct long lines of transportation, and restrict access of competing powers. The intellectual foundation for that dominance lay in the scientific positivism of the Enlightenment. The Enlightenment was initially a French intellectual movement that became pan-European in the 17<sup>th</sup>

and 18<sup>th</sup> centuries. The movement saw science and mathematics as the paths to human liberation. Physical evidence and logic could reveal the hidden mechanisms that operated the world. Voltaire led the charge against ecclesiastical authority, and the successes of Descartes, Bacon, and Newton gave sufficient proof of the power of reason and pragmatism. Science and technology revealed much about the world as God had made it. In the scientific world, the evolutionary ideas of Darwin were yet to come, and the concept of a world with purpose and design was still the paradigm. By the 19<sup>th</sup> century, scientifically derived knowledge was the only kind of knowledge accepted by the scientific positivists, led by August Comte.

Among the consequences of Enlightenment thought was that there was an inexorable order to the world that was manifest in human societies as well as in physical objects. Belief in order was no longer based on ecclesiastical authority, but on presumed laws of social development. It was concluded that social hierarchies could emerge through innate intelligence. Herbert Spencer later concluded that social institutions progress by natural selection and that the emerging order of industrial power was a result of an evolutionary law. This form of social Darwinism was more a development from Spencer than from Darwin (Lewontin et al. 1984). It allowed the colonial powers to justify the use of timber resources that lay in their colonies for their benefit. The idea of using colonial forests for timber to save the remaining English forests was explicitly stated by John Evelyn in 1664. It was assumed that there was a natural hierarchy of rights to resource use.

In the years after the American and French revolutions, democracies arose and political and social institutions generally declined. These changes were parts of profound economic and social changes. Forests that had been governed by decrees that largely protected Royal hunting rights were now evaluated by different factors. The industrial revolution led to accelerating changes in land ownership. The widely adopted factory system of production vastly increased forest cutting for fuel, iron and glass manufacture, and agricultural land clearance. Scientific positivism emerged and supported the technological developments of the era for the manufacture of fabrics and metals. With a growing population and an expanding industrial production ever since the 17<sup>th</sup> century, increased urbanization and pollution made the loss of forest land evident to urban and rural populations alike.

The economic expansion throughout Europe was also accompanied by broad social disruptions. As the industrial system overtook agriculture in political and economic power, social progress was uneven and land-use patterns were disrupted. The demand for cropland continued to grow, and with the demand for industrial wood, the decline of forest land was dramatic. The crop failures in the 1840's and the social disruptions of urbanization led to widespread famines and riots, and to a full-blown Peasant's Revolution of 1848 in Germany and Austria. Though this revolution soon collapsed and a counter-revolution of sorts set in, the forces at work would lead to the rise of Marxism and other social movements.

Despite these disruptions, a period of general economic prosperity ensued, and Germany, though it was still divided, emerged with an industrial base and a commitment to economic development. Despite its problems, the industrial society became the epitome of modernity for all countries in Europe, Asia, and in the Americas, and uncultivated land became associated with an uncivilized society. From the late 18<sup>th</sup> century through the 19<sup>th</sup>

century, further industrialization and the expansion of agricultural and pastoral land shrank forests throughout Europe.

The loss of domestic forests led to increased pressure for securing foreign resources, and to attempts to increase the productivity of the remaining domestic forest lands. As an increasingly scarce resource, wood became an object of economic importance, and a scientific and economic approach to forestry offered some domestic relief for wood supplies. After the 'Thirty Years' War, 17<sup>th</sup> century industrialization rapidly accelerated what had been a gradual decline of forests. With both agricultural incursions and the explosive increase in industrial demand, the supply of wood in Europe became a critical national and international issue. Shipping and the construction of navies for defending that commercial enterprise assumed central economic importance, and timber for trade as well as timber for ship building became a critical commodity.

By the end of the 18<sup>th</sup> century, Germany and France had lost over 70% of their forests. The British Isles and Denmark lost over 95%. The total elimination of the forests of England was only averted by importing timber, first from other parts of the British Isles and then from colonies. When supplies from Ireland and England grew short, England and France competed for the forests in the Baltic States, then in the Americas, and next in Africa and Asia.

Germany in the early 18<sup>th</sup> century was not a united country and, unlike the colonizing powers of the time, it had limited access to foreign sources of wood except in the Baltic States. There, it had to compete with other countries for access to forests. While England and France, as well as Germany, had advocates for domestic forest protection in the 17<sup>th</sup> century, the English and French largely came from a history dominated by efforts to protect Royal forests by regulated exclusions.

In France in the late 17<sup>th</sup> and early 18<sup>th</sup> centuries, Louis XIV was consolidating the economic power of France at home and in North America. It was the age that gave birth to the Enlightenment. Voltaire could use the term "enlightened" because reason and regulation were brought into governmental affairs. The main executor of the King's power was his secretary, Jean Baptiste Colbert, who organized the economy and promulgated the ordinance of 1669 on Eaux et Forêts (water and forests). To bring order to the general finances of France, he established a tradition of forest regulation that led to the establishment of a French Forest Service. Within that system, training for foresters was established in 1827 in the forestry faculty in Nancy that was later visited by Pinchot and other American foresters.

In England, John Evelyn advocated the study and protection of forests in 1662 and had some effect on The Royal Society, and ultimately on forestry legislation. However, interest waned when prices for wood rose and fell according to needs and supply. By the 18<sup>th</sup> century, both England and France relied more on iron and coal for construction and fuel, and on foreign sources to compensate for any local shortages of wood. With the invention of iron-making technologies using coal in the late 18<sup>th</sup> century and the use of iron ships in the 19<sup>th</sup> century, there was a collapse of wood markets in England. By 1862, the collapse was so severe that only a scientific interest in forest botany sustained any studies in forestry in England. A 20-year hiatus in education and training ensued, just when that interest in America was emerging. While botanical studies continued to occupy many British scientists, forestry education did not further develop in the United Kingdom until

after interest was revived by the trade in tropical timbers from its colonies. In fact, the development of the Indian forestry tradition was dependent on the same German botanist turned forester, Dietrich Brandis, who had so strongly affected Gifford Pinchot in his visit to the continent.

In contrast to the fits and starts of interest in domestic forests in England, Germany had a continuous history of interest in forestry that stemmed from its history of land ownership and its lack of foreign sources of wood. By the 16<sup>th</sup> century all of the land in what is now united Germany was claimed in either private or royal and public ownership. There were no longer any wild or open forest lands for free exploitation, and regulations of one sort or another were extant. After that time, the land base was recognized as a limited resource that had to be consciously allocated. Following the Thirty Years' War, which devastated the German States, the French ideas of a merchantable forest gained credibility in Germany. Just as agricultural land or the crops that grew on them could be considered as capital, forest land or the trees could be considered as capital on which a return could be expected.

With the growing industrial needs for iron and a wood deficit, more rapid tree growth on forested land became an objective of land management. Since all land was claimed, however, and the state could exercise only limited control over private lands, the state forests came under intensive management. There, the goal was set to double wood production on a sustainable basis (Ernst 1998). Armed with the example of the French ordinances designed by Colbert, von Carlowitz introduced silvicultural economics to Germany in 1713 to guide planting, tending, and harvesting trees. He developed ideas for economic accounting for forest growth and investments, and for establishing permanent forests. Unlike in America, the alternative of simply liquidating the forest capital by cutting the trees and abandoning the land was not feasible in Germany.

In the spirit of the Enlightenment, there was some scientific study of tree growth and adaptation by Henry-Louis Duhamel du Monceau in 1755 in France. Understanding the patterns and components of tree growth improved control and predictability of managed forests. Thus, foundations for scientific forestry were started by the mid-18<sup>th</sup> century. Forest planning went well beyond traditional interest in hunting reserves, grazing, and fuel. It focused on supplying wood in an industrial economy. Different species were chosen for various types of management. On this basis, a series of German forest scientists, including Georg Hartig, Johann Cotta, and Karl Gayer, ultimately developed the idea of "dauerwald" or perpetual-yield forests. While many differences among German systems of treating forests developed, Germans dominated forestry throughout Europe and North America from then until the beginning of the 20<sup>th</sup> century.

On that foundation, the von Langen brothers and Reventlow introduced analytical forestry into Denmark (Reventlow 1879). Though not directly trained in forestry, Brandis took analytical forestry to England and India. His work later influenced the concepts of forestry in other British colonies. One of his former students, William Schlich, opened a forestry school in England and lectured at the Forestry Institute at Oxford. Schlich also influenced Bernhard Fernow, who had used Gayer's texts for his own studies. The foundation for American forestry education through universities and schools of forestry was laid by Fernow, Carl Alwin Schenk, and Gifford Pinchot, all of whose ideas were firmly based on German concepts and whose training was almost exclusively of German origin.

It is not surprising that North American forestry became largely a product of German theory and practices of the 18<sup>th</sup> and 19<sup>th</sup> centuries. But in Germany, conflicts between conservation and use did not create the same kinds of confrontations that developed in North America. There were, however, conflicts in Germany between the "scientific" and the "romantic" views of Nature then and through the 20<sup>th</sup> century. German romanticism was certainly alive and active since the 18<sup>th</sup> century, but seemed not to have affected forestry until the end of the 19<sup>th</sup> century and into the 20<sup>th</sup>. By that time, the post-Enlightenment scientific influence of German forestry had exerted its influence on North American and world forestry, and the issues of conservation had been joined in North American terms. In the 20<sup>th</sup> century, the issues of conservation in Germany were not seriously addressed until after World War I, when those issues became part of the political conflict between the Social Democrats and the Communists. The competing themes of forests as a natural source of reverence versus a resource of economic value surfaced in Germany. While the battles were joined in North America, the generating forces existed in Germany and in the rest of Europe.

Forestry in Europe originated in attempts to sustain domestic forests. Efforts there served as the model for the United States and other countries. The conversion of wasteland to cultivated and productive forests was an outgrowth of agricultural development that had religious sanction and royal precedent. But the economic forces that created the higher demands for wood and the pressures for industrial logging also stimulated demands for a more natural way of life. Countervailing pressures arose against the evils of impersonal industrialization, and for maintaining a vision of a past Golden Age. The dichotomy seldom resulted in the kinds of confrontations seen in North America because most of the original types of European forests were long gone by the time the conflicts were rationalized. But the seeds that had developed in Europe flowered into the conflicts in North America.

### **The Romantic Reaction**

In spite of having a well-regulated economy and a set land ownership pattern, conflicts still erupted. In 19<sup>th</sup> century Germany, disputes arose over changes in uses of forest land, particularly state and royal land. Especially when the forests were put under production goals, greater and more stringent restrictions were placed on peasant access to forests for fuel gathering, pasturage, and hog foraging. Along with population movement and the growth of an urban working class, the instabilities of the industrial revolution impinged on peasant welfare. The Peasant's Revolt of 1848 was the result. To the peasants, their burdens were seen as a continuation of the medieval tyranny of the landlords. Their welfare was being sacrificed for the profit of the aristocrats who put game and timber values before peasant welfare (Riehl 1854). While only a minority directly supported the opposition to commercial forestry, there was a broad and strong reaction to the excesses of the Enlightenment. The seeds of revolt against the Enlightenment were sown by its success in mechanizing the world. The peasants were periodically threatened, and the forests continued to decline.

The Industrial Revolution and the European expansion were accompanied by huge social and political changes. After the French and American Revolutions, and the establishment of the principles of liberty and equality, authoritarianism was broadly rejected and individual rights and freedoms in political and religious matters took root. The rise of liberal democracies was still to come, but at the beginning of the 19<sup>th</sup> century, the power of individual rights over state and church authorities was beginning to be exercised (Fuku-

yama 1992). For many intellectuals, the strict rationalism of the Enlightenment was a sterile barrier to knowledge, and strict Calvinism was a barrier to the direct knowledge of God. The harsh conditions of urban life and the growth of a laboring class led to a longing for a more bucolic life in which people might have more power over their own destinies. "Naturalism" rose out of the desire for a more "natural" way of life, and the romantic philosophers, most notably Immanuel Kant, considered sources of knowledge beyond strict rationalism. For many, if not most people, the pains of industrialization were not assuaged by the greater economic and military power that followed. Rather, the dehumanizing effects of industrialization led to a rise in nostalgia for natural landscapes, and for a shift in political and religious movements emphasizing individual autonomy. In the growing awareness of environments and of a lost "natural" way of life, forest heritage played a large role in visions of what had been lost. Thus, the forest as a metaphor for a natural way of life became strongly established in Europe. But it fulfills much the same role in current society. Conflicts over forests have assumed meanings in terms of conflicts over authoritarianism and the dehumanizing effects of industrial globalization.

At the end of the Enlightenment, support for the validity of Nature over industrialization was provided by the concept that Nature preceded the human intellect, and that human knowledge depended on the Nature humans could know. Jean-Jacques Rousseau emphasized that knowledge was derived from Nature and that the common person's innate knowledge was valid. Immanuel Kant took this notion into Germany, and combined it with rationalism. He criticized pure reason and asserted the existence of prior knowledge that was available to common intelligence. It was the support that Kant gave to individualism, and to the ideas of transcendentalism, that Emerson found so helpful in America. Kant also gave impetus to the romanticism of Goethe, who popularized the virtues of Germany's Nature, which he believed was being sacrificed to industrial progress. His essays evoked visions of idyllic forests and nostalgia for more idyllic times (Vogt 1996). There was a longing for stability that may have existed in memories of past ages. For a few, the new explorations of scientist-philosophers such as Alexander von Humboldt gave a hint that a Golden Age of primeval life could still exist in foreign lands. The Brothers Grimm also began a new discipline of collecting folk tales that often took place in a forest background. There were strong references to the forest heritage of the German "volk" that encouraged a national pride and evoked a historical connection of common people with their land and forests. (Riehl 1854). As they developed later in the 20<sup>th</sup> century, these aspects of the forest metaphor provided strong support for German protests against the kinds of industrial logging that are seen to destroy forest idylls both at home and abroad.

The intellectual conflicts that developed between the Enlightenment and Romantic views of human development were strongly associated with the loss of forests and the evils of the industrial system. However, through the 19<sup>th</sup> century, the German Romantics had little direct influence on forestry or the forest sciences. Influence would await an ecological perspective introduced by Gayser. The native forests of historic pride were largely historic constructions that could not provide grounds for any great public involvement, or confront the economic and scientific view of forests. Nevertheless, both the romantic and the economic views of forests were deeply embedded in European culture.

For all of their differences, both sides of the philosophical dichotomy about forests were based on a common but unexamined assumption that the forests were in a condition that revealed God's intention. The inherent condition of Nature was assumed to be a

stable state that was God's endowment for humans to either leave alone or to develop into a productive garden. While they disagreed about how forests should be shaped in the future, they shared a common understanding of the endowment. Before massive logging had devastated them, the forests had been in the stable condition that God had intended.

As found by Europeans, the forests of the New World were presumed to be in the same pristine state that had existed for eons. This assumption was carried throughout the western world. It is one of the foundations for modern conservation movements. Based on this assumption, if an ecosystem has been destroyed or severely perturbed, it follows that large efforts may go into "restoring" what has been lost. Perturbations are deviations from an ideal condition and we would seek to restore the prior state. To maintain forest productivity, we should try to mimic "natural processes" — to maintain a condition of "natural" productivity. On both sides of the dichotomy, a stable condition is assumed to have existed and to be the goal of human endeavor. In 19<sup>th</sup> century America as in Europe, the common assumption about the nature of Nature was that there was a fixed order to the universe.

### **European Art and Philosophy**

The Enlightenment that had rejected Biblical authority was exploring the elements, the stars, and the planets by physical means for evidence of orderly laws of motion. The progeny of the Enlightenment in the 19<sup>th</sup> century began the exploration of an evolutionary order of plants and animals after Darwin, by laws of inheritance. Throughout Europe in the early 19<sup>th</sup> century, there was a common culture that idealized the Nature of forests. Ancient trees were considered to be silent and passive denizens of a virgin forest that was being degraded by the presence of humans. Forest degradation over the previous centuries now threatened to repeat itself in the New World. In England, where Cole was born, Constable's and Turner's idealized mythic landscapes were inspirations for the Hudson River School. In Germany, Caspar David Friedrich led a school of primitivism that also idealized the forest. He, like Cole, believed that unspoiled Nature is the freshly uttered word of God. This vision was brought to the New World. The explorations of Alexander von Humboldt in the New World inspired both European and American scientists and artists to understand a world that was not previously accessible. von Humboldt, as well as Goethe, were inspirations for Emerson, Cole, and the European romantics. Their artistic vision captured and gave form to concepts that involved the history of nations, the nature of humans, and the human place in the universe.

The early 19<sup>th</sup> century also witnessed a culmination of landscape painting in Europe that had evolved over five centuries and had reflected popular views of forests. From the Middle Ages until the Renaissance, all painting was of religious figures for decorative purposes and for religious instruction of the illiterate. But starting with Giotto and Lippi at the beginning of the 14<sup>th</sup> century, a realistic style for frescoes and the use of oils emerged. Storytelling became a more significant function for reaching a popular audience. The landscape became a background first for portraits of saints or burghers, and for religious or mythic events. Through the 14<sup>th</sup> and 15<sup>th</sup> centuries, the forest was a pastoral setting typified in the "Alba Madonna" of Raphael. Prominent artists like Leonardo da Vinci often included landscapes in the background of portraits, as in the famous "Mona Lisa". Forests were often represented as cultivated gardens, which fit with the allegories of Eden as a lush garden. In this manner in the early 16<sup>th</sup> century, Cranach the Elder pictured Adam and Eve surrounded by lush vegetation in a dense but hygienic forest.

By the 17<sup>th</sup> century, a new concept of forests began to appear. In Bellini's "The Feast of the Gods," executed in 1514, the forest was as untamed as were the gods. Both were given equal prominence in the painting. By mid-century, Raphael allowed the forest to dominate the painting of "John the Baptist in the Wilderness" and Breugel the Elder featured a forest landscape that nearly dominated the painting of "The Temptation of Saint Anthony." Through the early 18<sup>th</sup> century, however, forests were depicted adjacent to thoroughly tamed pastoral landscapes or as allegorical fantasies of gentle animals. It was the development of "open air" painting in the Netherlands, and the rediscovery of wilderness in the period of global exploration that liberated artists to focus on images of a primeval Nature.

The countryside of the Netherlands provided real models for landscape painting and began to affect French artists. Nicolas Poussin could introduce earthy images of mythical figures and could place them in untended forests, often with themes that featured wild fauns and satyrs romping in the wilderness. The association of forests with wild men and women was already established in literature and theater, but was given widely available visual expression in paintings. The subject matter remained traditionally religious or allegorical, but a different view of forests was introduced. After the 17<sup>th</sup> century, forests were portrayed realistically and not always only along the margins of bucolic pastures. But if forests could now be studied by artists and brought to the attention of a broad public, they told two stories. On the one hand, they continued to be the playground of fantasies of a Golden Age. On the other hand, the forest wilderness could be the dark and threatening hiding places for evil and dangerous spirits. Wild behavior and Bacchanalia were associated with untamed forests. Civilization was implicitly needed to control such behavior through pastoral activities that tamed the wildness and made it productive. Forests were the backgrounds for a human drama in which wild nature and uninhibited wild behavior were associated; both could be tamed: one physically, and the other morally.

Partly as a product of romanticism and a move to "open air" painting in the late 18<sup>th</sup> and early 19<sup>th</sup> centuries, Naturalism and Realism depicted untended forests as benign and pleasant. With the leadership of Théodore Rousseau and Jean-Francois Millet, the Barbizon school of landscape painting grew. Adherents avoided idealization of an imagined Nature. Instead, they emphasized the nobility of common people and of living close to Nature. With the impetus of the 1848 Revolution and the rise of Realism, the forest itself became a source of beauty and meaning — a symbol for redemption of the human spirit from the constrictions of a rigidly hierarchical society. This movement was contemporaneous with the Hudson River School of American painting, with Courbet and Corot in France, Caspar David Friedrich in Germany, and Constable and Turner in England.

Emanuel Swedenborg in Sweden and Jean-Jacques Rousseau in France were philosophical sources of the revolt against neo-classical thought. With the grip of the Enlightenment as advanced by Voltaire in 18<sup>th</sup> century France, Rousseau thought that "Everything is perfect coming from the hands of the Creator; everything degenerates in the hands of man" (Masters and Kelly 1992). Rousseau's thoughts on nature and wilderness were echoed by Emerson and Muir. Rousseau also sought escape from the pressures of human society and

...liked to look for some wild spot in the forest, somewhere deserted where nothing showed the hand of men or spoke of servitude or domination, some sanctuary which I

could think I was the first person to reach, where no annoying third person would come between nature and myself.

(Masters and Kelly 1995)

To Rousseau, the problem for humans was society's corrupting influence on initial goodness. He wrote,

The first men were very ignorant. How would anyone dare to say they were corrupt in times when the sources of corruption were not yet open? Before these horrible words of 'yours' and 'mine' were invented, before there was that cruel and brutal kind of men called masters, and that other kind of men, rascals and liars called slaves; before there were men abominable enough to dare to have an excess while other men were dying of hunger; before a mutual dependence had forced then all to become deceitful, jealous, and treacherous ...

(Rousseau's last reply to M. Bordes, Masters and Kelly 1992)

## **Enlightenment and America**

When viewing America, the European Romantics hoped that it would be the earthly paradise they had lost. Even as early as the late 17<sup>th</sup> century, there was strong support for the view that wilderness before human involvement was good in itself (Nash 1967). It may often have been pictured as a tamed countryside, but Nature in itself, separated from civilization, could be bountiful. At the same time, however, Europeans could also project an image of a wilderness that was full of savages and wild animals. It could embody an unruliness that gave license to behave in a bestial manner, and their experience from confronting Nature in America was with an environment that was wild and hostile rather than bucolic. The Pilgrim settlers from the English perspective, considered that "... In a country full of civilized inhabitants, timber must not be suffered to grow. It must give way to fields and pastures, which are of more immediate use and concern to life." They found in America, a "hideous and desolate wilderness ... the whole country full of woods and thickets" (Thirgood 1981). Their duty was to clear it and within two centuries of their occupation, they had succeeded in removing seven-eighths of the original forest cover.

What was transplanted to America was, first and most strongly, the Enlightenment view of society and of forests. By the late 18<sup>th</sup> and early 19<sup>th</sup> centuries, the concept of progress was united with the need to civilize the wild in nature and in human behavior, and to conquer and occupy the land. Only later in the 19<sup>th</sup> century did the Romantic reaction cross the ocean. The mixture of conflicting views of the forest that continued in Europe and America through the 19<sup>th</sup> and 20<sup>th</sup> centuries had strong philosophical, artistic, and literary foundations, and was deeply imbedded in the culture on both continents. The American population was nearly doubling every 20 years, and a huge European immigration made the country as much European as native-born.

The 18<sup>th</sup> and 19<sup>th</sup> century European views of forests were extended to the indigenous inhabitants who occupied and were "discovered" in those foreign lands. Pilgrims considered the indigenous people to be as uninformed of basic truths, which of course were to be found in the Bible, as wild animals. Indigenous people were simply parts of the savage

landscape (Keiser 1933). They were the passive participants in a morality play that required the converted to tame an ancient wilderness into a pastoral countryside. The indigenous people were part of Nature that had to ultimately lose out to progress. Part of the American myth, embodied in "The Last of the Mohicans" (Cooper 1826), which at first accepted the European ambivalence about the Indian, evolved from an arm's-length appreciation of their "unique gifts" to finding them to be an obstacle to God's will and hence "savages." By 1850, the predominant view was one of the savage (Carr 1996). For the pastoral view of Eden, the indigenous people were irrelevant, and for the progressives, they were a hindrance.

While the "uninhabited" lands were of God's making, the human endeavor was to form them into productive fields and gardens. They could not discern that the New World of lands had been long occupied, that the landscape had been modified by the inhabitants, or that knowledgeable societies already existed there. In the period of the great European explorations, invasive explorers could occupy land in the name of a King or Queen because the people in those lands were thought of as a part of the unoccupied landscape. Explorers could occupy and claim ownership because no one else who counted was there. The indigenous people were not considered capable of appropriately using the land, or even of being aware of their participation in creating the landscape. Their agriculture, horticulture, and uses of fire to control the vegetation were not observed, or if seen, were not understood. The people were seen as a part of the unconscious landscape - as passive in its formation as were the trees. They were primitive savages, or at best, were considered to be "noble savages" through the 19<sup>th</sup> and early 20<sup>th</sup> centuries (Barker and Sabin 1995). To the classical mind of the Enlightenment, the well ordered universe consisted of hierarchies of beings, with plants and animals serving the needs of humans. The hierarchy of humans and societies also fit into the classical concepts of God's order. It was clear to them that humans stood at the top, Europeans were at the top of the human hierarchy, and men of course, were above women.

### **The Impact on Appalachia**

The Cherokee civilization in the southern Appalachians was in the last stages of collapse by the late 1830's. Settlements that had been established in drainage basins centuries before were being abandoned, as was their traditional system of agriculture and horticulture mixed with hunting and gathering. Before the Cherokee, the late woodland culture had been more dispersed, and a single-family group might have occupied a single valley such as that of the North Turkey Creek. They, as well as the Cherokee who migrated from the Mississippian cultures to the west, fully used the valley from the flats around the creek bottom up the ridges to the peaks of the mountains. But the Cherokee brought a more intensive agricultural and horticultural system — and a more complex social organization. They continued to use the forest edges and mountain ridges for much of their food supply, but they also concentrated activities around areas of cultivation. The towns they established contained as many as a hundred families living in separate houses. Around the towns, various agricultural and horticultural crops were cultivated in suitable sites, and hunting and gathering extended their area of active use throughout whole river basins. When necessary, however, the towns could be moved, and land-use patterns could be kept flexible to respond to biological or societal pressures. Among the several "nations" that had developed before European invasion, the Cherokee were one of the most sophisticated, and were evolving unique land-use patterns.

Populations rose and fell, but throughout the Appalachian Summit region there was continual activity and use of the local drainages such as North Turkey Creek. This creek drains one of the narrow valleys that typically cut across the southwest-to-northeast folded hills of the Smoky, Black, and Blue Ridge Mountains. On the flanks of the valley, rocky ridges alternate with poplar coves that hold deeper soils, and where North and South Turkey Creeks join the French Broad River, a defensible riverside fortress could anchor the settlement and use of the whole valley. Unlike the broader expanses of flat land that lie to the east in the Piedmont, these hills naturally subdivide groups into independent basins.

In later years European settlers would also find themselves segregated into small, relatively isolated enclaves in these coves where a rustic, backwoods culture would continue to the middle of the 20<sup>th</sup> century. The settlers first coveted the same bottomlands that the Cherokee farmed for their agriculture. In the late 20<sup>th</sup> century, however, social preferences changed and the uplands and ridges are now preferred for expensive homes. The sites have been undergoing perpetual change, not only in response to environmental forces, but also in response to social factors from ancient days to the present.

In the bottoms, the soils are fertile and easily worked. The Cherokee grew three kinds of maize, eight species of beans, and 26 varieties of squash, along with sunflowers and tobacco. Along the hills of the lower elevations, amaranth could be gathered, 15 species of berry shrubs provided ample harvests and three species of grapes could be gathered from vines that climbed into the trees. Among the trees, ten oak species, three hickories, and walnut yielded nuts in the fall. Along the edges of the deeper forest, deer, bear, elk, and turkey were plentiful. In all, over 800 species of plants and animals were used, and all parts of the valleys and hills were included in their home environment. The plant and animal diversity in these hills is among the highest in North America, and in recent studies sponsored by the U.S. Forest Service, I found a high level of diversity among plots that were distributed over several thousand feet, and different drainage basins.

Burning and clearing where feasible and maintaining hunting and gathering trails made the entire valley a part of the Cherokee's relatively stable management system. Humans and non-humans shared a complex world of ecological zones that satisfied different needs. Humans adapted to a diversity of ecological conditions. There would have been times and places where over-harvesting led to local displacements, but the food array seems to have been relatively stable over the centuries preceding European contact. Bartering with adjacent groups and tribes provided goods not readily available in the hills. The Cherokee food and resource supply system was rich in redundancy and used the available variation within and between different biological zones. It was conceptually based on a relationship between humans and the non-human world.

The influence of Europeans was not a sudden single event. After a first encounter with Hernando de Soto in 1540, Europeans were curiosities who provided trading opportunities. Along the Coastal Plains and into the Piedmont, trading with both the French and English supplemented the usual intertribal barter. By 1670, coastal settlers in Virginia had some contact with the Cherokee. In the following decades, a trade with neighboring tribes increased, though the Cherokee remained relatively isolated from a general Southeast trading system. However, regular trade routes were gradually built up, and by the beginning of the 18<sup>th</sup> century, routes from Virginia and Charleston were regularly used. Motivating the interest in the Cherokee region was the huge profit that could be made from the deerskin and beaver pelts that the Cherokee exchanged for a few metal tools, some cloth, and guns.

For the Cherokee, the change from a barter system to a commodity system in which there was an apparently unlimited demand for their furs was more disruptive than could be anticipated. The concept of private property and land tenure was introduced, and the resource balance was irreparably disrupted. The addition of rum to the trade mix further debilitated the social order, and widespread over-hunting resulted in marked declines in deer populations. The horse and gun allowed a single hunter to garner much more game over a wider range than was previously possible. As a result, individual hunting for profit displaced subsistence hunting for the social group. The association between hunter and hunted that had been an important part of the Cherokee system of belief was also lost.

By the middle of the 18<sup>th</sup> century, the cow, pig, and horse were slowly adapted for use, despite the difficulties that these animals posed for those who had to tend them. They required feed, shelter, and protection from predators that could only be provided in a system of sedentary agriculture. From the diaries of William Bartram (1791), it is apparent that in the late 18<sup>th</sup> century, the Cherokee had adopted many aspects of European agriculture. A decline in traditional settlements ensued.

Eventually, the Cherokee became allied with the English in their wars against the Spanish, French, and their Creek allies. In the many complications of alliances and warfare among various tribes and among the European nations, the Cherokee ultimately suffered population declines. Whole settlements were destroyed by enemy action in warfare. Finally, diseases took their well-known toll.

By the end of the 18<sup>th</sup> century, little was left of the traditional structure of Cherokee society. The remaining Cherokee were deprived of their traditional abundance of game and sought out arable land for individual cultivation on private plots. The adjacent woodlands then became only sources of forage that were often overgrazed and degraded by pigs, cattle, and horses. The multiple and complex uses of forests and forest edges was foregone in favor of the simpler agricultural system. But even these people were eventually removed from their farms when their land was sought by white farmers.

The discovery of rich deposits of gold on Cherokee land, enough to make North Carolina the leading gold producing state in the 1830's, sealed their doom. In 1838 President Andrew Jackson forced all that could be captured out of the Appalachians and onto the infamous "Trail of Tears" to Oklahoma. This act was part of the American westward expansion that just two years earlier had carried Narcissa Williams from New York to Oregon. Today, there are very few Cherokees in the Southern Appalachians outside of the Indian Reserve.

The American perspective on the Cherokee was that they were a part of nature. Contemporaneously with Rousseau, William Bartram spoke admiringly of their "divine simplicity" and of their "friendship without fallacy or guile, hospitality disinterested, naive, undefiled, unmodified by artificial refinement" (1791). He attributed their morality to innate properties and not to culture, as opposed to Europeans. He assumed that there was no moral instruction in Cherokee society, and expected that any such indigenous people would wish to emulate the European agricultural and industrial model. The Cherokee were also understood to have no conscious effect on the landscape, and it was assumed that the land could be made productive with European crops, animals, and cultivation techniques. This, in fact, did happen after the destruction of Cherokee settlements and support

system. But even so, the American settlers had the Cherokee removed from their home territory.

European views were also imposed on the forests. Where once a variety of different forest margins were used, a simplified dichotomy of farm and forest was forced. The more complex, alternative way of living with forests was largely ignored in the contention between those who viewed forests as a wilderness goal and those who saw forests as an economic resource to liquidate. While the American experience had unique features colored by the political and social environment of the developing nation, it was based on positions developed in Europe in prior centuries. It is to those influences that we now look to fathom the nature and depth of our conflicting views of forests.

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## CHAPTER 5. EUROPEAN ROOTS

IT IS DIFFICULT to overestimate the global impact of the European Enlightenment on our current views of forests and conflicts around forests. The dichotomy of views that continues to dictate the terms of contention over forests was formed by contrasting concepts of Nature that were sharply defined in modern terms during the 18<sup>th</sup> and 19<sup>th</sup> centuries in Europe. Those views were then projected onto other forests around the world. Scientific advances during those years established the practicality of Modernism, and research paradigms in genetics, ecology, and forestry continue to support what the Enlightenment began. The Romantic contrast was also given form during that period and developed into the various western wilderness movements.

Impacts on our modern understanding of the conflicting notions of forests were also profound, because the bases for conflict did not spontaneously arise. The disagreement was already fundamental to western thinking and would be made more rational and arguable in those years. The precipitous increase in forest consumption that brought public attention to forestry issues was due to new uses of timber and increased accessibility of forests to new industrial demands. And because colonial resources became accessible, the intellectual conflicts over increased destruction or conservation could be eased at home. Europeans had the luxury of expanding their resource base to Africa, Asia, Oceania, and the Americas. At the same time, they brought their dichotomous views to their colonies. But, as reviewed in the last chapter, the forests that gave rise to the Enlightenment views of Nature were not in a stable or virginal state. The European forests that emerged from the Age of Reason and into the Enlightenment were the battered remnants of forests that endured near-total destruction. They were not the wild forests envisioned by Romanticists, though they could still inspire images of past Golden Ages and some hoped that they could be reconstructed as an economic resource.

In the millennium before the 19<sup>th</sup> century, the relationship between humans and forests could be characterized more like a war waged by humans on forests than by any other analogy. Centuries of forest exploitation had reduced the area of European forests by two-thirds. By the end of the 19<sup>th</sup> century, the loss had become sufficiently apparent that concepts for sustaining European forests developed. Since Europe emerged from the Dark Ages, various twists and turns of national economies and politics have both helped and hurt forests. Through it all, there have been persistent conflicts that have had impacts on modern developments. The Renaissance gave its color to forest conflicts and conditioned the world for continuous patterns of invasion and romance.

### **Renaissance**

The great clearing of Europe's forests had several starts in various places, but originated sometime between the 11<sup>th</sup> and the 13<sup>th</sup> centuries. After the collapse of the Roman Empire and the eventual closing of the Dark Ages, there had been a general climatic improvement in western and southern Europe — the Medieval Warm Period. As agricultural production rose, the Dark Ages receded and the Renaissance emerged in fits and starts. On the northeast coast of Italy, Ravenna was the seat of the Western Roman Empire and of Byzantine Italy, but the economic power lay in Venice. The sea-going Venetian Republic had a thriving shipping industry and a commercial trade in wood in the Adriatic. By the 11<sup>th</sup> century, it had already developed as a major port for trade between Europe,

Byzantium, and Asia. After a war against the Normans advances into the Mediterranean, Venice secured free trade throughout the Byzantine Empire.

Seagoing trade required ships that could transport not only goods, but could also fight wars of defense and offense among competing states. A large industry for the making of ships, sails, and armaments settled into a section of the city called the Arsenal. Through its contacts with Byzantium, Venice also revived glass making and rediscovered old Roman techniques to make a clearer glass than was available elsewhere.

The combination of shipping, shipbuilding, and glass manufacture added to the large population that was attracted by its growing wealth, placed a huge strain on the available wood supply. The timber that grew along the coast was first attacked and exhausted, and only by cutting further and further along the coast and up the river valleys extending down from the Alps, could Venice supply its commercial needs. Cutting extended well into the valley of the Po and across the valley to Genoa by the 11<sup>th</sup> century. With the rise of competitor cities in Florence, Padua, and Milan in addition to Genoa, struggles for dominance occurred. But in the 15<sup>th</sup> century, when faced by a Turkish threat to its maritime trade, the shipbuilding industry found that it had already used the last of its reserves of oak timbers. Venice failed to secure new resources, and its economy collapsed.

The center of shipping and international power then shifted most notably from Italy to Spain and Holland. In North-central Europe, there had been a gradual decline in forested area since the dawn of agriculture. But with the expansion of agriculture during the climatic warming of the late Middle Ages, the increased populations and the expansion of trade, the pace of forest clearing accelerated. Most of the loss occurred during the last millennium. In Northern Europe, the usual form of land use since the Saxon and Scandinavian migrations was for agricultural fields and grazing areas to be cleared around compact villages. During periods of prosperity, the circles of cultivation grew. During times of famine or pestilence the surrounding forests reclaimed edges and old fields. Outside of these areas the land was considered to be an unclaimed "waste," which was nominally under the control of the king or local lord. Manorial forests were primarily hunting reserves, within which peasants could gather fuel and had limited grazing and hunting rights. The occasional interruptions of human population growth due to such factors as the Bubonic Plague of the late 14<sup>th</sup> century caused only a temporary hiatus in forest decline. Still, since saws were not developed for felling trees for another five centuries, clearing the forest was slow and arduous work. A large initial investment of labor was required for clearing before grains could be planted and harvested and even before sheep or cattle could be grazed.

The Church helped drive the agricultural advance into forests. All through the Middle Ages and the Renaissance, the monastic influence was especially strong in receiving "waste land" from the crown or Pope and clearing outposts of civilization for God's work. Clearing land of trees was always difficult, and limited by the capacity of axes to cut large trees and of digging tools to dig stumps. A field edge could be gradually advanced as an adjunct to other farm activities, but to go into uncut forests required a large investment of time and effort. Among the few who had the support and dedication were the monks. It was a tradition started in Italy, but carried on with great success in England. Once fields and gardens were established, such as by the Benedictines, the adjacent lands could then be more readily cultivated, and markets and transportation could follow the routes established by the monks.

It was the mission of the monks to bring order out of the chaos of the wastelands, and to subdue and convert the Celts and their Druid priests, who worshipped trees, practiced idolatry, and took refuge in forests that sheltered satanic spirits. Once a monastery was established, monks could extend their fields and drain further swamps. Settlers then came into new areas and used established transportation networks for their own metal works, mills, and vineyards. Great land holdings were accumulated and, in addition to revenue from agriculture, the nobility or royalty could then set up hunting and timber reserves for their own use in the remaining "unused" land. With only a very gradual increase in human density, and no new technologies that either increased the demand or supply of wood, a kind of steady state existed between forest and field. At the edges, the forest would have continually receded and then expanded as population pressure for land increased or decreased.

In addition to fields, the monks established orchards, sometimes called "Love Gardens," following the example of St. Augustine. These tree gardens became the medieval ideal of a paradise, made by monks to resemble their vision of Eden on earth. The association of Eden with a cultivated garden or orchard was drawn from these experiences with real gardens throughout Europe. Thus, the concept of going into the wilderness to create a garden as a sort of mission outpost has very deep roots. Religious motivations had very significant economic effects, and imprinted visions of long-term purpose on those economic developments.

By the 11<sup>th</sup> century, conflicts over land use intensified. In England, the Norman invasion of 1066 resulted in the imposition of new regulations on traditional land uses. The Normans established extensive Royal forests, and Henry II further expanded them. He also enforced prohibitions on poaching and excessive tree cutting. The limits to peasant use imposed by the Plantagenet court was an end to the system with flexible boundaries for forestry and other land uses. For protein, the peasants who lived near forests depended on hunting that often involved poaching. As regulations became more stringent, conflicts ensued (Dyer 1983). The forest conflicts that inevitably increased in that time and during the rule of Richard I, the Lion Hearted, were local issues, but they occurred often enough to be taken up in folk tales and ballads.

There was a reaction to the loss of use of the forests by the peasantry. The withdrawal of forests from common use contributed to peasant revolts, and provided the foundation for the tales of Ivanhoe and of some of the stories of Robin Hood. They featured the alienation of peasants from their traditional homes and their uses of the forests. In the 12<sup>th</sup> century, the Arthurian Legends and the romances of Gawain and of the Green Knight became popular and eventually led to the modern romances. While neither Robin Hood nor Arthur may have been real individuals (Hilton 1999), they did originate in times of social upheaval and gave rise to a romanticism about adventures in forests by those seeking wisdom and redemption. In romantic literature, forests were places where normal rules and values of society were suspended or defied.

The Arthurian Tales include adventures inside and outside of Camelot, where forests represent the edge of civilization. In Robin Hood, the adventures take place largely within the forest, from which heroes make forays into towns and roadways, and return safely to the forest (Singman 1998). While the perspective differs, the popularity of these and similar legends in ballads and folklore indicates that the vision of a forest as a refuge from alienating forces was well established even before the Renaissance. The legends may have

largely been a reaction to unstable economic and political forces. Regardless of their social causes, the legends had a lasting effect on post-Renaissance perceptions of forests.

By the time of Richard II, 200 years later, most of the forested land in England was designated as Crown land and came under some form of regulation. Nevertheless, with England's population growth, continued clearing for agriculture, and its growing navy, timber shortages soon developed. While the extent of forests and the supply of timber fluctuated widely according to population pressures and economic conditions, there was a general decline of forests through the 18<sup>th</sup> century.

Similarly in France, forest clearing for agricultural uses was common through the Middle Ages and the Crusades. To expand his wealth and territories, Charlemagne is said to have charged his agents to find capable men and to give them woods to clear. Benedictine and Cistercian monks cleared much of the French woodlands and extended their activities into the Low Countries, Germany, and Russia. Through the Middle Ages and the Renaissance, the great clearing of European forests followed a pattern of clearing openings for agriculture and logging for construction and fuel; first for domestic heating and later for metal and glass manufacturing and other needs.

During the emergence from the Dark Ages, agriculture expanded through northern Germany and eastward. The exploitation of forests and the expansion of agricultural lands were common means for the landowners and kings to gain wealth and power. This activity extended down the Danube, where the Magyar kings invited Rhineland Germans to fell forests and become farmers in the area. Slavs were similarly induced to develop Polish, Bohemian, and Moravian colonies in Eastern Europe. There was a persistent effort to balance the various uses of forest land, but with an expanding population, an inexorable decline of forests followed and land, once converted, rarely reverted to forests.

As the Age of Discovery dawned, the pressure for wood could be partly relieved by developing foreign sources of timber. Spain, Portugal, England, France, and the Netherlands deforested lands well beyond their borders. By the 17<sup>th</sup> century the pressures for wood production in France had forced logging of the Pyrenees. Nevertheless, royal forests were depleted and silvicultural management became necessary under Louis XIV.

The European conflicts over forests that emerged in the 17<sup>th</sup> and 18<sup>th</sup> centuries were firmly based on a long history of conflict that took form in the agricultural expansion at the end of the Dark Ages. From the time of Charlemagne and onward, regulations were placed on the use of forests. The peasants could extract fuel wood, and had limited rights in the forest, but they perceived forests as wastelands that could yield produce if they were cleared. True forest dwellers, which might have lived primarily by foraging, were killed or converted in the advance of Christianity and civilization. But as the population outgrew the capacity of the soils and technology to produce surplus value, the use of marginally productive land for agriculture expanded. Conflicts were therefore inevitable between peasants and nobility. Dissatisfied with limited access to hunting and agricultural land, the peasants pressed for more land. The nobility, in turn, hired conservators of forests, also known as foresters, to maintain their own status quo.

In England, folk tales romanticized the forest dwellers that lived outside the regulation of landlords. The legend of Beowulf from early English literature is a tale of a Swedish warrior who is called to Denmark to save the inhabitants from the ogre Grande. It is the first narrative tale written in Old English, and is a founding myth about the country's

Norse origins. In the tale, the ogre emerges from a forest near a castle and kills many of the warriors who had settled in after a night's revelry. To put a halt to these periodic raids, they call on Beowulf who comes and kills the ogre. Alas, the ogre's mother emerges from a deep lake in the midst of the wild forest to avenge her son's death. Beowulf then must go through the forest to find the mother's lair, dive into the lake, and nearly dies before killing her in the world at the bottom of the lake. When he emerges from the lake he is given great honor and gifts, and stays to become a great leader with even more wisdom and strength than he had before. His death is marked by a great Viking burial at sea, but his experiences in the forest marked his trial and rebirth. The author of the story was probably an Anglo-Saxon who wrote around the middle of the 6<sup>th</sup> century CE. Later versions written in the 8<sup>th</sup> or 9<sup>th</sup> centuries took on more of a Christian coloring. The themes were echoed in the Arthurian legends (Raffle 1963, Kleberg 1950). In the Knight's Tale from the Canterbury Tales by Chaucer, the burial of Arcata echoes the preparations for Beowulf's burial. These tales form the counterpoint for a wild past that stands in contrast to the agricultural system imposed by governing bodies.

In the forests of northern Germany, settlement centers grew into towns, where local agricultural and timber goods were traded for things from distant places. Such activity led to the development of the Asiatic League. The League controlled trade in the Baltic until the Black Death, the Hundred Years' War, and the Thirty Years' War ultimately allowed Holland, and then Britain to gain control of the trade.

To the east, the Teutonic Knights also worked into the forests along the Danube. By the 16<sup>th</sup> century all of the land in Central Europe was claimed by someone, and the demand for timber could no longer be satisfied as a by-product of agricultural clearing. At the time, the metal smelting and glass making industries were growing rapidly. Both activities required charcoal. Partly because of the need for materials, the trading industry also was growing. It required ships and navies to protect shipping, and its demands for timber far exceeded the capacity of local European forests. England had already denuded much of Ireland's forests by the 16<sup>th</sup> century. Imports of timber for Dutch and English shipbuilding from the Baltic States grew so rapidly that much of western Norway was denuded within a century, while the rest of Scandinavia started an industry based on exporting timber. Thus, although Holland had almost no forests of its own left by that time, it could support its shipping industry with timber from Scandinavia and the Baltic States.

During the 16<sup>th</sup> to 18<sup>th</sup> centuries, the forests in the southern river valleys of Finland, the southeastern plains of Sweden, the fjords of Norway, and the plains of Jutland in Denmark supplied wood for central Europe. However, by the late 18<sup>th</sup> century, most of these forests had been heavily cut. In Denmark only 4% of the land remained in forest. Again, this is when the von Lange brothers from Germany and Reendow from Denmark introduced in 1740 a form of sustained yield forestry from Germany, under orders of the King of Denmark and Norway.

For the countries that relied on shipping and colonization, a central objective of foreign policy was to protect trade by controlling sea routes. The ships of that time required strong timbers, long enough to enclose large spaces for cargo or armament, and then they needed mast trees. Tall trees with sufficiently slow growth so that the masts were supple, strong, and long enough were rarely available on the continent. The coniferous trees of Scandinavia were sought after, but only the old-growth of the New World could provide mast timber in quantity. In the 17<sup>th</sup> century, timber became a critical resource for national

security, and France and England had state-mandated forest practices for their domestic and foreign forests. France and Holland threatened English access to Baltic and to North American sources of wood. The Maritime Wars of the 17<sup>th</sup> and 18<sup>th</sup> centuries, which involved trade with North and Central America and with India, could be considered timber wars as much as they were wars for military and commercial domination. The price of conifer timbers was one of the economic factors that led to the German conversion of hardwood-dominated forests to conifer plantations.

Since forests were seen as critical resources for global economic power as well as domestic amenities, efforts were made to maintain strategic supplies at home. In England, 1660 was a time of internal turmoil. The monarchy was restored under Charles II and foreign relations focused on stabilizing past gains. England successfully defeated the Dutch in New York, and Charles tried to establish good relations with Louis XIV on the continent.

One of his domestic accomplishments was the establishment of the Royal Society, to which one of his advisors, John Evelyn, was one of the first appointments. Evelyn immediately argued for the study and conservation of English forests. When commissioned by the navy, he produced his "Sylva: A Discourse of Forest-trees" (1664), which went through many revisions and became the foundation for scientific forestry. He was familiar with the French ordinances of Colbert and was eager to apply scientific forestry in England. It also became apparent to him, however, that England's needs far exceeded her domestic growth capacity. In 1664, he could frankly state to the Royal Society that the way to save England's forests was to exploit those of the New World. Using both the forests and the iron ore of North America, iron could be produced and shipped to England where it could be manufactured for export back to North America and to other markets.

From the 17<sup>th</sup> century until well into the 19<sup>th</sup> century, the timber harvest in North America was simply a massive conversion of standing American capital into European military and political power. Within England, there were political struggles between those who wanted to protect their domestic iron production and those who wanted only to protect their manufactured products. Those who had access to iron ore wanted to limit imports to only charcoal and timber. Those who lacked cheap sources of ore wanted to import iron for manufacture. In either case, by using American forests for timber and iron smelting, England would have enough iron for "peace of our days" while leaving England with a fleet such that it could be "the great sovereign of the ocean and of free commerce" (Evelyn 1664).

As long as Europe could export its problem of using more forest products than it produced, it was never forced to face the consequences of its inherent conflicts in allocating forest land. An exception was Germany in the late 19<sup>th</sup> century. There, the concept of sustainable forestry forced planners to consider the forest as a finite resource. Conflicts over forest use were faced directly and well-regulated forests for wood production became the norm. Elsewhere in Europe, from the 11<sup>th</sup> century through the age of industrial expansion, the need for and price of wood increased, and destabilized any local, steady-state use of forest land. Whenever forests were precipitously reduced or removed, conflicts for different forest products and for alternate uses of forest land increased competition for the forest resource. Higher valuations of forest products usually resulted. Relief was achieved by simply extending trading routes or by conquest. During the period of the great forest removal in Europe, the first regulation of forests was on a local basis. When the scale of use extended to national boundaries, and when those

boundaries could be breached, international trade was regulated by sovereign nations. Long before the Renaissance, however, timber had been gathered from distant sources.

## Rome

In fact, this pattern was well established by the time of the Roman Empire. Before the establishment of the Republic, most of present day Italy was well forested (Prelim 1993), except for areas that the Etruscans, Sabines, and others had cleared for their agriculture. Most of the coastal areas of Italy were covered by the typical Mediterranean evergreen forest. Myrtle and bay gave way to beech and fir forests in the hills around Rome. In some areas, closed forests grew, and, according to legend, the Latin 'race' originated in a forest environment. Previous to the 3<sup>rd</sup> century BCE, Rome was built largely out of the wood harvested in its nearby forests. After the Gauls burned Rome in 390 BCE, the Republic favored stone and brick for rebuilding. The use of brick, however, required substantial supplies of fuel wood, and the subsequent demand for fuel depleted local wood supplies. The Roman success in establishing security from the coast to the Apennines allowed them access to the coastal and hillside forests for timber. Subsistence farming by a peasantry was replaced with extensive *Latifundia*, the equivalent of modern industrial agricultural holdings with tenant farmers.

The expansion of Rome into North Africa and into the eastern Mediterranean came at a cost to its own agriculture. Grain was produced more efficiently in conquered lands than in local fields. Conquests, however, provided access to the forest resources of the Apennines and all of northern Italy, as well as to those of northern Africa and Sicily. While wood from forests near Rome was depleted, there was little general concern for forests. The major concern was over the status of forests as a strategic resource. The shift of land ownership towards large private holdings instead of public ownership worried Cicero, who was concerned that the loss of timber from public lands could compromise Roman power.

During the early years of empire, Virgil was concerned with the changes in agriculture, but primarily with restoring the pastoral landscape that he considered to be the strength of Rome. In his "Georgics", he appealed for a "back to the land" movement by recalling for the urban Romans that:

The farmer cleaves the earth with curving share;  
This is his yearly task, thus he sustains  
His countrymen, his little grandchildren,  
His herds of cattle and his faithful ox.

He goes on to extol the virtues and joys of country living. He also distinguishes the pastoral from the wild forest in the 6<sup>th</sup> book,

But neither the wealthy forests of the Medians  
not glorious Ganges, nor the Hermus, turbid with gold,  
can equal noble Italy; no nor Bactria  
nor all Arabia rich with incense-bearing groves  
(Virgil 1969).

Virgil's poetic vision was of a thoroughly pastoralized earth in which Rome could look to foreign countries for forest products. While Virgil preferred rural to urban life, his ideal countryside was a well-controlled Nature without wasteland. However, soon after a sequence of Roman Emperors, the changes in Roman society and its dependence on foreign produce created severe conflicts among many segments of society, and generated a

broad sense of instability (Hight 1957). Since all of Rome's engineering and military power couldn't control its fate, more basic elements were sought to make the world more understandable. In contrast to Virgil's bucolic views, the more romantic poetry of Ovid became popular. His "Metamorphoses" gathered various tales of the nature of humans and gods with a very different picture of forests. These poems, completed around 40 years after Virgil's "Georgics," picture the nature of man as in transition between god and human. Transformations could occur between animal or plant and human form. He described a Golden Age before the Bronze Age:

The race of bronze came next, the third in time,  
More fierce and warlike, yet unstained by crime.  
The last was iron; and sin in every form,  
With that base metal, took the world by storm.  
All simple faith, all truth and honor fled,  
And force and fraud and treachery came instead,  
With sinful greed of gain. Men set their sails,  
And mastered (unfamiliar lore) the gales.  
Long, long the timbers on the hills had grown,  
That insolently leaped o'er waves unknown.  
The land, once common like the light and air,  
Was parceled with proprietary care.  
Not only must the bounteous soil bestow  
The food it owed; men probed the depths below;  
And raked the buried treasures, that impel  
To evil, from their hiding-place near hell.  
(from Watts 1954)

For Ovid, the Golden Age for humans was before the Iron or even the Bronze Age, at a time when humans were part of nature. Ovid's humans are part demigod and reflect uncivilized origins in their characters. This view contrasts with Virgil's concept, presented in his "Georgics" and in the "Aeneid", of humans who seek the order and stability of civilization in a Roman Golden Age (Solodow 1988). The conflict in later centuries between the Enlightenment and Romanticism is presaged in Ovid's contrast with Virgil. Ovid's natural person is wild and not a member of a Virgilian pastoral civilization.

But Rome did establish a foreign empire and continued to exploit the forest resources by conquest into the rest of Italy, and into France, Germany, and England, wherever new forests became available. It immediately incorporated adjacent lands into the Roman state and opened them to exploitation. Romans invaded the former wilderness of the Po valley and continued across the eastern and western Mediterranean and into North Africa. They found Britain to be overgrown with forests, with "timber of every kind," and soon exploited the coastal forest resources as far as their transportation system allowed.

Having cut their own forests, they found the forests of their colonized lands to be not only profitable to exploit, but also awe-inspiring. In their campaigns northward, Pliny accompanied the Legions in German campaigns. He felt humbled by the pristine forests that were untouched by the ages and that had "remained unchanged since the world began." The Romans felt that there were wild spirits in the land and that the native inhabitants lived as "noble savages" in a happy state, without the accouterments of civilization.

The images of Ovid must have reflected these discoveries of people who had a culture before there was a civilized agriculture.

In fact, when the Roman Empire was established, the people of Britain, Gaul, and Germany were far from uncivilized brutes. Britain had an agricultural system of small villages for over 2,000 years before the Romans overran them. The Danes in northern Germany had extensive rectangular fields of barley and wheat and an iron technology introduced by the Celts at least 500 years before Roman times. A Bronze Age technology had been active for almost two millennia in the area of Czechoslovakia and Germany, and an Iron Age culture that dated from around 600 BCE had spread from the Caucasus and along the Danube basin westward and northward through Central Europe. The populations, however, remained largely scattered in small villages, practicing subsistence agriculture. Until they encountered the Roman Legions, they saw no need for a large-scale system of organized resistance. But when these small independent units met the highly organized Roman Legions, especially in open fields, they were overwhelmed. Eventually, experience with Roman tactics allowed them to develop counter-tactics of their own and to enlarge their scope of planning.

One of the consequences of the Roman practice of including local soldiers into legion ranks was that native warriors could later defect to their home forces and lead them against Rome. In Britain, Cassivellanus emerged to organize the native forces. In Germany, Arminius led local forces to annihilate three Roman Legions in the Teutoburg Forest, stopping the Roman advance before it could reach the Elbe. Caesar Augustus was stopped by what his general Varrus thought of as an army of brutish warriors who could only make war, sleep, and eat. The historian Tacitus, who accompanied the Legions, concluded that the Germans led simple lives, practiced a natural religion, and were indifferent to property and rank. These tribes defeated the legions by concealment and sudden selective attacks when the advantage was theirs. When facing superior forces they seemed to melt into the forest. They would reappear at another place undetectably, striking in places and times of their choosing.

From these experiences, the legends of the wild savages of the forest with magical powers were promulgated to go along with the legends of the noble savages. In fact, a romantic Roman view of non-Romans was emerging that saw contemporary foreign people and previous natives of Italy, such as the Sabines, as virtuous and noble. These legends were to form the foundation for a German volk heritage and for the Arthurian legends of the English.

The Roman demand for timber for construction and for fuel for its iron and glass industries and its baths placed huge drains on the Italian and neighboring forests. Quality timber was taken in southern France, Iberia, and North Africa. When industries found it economical to move out of Italy, they built mills in adjacent countries and drew even more heavily on these foreign forests. The reach of these industries into the forests was limited by the transportation system. Since the industries apparently could not develop secondary local markets, the cost of transportation increased as the distance to Rome increased. Though iron smelting was limited to the easily accessible coasts of Britain, this industry destroyed the British coastal forests within a century. It then collapsed due to this deforestation. With the collapse of the Roman Empire, and the decline of populations throughout Europe, the northern forests recovered until they were again exploited in the late Middle Ages.

So the fate of forests under Roman influence was one of continuous retreat. The forests of Italy were first looked upon as a hindrance to agriculture and as a supply of timber and fuel for a growing empire. Accordingly, the readily accessible forests were cleared, then those of their neighbors were over-cut, and ultimately those of their colonies were abused to the extent allowed by transportation technology. Despite warnings to conserve forest resources for future use, and the adoption of some constraints on cutting, forests were cut whenever timber or fuel was needed. As their over-cutting advanced, the Romans also generated a more romantic and mystical view of forests. The lessons for forest conservation that might have been learned either for protecting future production or for preserving national values were always applied too late to save their forests (Hughes 1975).

### **Before Rome**

In 480 BCE, when Persia was a power in the Eastern Mediterranean, it sought to control the forests of Greece. Persia wanted the timber for use by its own navy, and it wanted to deny this militarily significant resource to any Greek State. When Athens rose to power after defeating Persia, the euphoria of being the central power of Hellas led Athenians to massive construction of civic buildings, fleets of war, and trading ships. It also used charcoal for smelting silver and other metals. Athenians may have had ambitions to ultimately control the whole Mediterranean basin, including Italy, which it knew had vast timber resources. However, they looked first to their north, to Attica, for wood, and then further still to Macedonia. But Athens had to contend with Sparta in the Peloponnesian Wars to secure that access. It even tried to obtain wood from Sicily, without success, and ultimately lost the military campaigns to Sparta. For Plato, Aristotle, and other Athenians, the forests of Attica were more than a source of timber, they also helped resist erosion and enabled the hills to yield reliable supplies of water. There was also a religious source of interest in preserving sacred groves, in which any harvesting was considered to be a sacrilege. At least to some of the Athenian leadership, it seemed clear that over-cutting forests would lead to soil depletion, and pose threats to agriculture and water supplies. But this idea was never raised to the level of government action.

Eventually, when Athens was limited in its access to wood and faced with eroding soils and declining agricultural yields, its power declined and Macedonia's power rose. Forests still covered most of the Macedonian landscape, and its timbers became a coveted resource for trade throughout the eastern Mediterranean. That enterprise helped to support the foreign adventures of Phillip II and Alexander. These forests remained a strategic resource long after their Asian conquests had collapsed. Though diminished, they remained a coveted resource to the Romans, who defeated Macedonia in war and made it the first foreign province of the Roman Empire. To ensure the availability of its timber for Rome, the Empire banned any tree cutting by Macedonians, and logged the remaining forests for its own uses. Those lands have subsequently been periodically denuded and now have little forest cover. However, the Greek and Roman deforestation was not the first such episode in the region.

The Mycenaeans before them, around 1500 to 1200 BCE, needed timber resources beyond their own shores to support their industries. They had expanded their power and developed into a large international trading center, with a bronze and pottery industry that dominated commerce throughout the eastern Mediterranean. Feeding upon itself, that economic expansion attracted people from around the Mediterranean and led to an expansion of agriculture, and the need for fuel for heating and for industrial uses. Over a few hundred years, the demand for wood outstripped the resources around the once pine-for-

ested Peloponnesian peninsula and adjacent islands. Ultimately, the reach of the Mycenaeans extended to Troy and to the whole northeast coast of the Mediterranean. The forests of the coastal areas were stripped of their timber and fields were cleared to produce wheat for the growing population. The island of Cyprus was also once well forested, but its forests suffered a similar fate.

Inevitably, these practices destabilized populations and established transient industries that were dependent on forests for their competitive advantage. The lush appearance of these Mediterranean forests hid their fragility. Rainfall was marginal, and the soils were highly susceptible to erosion, so stripping hills of their forest cover caused large and long-lasting losses of productivity. The introduction of goats further guaranteed the long-term loss of forests. With increased soil erosion due to a lack of forest cover, agriculture yields inevitably declined. The whole economic system of Mycenae went into decline. The whole cycle of rise and fall took between 300 and 400 years. It took an equal amount of time for the Greek mainland to recover from those early abuses of its forests before the rise of the Hellenic cultures. It then took another equivalent period of time before the Golden Age of Athens could be supported.

Before the Mycenaeans, the Minoans of Crete used their forest resources to create a center for trading surplus pottery and bronze, and a shipping industry to support that commerce. When their forests were over-cut and wood supplies declined, their trade with the eastern Mediterranean was taken over by the Mycenaeans. But for the Minoans, the impetus for the original use of the forests of Crete was not for their own industries. It was as a source of timber for Babylonia, which had been using Phoenician ports for its trade since 1800 BCE.

In the development of Mesopotamia, wood was always a precious commodity, and local supplies were inadequate throughout the Middle East. In Egypt around the 4<sup>th</sup> and 5<sup>th</sup> millennia BCE, wood was heavily used to build villages. By the Dynastic period, graves with wooden caskets were used. After the unification of Egypt, the flow of timber from the upper Nile fed the growing empire, but forests to the north and east were also needed. These were available through direct Mediterranean sea routes. While Egypt's monumental construction made heavy use of stone, long timbers were needed for the construction process and for most of the roofs. Native timbers were not sufficient to meet this need. To obtain the favored cedar and pine, Egypt developed a log trade with Phoenicia by around 2600 BCE. Egypt also traded for dense furniture hardwoods from Ethiopia, so that even without substantial forest resources of its own, Egypt could control sufficient foreign forest resources for its needs.

From the early Dynastic period, there had been substantial Egyptian trade with Mesopotamia. All through the periods of expansion and contraction and warfare with the Hyksos between the Nile and Mesopotamia, timber trade increased. The Babylonian Empire had extended its trade from Mesopotamia westward to the Taurus Mountains and into Lebanon since around 3100 BCE. From then on there had also been constant trade and competition for forest resources all along the Eastern Mediterranean coast. With greater economic and military power, Thutmose III (1475 BCE) expanded the Egyptian Empire to the east, at least partly to control access to timber, which could then be imported from present day Syria, Lebanon, and Cyprus, as well as from Somalia and Thebes in Mycenae. There was a continuing series of wars for control of the timber as well as other resources across the Levant. The Babylonians and, before them, the Sumerians and Akkadians first

used the oak and cedar resources of the nearby forests of the Zagros Mountains to the east. They then extended their reach northward and westward to the Taurus Mountains of Syria and Turkey by floating timbers down the Tigris and Euphrates Rivers. With the centralized power of city-states and their expanding timber needs, they may have engaged in the first of the western world's timber wars.

At the beginning of the 3<sup>rd</sup> millennium BCE, one of the turning points of civilization grew out of the development of writing. From the very beginnings of writing, it is clear that in the societies that had developed a script, a well-organized agriculture had already long been in existence. Writing developed into a transcription of the common spoken language only after a long period of abstraction from pictographs to either the phonographic or the logographic systems of writing. It took over 5,000 years from the use of clay shapes to mark goods to evolve into cuneiform inscriptions on clay tablets that designated the types and amounts of goods traded. By 3200 BCE, clay tablets were in common use for such designations. Over the next millennium, the Sumerian script was developed in Akkadia using phonographs of consonant sounds to write narratives and concepts. About the same time, the Chinese form of logographs, where each word had its own character, was developed and by 1800 BCE, they had a working set of morphemes for transcribing descriptions and concepts. It wasn't until the Mycenaean Greeks developed a complete alphabet of consonants and vowels around 1400 BCE that the modern European languages could be fully transcribed.

Since the agricultural transition started around 10,000 years ago and city states began trading in agricultural surpluses around 8,000 years ago, the legends of life before agriculture would have been filtered through several millennia before being recorded. The development of writing required an agricultural trade to stimulate it, and after several millennia writing developed to a point where narratives could be transcribed. The written legends concerning forests, therefore, reflect an agricultural and urban perspective in which forests are seen as alien and foreign.

Around 2700 BCE, we can get a glimpse of what the people of those early civilizations thought about the forests, which they were already cutting for their settlements. From these times come the first records of script used for a narrative form of story telling. The first story is about a king, Gilgamesh, who lived and ruled in Uruk, the capital of Sumer, around the beginning of the 3<sup>rd</sup> millennium BCE. In this story, the forest is presented as a place that is outside of, and stands in contrast to, the city. It took several hundred years before three fragments of a version of his life could be brought together into a single epic. The story includes a description of the area around Uruk. From Uruk, planning and preparation were required for the long and arduous trip to the hills where the gods lived. They may actually have been the Taurus Mountains, some distance to the north, where the revered and valuable cedar forests grew. There are two facets to the views of forests that are revealed in the narrative. One concerns the forests themselves, and the other reflects the meanings that the forests carried for the people.

When Gilgamesh decides to go into the forest to cut cedar trees, little mention is made of the value of the timber, except that it is necessary to go to great lengths to obtain it. The value of cedar logs is of minor importance in the tale. What is noted about the logs that float down the river is their similarity to dead bodies and the premonition of death that they convey. The forests themselves embody another, more ancient law than the laws of civilization. Gilgamesh must go to the mountains to cut timber, and he must face and

defeat the hill tribes and the god Humbaba, protectors of the forest. In the Zagros and Taurus Mountains at the time there were still hunting and gathering societies that had little agriculture. These societies were well known to the cities with which they traded and sometimes fought. They would have lived in small bands, and were likely without the bronze weapons that could be forged in Uruk. Before Gilgamesh goes on this journey, he befriends one such uncivilized person, Enkidu, a wild man who is seduced into captivity by a prostitute and tamed into civilized ways. He becomes the alter ego of Gilgamesh. He is a friend containing another, less-civilized aspect of Gilgamesh's own personality. Over the protests of Enkidu, they go to the Cedar Mountain, succeed in killing Humbaba, and cut great volumes of the cedar. However, in recompense from the gods, they learn that Enkidu must die. Fighting against that turn of fate, Gilgamesh seeks salvation from a higher god but instead gains the wisdom of his own mortality.

The three stories are imbedded in the one epic. One is about Enkidu, the primitive; the second is about Sumerian myths of the dead; and the third about how Gilgamesh conquered Uruk and was considered to be part divine soon after his death (Tigay 1982). The last one refers to a common theme of a great flood, and combines that with how Gilgamesh, the fifth king in the 2<sup>nd</sup> Dynasty of Uruk, forced the people of Uruk to build a great wall after the flood. The timing of the story coincides with the displacement of Innana as the primary Goddess of Sumer by male gods and, in general, the displacement of female deities symbolizing fertility and regeneration by males symbolizing strength and conquest.

The story of Enkidu reveals several aspects of the Sumerian view of forests. He was the original wild man who is befriended by Gilgamesh and who forms the counterpoint to civilized man. Interestingly, he is portrayed as being captured on the open prairie but having a home in the forest (Kluger 1991), with both types of environment lying outside of the limits of civilization. He is a primeval innocent, blissfully lacking self-consciousness. He is formed from clay and is animal-like. The two protagonists struggle, and Gilgamesh wins. But with Enkidu's removal from the wilderness, he becomes human and civilized, and the two form the unit of power to rule the kingdom. Gilgamesh decides to challenge the god of the forest, Humbaba, and to cut the cedars. Enkidu pleads unsuccessfully with Gilgamesh not to destroy his motherland. After they kill Humbaba and cut the forest, they return, and in a struggle with the goddess Ishtar, Gilgamesh kills the Bull of Heaven and completes the male domination over the female divinities. But now, Enkidu, the more primitive of the two parts, must die, and Gilgamesh must face his own mortality with the death of his alter ego.

The Sumerians had apparently already heavily logged the nearby Zagros Mountains to the east and had to go to the more distant Taurus Range for timbers for their opulent structures and fuel for bronze production. Through a succession of kings and shifts in locations of the capital, these first city states in the Mesopotamian Plain were relatively small by modern standards, but as their populations increased they traded ever more widely to the east, north, and west. During the next millennium, Sargon of Akkad ruled the Mesopotamian Plains and alternately fought and traded with the hill tribes. There were also sporadic wars between the cities of the upper and lower valleys, and Babylon became the dominant center. Hammurabi promulgated his laws throughout the area. Later the Hittites came to control the head of the Fertile Crescent. By 1,000 BCE, the Phoenician control over Mediterranean trade was peaking and its cedar forests, which had long been used

in Egypt, came under intense pressure from Babylon. The rising power of Israel allowed Solomon to import quantities of the cedars of Lebanon. Under the combined pressures of Babylon and Egypt, the cedars were virtually gone within a few hundred years, despite religious strictures intended to protect them. Put another way, the religious strictures extended their life by only a few hundred years.

Fundamental assumptions inherent in these stories are that forests are foreign and that the city is the embodiment of civilization. The dichotomy is already well established with the very first written stories, which are a founding tale about early Sumer. It is clear that forests can yield products of benefit only if logged, cleared, or otherwise worked on by civilized humans. The record of human use, at least from the societies developed from western agriculture, indicates that the pattern of forest destruction and of advancing the frontier of destruction is limited only by the capacity to transport timber. But there have also been persistent expressions of the value of forests beyond their commodity values. The forests of Sumer house other gods. A human is transformed by conquering both the forest and his inner fears. The transforming value of forests that is so emphasized in the literature of the Middle Ages, and the value of seeking the hidden treasures of wisdom, are established with the very first literature. To be sure, there have been persistent expressions of concern for maintaining a timber resource as a political or military expedient, but the voices for maintaining a forest environment also have always been present.

In later literature, the dichotomy is again made clear in Greek and Roman mythology. For Homer, the gods lived at ease in a sylvan Elysium, and Arcadia was located in pastoral Sicily, as it existed before being logged over. To Plato and the Neo-Platonists, the forests were chaotic, disorderly wastes. This unworldliness lent them a spirituality. In 4<sup>th</sup> century BCE Greece, large, old trees were protected. Groves were the reserves of the gods in which no cutting, hunting, gathering, or grazing was permitted (Hughes 1983). To Virgil, the forest may have been a place for pastoral harmony, or a dark and vast exile. It was an uncharted place beyond the city, which should be civilized. For Ovid and the later Roman writers, the forest was a place where metamorphoses occurred. It was a place of demi-gods and nymphs, where humans could approach the gods, and express the wilder human emotions. These visions are echoed in the European literature from Beowulf to modern works, in the romantic paintings of middle Europe from the 16<sup>th</sup> century to the Hudson River School, and in the photographs of many coffee-table books today.

As a religious motif, the early Christians carried a Babylonian vision of a desert or forest wilderness that lies outside of cities where spirits and supernatural beings abide. The wilderness therefore was a desirable place for supplicants to seek revelations. Thus, St. Anthony could experience the wilderness as a place of trial and physical hardship, but also as a place for reflection and inspiration. The Latin *foris* and *forestare* and the French *forêt* are words for foreign places to which outsiders or those who are banned from civilization are assigned. Forests therefore were defined as places that belong to no one and where Roman law had no jurisdiction.

One of the areas that lay outside of Roman and Church rule through the Dark Ages was the land of the Celts and their Druid priests, who resisted the incursions of civilization. But by placing these areas beyond the bounds of civilization, the Church created a fascination with the forbidden that ultimately allowed forests to be romanticized. In the Middle Ages, several visions of being on the outside accumulated in popular tales. Associations were generated between forests and unregulated hunting, the quest for holiness,

chivalry, and courtly romance. These are captured in the Arthurian Legends of Chretien de Troyes and in *Ivanhoe*. When these stories were written, forests were being cleared and Royal regulations were restricting use of forests by commoners.

The forest could also be a refuge for exiled lovers, as in the 13<sup>th</sup> century tale of *Tristan and Isolde*, and Chaucer's *Canterbury Tales*, which used several of the same themes though written 200 years later. These stories transformed the forest into the romantic locus of human renewal and transformation. By living in the forest, humans were transformed to embody their better natures.

In the Peasant's Revolt of 1381, the peasants attacked the Lord's forest, protesting other restrictions on their use of the forest and on hunting. These events helped lay the foundation for the *Tales of Robin Hood*. By Shakespeare's time, the forest as a place of transformation was portrayed in "*A Midsummer Night's Dream*". Thus, literary works portray the forest as a place of refuge (*Tristan and Isolde*, *Robin Hood*), of transformation and renewal (Arthurian legends), threat and salvation (*Beowulf*, various Grimm tales), and themes of eroticism and primitivism.

The mystical perception of forests has been embedded in European thought since at least the invention of writing. That perception eventually evolved into a romantic and non-savage understanding of the transformative power of forests. The forest then became a place of struggle and testing for knights and hunters, whose lives were transformed in the wilderness. It further evolved into an elevation of primitivism and eroticism. These views were also transplanted into the American understanding of forests, especially in its painting and Cooper's (1823) "*Leather Stocking Tales*." More recently, the tradition continues in *Tarzan* (Burroughs 1914) and similar stories, and in the association of the primitive with the erotic in D. H. Lawrence (Burns 1980).

The strength and continuity of that perception is juxtaposed with the knowledge that forests supply critical resources. Both views predate even the invention of writing. Both views have been continuously expressed throughout Western history as long as there has been a history. The strength and continuity of the contrast between those views of forests suggests that there is a basic dichotomy in our perception of the world. We might then ask if non-European societies have the same conflicting views as Western societies. We might ask if Eastern religions and societies have a more holistic view of human societies and forest ecosystems. If a Chinese understanding of the relationship between Nature and humans, for example, is one of continuity between all organisms instead of a dichotomy (Tu 1989), a basis may exist for treating forests as more than a commodity for immediate exploitation and conversion into an economic resource.

## Asian Forests

Unfortunately, the history of forest abuse is as prevalent in Asian as in European traditions. The expansion of agriculture in Asia took somewhat different paths, but did not lead to a sustainable forest any more clearly than in North America and Europe.

By 6000 BCE small agricultural settlements had been established in the Taurus Mountains of Syria and Anatolia and east into northern Iran. Their trade extended to the Red Sea. To the east, across Bactria and Baluchistan and through mountain passes to India, agricultural settlements also existed and grain-based farming was established about 7000 BCE. Since central Asia is a center of origin for a large number of fruit and nut trees, it is also likely that an economy developed based on an interface between forests and arboriculture. With the general climatic drying in this region during the Neolithic, the forests would

have receded into the Pamir Mountains and the foothills of the Himalayas. At their edges, a mixture of grazing, agriculture and arboriculture supported complex but mobile societies.

At roughly the same time that Uruk rose to prominence, the cities of Harappa and Mohenjo-Daro above the Indus River also rose as trading centers (Allchin et al. 1978) based on the agricultural surplus of rice, barley, wheat, and millet (Pandey 1996). Climatic conditions in that region would have been much moister than at present. They supported an open, deciduous forest in the Indus Valley, and a tropical monsoon forest along the Ganges. What is now desert would have been covered by open forest. In north-central India, a deciduous forest would have been growing. The Ramayana speaks of droughts in the plains and of seeking water from the hills. At Harappa, where some indications exist of contact with Sargon of Akkadia, the depletion of local forests for fuel and to clear land for grazing was noted. The peasant style of shifting agriculture would not have led to a rapid or massive forest clearing but could still have gradually deforested the region over a period of several hundred years (Sankalia 1974). Then, during the Vedic Age, the invasion of pastoral Aryans generated more forest clearing for grazing and barley agriculture. Combined with a drying climate, the forest edge receded from the river plains into the foothills of the Himalayas.

Trees were used as commodities and amenities, and as objects of religious veneration. The ascetic life was revered and was particularly well practiced in forest environments (Porteus 1928). Gods were located in forests (Gupta 1971), which provided leaves and flowers for use in worship services. They were also considered to have at least a latent consciousness, and they had enjoyed some protected status at least since the 6<sup>th</sup> century BCE (Pandey 1996).

Access to tropical rainforests was limited by the physical difficulties of clearing permanent fields, and populations remained largely concentrated in the plains. Yet, over the centuries of the early Aryan period, persistent intrusions from peasant villages gradually reduced the forest cover (Sankalia 1977). In the Buddhist period, and up to the first millennium of the Christian period, the Hindu and Buddhist religions encouraged the preservation of forests as the sacred abode of saints, spirits, and sages (Pandey 1996). Nevertheless, gradual incursions for farming and grazing occurred. In the 4<sup>th</sup> century BCE, Alexander's army could still find a hiding place for his army in forests where only a semi-desert now exists.

In the tropical rainforests of Borneo and Sumatra to the south and east, valuable rattan, camphor, and other resinous woods were actively traded in the 10<sup>th</sup> to 13<sup>th</sup> centuries CE by Chinese, Indian, and Arab merchants (Hall 1968, SarDesai 1989). These activities probably had little effect on the total forest cover in Malaysia and Indonesia. Indigenous forest dwellers had moderate impacts.

During the Mogul occupation, further cutting reduced the Indian forests. Protection of the remaining forests was designed to provide hunting for the nobility. But the great deforestation occurred in the late 18<sup>th</sup> and the early 19<sup>th</sup> centuries, when the British needed teak timbers for building ships and railroad cars. Destructive logging was extensive. The need for a more controlled system of planting and harvesting became obvious if the colony was to continue to supply British needs. It was then that Dietrich Brandis was brought

into Burma and India to set up a system of forest departments in the British administrative services. His work later influenced the development of English forestry.

In China, forests once covered about 56% of the land; they now cover 9%. The loss was gradual and depended on agriculture. The cultivation of millet (*Panicum*), and of rice of the japonica type, was probably indigenous from 5000 BCE. Wheat and barley cultivation spread from Southwest Asia around 4000 BCE. Peasant agriculture continued until the early dynasties, when regional political landholdings dominated small holdings. The rise of agriculture in northern and central China came at a time when the climate was substantially moister and warmer than at present. Trees then covered areas that are now devoid of forests. The Tibetan Plateau was covered by an open forest grassland. Since then, a cooler and drier climate forced the forests to recede from the north to the south and east. Forests remained in the Yellow River and Yangtze River Basins, and in a temperate evergreen forest belt in South China.

There seems to have been no great single period of deforestation during the Neolithic period of what is called the Yangshao culture. In the Neolithic village of Pan-p'o, at around 4500 BCE, timbers were used for construction, but they may already have been a precious commodity. Technological advances were made, including intensive use of bronze by the Shang culture, which rose at around 1700 BCE. At that time, intensive agriculture on deep, rich soils supported a large population increase. A highly structured society built walled cities. The center of the Shang, at Anyang in east-central China, was clearly agricultural though wild game was still an important part of the diet. Wood was sufficiently abundant that it was commonly used for construction and for farm implements (Fang and Xie 1994). Cattle grazed in the forests and the forests were burned to improve fodder. Indica and japonica rice varieties and two types of millet were grown. As agriculture intensified forests were cleared by cutting and burning (Lowdermilk 1926).

During the early part of the second millennium BCE most of the central Chinese forests were lost (Menzies 1994). To the north and west, a more nomadic, steppe society included Mongols, Huns, and Turks. Tribes were in continuous struggle with the Han Chinese for control of northern and western China. The less accessible forests of the Northeast remained, but they were periodically reduced for military rather than for economic reasons. In Southwest China, where both the Tibetan highlands and tropical Southeast Asian vegetation exist, a different mix of cultures and vegetation prevailed. In all cases, however, the peasant agriculture that endured over at least 5000 years of continuous occupation removed most of the original forest cover.

The Chinese experience indicates that religious teachings alone cannot support long-term forest conservation. Forests were destroyed there despite Daoist and Buddhist teachings that emphasize the desirability of harmony with Nature, that trees have spirits, and that tranquility is to be found in forests. The Chinese carry a belief that forests also contain perils that, if overcome, can lead to enlightenment. In addition, concepts of regulating forests for a sustained yield have had their champions from the time of Mencius (4<sup>th</sup> century BCE) and since (Steen 1984), but with little long term effect. Civil regulations periodically were imposed on forest use, but they were always difficult to enforce. Nevertheless, village forests could endure and supply farmers with fuel, medicines, and materials for implements and village crafts. Under standard Chinese agricultural practices, provisions were made for forest and for orchard tree cultivation. During the Han Dynasty, another period of population growth brought additional pressure for food production, and a commercial

agriculture developed that included the culture of fruit trees. Agricultural manuals that date back to the first century BCE include methods of tending forest trees as well as fruit trees. By the 6<sup>th</sup> century CE, timber trees were raised in nurseries, outplanted, cultivated, and felled according to the agricultural principles of the time. The Manchus imposed regulations on the use of forests for the hunt, much as the Saxons did in Britain, but their effect was contested and only temporary. Large land holdings were controlled by temple authorities and monastic orders, which managed forests as a landscape resource. These forests were intended to be secluded and protected, and were not used.

While the loss of forests in northwest China can also be partly attributed to sporadic episodes of climatic drying and desertification, the major cause of removal was peasant encroachment. At first, removal was gradual, but it accelerated during the 17<sup>th</sup> century BCE due to population growth. South of the Yangtze River, concentrations of farmers were relatively light in early times. After the Ming Dynasty, around 1400 CE, that region also became fully occupied, and little open land was left. After 1890, when the country was opened to western intrusions, rapid industrialization and development of long distance, rapid transportation permitted logging into the upper reaches of previously inaccessible forests.

In Japan, the story is much like that of England. In the 14<sup>th</sup> and 15<sup>th</sup> centuries cities grew, the population increased and warfare was common. Agriculture was introduced to Japan from Korea after the 4<sup>th</sup> century BCE, and it gradually occupied lowland river basins. Buddhism grew to prominence around the 6<sup>th</sup> century CE, creating a period of large temple and monument building. These activities contributed to a depletion of large trees from Japanese forests. During the climatic warming of the 11<sup>th</sup> century the population grew, and forests were gradually depleted. In the 16<sup>th</sup> century, population growth led to a second forest depletion and the imposition of enclosure laws to ensure the availability of timbers for construction of large temples and monuments.

As domestic forests were depleted, other sources of timber were sought. However, while England successfully shifted its source of wood to its colonies, Japan could not. The attempted conquest of Korea under Hideyoshi in the late 16<sup>th</sup> century was opposed by Ming China, and it failed. Under the subsequent Tokugawa policy of national isolation, Japan could rely only on domestic sources.

The forests were largely controlled by village governments and managed by peasants rather than the central government. Local shortages of wood, however, only led to further forest loss across the country. In the 17<sup>th</sup> century the shoguns began to apply restrictions on the "lord's forests" to control deforestation and to ensure timber supplies. With the rise of a commercial lumber industry, conflicts with farmers became more frequent.

During the Edo period, very heavy logging was conducted for construction of monumental buildings and for rebuilding cities, which burned fairly frequently. The over-cutting induced rapid soil erosion, and declines in forest yields were soon apparent. While the country was largely still pacified under the ruling elite, population growth and concentration into cities continued, as did the high rate of forest loss (Totman 1984).

Foreign adventurism also continued and was accompanied by military needs for timber and civilian needs for construction of large monuments. Nationally, this led to regulations on the production and consumption of trees, to the beginnings of afforestation programs, and to intensified conflicts with farmers. After the Meiji restoration of imperial

power, many forest holdings of various types were turned over to the Emperor. Major modernization efforts, however, called for heavy logging. By 1900, two-thirds of forest lands were under Imperial, national, or municipal ownership. These changes led to violent resistance, illegal logging, and to even more rapid deforestation.

At the end of the 19<sup>th</sup> century, the loss of forests also led to scientific forestry and planting and management programs, which allowed Japan to improve the condition of its forests. At the same time modern foreign military adventures resulted in colonization of Korea and Manchuria. From these colonies, logs were imported back to Japan. More recently, Japan has been a major importer of logs from the remaining tropical forests of Southeast Asia.

In Asia, as in Europe, there was a long and continuing romantic view of forests. Aryan literature considered forests as dark, dense, and dismal, but also as places where merit could be earned by giving up material goods and living in solitude. The Buddha similarly viewed forests as a place of refuge where one could find a haven and seek enlightenment. In China around 300 BCE we see one of the earliest expressions of a dichotomy between considering humans as essentially good and seeing them as requiring training in order to control their inherent wildness. The conflict between Mencius and Hsun Tzu helped to develop Confucian philosophy, and presaged an aspect of the conflict between the European Enlightenment and Romanticism by 2,000 years. But the contrast between the wild and the need to civilize the wild was confined to human behavior. The forest allegory was apparently not a part of the Asian mythology as it was for the European. The desirability of civilizing humans was not extended to a need to civilize Nature.

In the arts, the concept of the place of humans in nature developed around 1,000 CE during the Song Dynasty in China. At that time painting expanded from an exclusive product for the educated class to a product for merchants and more common people. In the 8<sup>th</sup> century, landscape painting of the famous blue-green style had become established. By the 10<sup>th</sup> century, in the Tang Dynasty, human figures dominated the landscape which was used primarily to place the human subject. During the Song Dynasty in the 10<sup>th</sup> to the 13<sup>th</sup> centuries, a period of political unrest ensued and Buddhist priests took to painting landscapes as a means of contemplation. They established an iconography of trees in the landscape. All aspects of human life, including views of the artists themselves, were placed as small accents within landscapes of mountains, forests, and rivers, drawn in a realistic style. These were not allegorical paintings, nor were they depictions of human occupation. Instead, they were interpretations of humans as one of the dependent elements of Nature. In the portrayal of landscapes, there was order and structure. The mountains and rivers were considered to embody continuity, while human affairs were ephemeral. While these depictions may hint at a concept of harmony between human society and Nature, it is a harmony with a landscape strongly modified by humans. The forests that remained available to the artists of the Song Dynasty could only have remained in the remote and inaccessible mountains. Forests may then have been an adornment for monasteries. Their protection in temple grounds and in special areas did not necessarily imply a desire to favor forests over farmland, or to exclude grazing and other uses of the land. There was a dichotomy between views of the forest as harboring spirits and having merit as sanctuaries versus their utility, but spiritual values that might prohibit cutting were relegated to remote reserves. There is no comparable Asian view of forest wilderness as embodying an ideal state of existence as there is in Europe and North America.

The tribes and nations to the north and west of central China, in the Tibetan highland and in the moist tropical forests of Indo-China, Malaysia and Indonesia, had more direct contact with forests. They have also traditionally been considered by the Han Chinese to be less than fully civilized. In the north, many were nomadic. Elsewhere, many practiced a form of hunting and gathering, perhaps supplemented by some forms of shifting agriculture. The areas now contain some of the last frontier forests on the globe.

Callicott and Ames (1989) argue persuasively that there is something to an Asian perspective that is conducive to a more benign treatment of forests. We might then ask why this more adaptive Asian perspective on nature didn't have a more benign result. Callicott and Ames also decry the current state of deforestation and nature abuse that is occurring throughout East Asia. They suggest that this state is due to a western intellectual colonization effect, and that Asian ideas are therapeutic. They argue that the failure of a more resilient Asian attitude toward nature to stem the widespread destruction of forests is due not to a separation of ideal and practice, but to a western dominance of thought. They further argue that the dominance is now fading and that western thought can now be liberated by study of eastern concepts.

I am inclined to disagree. Asia has a long history of forest destruction that predates written records. From what is known of forest abuses during the historic period throughout the major centers of Asian civilization, it seems clear that ideal and practice have long been separated. The Chinese adopted a cultivation system that could effectively utilize the lowlands of central China. Over the next 2,000 years forests were removed until they existed only in remote and inaccessible areas. The removal of forests was perhaps more gradual than in Europe, but it was no less decisive. The benign ideal was separated from common practice by space as well as philosophy. The monastic sanctuaries were remote from the kinds of agricultural practices that eroded forest ecosystems. In China, as elsewhere on the Eurasian continent, that separation was achieved by removing the forested sanctuaries away from centers of agricultural activity.

Major confrontations between alternative uses of forest land have occurred in Asia in the 20<sup>th</sup> century. But the basic causal dichotomy, treating forests as material resources versus treating them as a respected entity, is much older. It is common to all of the dominant societies of today, both in the West and in the East.

**Dichotomy  
and  
Perspective**

We might ask if the dichotomy of forest perspectives is a necessary consequence of human perception. Are we doomed to always engage ourselves and our forests in discord? It seems that the dichotomy is the same in all industrialized cultures. It is a shared heritage that arose well before agriculture gave birth to writing, and before the written word had overpowering dominance in shaping thoughts in agricultural societies about the nature of forests. In fact, when scribes first wrote narratives and legends about their world, it was only after several millennia of agricultural alteration of the environment. The written history of forests comes not only from an agricultural perspective; it is based on forests that had been physically altered by agriculturists to create sharp boundaries between field and forest. The structure of forests, and of our thoughts about them, both predate writing. We have to look to some time before the invention of writing, perhaps even before the beginnings of agriculture, to see if there ever was a time when our views of forests did not diverge.

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## CHAPTER 6. THE TRANSITION TO AGRICULTURE

TRANSITIONS TO AGRICULTURE took place at several times and places. Some occurred even in modern times as hill tribes, for example, experimented with mixed forms of cultivation. As the development of hand tools advanced and knowledge of plant and animal behavior accumulated, humans became more adept at providing for their own sustenance with their available resources. Ever since modern humans first emerged and migrated from East Africa they probably have experimented with various ways to influence plant and animal behavior. They were also capable of large migrations, and would have been readily able to shift their areas of settlement either as they depleted local resources or as local climates changed. In their earliest migrations out of Africa, they would have moved with a forest edge that was changing during the late Eemian cooling period, and would have subsequently lived through frequent sudden and large climate changes. The latest of these climate driven events were the last glacial maximum, the warming and the millennium of cooling in the Younger Dryas that ended suddenly around 10,000 years ago when the Holocene began.

Since early human populations often would have been somewhat isolated, each of them could reasonably be expected to have developed unique ways to meet their needs in their changing world. They each had distinct initial conditions, and many could have tried novel ways of meeting their resource needs. It is difficult to imagine that the development of cultivation occurred in one place and at one time. Rather, it seems likely that various species and methods of cultivation were tried in fits and starts in many locations. Ultimately, a few species and methods were favored. Over several millennia, a few agricultural systems became dominant (MacNeish 1991, Diamond 1997).

The question of why and how the transitions to agriculture occurred has been the subject of considerable research and is not our concern here. The major agricultural systems seem to have resulted in the divide we presently have between field-based civilizations and forests. Perhaps there was a kind of inevitability to the process of alienating forests from civilization. We might now ask if opportunities for a more benign coexistence ever existed, and if so, why they weren't taken.

The environments of the forest edges from which agriculture developed differed from valley to valley, and from bottom land to upper slopes. Each offered different opportunities for the residents to continue life either without agricultural development or with a mixture of some food production systems with foraged resources. The environments and plant species used in the transition differed with location. Variations in the development of tools provided different opportunities for their adaptation to cultivation.

The earliest known developments in cultivation were by the Natufians in the hills of Southern Turkey and Northern Iraq and Iran around 7,000 to 8,000 BCE. They occurred during the warming period after the glacial maximum and after the Younger Dryas, when climates and vegetation were still in transition and human technology was evolving from the Mesolithic to the Neolithic period. Sea levels rose, and lifted the Mediterranean above the Black Sea. When the passage at the Bosphorus was breached, massive flooding along the banks of the Black Sea could have given rise to legends of the flood as later told in Sumerian stories. Forests were present at upper elevations where rainfall was steady. Open

woodlands occupied the slopes, and rivers with floodplains were within walking distance. Simple tools for harvesting and seed planting were sufficient in the Levant and Central Asia for the beginnings of cultivation (Henry 1989, Dolukhanov 1994). Signs of seed gathering and the use of harvesting tools from sedentary home sites are found there (Bar-Yosef 1995). After a few thousand years of gradual change, efforts were made to channel water into cultivated plots. While the technology allowed for better environmental control, agriculture did not offer a better diet. Instead, it provided a higher average pay-off for any invested energy (Richerson et al. 2001). At various times many settlements were established and later abandoned in the hills of the Taurus Mountains, where hunting a broad variety of animal species was feasible and where at least 14 species of plants could provide a varied diet in at least one settlement.

It is also likely that there was no single, continuous development of an organized multifamily society. Such groupings may have started with many, more or less independent clusters of small family groups that used a similar technology to manage survival for a few generations. Family groups would have continually moved as they exhausted local resources, but some apparently found sites in which the multiple resources needed for survival were available and were sufficiently robust to permit a sedentary lifestyle. The rainfall in the area of the Levant was higher than at present, and supported forests and open woodlands. In Central Asia, the rivers flowed from the mountains into interior lakes. In the Fertile Crescent water flowed from east of the Taurus into the Tigris and Euphrates Rivers. When the rainfall began to gradually diminish in the Near East, perhaps around 6,000 BCE, the oak forests began to decline in the Levant (Wright 1993). With less rain, gathering required foraging over a wider range or a concentration of activity around water courses, and rain-fed cultivation would have had to be supplemented by irrigation (Kühne 1990). Efforts to control that critical resource would have had a high return when water was taken from the rivers in the lower elevations to the south of the Taurus. In the upper elevations of the Zagros, in the hills of what is now Kurdistan, and from the northern Iranian plateau into present-day Turkmenistan, rainfall was sufficient to maintain forests (Dolukhanov 1994). In the plains of southwestern Mesopotamia, however, water control became more critical and could have induced a greater reliance on irrigation (Oates 1968). What started in the forested hills with hunting, gathering, and some cultivation became primarily cultivation and water management for a few species that were amenable to the available technology.

In Mesopotamia, the Hassunian culture began the transition from using a broad spectrum of animal species that were hunted in the open forest to raising of domesticated animals. They also switched from growing the primitive relatives of wheat to the modern variety of bread wheat. Earlier, around 9000 BCE, a mutation of primitive Einkorn wheat had been found that did not scatter its seeds but held them on the stalk, allowing harvesters much greater collecting efficiency. Such a plant would not have been likely to survive without deliberate preferential intervention. The Emmer type of wheat was found around 7000 BCE. It was a mutant with double the chromosome number. It had larger seeds and a broad climatic adaptability that allowed it to be planted more widely than the Einkorn. Neither type could have dispersed naturally due to the effects of their genetic mutations, and both seem to have been widely used in sites where they could not have grown without the aid of primitive cultivators. Both were used in the hills of the Zagros Mountains and have been found in excavations at Jarmo, but only Emmer has been found in Hassuna, which lies in the nearby Euphrates valley (Helbaek 1959).

Barley was also developed as a cultivated crop around 5000 BCE, when some mutant plants were found that didn't disperse their seeds, and when a six-rowed spike developed from the normal two-rowed spike. Barley was transferred to the cultivated plains from its hillside origins. Peas and lentils were also domesticated during this period. Thus, several fortuitous mutations and opportunism combined to provide a suite of species for concentrated food production. These species made a diet with enough variety to sustain people. The diet was not as diverse as previously available, but it was enough for survival. In Central Asia and the Caucasus, pistachio, grapes, apple and other fruit-producing species were also available. Hence, the people there assembled a different suite of species for their survival.

By around 6000 BCE, evidence also exists for a progression to agriculture in present day Turkmenistan, Northern Baluchistan and the Indus Valley. In the Caucasus, dense forests and forest edges were rich in food and general plant species diversity. These forests harbored bears, foxes, boars, and wild goats, pigs, and onagers, the predecessors of cattle. In Northwest Afghanistan, environmental changes caused shifts in drainage patterns. As in Mesopotamia, these shifts induced changes in technology for reliable food production (Kohl 1984). Combinations of useful species varied among regions, and different systems of agriculture, arboriculture, and animal husbandry were adopted. In the period after 6000, but before 4000 BCE, the shift in Mesopotamia to the lower river valleys with deep alluvial deposits and easy water control allowed the Ubaid culture to develop. Concentrated agriculture could support much larger populations, which could then be organized for different tasks of cultivating, planting, harvesting, and water channel management. Ultimately, this activity led to the founding of city-states such as Ur around 5000 BCE and Uruk by the middle of the 4<sup>th</sup> millennium BCE.

A strong hierarchical social organization developed, and large construction projects created monumental temples and administrative centers from which a military establishment could control an extensive area of hinterland as well as colonies. City-city conflicts were common, and the high levels of social and political organization necessary to organize societies and their defense were created well before Uruk was established.

In Mesopotamia, there is evidence that the climate continued to deteriorate; soil salinity increased and local grain yields declined sharply. Agricultural practices had to be altered, and there was an increased reliance on long-distance trade for food and other resources. As any urbanized civilization grows, it must expand its area of resource acquisition. To the east, this process could have involved trade with Baluchistan. To the west, trading took place with areas of the Eastern Mediterranean and eventually with Egypt by around 4500 BCE.

The cuneiform script was developed in the city-states for trade and accounting purposes. Professional scribes existed by 4000 BCE, some 5000 years after the beginnings of agriculture. The script was eventually developed to the point of being serviceable not only for these administrative purposes, but also for recording narratives. The earliest stories recorded on clay tablets around the beginning of the 3<sup>rd</sup> millennium (Dreyer 1999) were thus written at a time of societal change, well after the establishment of an agricultural society of city-states and kingdoms. But the kingdoms were small enough so that the areas outside of government control were still within a few days' walk. A nonagricultural way of life was still part of the common memory. The principal deity was the goddess Inanu, but the kings who exercised governmental control were male, and the second King of Uruk

after the legendary flood was Gilgamesh. The legends surrounding Gilgamesh depict a world in which agriculture gave power to those who could harness its capacity for providing surplus wealth and who could organize a society and protect its core within city walls. By the time of the writing of the story of Gilgamesh, the organization itself had become the defining element of civilization. Areas and people outside of the city or its areas of agricultural production were already defined as being outside of civilization.

The independent development of cultivation in the Far East, in the Yellow River Basin, followed the Mesopotamian by less than a millennium. Millet and rice were cultivated on semi-arid sandy plains above the rivers. Beans and peas were grown in Thailand by around 6000 BCE. Along the Yellow River the forests grew only in the highlands, well above the areas of cultivation, and were already remote from the flat and fertile, though dry fields (Fang and Xie 1994). It is not clear where the original cultivators came from since the area itself was so dry, but by 2500 BCE there was a population explosion. A mixed pastoral and agricultural economy developed, and organized villages appeared shortly thereafter. Gradually, a logographic writing system capable of recording stories developed. The time between the early development of agriculture and the writing of tales related to life experiences was about the same as for Mesopotamia. That period of development was longer than the time since the beginning of writing to this day.

The first writings describe a separation of civilization from forests in ways that suggest a condition that had existed long enough to be seen as traditional. The entire written record of human history has been founded on an agricultural perspective that preceded the invention of writing by several millennia. It was long after the forest had receded from the edges of human habitation, and after the definition of civilization had placed the forest and its people outside and in a foreign territory. The dichotomy was established early in our history and in our consciousness, but the transition from the various forms of hunting and gathering to agriculture was not a single event from a common foundation in which modern societies developed in a consistent pattern.

MacNeish (1991) considers the necessary and sufficient conditions for that transition and compares the forms of the transition found in the Andes, Meso-America, the Near East, and the Far East. The particular crop species that formed the foundation for an agricultural system obviously differed among these regions. The pressures to change and the opportunities to adopt an agricultural system also differed (Thorpe 1996). But the transition was from a forest-edge environment, either at the edge of a prairie or a water-course, to a partial adoption of crop cultivation, to an eventual complete dependence on cultivation for the dominant societies of today (Vrba et al. 1995). As I have argued in the previous chapter, the demise of forests followed a sequence of pushing the frontiers of forests away from the centers of civilization, the simplification of the food producing ecosystem, and the relegation of forests to an isolated ecosystem.

### **Cultivation of Species**

From around 8000 BCE, Near-Eastern development emerged from the hills of the Levant, where there were domesticable animals, a combination of grains, and various other food species. These resources were sufficient to provide a basic diet, and the social structure adapted to the environmental changes that were impinging on people's lives. From there the model and the suite of species was taken largely intact to Europe by around 4000 BCE. Soon thereafter, the Bronze Age began, and a modern type of agriculture developed. Later they mixed their crops with the more tropical species that entered from Indian and

Malaysian origins. The Andean centers of agricultural dominance started from the hills and sea coast around 6000 BCE. The economy that developed there was based on potatoes, peppers, beans, and squash, to which maize and peanuts were eventually added. The Meso-American center developed at around the same time, and eventually came to focus on maize, beans, and squash, which slowly spread to North America.

From the agricultural perspective, as comprehensively reviewed by Diamond (1997), a certain inevitability seems to drive the success of a relatively few sets of cultivated species over the hunter-gatherer systems and forces the simplification of cropping systems that we see today. In any case, the written tales consistently view the alienated forest and forest dwellers as a singular "other," despite the fact that the ones that were displaced were of many different types. Those who were displaced were consistently considered to be of a wild or ancestral type who remained outside of civilization. Even in areas of the world where forests remained close to agricultural fields, and where forest dwellers continued to trade with agriculturists before the victory of agriculture, the multitude of non-agricultural systems of living were merged into a single alienating concept. The invention of writing seems to have focused on the complexities of civilization and to have homogenized forests into a simple and uniform system.

In historic times, the great expansion of human culture was largely at the expense of forest ecosystems, particularly at their edges. By clearing shrubs and small trees for crops, by irrigating the prairies and steppes, and by applying other technologies, other areas of arable land were expanded. The forest edge became more sharply defined and the forest itself was invaded. With the advent of writing and the rise of city-states, our inventiveness and technologies have focused on human interactions. To the detriment of both human and nonhuman ecosystems, we dominated the nonhuman world and considered our interactions with other ecosystems only insofar as they served our more immediate uses.

Almost inadvertently, we have expanded the area under cultivation and accelerated the rate of species extinction by orders of magnitude. We have also narrowed the species base on which we depend for food from more than five million potentially edible plant species to direct utilization of 100,000 species. Of these, only around 500 species are domesticated, only 20 species provide over 90% of the daily human caloric intake, and only three provide around one-half of our daily caloric intake. Of the more than 25,000 tree species in the world, only a few dozen have been deliberately cultivated and only ten of these may be needed to provide all of the industrial wood needed. We also use only a small fraction of the genetic variation available within each of these species, and have reduced the systems of cultivation to a few standard types in order to use the few varieties that we have developed most efficiently.

It can reasonably be argued that through trial and error, we have chosen the very best varieties of the very best species for cultivation and can continue to incrementally improve our use of the remaining resources. Following this line of thought, it can be argued that there can be few substitutes for the species we have already developed, such as wheat, maize, or rice, and that only a few species are needed to supply all of our industrial needs. The argument goes that there are certain characteristics of plants that make only select species amenable to industrial development, and those that have been developed are the only ones that we need.

An obvious counter-argument to this line of thinking is that our human ecosystem is based on more than just those species that have directly marketable value and that we depend on many more species in forests and fields to provide ecological support for the species that are harvested. The crop species require many other animals and plants for the crops to be viable. Another counter-argument is that the history of species development is full of accidents and twists of fate and is not at all predetermined to yield the best results in the long run.

However, the systematic exploration of even the most likely of possible alternative species has hardly begun, and this work remains a minor activity relative to the investments made on genetic engineering of a few crop varieties. The reduction of species and genetic resources obviously is not a new phenomenon. It has precedents throughout the history of agriculture and is one of the consequences of the transition to agriculture.

**Humans,  
Forests  
and Food**

Long after the ability to write narratives was developed, the traditional hunter-gatherer lifestyle persisted, and hunter-gatherers traded with the more developed communities. Larsen (2000) points out advantages of the traditional hunting and gathering that persist to this day. To those living in an agrarian or urban world, however, the traditional lifestyle presented a marked contrast.

The persistent coexistence of people with traditional and modern lifestyles was made apparent to me a few years ago in a Cameroon rainforest. A team of us went there to examine issues surrounding the conservation and sustainability of forests where a logging operation by a Dutch firm was planned. The local residents were Bantu-speaking people in an area that had been colonized in the 19<sup>th</sup> and 20<sup>th</sup> centuries by Britain, France, and Germany. Before that, the area had been under the partial control of Arab traders. In the major port city of Douala, I saw the modern mixed economy of a developing nation. Computer support shops and fax service centers, along with open market areas, were served by open sewage ditches. In the villages, a wide variety of skin color and facial types, ranging from Arabic to central African, could be readily discerned. It was explained to me that people often moved from their home villages to the city centers and back as the economy fluctuated. When I visited, there was a glut on the international cocoa market, which caused a national recession and increased unemployment in the cities. Many people were moving back to their home villages where, despite the depressed commodity prices, they could subsist with a form of shifting agriculture, trapping small mammals, and harvesting fuelwood from designated areas of the nearby forest. It was easy to imagine that the Bantu, who had been living in the area for at least 50,000 years, had accommodated to the shifting tides of humanity. Manioc and maize were added to the system of cultivation when they became available, and commodity crops were grown when the cash economy developed. The Bantu otherwise maintained a subsistence economy that was suitable for that area.

Under the auspices of the Centre for International Forestry Research (CIFOR), we were searching for ways to estimate the sustainability of forests with and without managed logging, and we needed to sample areas in primary forests. Under the canopy of the mixed evergreen hardwoods, we were looking at the dispersal patterns of mature, old trees whose crowns had spread over the top of a continuous layer of smaller trees. The cool shade of the upper and middle canopy, the sparse undergrowth and a few lianas made walking and estimating distances relatively easy. We could see how some saplings had found openings in the upper crown level and were ready to emerge. We walked into some brush and on the

other side, in an opening, we found ourselves in a Pygmy settlement. It was only large enough for one family group, which had apparently wanted to avoid such intruders. The settlement consisted of three small huts made of banana leaves over a bamboo frame. Each had a single mat of leaves in one corner that might have been a bed. Outside there was a fire pit, but no other structure or furnishings existed that would mark the area as having been occupied by this family. What was most surprising was the presence of three pepper shrubs, the only evidence of cultivation possessed by these traditional hunter-gatherers who foraged for yams. Their failure to cultivate crops was not a decision arising from ignorance, it was a decision based on choice (Bahuchet et al. 1991). For tens of millennia, people of the deep forest could subsist in small, scattered family groups by hunting and gathering. They wished to, or were forced to, stay somewhat separate genetically from the Bantu (Cavalli-Sforza et al. 1999). They could trade their bush meat for salt and other necessities and, by the evidence of the pepper plants, could occasionally adopt a species to cultivate, but only as a condiment for their main diet.

I was embarrassed by my voyeuristic invasion of their privacy, but I wanted to see them and learn about their daily life. Through persistence, they maintained their distinctive system and coexistence with Bantu, Arab, and European systems; it seemed that they had endured this way for millennia. I found it easy to repeat the same error that the Europeans did when they encountered indigenous North Americans, assuming that the existing system was frozen in time from previous millennia. It seemed that this was an original way of life, but since societies continually evolve, and we lack evidence of how this society has changed, we can only speculate that widely different social systems such as these can coexist and coevolve.

Long-term coevolution is also demonstrated in the Amazon Basin, where various mixtures of systems of hunting and gathering, and systems of arboriculture and agriculture have coexisted for several millennia. In the neotropics, settlements along aquatic forest edges around 11,000 years ago were contemporary with the beginnings of North American settlements (Roosevelt et al. 1996). People in the Amazon Basin had access to a very rich diversity of plant and animal foods. The last global glaciation events had dried the neotropics and left fragmented forests in disparate parts of the Amazon. The forests later merged into a highly diverse rainforest (Lewin 1986). However, Amazonia is a mosaic of diverse soil types, patches of savannah, and innumerable rivers and lakes (Roosevelt et al. 1991). This complex ecological structure offered the original nomadic foragers a variety of forest edges to inhabit and exploit (Moran 1991).

The patchy distribution of natural forests and, within them, the patchiness of species is still exploited for food by the Yaqui in the Bolivian Amazon. These people have no dependence on agriculture (Stearman 1991). The Kayapo of the Brazilian Amazon have systems of forest manipulation that induce secondary forest structures, which produce concentrations of food species in strategic locations (Posey 1985). There is also evidence that by 9000 years ago, humans manipulated forests to enhance food crop productivity. By cutting and burning (Roosevelt et al. 1996) they supplemented frequent natural disturbances that regenerated early successional forests (Bailey and Headland 1991). Thus, there is probably no forest in the neotropics that was not intentionally influenced by human actions long before agricultural systems were conceived of anywhere in the world.

With the development and introduction of manioc around 4000 years ago, and maize around 3000 years ago in Mexico, agricultural crops were sporadically introduced as a

supplement to otherwise fairly rich and varied diets (Hard and Roney 1998). While the introduction of agriculture took various forms and occurred at different times, large city-states were established as chiefdoms by the Marajo Amazonians before the Andean or coastal Peruvian empires were established. The Marajoans had apparently developed a full-scale agricultural system with a military establishment before the present era. The system continued to around 1300 CE, when it mysteriously disappeared (Roosevelt 1989). However, during its development as a social system, there was a shift from broadly based plant and animal food resources to maize and manioc staples, and a shift from a religious and political dominance by women to one in which males came to dominate. After its demise, other chiefdoms were established in the Central Amazonian Basin, around present day Santarem. These were in the process of expansion and further development when the Europeans came and obliterated those societies.

The processes of agricultural encroachment were not uniform even within the Amazon, but depended at least partly on the available biological resources that were unevenly distributed. In particular, in the river floodplains, or the *Varzea* as it is known, the riverine margins provided forest edges for human settlement. Food resources were concentrated at the edges, which provided opportunities for foragers to select species and varieties (Meggers 1985). In at least one instance, the flooded forest was managed for fish production instead of for manioc or maize production, though both manioc and maize were cultivated (Chernela 1989). In the backwater regions of the *Varzea*, the floodwaters do not carry the silt on which maize could grow well, but the flooded areas containing standing forests can produce higher levels of fish yields than permanent streams and unflooded estuaries. In those areas, standing forests are more productive than areas cleared for agriculture.

In all cases, extensive trade occurred between those who derived their food primarily from the forest and forest edge and those who derived their food primarily from agriculture. There was continuous contact and interaction among people, and the choices that were made often favored a forest over an agricultural system. Even within the Amazonian aquatic system, conditions varied among forest edges and among various savannah and field edges. In all cases, however, the option of a forest life was available.

In other tropical forests, such as in Malaysia (Brosius 1992), New Guinea (Dwyer and Minnegal 1991), and the Philippines (Brosius 1990), the forests can provide sustenance for human societies without agriculture, but with very different food species and systems of foraging and partial management. At least in modern times, trade is an important part of the economy, but not always a necessary component. It is not clear whether inducing and managing secondary forests is necessary, but it is often an important component of food management. Thus, for forest dwellers, the use of forest foods is not a social necessity. They often trade for crop species and cultivate some species, but they do not depend on a few staples for proteins or calories.

It seems clear that forest edges are, and always have been, more varied than the agricultural plains. At the time of the transition to agriculture, forest edges had been opportunistically manipulated to provide a secure, multi-species resource base. Edge dwellers adopted crops and traded as possible. They accumulated particular assemblages of species for use in different systems that included foraging, hunting, and cultivation in various combinations.

We may reasonably conjecture that everywhere, the transition to agricultural crop species was from a very wide species base to a much narrower one. Most evidence for the beginnings of the transition begins either at the beginning or end of the hypsithermal, when a general global warming elevated temperatures above their present levels after the retreat of the last great glaciation, around 11,000 years ago. Harvesting tools were developed, and permanent dwellings in small settlements began the social organization of human societies. At that time among the various human groups, many thousands of plant species would have been available for food and medicines. Hunting and trapping also provided a wide range of animal species, a very few of which were amenable to herding. In any one society, with the exception of those who lived in marginal sites such as the desert or tundra, many species would have been used at least sporadically.

As climates dried at the end of the hypsithermal, around the 6<sup>th</sup> millennium BCE (Mullins 1998), rain-fed agriculture was aided by irrigation, which would have been relatively easy in the lower plains (Kühne 1990). Effort was focused on species that could be adapted to more intensive cultivation that would justify the effort required for irrigation. In each of the centers of agricultural origin, a few species were the focus of development and eventually came to provide the great majority of the daily caloric intake of the whole society. Cultivation yielded a 10- to 100-fold increase in harvestable calories per arable acre. These bountiful crops gave the agricultural economy the power to grow, but also narrowed the number of species used. Of the few hundred species that have been domesticated, relatively few have formed the basis for agricultural societies (Vavilov 1992.).

Storability of grain species made it possible to spread out the availability of calories over seasonal and even annual fluctuations in harvest. Prior to agriculture, humans had a minor dependence on each of many species. With agriculture, they were highly dependent on a few species. In the Near East the transition came to eventually focus on barley, oats, and wheat, plus sheep, goats, pigs, and cattle. In Asia millet and rice, plus the horse, camel, chicken, and buffalo were the early species of choice. Barley and wheat were added later. In the Americas maize, beans, and squash, plus the llama and alpaca, were the main domesticated species. It is interesting to note that even today, worldwide, only 14 mammal species have been domesticated seriously, and of these, only five are globally distributed and are of major economic significance.

Despite disadvantages in dietary quality and variety, it was the agricultural societies that eventually dominated the continents. More food could be obtained from sites that were amenable to cultivation, and could support larger populations in those areas. They could then organize city-states and accumulate wealth and power that allowed them to dominate nonagricultural societies. From one perspective, the technology preceded the social organization by providing a better resource base for population expansion and ultimate dominance. Alternatively, it is argued that those who were under the stress of a changing environment were forced to organize social structures larger than traditional family groups in order to survive with cultivated plants. From the latter perspective, social structures were developed that allowed them to exploit a new environment, to grow crops, and then to dominate (Diamond 1997). In the long evolution of agricultural systems, there are several possible chains of causation that could have led to the dominance of agriculture. Since the transition was generally slow and the alternative systems were often readily visible to early farmers, they would have had persistent comparisons with a way of life that

was perhaps healthier from time to time, and was less constrained by social hierarchies. For them, there was indeed a Golden Age that wasn't far out of reach.

But just as there were many initial conditions from which agriculture emerged, and many transitional paths taken, there were many different Golden Ages that were the stuff of dreams even for the agriculturists. There was, for the common person, at least the appearance of less labor, more leisure, and less regimentation outside of civilization. But civilization produced greater food security and permitted populations to grow. With growth came military power and large and structured societies. Eventually, a leisure class appeared, as did writing and all the inventions that we associate with the modern world. The transitions would not have been uniform from place to place. "Progress" would initially have proceeded in fits and starts over long periods of time. It would not have been until much later in the historic period that the agricultural systems would have evolved into the few sets of cropping systems. Urbanization would have also removed most people from contact with the hunter-gatherers.

The development of a common dichotomy of the wild and primitive, as distinguished from the ordered and civilized, is a result of a coalescence of a few common threads from a multiplicity of origins that existed before history. By the time of the first written stories in Sumer, Gilgamesh already mythologizes the forest as an alien world. It can be imagined that the first scribes, who adapted the cuneiform script from its utilitarian function of recording trade and taxation to record narratives, must have recorded the ancient and already enshrined myths that were the significant foundations of their society. It was in the 2<sup>nd</sup> Dynasty of Uruk that parts of the story were first written. It was well after agriculture had descended to the plains, a thousand years after Uruk itself had been established, and a few hundred years after Gilgamesh was King. It was a time when the climate had begun to dry and the forests of the Zagros had begun to decline (Oates 1968). The first cuttings of the cedars of Lebanon had begun, and a timber trade with Egypt had started. This was 400 years before Sargon ruled over Akkadia, and a thousand years before Hammurabi set down his code of laws in Babylonia.

Our alienation from forests, therefore, was established well before the beginnings of literature, which was instrumental in simplifying our concepts of forests. The dichotomy that is expressed in our modern conflicts is indeed ancient. The beginnings of agriculture were poorly remembered, and the many and variable kinds of forests that could sustain life were already relegated to an ill-known foreign territory. The biological complexities of forest life were largely ignored in the literature of the agriculturists and urbanists.

The story of Gilgamesh carries many elements of interest and has common roots with biblical and other creation stories (Damrosch 1987). In these founding myths, forests are clearly outside of human settlements and are the home of gods, the location of "otherness", where dangerous spirits abide, but where a primitive self may be found before it is socialized. The themes are carried into Greek and Roman mythologies of wild men who existed in a Golden Age of simplicity and innocence. While Homer could imagine Arcadia as Sicily stood before logging and Ovid could imagine an idyllic wilderness, the Greek and Roman forests were long since removed. There was a divide between idyllic forests and tangible forests that had to be cleared. To the Romans, uncivilized areas were adjacent to the Empire and were occupied by the Scythians, the Ethiopians, and the Germanic tribes, with whom they battled and about whom they created myths of the forest wilderness. From the Roman perspective, the forests were to be made productive, and those that hid

an enemy were menacing. The battle of the Teutoberg forest was a disastrous loss for the legions of the Emperor Augustus, who sought to civilize the wild. But to the Germanic tribes, it was a victory of the indigenous people who lived in a still largely forested environment.

With the gradual settlement of Germany and its development as an agricultural society, its original forests were lost. Following the industrialization of Germany, intellectuals such as Schiller and Goethe (see Vogt 1996) were led to view its forests differently. The roots of the German people were in the forests. Their virtue derived from that milieu, and forests could evoke a Germanic Golden Age. The Arthurian medieval legends of Chretien de Troyes were brought by von Eschenbach into German literature and used in the powerful musical evocations that Richard Wagner instilled in his last opera, Parsifal. That character is an innocent in the forest who finds deep wisdom there. In a more sophisticated manner, Nietzsche ascribed the purification of the virtue of Zoroaster to his wanderings in the forest, which is a buffer zone between the spiritual and human domains.

While the biological forest was simplified and its complexities were largely lost in literature, forests have always had multiple cultural properties. The process began with the agricultural dichotomy between civilization and "foreign" territories and behavior. With further alienation and the reduction of the forest edge, any forest that was close to civilization was either a threat or a wasteland in need of taming or removal. Forests that were sufficiently distant in time or geography carried the mystery of our unknown origins. There, chaos might not only be tolerated; it might be the necessary basis for creation. There was a separation of farm from forest, and a dichotomy of a revered and mysterious forest versus a dark and threatening wasteland.

### **From Dichotomy to Duality**

From the very beginnings of history through the 18<sup>th</sup> century in Europe and Asia, the forest was either a place of reverence or a chaotic threat. The two concepts coexisted but in separate contexts. A forest could not be both. Hence, forests that grew near civilization had to be made orderly and either converted to pasture or field, or grown as another regulated crop. But with the colonization of the Americas, and ultimately with the closing of the forest frontier, actual experiences with specific, standing forests forced both sides to meet in the same forests. The different aspects of a forest could then be understood to be visions of the same forest. The values that are placed on the standing forest and its harvested products, including spiritual as well as many sorts of material values, must now be reconciled in every forest.

Forests became either one or the other, even though both aspects were present in each forest. Conflict occurs because one or the other side seemingly dominates. Until the late 19<sup>th</sup> century, the dichotomous views of forests could coexist as long as there were distant or foreign forests that could fulfill dreams of past Golden Ages. Conflicts were latent within the dichotomy, but were rarely realized in actual standing forests. It wasn't until the 19<sup>th</sup> century in North America that the European proponents of these views were forced into contention in specific forests, and became engaged in national political issues. The Romantic philosophy that conflicted with the Enlightenment establishment could find actual forests in which to contend in the New World.

Among the efforts to resolve the conflicts in the United States, the separation of National Parks from National Forests can be seen as a concession to an ongoing dichotomy. The ongoing struggles to maintain pure wilderness in some areas and production

forests in others indicate that the nature of each contrasting type of forest is ambiguous. It is obvious that all forests have been impacted by humans to some degree, and that forest products are multidimensional and include far more than what simple measures of monetary income can indicate. The conceptual differences that existed for millennia in Asia and Europe, and that previously could be separated in space and time had to meet, and the duality of forests would emerge. However, simple recognition of this is not sufficient for resolving conflicts.

In addition to the physical and philosophical confluence of conflicting aspects of forests, another strong force affects our behavior. In the 19<sup>th</sup> and 20<sup>th</sup> centuries, the rise of liberal democracy, caused in large part by the pursuit of freedom, generated fragmented interest groups (Fukuyama 1992). Instead of Royal decrees regulating forests, roughly similar levels of power are given to institutional, industrial and other interests in the treatment of forests. Conflicting visions of forests could now be formulated in popular political terms with political consequences. But political resolutions involving biological issues are notoriously unstable.

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# CHAPTER 7. THE DEVELOPMENT OF FORESTS, MAN AND ECOLOGY

## The Development of Forests

BEFORE THERE WERE HUMANS, there were forests. For nearly a hundred million years before the first human emerged, conifers, and later hardwoods, had been growing. Technically, the hardwoods are angiosperms, or plants that enclose their ovules within protective tissues. Originating more than 65 million years ago, they proliferated into vast numbers of our modern-day species and genera of woody shrubs and trees. And for around 100 million years before that, conifer trees dominated over ferns and other large plants. Moreover, those ferns had grown for over 100 million years before even the conifers emerged.

The evolution of a vascular system allowed plants like ferns to lift their leaves above ground level, providing a vertical dimension in which leaves could better utilize and compete for the sunlight. A vascular system supplied water for those leaves to function well above the forest floor.

In the subsequent movement and development of the continents, and as seasonality developed, the conifers and angiosperms evolved and dominated broad regional zones. In cold climates, only tundra vegetation grew. In warmer regions, if the water supplies were too low or the soils too shallow, only prairie or desert plants grew. Frequent fires also limited plant distribution, particularly in prairies. But within those broad limits, only a few centimeters of nontoxic soil, a little more than 40 centimeters of annual rainfall in a temperate climate, and the arrival of seeds of suitable species are required for a forest to develop. At lower altitudes and latitudes air temperatures are higher and more water is needed for growth. At higher levels of either, less water is required. Tree species with different climatic tolerances, therefore, tend to segregate into geographic zones. Selection of species, populations or individuals with different shade tolerances, soil preferences, and competitive abilities is one of the driving forces of evolution that segregates their distribution throughout a forest and among the forests of the world. Over many millions of years, thousands of forest tree species evolved and filled the planet's varied and changing environments.

The optimum types do not always grow in any particular forest. Other factors, such as historical accidents, may limit their opportunities for introduction into a forest. One of the most dramatic examples is the almost total confinement of the genus *Pinus* (the pine trees) to the Northern Hemisphere. In addition, simple random variations in seed fall, or accidents in seedling survival, can create large variations in composition among different forests. We can rarely say with any certainty that any individual, population, or species is optimally distributed. We can only say that where they grow is one of several possible ways that a forest could have been assembled.

Another feature of trees that limits our ability to understand the observed patterns of their distribution is that we can rarely say what factors of the environment were important in determining the species distribution in any particular forest. Since trees have complex life cycles, and respond to many different environmental stresses, it is rarely clear that any one environmental factor caused a tree species, population, or genotype to be where it is.

There is actually an evolutionary argument against any one genotype, population or species being optimally adapted to where it currently exists. If it were the case that organisms are where they should be because natural selection has made them so well adapted, it would imply that there is only one single limiting factor. But, if there are a number of limiting factors, as there must be, natural selection must be operating on many attributes of the organism simultaneously. This is generally a recipe for getting nowhere fast. In other words, the genes which natural selection might want to change for one characteristic may be held back from change by a linkage within a chromosome, or they may be involved in some other pathway on which natural selection is working the other way. Furthermore, these genetic changes typically occur from some selection pressure of the past, and depending upon how fast or how directed the pressures of natural selection are, there can be a large "lag effect" on how new or more appropriate combinations of genes develop. Hence, it can be very difficult to radically extend a species' ecological tolerances in short order. Even if selection is a critical factor in determining the distribution of trees in a forest, we often simply do not know what that selection effect is.

On Early's Mountain, for example, if you stop at any point in a walk through the forest, you can often count on seeing stems of six species of oaks, ten other species of hardwoods, and five conifer species. In addition to these, there are some rarer tree species present and many shrubs and vines. Over all of Early's Mountain a complete survey would be likely to encounter 50 species of trees and shrubs. One of the fascinating questions that tease forest scientists is whether each of these species has an independent natural history. On Early's Mountain one wonders why there are not far fewer species, or why there are not hundreds more. On a larger scale, we can see that oaks generally grow in the Northern Hemisphere, and that the continents have different sets of them. Within North America the eastern and western forests have different sets of oaks, and species are partially segregated according to northern and southern ranges.

By their own dynamics and in their own rhythms, forests drifted with the continents. They generally expanded during warm and moist periods, and contracted during cold and dry periods. Forest species evolved as various parts of the world went through a series of ice ages. The forests developed long before there were humans, before the age of mammals, and before the age of dinosaurs..

During the Cenozoic era of the last 65 million years, a mixture of conifers and hardwoods covered around half of the land area of the Earth. They were present wherever the soil and moisture resources were sufficient to support more than grass, shrub, or desert. By this time, the continents were in approximately their present positions and the latitudinal distinctions of boreal, temperate, and tropical forests began to appear. Trees did grow closer to the poles than they do now. A gradual cooling trend ever since has been interrupted by glaciation and interglacial periods, during which the forests contracted and expanded accordingly. And all along the ragged edges of forest stands, a diversity of habitats developed. Through the ages, these diverse habitats have given rise to around 25,000 tree species, which survived and evolved with the morphologies we see today. The trees also provided the environments for the evolution of many other forms of life in highly complex ecosystems.

The last large movement of tree species was driven by glaciations. Although they have occurred periodically for around 2.5 million years, the last one reached its maximum extent around 18,000 years ago. The effects of this last glaciation can be traced in many areas

where lakes and bogs received annual deposits of pollen from the surrounding vegetation. By estimating the age of a long series of sedimentary deposits and identifying the species by their characteristic pollen, Davis (1983) could reconstruct the times when a species was present in the area of a single deposit. Since most deposits were undisturbed over the intervening years, she reconstructed the geographic movement of several tree species through much of Eastern North America by surveying many such lakes and bogs. She found that, at the glacial maximum, the cold and dry climate had compressed the range of northern species to the Atlantic Coastal Plain and the Mississippi Valley. Only pine and spruce grew then in the Appalachians (Davis 1983). As the glaciers retreated, the trees expanded their ranges back to the north and east. First the spruce and fir advanced northward on the heels of the glaciers, soon followed by pines and poplars. Then beeches, oaks, and maples advanced from small persistent boreal populations, from the west and from coastal refuges (Adams and Faure 1997). The oaks were among the fastest species to extend their range from the south into Canada. They have maintained populations in the southern and central sections of the United States (Davis 1983). The spruce, fir, and northern pines have since moved further north, leaving some remnant southern stands at higher elevations. Most of the other species remained to form a very diverse ecosystem, and some warm-climate species moved in as the soils developed and the climate warmed. The forest-savannah boundary was very sensitive in the Western United States during the Holocene. This forest edge moved several hundred miles within a century, changing the distribution of tree species accordingly.

Glaciers also allowed, or forced, humans to migrate into North America from Asia. These people moved rapidly down the West Coast into Central and South America and across the continent to the eastern woodlands. As the tree species were rebounding northward, humans entered the ecosystem and modified it even as it was responding to large climate changes. In South America, though glaciers probably had less direct impact, the drying and cooling effects were felt throughout the continent. The species of the moist Amazon forest retreated to a few refuges from which they subsequently expanded. Arid conditions in southern South America created grasslands where humid forests now grow, and on the Matto Grosso plateau deserts formed. The Andes were colder and drier than they are now, and the treeline was several hundred meters lower. The Chaco region, which is now so rich in biodiversity, was then a semi-desert.

The hypsithermal around 10,000 years ago brought more moisture, but there were periodic fluctuations in moisture and temperature over the next several thousand years (Pielou 1991). The forest cover and the species that occupied various sites fluctuated considerably during the time when humans were colonizing the area. Humans may have been present through much of the period of forest expansion, and could have occupied larger areas outside of the river basins that later formed the large centers of agricultural civilization. If so, little trace of them has been found.

A similar story of large-scale movement can be told in Europe, where refugia for plants during the Ice Ages apparently existed in the southern parts of present-day Spain, Italy, and the Caucasus. Human occupation long predated the glacial events, so it can be expected that both humans and forests moved in harmony as they retreated and later advanced in the wake of the receding ice.

In Asia, the last glaciers had little direct impact on the form of the landscape, but by their cooling and drying influence they expanded the deserts and steppe regions, and

generally shrank the forested areas to the moist hillsides and southern latitudes. The Gobi Desert expanded and, until the Holocene, the Himalayas and the deserts limited forests to mountainous foothills and the coastal regions. In Southwestern Asia or Southeastern Europe, from the foothills of the Pamir Mountains to the foothills of the Caucasus to the Levant, the flow of water from the hills compensated for the desiccation of the atmosphere. Forests and their resident human populations could be sustained. There seems to have been a moist climate with closed forests along the coast of the eastern Mediterranean, and a forest-steppe vegetation that extended up to 50 km inland (Adams and Faure 1997). In the early Holocene, around 8000 years ago, the Levant was even moister and the closed forest extended perhaps to 70 km inland, and the steppe another 50 km inland from that. From about 5000 years ago to the present, this area has become drier. It could still support a forest for up to 70 km inland, but does not currently due to the impacts of grazing and deforestation. The range of individual tree species would have changed even more than the boundary of forest vegetation.

In fact, the last glaciation event is only the latest in a long series of large climatic fluctuations that humans have endured over the last 100,000 years. Following a period that was warmer and moister than the present, this Eemian optimum lasted from around 130,000 to 120,000 years ago. It was followed by a late Eemian cold period that was both cooler and drier than at present. Ever since, humans have continually lived through periods of climate change that have forced modifications of living patterns. Large and irregular fluctuations have taken temperatures from glacial conditions to near present ranges around 24 times. Similarly, sudden cooling or "Heinrich" events have occurred irregularly and plunged temperatures by up to 10°C in only a few decades. There have probably been many such events, and several have been particularly rapid and severe. Some evidently lasted for a sufficient number of years to have long-term effects on the vegetation. The boundary between forest and steppe or prairie vegetation, where most human activity was concentrated, moved over long distances. However, the length of time in either the warmer or colder phases, usually a few centuries, was too short for even the forest boundary to stabilize. The broad forest edge, composed of pioneer species at the advancing front, was trailed by species adapted to the secondary stages of succession. This edge was always either advancing or retreating and never approached equilibrium conditions (Adams and Faure 1997). For pioneer species, the biological conditions of advance are not the same as for retreat, since rapid advance is into mineral soils and low vegetation, while retreat is into organic soils and tree competition. Climate, therefore, is part of a mosaic of physical and biological factors that can keep the vegetation from reaching any stable state.

The warm period that ended the last glacial maximum lasted a few thousand years to around 9000 BCE, when the last sudden cold and dry period, the Younger Dryas, affected vegetation. The trees that had been emerging from glacial refuges were again decimated by the return of glacial conditions, and suitable environments for humans would have similarly shifted. The Younger Dryas ended suddenly a millennium later. Temperature and moisture rose over only a few decades, causing large shifts in the forest and human environments. It was at this time, the beginning of the Holocene, that cultivation began in earnest.

At the time of the glacial maximum in the northern hemisphere, a generally cooler and drier climate prevailed in Africa, except in the Levant, the Atlas Mountains, and the northwestern Sahara, where a forest steppe vegetation was common and a few localized

moist forests grew. Otherwise, the Sahara grew and the rainforest receded in Central and West Africa. The Congo Basin was a wooded savannah with tropical moist forest only along the major rivers. The West Coast, however, housed rainforest refuges, from which the present forests were recomposed. A moistening trend developed, even over the Sahara, and some mid-Sahara mountains supported some forest vegetation (Adams and Faure 1997). A gradual drying trend set in around 5000 years ago, and the contemporary distribution of forest is similar to that of 2000 to 3000 years ago. The rainforest expanded into the present desert areas, but in Eastern and Southern Africa conditions moderated to about their current levels of rainfall and forest cover.

Since the last glacial maximum, a drier atmosphere than exists today gradually became cooler and moister and the sea level rose in Austral-Asia. Forests existed before the dry period recovered, and since human activity was continually present it was probably largely focused on the open woodlands along the southeastern coasts and where today's tropical forests lie. In contrast, around 5000 years ago the northeastern forests may have had a warmer and moister climate and a more extensive tropical forest zone than they do now.

In the long history of forests, their general pattern of distribution evolved over many millions of years. The last glacial upheavals imposed large-scale changes that have continuing effects on modern forests. During the early Cenozoic, forests covered more land than at present, and during the coldest periods of the Holocene, they covered less. But throughout, they occupied most of the dry land area of the world that is suitable for plant growth, and they always contained most of the world's biodiversity. In the absence of agriculture, forests would now cover a little over half of the world's ice-free, dry land area. With agriculture, forests actually occupy around 31%, while cropland covers 11%, and pasture 24%. Swamps, mountains, and deserts occupy 32%. Though now reduced in area, forests still support more species of large plants and animals than fields or pasture do. Thus, forests and their edges supply much of the world's species diversity. Forest dynamics, therefore, drive much of the dynamics of change in all of the living world.

On the human scale of events, the complexities of forest interactions are largely unseen and unknown. The character of forests and the dynamics of the forces that constantly change them are little studied. In modern encounters between humans and forests, the size and duration of a single forest generation lends it an aura of stability. Certainly, the antiquity of forest ecosystems, far more ancient than human societies, lends the illusion of stability. But forests have changed, and they are changing, over significant geographic and time scales. It behooves us to understand these ecosystems and how they are changing.

It is also well for us to understand how forests have affected humans and how we may interact with them. In the history of forest evolution, the intrusion of the genus *Homo* is a very recent event. In the 2 million or so years in Africa that various prehuman *Homo* species rose and declined, the development of bipedalism and the use of fire and rudimentary tools were of little significance to the forest ecosystem. Of greater significance to forests were the periods of glaciation at around the same time. Through many cooling and warming cycles since then, the ranges and constituents of forests would have changed drastically as glaciers locked up free water and desiccated as well as cooled large areas of the earth's surface. The areas of steppe vegetation expanded and those of deep forest shrank, forcing large changes in the location and composition of edge species and requiring adaptability to rapid and extensive environmental change. Bipedalism and the adoption of an omnivorous diet would have been advantageous, and early hominids could have migrated out of Africa

along the shifting forest edge to find and adapt to new and different local niches. Early humanoid evolution seems to have been concentrated along the edges of savannahs and forests, with adequate, but not excess, moisture (Wesselman 1995) during periods of climate change, and in regions of East Africa where the high forest gave way to miombo woodlands (Avery 1995).

When distinctly modern humans first roamed the earth around 100,000 years ago, they were not very fast or strong. They walked upright and had an omnivorous diet sustained by hunting and scavenging on large and small animals and by gathering fruits and nuts. Their Hominid ancestors had long since descended from a tree habitat, but these *Homo sapiens* were still too slow for life on an open prairie. They also were poorly suited for dense forests, where there is little space between layered tree crowns, and deep shade covers the ground. There, only the high canopy provides the leaves and fruits consumed by other forms of life. Primary productivity in dense forests lies at the top of the tree canopies. Under high forests there is meager sustenance for any but the parasites and scavengers that can subsist on fallen vegetation.

But neither is life easy where no trees can grow, such as in high mountains, high latitudes, and in the deserts. Life there is sustained only at or under the surface, and large predators can easily hunt slow human prey. For primitive humans in small family groups, not only did the prairies and the steppes offer little shelter or fuel, they had little diversity of useful plant species. So for the two million years or so of pre-human, hominid existence and for the 100,000 years of distinctively modern human life, our ancestors could readily find food, shelter, and fuel only at the edge of the forest.

### **Humans at the Edge**

For most of their history, the home environment for anatomically modern humans has been the forest edge. Following a warm and moist climatic period, Eurasia entered a period of cool and dry weather around 100,000 years ago. From then until around 20,000 years ago climates were highly unstable. It was also around 100,000 years ago that modern humans rapidly displaced other earlier human types from Africa to Asia. Over the past 50,000 years, modern humans have migrated all over Eurasia, the Americas and Oceania.

The first humans did not encounter an alien forest environment from a prairie dwelling, nor did they encounter the prairies from a home inside the forest. They lived with both and derived sustenance from both, but were not centered in either. This forest edge, however, was not the narrow margin between what we presently consider to be well-defined systems of field versus deep forest. It was a wide band of secondary and successional vegetation of many different compositions, which contained a multitude of habitats for a life where both the deep forest and the dry prairie were accessible.

Modern humans survived well in that broad forest edge, which moved according to forest frontier dynamics. There, fuel and shelter were available, the diet was varied, and people could forage as needed in closed and open forests and in prairies. Long-distance foraging, which could vary with the seasons and resource availability, seems likely to have been a universal human adaptation. For over 90% of the time that *Homo sapiens* have had to evolve to their present state, the pressures for adaptation have been for fitness in variable forest edges.

But the forests themselves were and are changing even as they give the illusion of stability. On a large scale, the boundaries between tropical and temperate zone forests shifted with continental drift, as did those between temperate and boreal zones closer to the poles.

The great Amazonian forest was once thought to have had stable dimensions but is now believed to have suffered shrinkage during dry periods. During glaciation, the great deserts expanded and the Gobi reached across northern Mongolia nearly to the Pacific Ocean. On each continent, forests grew and shrank over spans of thousands of years.

In general, forests endured the great extinction of 65 million years ago, and when the mountains began lifting, they developed elevational zones of vegetation and changed the climatic influences around them. As air currents flowed around the mountains, seasonal rainfall patterns changed, forming deserts in some places and moist forests in others. Forests existed long before present-day climatic patterns of the globe developed, and they responded to those climate changes.

The biotic environment was also continually changing. Predators and prey, hosts and pathogens, competitors and mutual cooperators all were constantly changing. The growth of forests is the aggregate result of the regeneration dynamics of thousands of species interacting, combined with the effects of limiting external factors. All of these are constantly in a state of flux.

On the more recent time scale, since humans occupied the forest edge, the prevalence of change also was noteworthy. In North America, particularly in the western parts of the continent where the forest-prairie boundary is very sensitive to levels of rainfall, there have been large and rapid changes in the location of forests and in their composition (Millar and Woolfenden 1999).

In Eastern North America, glaciation brought prairie and tundra vegetation to areas now occupied by forests. In the last 5000 years the forest and prairie boundary has shifted by as much as 400 km in the Central States. As the glaciers retreated, boreal forest species moved northward and to higher elevations in the mid-latitudes. Those species were replaced by various mixtures of species, including the mixed conifer-hardwood forest, the deciduous forest, and the southeastern evergreen forest. Immediately after the glacial retreat, the population centers for species that served as founders for expansion were either along the Eastern Seaboard, the Southeastern Coastal Plain, or the Mississippi Basin. From there, the rate of expansion depended partially on the rate and type of reproduction of each species, and the vectors that carried seeds into new habitats.

From the Southwest, oaks would have traveled very rapidly northward and eastward. Hickories moved rather slowly northward and westward from eastern centers of origin. The present oak-hickory forest, therefore, is not a co-dependent community. Rather, it is an artifact of the history of migrants that happen to have crossed paths. The same is true of the spruce-fir forest type in the Appalachians. We designate it as a community today, but it may be a passing phenomenon in the long term (Davis 1983). The waxing and waning of the individual species that compose these forests seem to be a combination of independent individual affairs — individual dominance in specific forests appears idiosyncratic. As put by Delcourt and Delcourt (1987):

...the locations of modern population centers and distributional limits for most tree taxa do not reflect their past distributional histories. Rather, dynamic and individualistic shifts have occurred in not only the locations, but also in the total area and relative dominance of all major temperate and boreal tree taxa during the late Quaternary.

Forests may therefore be inherently unstable due both to the fluctuations of external driving factors and to variability in their own replacement dynamics. In the forest edge, this instability may also be driven by events occurring in the core of a deep forest, which are not the same as at the margin of an open forest. This condition would be most apparent where the edge of a forest lies adjacent to a prairie or along the sides of internal gaps, but also exists along extensive boundaries where water, light, or soil conditions change and offer new environments for life. Forests at the edge have an exposed vertical dimension not available in deep forest or in open fields, that can be exploited by various organisms. At the edge, limiting conditions may undergo constant change as the dynamics of open forest and prairie also change. Thus, the number of plant species at the limits of forests is greater than in either forest or prairie alone. The mixture of species is expected to change, so there is an added temporal diversity even if the boundary remains in a stable environment.

At the forest edge, the rainfall, soil depth, and air temperature supported the sizes and kinds of plants on which humans could forage and animal prey species could thrive. Open water, game, berries, nuts and fruits, shelter, and fuel were available to sustain at least small extended families. But conditions in these edges were far from stable, and early humans had to adjust to changing conditions.

People would have had to use their uniquely high mental capacity to foresee events, to predict consequences, and to acclimate to a broad array of changes. It is a hallmark of humanity to adjust to adversity and change. That is not to say that the adjustments were easy. Constantly shifting compromises had to be made between the efforts needed to gather different and distant resources, hunting and gathering, cultivating plants in some areas at some times, and defending the home and its resources.

In that way of life, we would also have moved with the forest edge as it advanced and retreated with climate changes (Bonnefille 1996). In times of increasing warmth and moisture, as during glacial retreats, shrubs and pioneer tree species could establish seedlings on open soil and provide a wide expanse of open forest. In times of cooling and drying, only the older trees might endure and the forest edge would appear to be more abrupt. But as long as we could shift with the forest, our traditional home has been centered in neither deep forest nor prairie. It has been at the threshold of the forest.

### **Between Field and Forest**

In order to adjust to change, we humans seem to have struck a Faustian bargain. To develop a high capacity for change, we needed a long period of gestation and post-natal development in a stable and relatively secure home environment. We wanted and needed the familiarity and stability of a nurturing home, but the ecological niches we occupied were inherently unstable. It seems likely that a major attraction of an agricultural lifestyle was the stability it seemed to offer.

Contrary to both Thomas Hobbes and popular opinion, pre-agricultural life was not necessarily poor, brutish, or short (Hobbes 1651). Many hunting and gathering humans enjoyed a varied and generally nutritious food supply. Their life would have to be secured by long treks to obtain periodically accessible resources, from settlements located at centers of prime resource accessibility or defensibility. Only occasionally would they have to migrate very far from their settlement area.

The price of agriculture was considerable. Early agriculturists suffered more diseases and poorer nutrition as grains came to dominate their diet (Larsen 2000). At least on fertile

and cultivatable sites, agriculture could yield many times more food than gathering untended plants or seeds, but, as settlements grew, access to wild foods was severely limited. The security offered by a storable grain supply may have induced acceptance of grain agriculture, even though access to other foods was lost.

The change from a familiar hunting and gathering lifestyle to one that offered a secure source of calories could not have been simple. The choice would have differed among people and times, and would have involved a complex set of adjustments. The transition might not have been made because of individual choice. The social organization and cooperation of crop growing also generated a political and military organization that could dominate individuals as well as adjacent societies. The change could well have been gradual with a partial dependence on cultivation and a continuation of foraging. From time to time and place to place, different combinations of hunting, gathering, and cultivation may have been tried. Alternative forms persist among hill tribes and forest dwellers today. The alternatives would also have been viable for early agriculturists who could entertain other lifestyles either in fact or in imagination (Brody 2001).

There appears to be little reason to suggest that the particular path of agricultural development that came to dominate Eurasia and the New World was a unique optimum. Several alternate modes could as well have evolved (Diamond 1997). However, the commitment to depend on agriculture would have necessarily been made by people who were amenable to living in large social groups. These larger organized societies would engender military capabilities.

It is important to remember, however, that the hunting and gathering way of life from the forest edge was the dominant way of life for people for all but the last 10,000 years. Hunting and gathering societies achieved a stable coexistence with Nature, even as individual resources waxed and waned.

The great human migrations of the past 50,000 years probably followed those moving edges. But over the past 10,000 years of the Holocene, the advance of civilization has consistently forced the forest and its bounding edge to recede. The rise of agriculture in Mesopotamia, India, and Meso-America spawned an explosion of human population and created social orders that generated centers of technologies. These developments allowed human expansion into open forest land, and the removal of forests to provide new land for human use. The lands that were most readily accessible for cultivation were along this forest edge.

In the early Holocene, the climate was warming, and large areas of forest edge would have been available for traditional human uses. However, as a gradual cooling and drying occurred, a stress would have been placed on foraging groups, and the edges of field and forest would have been subject to heavy exploitation and cultivation. As these areas were converted to human use, the boundary between field and forest was sharpened and the amount of edge was dramatically reduced. Humans were destroying their natural habitats. They also were converting deep forests to other uses. Hence, once people adopted agriculture as the primary lifestyle, there was no turning back.

### **The Edge in Appalachia**

It is easy to imagine that the forest of Appalachia is much as it was in centuries past, before the European invasion, when the Cherokee raised maize and squash along the river valleys, hunted the abundant game, and gathered berries, fruits, acorns and nuts from the hills. These mountains and valleys are rich in diversity, and have sustained human

habitation for millennia. Their durability convinces us to assume that they will continue to do so for millennia to come.

In fact, neither the forest communities nor the Cherokee societies were ever static. The abundance of life on the forest floor has always required constraints on the unimpeded growth of the most aggressive competitors, and disturbance to the succession of the most tolerant species. Cherokee fire management and preferential treatment of useful species created an environment for abundance. As their populations waxed and waned, their practices varied in size and intensity. So yesterday's forests were not the same as the forests we see today, and tomorrow's forest will change yet again.

For me, the forest here brings a sense of calm. That feeling, of course, is relative to a more frenetic daily life outside the forest. Here, it is possible to live with a paradox of both a calming forest and a dynamic forest life that has always been in flux. To be sure, there were some periods of rapid change, and some periods of slow change. Some areas remained tranquil through periods of climate change. Other areas, which were more sensitive to environmental change, experienced frequent changes of species into and out of a mosaic of variable patches. Trees grow and migrate more slowly than humans; birds and amphibians have faster life cycles; insects have even faster cycles. And while each complex subsystem has its own dynamic, they interact and orchestrate a non-random forested world. Though we can derive a sense of quiet and peace from forests as a respite from our ever-changing social lives, the tranquility of a forest masks a vibrant harmonic of change occurring at various scales of time and space. Many of us may not be able to hear that undertone, but it is audible to the sensitive ear.

The area around Early's Mountain is largely forested, but most of it is neither in deep forest nor open field. In general, the forests here are transitional or secondary forests in two senses. First, we are in a period of climate change from glacial to thermal conditions. Second, there was a recent period of heavy logging and clearing. It generated a sequence of environmental and species replacements that is still in transition to some new composition. These are medium-term temporal trends that will persist for a long time.

Finally, the area lies in a transition between southern plains and mountain vegetation. Plants are migrating from glacial refuges on the coast and from central, continental refuges. These are large-scale trends that generate variability over large areas. Human influences were superimposed onto these long-term and large-scale transitional forces. The result is a high diversity of plants and animals that humans were able to exploit. Humans have created a perpetual transition zone.

Here, as in the rest of North America, the great indigenous populations did not reside in the dry plains or in the deep forest. Instead, people found the rich forest edges to be most hospitable. As is true for most of history, humans here were limited to areas that provided sufficient water and light for abundant plant growth that was accessible to them and to the game they hunted. The conditions for developing open forests are similar to conditions amenable for human life. Here, the boundary between the field and forest biome is an edge biome, which has a distinct dynamic. It is characterized by successions of many different species and a greater biodiversity than exists in either field or deep forest alone.

This kind of transition factor is significant in forest dynamics. It is the biological interaction among individuals, populations, and species that drives a multitude of combinations. The edge is broad and contains many different habitats and includes many different

species. Some of those species prefer more or less sun, water, soil acidity, and higher or lower elevations. Some have life cycles shorter than humans' and some live for centuries. In the edge, this kind of variability is forced by biotic interactions and by the interactions among differing local patches.

From the deep forest through the open edges and into the plains, there is an abundance and variety of products that humans can easily use. Since the forests regulate water flow and soil fertility beyond the forest edge, the whole system is vital to human life. Edges provide the habitat for deep forest species and for forest dependent plants and animals. They also provide the safety of access to multiple alternatives when any one resource may be threatened.

The inherent diversity of the edge that made human life possible was further supplemented by intentional and inadvertent human activity. The diversity provided stability by affording a redundancy of multiple resources that supported the many necessities of human life. Human life was secure as long as people could adjust to the vagaries of individual resources. From the edge, field and forest resources are available, and for most of our time on earth, humans have found conditions at the forest edge to be amenable to their style of life. Food, shelter, and fuel are all available to the limited physical capacities of humans, and are subject to modifications that an intelligence can design. Humans thrived on the abundance of differences and contrasts that exist in the edge.

In the southern Appalachians, the edges are particularly variable. The diversity of species is high, and many useful species grow within the region. The composition of forests, however, changes rapidly over short times and distances, requiring constant adjustment of resource gathering routes. The human lifestyle, therefore, was not nomadic; it did not involve a constant shifting of residence. The lifestyle was semi-sedentary, requiring periodic or annual shifting among areas for resource gathering. It was one that required recognition not only of patterns of difference among patches, but also of patterns of change. The Cherokee would have found that the plants and animals that successfully colonized a site would change as the colonizing invaders gave way to more competitive ones. As climatic cycles of moisture and temperature varied over decades and centuries, the composition of the forest shifted and required constant adjustment. It could be expected that the Cherokee sought homesites that had concentrated access to berries, fruits and nuts to gather, game to hunt, and a few crops to cultivate.

An indigenous population may have continually resided in these hills, including immigrants from the Mississippi valley. In any case, after a few millennia of human settlement and migration, the Cherokee branch of the Iroquois occupied the area and made their home in these hills. For a thousand years before Europeans entered, this largely Iroquoian culture dominated the area. Other migrants continued to come from the Great Lakes and Ohio River cultures, as well as from Mississippian societies. There is evidence however, that Cherokee society was quite stable. It developed the technology for the use of copper, had a well-developed pottery, and cultivated maize, beans, and squash in the millennium before European settlement.

But societies change. About 1000 years ago, there may have been a general climatic deterioration in North America, which may have accelerated the adoption of agriculture (MacNeish 1991). Social changes would have also affected the local life of the Cherokees, which became even more of a problem with the European invasion. That great calamity

did more than merely disrupt the usual historical processes. It obliterated whole tribes and imposed a new social order for both colonizer and colonized. As those drastic changes in the human societies were occurring, the forest ecosystems also were changing in their course of evolution. The intensification of agriculture expanded the area of cultivation and sharpened the boundaries between forest and field.

In the early years of colonization, logging was done primarily to clear fields and to obtain timber and fuel for local farms. Industrial logging came to Early's Mountain at the beginning of the 20<sup>th</sup> century, when the timber industry moved out of the Lake States and into the Southeast. The huge trees of the old-growth forests were commonly harvested and the accessible forests close to transportation routes were cleared. Since then, sporadic logging and an occasional escape of a spring fire used by local farmers has perturbed the usual succession. Succession here usually begins with herbaceous plants and shrubs on open ground. Pioneer tree species like poplar and pine then invade old fields. These trees are eventually replaced by shade-tolerant maples, oaks and hickories, which can compete in the shaded understory. If you had walked with me last year through the poplar cove, you would have seen this transition to the shade-tolerant species.

In more recent years, the demand for paper and timber has stimulated development of an industrial forestry that depends on plantations of fast-growing, short-rotation species that grow on the flat lands to the east. The forests here in the southern Appalachians also are responding to global markets for forest products. When the Cherokee first entered this area, perhaps 1500 years ago, the Eurasian and American continents could function independently of each other, biologically and sociologically. Since then, the world that was once mostly covered by forests has lost over 25% of its original forests. The modern expansion and contact of human populations over the earth has changed the character of forests everywhere. Forest edges and the core forests have steadily receded. Despite our continuing dependence on forests for their products and their services, we continue to lose forests on a global scale. There has been a continuing struggle between the need to exploit forests and the need to maintain standing forests. The usual result has been the loss of forests. We feel remorse at their passing, and the struggle shifts to a more distant forest, but the results seem to be the same. In my reading of human history there is a perpetual dichotomy in human attitudes and behavior towards forests which has generated much concern but has never been resolved. This failure to find resolution portends a grim future for global forests.

So changes have come to Early's Mountain and changes will come again at a local scale that reflects a global trend. Already the tulip poplars are getting big enough to be cut for good lumber or to leave to the ravages of age. The maples and oaks will be large enough to cut for profit somewhat later. There are some black walnut trees that will command high prices. If the demand for milk and meat increases, the lower edges of the mountain will be cleared for pasture. In another generation, my grave may be in a grazed field or under a parking lot. If no corrective action is taken, the global decline of forests that has been occurring for many centuries will overtake all of the southern Appalachians. Without a halt to the seemingly inexorable decline of forests around the world, the continued existence of a forest on Early's mountain seems doubtful.

### **Perpetual Change**

The evolution of human attitudes in agricultural societies was spurred by the development of social organizations that benefited from agricultural systems over foraging

systems. Once entrenched, the agricultural field became the home from which the uncivilized world could be observed and tamed for use, and which could be pushed to the edges of habitation and accessibility. The uncivilized wasteland of forests was the antithesis of the regulated and productive world. As discussed earlier, the displacement of forest ecosystems by a system designed to serve civilization was assumed to be an ordained order of succession. From the very beginnings of agriculture, there was the persistent countervailing view of forests and wilderness as more than a commodity — as a source of life itself. Therefore, there was a desire to maintain at least a remnant of that other system of life, though it might have been pushed further and further from daily encounters. Instead of displacement, some form of coexistence was assumed to be the appropriate form of relationship between forests and humans.

The two concepts of forest-human relationships developed in parallel from the beginnings of agriculture through the Dark Ages and into the 19<sup>th</sup> century. In western thought, the natural world of God could be found in forests and wilderness, where the corrupting influence of humans was not felt. The natural world was stable, ideal, and productive for some values such as biomass or biodiversity. As such, forests were ideal in some sense, and were stable expressions of God's design for humans to either leave alone or to develop. In either case, they were assumed to be stable as they were found.

In the 20<sup>th</sup> and 21<sup>st</sup> century, the basic assumption of stability continues, albeit with greater sophistication. For those committed to optimizing commodity values, the problem is to design management systems to keep forests from following their natural propensities, such that economic productivity is maximized. For those committed to restoring a natural world, the problem is to maintain or to reconstruct that former natural state of equilibrium. The conflict has thus evolved into compromises between these two objectives.

However, as discussed in Chapter 8, forests have never been stable, and as discussed in Chapter 6, the evolution of agriculture was not a simple displacement of a stable forest in a stable environment by another stable production system. The several beginnings of agriculture could have been due to many environmental stresses, but also required the existence of technologies and species that could be adapted to the several stages of a cropping system. In the major centers of agricultural origin the forest and its edges were being changed by complex influences.

Long-term trends in climate had very large effects, especially where the margin between forest and prairie was critically dependent on small changes in soil moisture. In such cases, relatively few species could be marginally successful in establishing an open-forest ecosystem, and these would respond to the single most limiting factor. In recent millennia, large scale and rapid movements of forest cover types, such as in the Western American States, could be attributed to changes in rainfall patterns. However, even when a major environmental factor like soil moisture was not changing over a critical range, other factors, such as pests, precluded precise optimality in the patterns of plant responses. Environmental factors themselves may be a complex of temperature as well as moisture. The timing of rainfall can be as critical as the total amount over a year. Responses, therefore, may be due to more than one factor at any one time. Furthermore, climatic factors are moderated by the topography of the area so that over short distances, large differences in the available moisture can cause reversals in the increase or decrease of forest vegetation. There are biological factors, such as competition from other species or different migration rates, that permit one species or another to expand or contract its range. Thus, a

species' relative ecological dominance in an area may be unrelated to its capacity to respond to the direct effects of any single climatic factor. Most species can be expected to be in some stage of transition in their relative dominance, ranges of occupation, or genetic composition. There will usually be a lag time in a species' response to any driving factor. Due to the complexity of the environmental factors and the complexities of their own life histories, every individual and population will have some redundancy in their behavior. The inexactitude of the responses gives rise to a random redundancy that is a basic feature of evolving systems.

Nevertheless, there is a strong presumption of order in the universe. That presumption is particularly strong in western societies. If responses are inexact, there is an assumed equilibrium for the biological system to which it naturally returns. The system may be perturbed away from its natural equilibrium, but it has a tendency to return to that natural state. For ecologists, the problem is to determine what that state is and to manage the system's return. One of the perturbing forces may be human intervention. Since the equilibrium is assumed to be a stable state, a management technique would be the exclusion of humans, to allow the system to return to that ideal condition. There may be lag times in response, and environmental factors may cause the equilibrium to constantly shift, but a general goal has been to return systems from their perturbed conditions to their natural equilibria.

One of the great problems in ecology, however, has been to distinguish what may be responses to environmental driving factors from random variations. Such phenomena as the association of spruce and fir in the Appalachians may be temporary accidents of two species on different migrational paths in this millennium. Such species may soon go their separate ways. The simple accumulation of such accidents may exclude species from appearing where they might be expected (Simberloff et al. 1996). Thus, the presence of a species, or an association of species, may not indicate a response to a driving factor, much less an optimality of that condition. The historical record may not be a sure guide to what was optimal, even in the absence of humans. It can only tell us that there was one condition that in fact survived and could be recognized.

Another great problem in ecology is that the succession from one species to another does not always lead to a consistent pattern of eventual success by the second species. Even when all other conditions are identical, the one that may win can depend on factors like initial abundance (Horn 1997). Another type of result that has recently been investigated involves replacement rates that are so large that periodic fluctuations in relative abundance are induced. Under some conditions the populations never settle down to an equilibrium, but periodically bounce from one condition to another. It is also theoretically possible for more than two such states to exist, and for the system to cycle among several possible conditions. It also is possible for systems to go through an infinite number of such states without ever returning to the same state twice (Watt 1947). This is a true chaotic condition that can exist even if the environment is constant, and of course would be even less regular if the environment is changing. The possibility exists, however, that the variations we see are not random variations or effects of variable conditions of the environment, but rather represent the way organisms ordinarily behave.

The alienation of forests in the post-agricultural world first resulted in their being viewed as stable expressions of God's will or of naturally stable processes. The natural world was assumed to be in a fixed condition. At least through the Enlightenment, theolo-

gians and scientists in the western world thought that condition must be ideal. These beliefs underpinned the concept that humans should develop the resource for human benefit, as well as the concept that humans are the cause of disturbance and should seek to restore God's Eden. If there were natural perturbations, there was an assumed process that resulted in a return to equilibrium condition.

The Darwinian revolution seemed to threaten the general assumption of the immutability of the "natural order of nature." However, it was eventually accepted that there could be an ordering to an evolved state, which represented an ideal and optimal condition. The discoveries of Charles Lyell also forced a modification of the assumption of immutability, since continents drifted and geological formations evolved. But this understanding also failed to change the basic assumption that there was a hidden stability. It only implied that the optimum condition shifted. It could still be assumed that as the optimum gradually shifted, the natural equilibrium processes continued to force nature to the modified optimum.

But it is now clear that forests are in dynamic processes of change in which accidents of migration, competition, and other external and internal factors can keep forests in perpetual states of non-equilibrium. The accidents and errors of small events can have large consequences. Chaotic dynamics can prevent populations from ever achieving a stable equilibrium, even in the absence of external influences. All of these factors may have caused the variations in the composition and location of forests we now observe. Thus, we cannot tell what a single ideal condition may be, either from past history or from present condition. It seems likely that there never was a single ideal optimum forest. If there was, we may never know what it was. What we do know is that variation among forest units is the norm of existence and that variation in these units as they evolve over generations is necessary for their continued existence.

The patterns of variation that have evolved are not necessarily the greatest levels of diversity that could have existed with or without human intervention. Some variants have certainly been reduced and elements of diversity have been lost due to human influences. But variation within and between forests would have been the usual condition of the environment that humans lived in.

The forests that the agriculturists emerged from were not the secure and stable reserves of mystery. They were highly dynamic and changing entities that were further changed by human intervention. Agricultural development was not a uniform process either. Changes depended strongly on local cultures and local history. The forests that the agriculturists experienced were not stable before or after the human expansion; agricultural ecosystems have never been biologically stable systems by themselves or in their interactions with the forests.

Nevertheless, in western societies, forests that have had minimum human intervention were and are idealized as the optimal types. They are targeted for saving as a residual of that ideal or for emulation in managed systems.

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## CHAPTER 8. THE MISUNDERSTOOD FOREST

### **Simplicity and Complexity**

BEFORE THEY ARE SIMPLIFIED to artifacts of short-term interests, forests might still be sustainable. They might continue to provide for our material and spiritual well being. Given the depth of our conceptual dichotomy, and the complexity of our feelings about forests, however, our conflicting methods of management and non-management may only continue to degrade forests and deforest the world. The dichotomy has evolved into a dualism over abusing or saving forests. There seems to be no middle way for both use and conservation — only a continuing decline of many types of forests. Between an agriculture-like silviculture and wilderness, there is no middle ground. We can neither segregate forests into two distinct types, nor is it seemingly possible to combine the two forms in any stable compromise solution.

In the early 21<sup>st</sup> century, solutions to the division are, at best, compromises over the exact degree of degradation that can be tolerated. Such solutions tend to be unstable expediencies, until the economic value of the declining resource is sufficiently high, or the transportation and other technologies improve to allow further forest conversion. There seems to be no end game or process for reaching a stable or optimal solution. We cannot decide what extent, type, and distribution of the various kinds of forest are biologically feasible. We seem to be only capable of continual struggle and forest degradation.

As human society changed from hunting and gathering to agriculture and city dwelling, we shifted from using a broad species resource base with a broad variety of techniques, to using few species and systems. The process has been continuous and has taken many different paths. Sometimes directions have proven to be beneficial in the long run, but they often have depended on historical trends in evolution (Gould 1989) and in human affairs (Diamond 1997). With the economic, military, and political power that followed from the rise of agriculture, we have reduced the diversity of life that existed at the forest edges. In a sense, the reduction of diversity has resulted in an increased stability. In the initial transition to agriculture, a more stable food supply was assured by storing excess production in organized city-states that could protect food supplies. But that security was purchased at the price of dependence on fewer resources, which now are subject to large fluctuations in world environments and economic conditions. Rather than achieving stability at the aggregate level of total food resources by using many species and systems of production, we have sought to achieve stability by limiting environments and systems to a simple few. One of the grand achievements of agriculture has been the development of species and environmental control systems that could provide food surpluses.

The way in which that success was achieved, however, puts severe limitations on future human development. In the transition to agriculture, humans changed from accepting wide variation in food resources and adapting to an uncertain environment. We reduced that variation by focusing on a few species and controlling their environments. For much of the world, however, environmental control may never be sufficient and the scales of time and space for economic control are too small to harmonize with biological events.

One result of the adaptation of agriculture was alienation from forests. They became the unknown territory of the chaotic wild. As we lost contact with them, we projected a

multitude of our fears and desires onto them. The less we knew of forests, the more we could impose our illusions on them. The forest edge was a common human milieu which was turned into a metaphor, or rather, into many metaphors. From the beginnings of writing, which was well after agriculture had become the dominant way of life, through the Middle Ages and through the time of the Romantics, the forest became the metaphor for many of our dreams and nightmares. With less experience of their real complexity, the forests were understood less as a network of ecosystems and more as an association of metaphors.

These dichotomous ways of viewing forests created mixed metaphors. Were forests embodiments of desolation, barrenness, and waste or were they Rousseau's forests of salvation? Were they chaotic or stable, benign forest or threatening, orderly or mystical, uniform or diverse? Were forests a resource requiring struggle to cultivate or a resource that produced without effort? In their reaction to the mechanistic abuses of the Enlightenment, the European and American Romantics developed the various themes of alienation, renewal, and salvation into a reinvention of Nature (Cronon 1996) that gave birth to modern environmentalism. An array of perceptions of Nature seems to coexist in the modern world. The varying perceptions reflect the fragmented nature of human civilization and "an extraordinary range of subcultures, levels of affluence, contact with natural habitats, and philosophical sophistication" (Soulé and Lease 1995).

In modern environmentalism, a global movement with widely diverse interests has coalesced around current issues of anti-technology, anti-reductionism, anti-industrialism, and anti-scientific positivism (Milton 1993). When applied to forests, and especially to old-growth forests, the biological myths of stability, productivity without effort, and inherent diversity are combined into a forest myth of benign refuge. Research over the past 40 years in forest ecology (e.g., Kimmins, 1997) and in conservation biology (e.g., Meffe and Carrol 1997, Soulé 1986), clearly shows, however, that forests are so complex that features of age, stability, productivity, and diversity cannot be readily combined in any single forest. Most old-growth forests have levels of diversity that are similar to most other forests, albeit differently composed. They do not appear to be any more stable in composition than forests of any other age, and any measures of stability are subject to various interpretations of what we think stable means.

The forest that is a metaphor of stability cannot be the same as the forest dense with ancient giants, and also cannot be the forest of greatest species diversity. The metaphors for these forests are mixed. The forest edges, in which most indigenous forest dwellers live, are highly manipulated and may be highly diverse, but are certainly not stable in composition. Nor are they necessarily ancient. The metaphor of the forest as a benign refuge is mixed with other metaphors that can only lead to contradictory visions of what forests should be or what role humans must play. Though each of the component metaphors may well contain desirable elements of what we would like forests to be, some are mutually exclusive. There can be no single environmental agenda for forests.

It has also been made abundantly clear, as emphasized by McKibben (1989), that by the beginning of the 21<sup>st</sup> century, we have come to the end of Nature, or of forests that can be considered to have had no human interventions. We have traced the demise of the forest edge and of the deep forests. We have long since lost any models of the forest primeval. The retreat to a vision of a forested Golden Age must be properly placed in the realm of fantasy. The Nature that we sought as a touchstone for reality has turned out, in modern

times, to be a highly constructed vision of what the Golden Age might have been or what it might yet be (Borgmann 1995). The architects of that construction were the Romantics, who built on the foundations of a long history of agricultural concepts and myths. In our post-modern deconstruction, we have taken the next step to relativism (Shepard 1995), which implies that any kind of forest development is as good as any other kind. We have even denied the reality of Nature and of forests.

But there were forests before there were people, and human and forest ecosystems did coexist for a very long time. What we understand now of how those systems can interact is dependent on our views of the forest. What we must now admit is that our views have been highly colored by our agricultural history. From that perspective, we held dichotomous views that allowed for both intensive human intervention and a degree of non-intervention by separation of forest kingdoms, one remote and sacred, and one domesticated and engineered. But with the closing of the forest frontier and the end of Nature, the continued loss of forests around the world forced the ecosystems to interact more intimately. Unstable compromises were the result.

There has never been a static world to which we can return as to an unspoiled Nature, nor can we fix the environment and define a fixed goal for future forests. There may be temporary agreements on dividing the world's remaining forests into a proportion of one or the other, but since neither is achievable, the goals will remain illusory and unsatisfactory to their advocates. Possible resolutions are too tenuous and do not clearly identify what is important to conserve or how to achieve that kind of conservation.

When faced with highly variable essential resources, we can either accept the variability and develop means of using multiple resources, or we can try to control that variability and use the resources that can be cultivated. In the transition to agriculture, humans concentrated production on a few species and developed systems to control the agricultural environments of production. For forests with multiple benefits, long generation intervals, and large geographic areas, that solution may not be feasible. A nonagricultural path seems more promising.

## **Towards Coexistence**

Let us assume that for reasons of religious obligation, psychological well-being, or scientific rationality, we cannot live without forests, and that we wish to live in some harmony with forests. If we accept these assumptions, simply rejecting previous solutions is not enough. Let's also assume that the human capacity for predicting and influencing the shape of future forests is very restricted, but is not trivial. Then our goals for forests can be modestly framed in terms of protecting our capacity to continue to benefit from them.

One of the first laws of ecology is that variability is an inherent feature of ecosystems. Planning for variability is a challenge. A consistent lesson to learn from our foraging history and from the evidence of the biological sciences, is that we have used, and Nature has provided, a multiplicity of ways to coexist with a variable world. But not only is the world variable, it is in constant flux and is changing in directions that we cannot readily discern. An old cliché is that the only thing that is constant in Nature is change. As expressed by Worster (1995), "A diversity of change ought to stand high in our system of values."

In this vein, one approach taken in forestry and conservation biology research has been to delineate zones within which there is a discernible end-point to development that might be altered by management. Unfortunately, there is a hidden assumption in such approaches that there is an optimum condition to which evolution directs the ecosystem.

That assumption leads to the research problem of discerning the optimum. It is also usually assumed that there is an equilibrium, which may be not only stable but also maximally diverse or optimal in some way. This assumption implies that there is a stasis and order that exists in Nature if only we could discern its exact features. Modern researchers recognize that there is usually a considerable degree of error in estimating the parameters of the ecosystem, but many seem to incorrectly assume that the problem lies in statistical estimation.

The historical basis for this kind of evolutionary thinking, as explored by Lewontin et al. (1984), lies in the recasting of Enlightenment idealism in the Darwinian terms put forward by Spencer. The latter recognized there was change, but assumed that the change was in a direction that optimized something, and was always leading to some end point that was ideal in some sense. The definition of "ideal" was dependent on the myth of naturalism or on a revealed order that happened to be the social *status quo*. The scientific problem was still couched in terms defined by the dual views of Nature.

With the recognition that whole ecosystems evolve, and that species are endowed with certain capacities that determine their place in a successional sequence, an end point to ecosystem development was postulated. Using the models of Haeckel and Clements, species interactions were given significance in determining the path to that stable equilibrium. That solution also proved to be illusory. Modern ecological thinking has turned away from Clementsian determinism and recognizes that there may be no knowable end point or optimizing direction (Worster 1995). The modern study of dynamic systems further indicates the myriad ways that populations may grow and interact, including non-equilibrium behavior (Levin 2000). In addition to the complexity of many species interacting, no one species may be developing toward a stable equilibrium, even in a world that is assumed. We are not capable of discerning the specific directions of evolution of forest organisms, or of ecosystem development, both because there is too much random chance in a biological system and because the system itself is inherently unstable. Even if there were a world in which no human intervened, it would not be stable.

Even though predictability of specific outcomes for even small patches of forest is a significant estimation problem, it is not impossible. For most phenomena of ecological significance to humans, the principal physical scale in forests lies at the patch or stand level, which may cover from several to a few hundred acres. For events at this spatial scale, the time scale of significance can be from a year to several hundred years, depending on the particular situation. Within that range, some predictability is possible. We can first consider the time scale and our limits of estimation and prediction.

### **Prediction and Uncertainty**

One way to consider the possibilities of prediction of future conditions is akin to the prediction of a day's temperature extremes and amount of rainfall. If we first postulate that tomorrow is going to be pretty much like today, we can assign an error rate to that prediction by looking at past records of consistency. We can then reduce the error of prediction by studying weather maps, by taking advantage of actual data, and by using the skill of scientists to understand patterns and their causes.

Working with more complex systems, with possibly more interactions, ecologists do the same sorts of things. For very short periods of time, a nearly exact prediction is possible with low uncertainty. If data is inputted daily into the same climate or ecological models, short-term predictions are quite accurate. In the short term, many factors that

influence survival and reproduction for a population of trees are approximately constant, but the chance that some of these factors will change over time. For many reasons, therefore, estimating the past or predicting the future over even a few centuries is a very inexact science.

There is yet another level of uncertainty that has emerged from recent mathematical research with biological systems. From relatively uncomplicated models of population growth and reproduction, it seems that instead of growing to some equilibrium size in balance with their resources, populations can force themselves to increase and decrease without stabilizing, even if resources remain constant. Populations can outgrow their resources, then crash, then may recover as resources are replenished, but over-extend themselves and crash again, etc., without ever settling into a steady state (Bishir and Namkoong 1992).

In ecosystems of interacting species, such behavior can also be easily generated, and in the evolution of plants it is also possible that species would evolve from stable to unstable behavior. This kind of chaotic behavior can be difficult to distinguish from errors of estimation. In the long-term, however, chaotic behavior suggests that it is difficult to tell if there is any clear or consistent direction to evolution. At longer intervals, as species replace one another, or as climates vary, the chances that completely unpredictable events will occur increase. We may find that the whole system does not repeat itself in any recognizable cycle and is inherently unstable. There may be no stable equilibrium to which the system can return, and no form or composition for a forest that could ever serve as an ideal or model of stability. If there ever was an Eden, we can never know what it was.

If we now consider the spatial scale, we find that instead of errors inexorably increasing with larger scales, errors can actually decrease. Within a given area, in which the factors affecting species interactions are constant, replication increases the precision of our estimates. But with large increases in geographic scale, more factors will differ and cause more variation to cloud estimation and predictability. Over continent-wide scales, almost all factors will vary to cause large errors in predicting patterns of species distribution.

While we can conclude that the longer-term and larger-scale events are ultimately unpredictable, we should not conclude that we know nothing, or that we cannot make useful predictions about events of significance to us. Scientific methods will never describe a past Golden Age, but they can uncover discernible patterns. Our actions in and around forests can increase as well as decrease their vulnerability to changing environments.

In the absence of a single ideal direction for forests, we must turn our attention to the range of conditions to which we can adapt, rather than trying to control an uncontrollable and unpredictable future environment. In the dualism that now exists, the single ideal is either an unimpeded Nature or an agriculture-like silviculture. But every forest is multidimensional, and there are multiple forms and degrees of human influences that can be imposed. We have a vast pluralism of ways to interact with forests (see e.g., Szaro and Johnson 1996, Bunnell and Johnson 1998). Because of the unpredictable variability that we face in future environments, and because we still have a largely unknown wealth of variability that has been the human endowment, we ought to and can use variability to buffer the uncertainty. If we cannot predict an exact future, then we should obey a more cautious and calculated approach. We should ensure that, for any likely future, we can maintain

essential values and the essentials of variability that will continue the processes of adjustment.

Obviously, the smaller the area of concern and the shorter the time interval, the more exactly we can predict or can hold a forest within relatively narrow limits. The spread of future conditions is smaller and the variations for which we have to prepare are less. Thus, for food species, we might predict next year's and the next decade's needs, and can expect a reasonable level of control over agronomic conditions for a few crop species. But even for those species it would be wise to prepare populations and genotypes for a wider range of ecological and economic demands than are currently needed. This is essentially the challenge put to the International Plant Genetic Research Institute (IPGRI) for global food and fiber demands on various species.

For forest species, the time scale of use is much longer, and the environmental control is much weaker. The range of adaptation, therefore, must be much wider for any one species or variety. I have advocated this approach for several years, and have developed strategies for genetic adaptation of agricultural crops and forest trees. Unfortunately, no such planning exists for optimizing levels and patterns of diversity at the ecosystem level. This is not the place to describe the details, but there are mechanisms for developing a broader diversity than now exists. We can also manage for diversity on narrow and on very broad scales.

Our evolution has required us to adapt to change and to live with variability. It may have even created a psychological need for variation. This possibility contrasts with the biophilia hypothesis, in which it is assumed that variability is a necessary result of the interconnectedness of all living things (Kellert and Wilson 1993). However, there is no apparent connection between the mechanisms for diversity and their desirability. A biophilic view of the world also assumes that the collection of species and other objects that exists today is the only collection that could have occurred. During their long evolution, forests grew into their present species distributions in a myriad of ways. Similarly, humans have made the transition to agriculture in many ways. Forests have been changed by accidents of history. It seems clear, therefore, that many other forest histories could well have occurred. Since we have difficulty in even estimating what we have in the forests of today, there is some uncertainty about exactly where we stand now in terms of forest composition, and even more uncertainty about where the forest dynamic is moving in the near future.

We assume that since there were forests before there were humans, forests can endure wide variations in future conditions. At the present rate of abuse, however, it is not certain that much will remain before the demise of the human system. For the benefit of humans and forests, it seems clear that we must begin to understand and to use the diversity that is now available. As a primary human goal, we must strive to prevent losses of populations, species and representatives of existing ecosystems, and then undertake programs that maintain and enhance the variability we have saved, but not be trapped by visions of the past.

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## CHAPTER 9. CONCLUSIONS

BOTH THE HISTORIES and futures of the collection of forests that now cover a third of the world's land surface are uncertain. From many forests, we wish to obtain arrays of benefits, including material products, spiritual sustenance, and scientific knowledge about natural systems. Our problem is complex in that we have multiple objectives, multiple inputs, and multiple outputs. Solutions can be structured into multiple populations or into units of production for short- and long-term benefits. It may be difficult to give up the dream of finding a single best solution and creating ideal conditions. Instead, we must learn to accept a plurality of ways to achieve multiple objectives.

It has not been the intention of this book to define any exact solutions. I make no attempt to say what parts of the world's forests should be placed in reserves, intensively managed for fiber production, or managed in any of the many ways between those extremes. My intent is to identify the nature of our conflicts and to assert the depth of commitment needed to approach a resolution between the various environmental interests and the various interests in production forestry. I have sought the roots of our thoughts about forests in order to give proper respect to the traditions of thought that have generated differences in forest views. If we can agree that there are very different understandings of forests and material as well as nonmaterial derivatives, it may be possible to agree that a multiplicity of forests and types of intervention is needed.

A larger scale of synthesis is needed to consider all of the global interests that exist around forests. The time scales needed for any agreements that are reached about forests must be considerably longer than liberal democracies normally address. The political cycles of democracies are much shorter than the scales of forests. For such vital resources, a form of mutual coercion, mutually agreed upon, may be needed (Wood 2000). That is, forests will require political and legal solutions for long term development of the forest and human systems to evolve.

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## EPILOGUE

*On Early's Mountain the forest is growing and changing at a pace that is slower than a human lifetime. I hope it continues and that my fellow humans will continue to live with it as they also change. Who they will be and what they will expect from their life with the forest, I don't know. I can only leave them with at least the same range of possibilities that I found in this patch.*

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