Chapter 5

Historical Ecology and Landscape Transformation in Eastern Equatorial Africa

PETER R. SCHMIDT

Archaeologists have an important role to play in land use and management policy in the tropics, especially in regard to perceptions that guide policy on tropical forest exploitation (Schmidt 1989). Given the rapidity with which tropical forests of all types are being eliminated, it is extremely important that we draw on our knowledge of prehistoric practices, both exploitative and managerial, used by prehistoric populations that utilized the tropical forests around them. Archaeological knowledge can provide important insights into both successful management and costly mismanagement of forests at extensive time scales. Moreover, anthropologists sensitive to the study of historical and contemporary thinking about tropical ecosystems have an important contribution to make toward informed policy that incorporates cultural beliefs about the potential and limitations of forested environments. If we merely indulge ourselves in polemical positions that assert that deforestation is a capitalist depredation, we shall miss an important opportunity to develop a more dynamic historical view. In this chapter I have tried to avoid this snare and instead adopt a historically informed, proactive posture that seeks to change the exploitative trajectory of modern human occupation of tropical forests.

A global systems view informed by macroeconomic analysis quickly reveals that the structural adjustment policies of Western governments and institutions, such as the International Monetary Fund and the World Bank, are responsible for most of what drives deforestation in the tropics today (Capistrano and Kiker 1990). This is sobering evidence. Nevertheless, recent policy formulations at these institutions have shown that it is possible

to change policy at the ideological level—witness the use of the human rights sanctions program—if "scientific" evidence can be adduced to support such a shift. In other words, if we can demonstrate that the operation of various cultural perceptions, such as multiple use or increased export earnings, leads to deleterious effects on tropical forests, we will have a much better opportunity to develop sanctions, that is, exceptions to structural adjustment policy. But this is only the first step in any long-term change in policy. It must be followed with strong evidence of the long-term impact of different management systems on tropical forests. The history of complex forest ecosystems that have encompassed cultural systems offers invaluable lessons that can be applied to the present and the future.

One of our strongest assets as archaeologists is the longitudinal quality of our studies. We strive to demonstrate the consequences *through time* of human cultural perceptions on landscapes. No synchronic science can hope to meet the need to identify and explain long-term trends and consequences. If we are to influence policy making, our presentations must, by necessity, incorporate an empirical component, precisely because we must illustrate long-term trends to be credible. My remarks here thus initially assume a strong empirical orientation.

To my knowledge no long-term historical ecology of a tropical African ecosystem has yet been written. This chapter represents a first effort at focusing on the processes of landscape transformation in an area once under gallery and woodland forest. It is an enormously complex history, the rough outlines of which are disclosed mostly through vegetational history, industrial history, and strong continuities in belief systems embedded in industrial and agricultural economies. My object is to show the role of cultural perceptions in landscape management, through time, in one area of equatorial Africa.

The historical ecology of "westlake," the coastal zone west of Lake Victoria in northwestern Tanzania,[1] is one of transformations induced by human cultural systems over the past two to three millennia. Many of the changes that we read in the environmental record of the region are entwined with cultural belief systems, both as instruments of change and as refractions of ways of coping with stresses resulting from environmental change. "Unraveling" or "decoding" the historical ecology of this region within the Great Lakes region of east-central Africa introduces several issues: how cultural systems adapted to severe degradation of a once rich and varied forested environment; how a cultural preference for certain economic activities led to significant declines in population; how centralized control over a governing ideology led to improved management of natural

resources; how shortages of critical resources led to significant changes in population dynamics; and finally, how beliefs about human reproduction may have sustained traditional behaviors that threaten the very existence of the culture extant in the region today. This paper can have only one logical ending: to ask if there is any link between the historical ecology of the past two and a half millennia and the terrifying incidence of AIDS in this region within the past decade, where the long-standing Haya culture now faces virtual extinction. Dreadful as the current health crisis is, this is not the first time that this region has confronted stresses caused by reduced environmental capacity and attendant disease. The westlake's historical ecology offers valuable insights into the genesis and rapid spread of AIDS among its people.

TECHNOLOGY AND THE ENVIRONMENT

The eastern part of the westlake region is occupied by the Haya people, a once prosperous folk who practiced a mixed economy expressed in an iron industry, fishing, hunting, and an agricultural system based on bananas interplanted with beans, as well as cash cropping and some cattle keeping. Over the past several decades culture change in the westlake region has led to the extinction or near extinction of traditional economies. The strongest sector of the productive economy, other than agriculture, was formerly steel production and its attendant industries, such as forging and wire drawing. Hence much of our environmental research has been directed toward this industrial sector and its distinctive needs.[2]

Our first research goals were to document when the most recognizable sectors of exploitative economy developed and were applied to the westlake landscape, and to analyze the cultural changes, particularly in technology and economy, that have occurred over the past two to three thousand years. This first step was more complicated than usual because no previous archaeological research had been done in the region. Moreover, very dense populations now live in the zone of greatest historical interest, the 25-kilometer-wide strip to the west of Lake Victoria. Most of the Early Iron Age settlements and industrial locales (200 BC–AD 600) are overlain by contemporary villages, which both hinders archaeological access to the ancient past and leads to significant transformations of ancient remains. Nonetheless our available evidence reveals patterns of development in the spread of industrial activity across the landscape several millennia ago. The combined impact of extensive, permanent agricultural communities

and an active iron industry on the natural environment would have been both episodic and profound.

One of the reasons for the development of a technologically complex iron industry in westlake was the local availability of highly refractory, that is, heat-resistant, kaolinite clays. The region's traditional smelting procedure includes a preheating process that employs clay pipes placed mostly inside the furnace. These pipes must be of the highest possible quality (Schmidt and Avery 1978). Not just any clay will do: it must be capable of withstanding temperatures of 1500 to 1700°C, which occur in the furnace blast zone. Productivity and efficiency were closely linked to the quality of this ancillary raw material and to the skill of the technicians who procured and wrought it. Differential access to this critical resource thus ultimately meant a lot in terms of wealth and power as well.

Ironworkers in the region today have conveyed to us much important information about the resources they use, as well as their best scientific judgments about which materials are suitable for high-temperature iron smelting. Local craftsmen still know what kinds of restrictions—ritual, economic, political, and environmental—were traditionally applied to certain raw materials. Their knowledge has figured substantially in our assessments of iron ores, clays, tree species burnt for charcoal, and other materials used in the technological system. Folk classification of what constitutes acceptable, ideal, or even undesirable raw material has been central to our goal of eliciting spontaneous, emic mental and emic behavioral definitions of essential ingredients. If the advantageous mineral and chemical constituents of these substances can be isolated in the laboratory, we can begin to understand what raw materials were preferred over others, why specific resource zones were more intensively exploited, and why some resources led to greater technological efficiency. These environmental assessments, based on informant commentary and on material analysis, provide the standards by which we can judge why and how past cultural systems in the region used the natural environment.

Another important part of our environmental research strategy for westlake has been documentation of the region's vegetational history, with particular focus on the environmental changes initiated and effected by human populations. The physiography of the region—inhabited ridges alternating with swamps—provides an exceptional opportunity for studying settlement history in relation to the vegetational history available in the pollen record of contiguous wetlands. We hypothesized that intermediate swamps that lay close to settled hillsides would receive their primary pollen deposition from both the hillsides and the vegetation within the

swamps; thus the pollen record from these areas might provide a good index to vegetational disturbance resulting from a variety of cultural activities, such as clearance of land for settlements and agriculture, use of forest products for industrial purposes, and the grazing of cattle.

The vegetational markers for some of these cultural activities are unclear, and there is a notable dearth of comparative pollen evidence in Africa. Though some rough indices exist (Hamilton, Taylor, and Vogel 1986), no precise comparative studies on agricultural clearance and cattle grazing have yet appeared that would enable definitive assessment of vegetational changes induced by humans during prehistoric times.

Our ultimate focus was on a dual goal: to trace the changes in the moist-forested landscape of westlake from ca. 2500 years ago to the present, and to discover how the exploitative economy and the cultural system have changed and adapted to a transformed landscape, by introducing systems of resource management and regulations that allowed continued utilization of key materials, at different spatial and temporal scales.

The significant contrasts we found between the bountiful forested environment of the earliest Iron Age (200 BC–AD 600) and the beleaguered environment of the very late Iron Age (AD 1700–1900) left us wary of models that would interpret prehistoric patterns of behavior in terms of patterns of the recent past. Yet the two eras share common features that must not be ignored simply because we see some problems in the application of "middle range" approaches. There are parallels in process, for instance, between the kinds of problems that Early Iron Age folk encountered when they had exhausted the forest along the lakeshore zone, and problems that ironworkers experienced with diminished forests during the nineteenth and early twentieth centuries. In fact, in certain contexts the recent past offered an appropriate model for environmental stress, patterns of which were discernible in earlier periods of the westlake economy.

Our most direct evidence for the ways in which early technologists in westlake exploited their environment has been recovered from archaeological excavations. The remains of smelting furnaces contain a critical material: the charcoal used to roast (presmelt) and smelt iron ore. Identifying the genus (and species if we are lucky) of this charcoal can tell us what kinds of trees were being used in smelting. This in turn can provide an index of the kinds of forests prevalent in the vicinity of the smelting sites and how that environment changed through time. Prehistoric charcoal can also suggest whether or not ironworkers preferred particular species, perhaps in different areas and eras. Such evidence is invaluable to our assessment of continuity and change in technological behavior as well as in

forest resources. Preferences for certain forest species may be related to widely varying considerations, ranging from their chemical composition to human political and ritual concerns.

SETTLEMENT HISTORY AND THE ENVIRONMENT

The context for environmental and technological interrelationships in westlake is clearly situated in the behavior of ironworkers who work the swamps and hill flanks outside villages to obtain the resources they need for iron production. The recent historical environment represents a series of significant transformations over the past 2500 years. The quality and availability of resources during the past century differed substantially from conditions in the earlier periods of the Iron Age, in the transitional and relatively obscure period from AD 700 to 1200, when technological activity was much reduced or even absent in the region, and in the earlier part (AD 1500–1700) of the Late Iron Age.

Comparison of smelting furnaces from the Early Iron Age and the historical era reveals differences in the material used to fill the furnace pit. Early Iron Age wood charcoal from forest trees was small enough that its high carbon exposure was probably sufficient to create a carbon boil in the blast zone. This early technology was clearly more demanding of forest resources at a time when forests were bountiful. The change to *Miscanthidium* grass during the Late Iron Age marked an important innovative advance that had significant environmental consequences. First, it would have reduced economic demand for forest trees. It also substituted an annually renewable resource for forest trees. This development was, in our view, an important adaptation that was related to the depletion of forest resources. It was also a major technological innovation since the greater amount of carbon contact area in charred grass created a more efficient furnace environment.

Archaeological evidence thus far is not sufficient to indicate precisely when this change occurred. We have not yet excavated a complete furnace from the Middle Iron Age (ca. AD 1200–1400), but our observations of slag in a dated furnace at the Kasiramfuko site suggest that forest charcoal was still in use in the thirteenth century, when iron technology appears to have been reestablished on the landscape after a long absence between approximately AD 600 and 1200. This long hiatus in industrial activity and the concomitant contraction of settlement to the Lake Victoria littoral sug-

gest that both may have been partly caused by the diminution of forests in the latter part of the Early Iron Age.

The likeliest interpretation thus far is that Early Iron Age peoples found the coastal zone of westlake in gallery forest. Over the course of extensive and long-term Early Iron Age settlement on poor forest soils, accompanied by intensive iron production, the zone gradually experienced deforestation, soil erosion and depletion, and resource scarcity in the industrial sector. Thereafter the settlement pattern shifted toward a predominantly lakeside adaptation with little or no practice of iron technology (none is yet documented); the once-forested environment to the west began its regeneration. Not until the thirteenth century do we find the return of iron smelting in the interior and the growth of settlements on the hills east of Lake Ikimba. The arrival of large numbers of cattle, brought by peoples of northern origin during the middle of the second millennium, inaugurated an era of greater agricultural prosperity and population increase, with the subsequent growth of centralized states and an increasingly intensified industrial economy. By the twentieth century, in many areas the productive economy had apparently stripped the environment of efficiently (that is, sustainably) exploited forests.

Two to three thousand years ago forests would have been readily accessible along the coastal ridges and their small valleys as well as in the permanently flooded swamps and in many of the seasonally flooded swamps.[3] The remote remnant swamp forests of the twentieth century-the last and only mature forests in the region-are an artifact of centuries of forest exploitation. Our observations of iron smelters today indicate that long treks through *Miscanthidium* and *Syzygium* swamp are necessary to reach the preferred tree species for smelting, *Syzygium guineense*. This may be one of the few remaining trees whose characteristics are adequate to meet the requirements of current Haya iron technology. Its exploitation is labor-intensive; high labor costs for charcoal production are one of the environmental factors that have militated against iron smelting. These recent historical exploitative practices may offer insights into Late Iron Age behavior, but they do not furnish an appropriate model for Early Iron Age forest use.

By the beginning of the present century, in most areas fuel was thus a much more highly restricted commodity than was iron ore. Iron smelters in the northern part of the region, particularly in Kiziba, were forced to relocate to the south near Lake Ikimba because of the depletion of forests in their home area. Direct historical testimony from these ironworkers indicates that they favored several species of trees and moved their smelting

locations periodically to save labor costs in fuel transportation. In other words, they followed the availability of certain forest resources in an environment completely remade by humans. Exploitation of forests for iron smelting had become a cyclical process, in which ironworkers harvested both from immature groundwater forests in the valleys and from seasonal swamp forests. Archaeological survey confirms that smelters of the late nineteenth and early twentieth centuries were locating their industrial activities along the margins of seasonal swamps contiguous to fuel resources (Schmidt 1980).

The severely restricted forest resources of the past century offer one of several explanations for the demise of iron technology in westlake. That the region was no longer self-sufficient in iron production by the late nineteenth century is confirmed by early European observers, who noted that iron imports, perhaps substantial, were obtained from Biharamulo (to the south), Ankole (northwest), and Karagwe (west) (Richter 1900).

ENVIRONMENTAL PERSPECTIVES ON LANDSCAPE CHANGE

The size and distribution of Early Iron Age settlements and their industrial locales suggest that those populations and their land clearance for agricultural and industrial purposes would have had a major impact on the natural environment. The density and complexity of Early Iron Age industrial sites offer unquestionable evidence that the ridges next to Lake Victoria had been cleared of most forest vegetation by AD 500 and that the first cycle of clearance may have occurred as early as AD 200. The era extended until ca. 600–700, when settlement began a retreat to the lakeshore zone, where communities are dated to the turn of the millennium.

Prehistoric Industrial Charcoal

Charcoal from prehistoric smelting furnaces in westlake provides an exceptional opportunity to study the type and location of forests used for iron-working purposes. We have often excavated charcoal in significant quantities at such sites, and extensive samples have been recovered from all sectors of furnace pits. We submitted some of our charcoal samples to the Musée Royale de Belgique for paleobotanical analysis. Because charcoal had been excavated from tightly dated furnaces, these analyses provided a way to trace changes in forest ecology as well as variations in the range of

forest species used in the iron industry over the entire span of the Early Iron Age.

Forest clearance to supply charcoal for smelting and forging iron can be linked to specific features of the cultural landscape. Variations in the species used can also indicate changing preferences for materials as well as differential access to critical materials, for any number of reasons ranging from ecological to political and ritual. We have amassed substantial amounts of data about the kinds of forest products used by Early Iron Age residents, particularly on the hills above Kemondo Bay, from which we may pose some important questions and offer some tentative interpretations.

First, one of the earliest iron-smelting furnaces at one of the Kemondo Bay sites (KM3) shows the use of at least twelve genera of forest trees. This remarkable range of types, derived from various microenvironments, gives the initial impression that by the early first century BC iron technologists were exploiting predominantly first-growth, mature, wet-forest trees. Some, such as *Celtis durandi,* are huge; others, such as *Entandrophragma cylincrium* (mahogany) and *Chatacme microcarpa* (which grows on shallow, ridge-top soils) are very hard, very large forest trees. Yet at the same time, middle-story trees and larger swamp trees (such as *Uapaca,* which makes excellent charcoal) were also in use. At another site (KM2) a furnace of similar date yielded charcoal made from sixteen different genera. The great diversity of genera and species in this case likewise points to a predominance of mature, moist-forest trees, including mahogany and ironwood (an extremely difficult tree to cut down), supplemented with middle-story trees and trees common to swampy and riparian environments. Here, however, several large forest trees with light, soft woods (such as *Canarium schweinfurthii*) are also represented.

The overall impression is that Early Iron Age furnaces in this earlier era were rather like a forest stew: bits and pieces of any tree that was available were tossed into the furnace, even though some species would in fact have had little caloric value. The most parsimonious explanation for the time being is that the first iron technologists along the lakeshore were working in an environment where forest clearance for agriculture, perhaps under swidden conditions, was being practiced. If mature, moist forest was being cleared, as seems to have been the case, great quantities of readily available wood (much of it of high quality) would have been left lying about near the new farm plots, sometimes for long periods. The presence of charcoal from light and soft woods, as well as from wetland trees, supports this picture of "omnivorous" use of wood, especially surplus wood from other activities.

As we shift our focus three to five centuries later a different picture emerges. Fourth-century evidence from the KM3 site shows a much more restricted list of fuel: only two moist-forest species were used at this site, immediately beneath the crest of an otherwise inhospitable rocky hill. The KM2 site, along the shore of Lake Victoria, shows only slightly less confined utilization of fuel woods during the fifth century. In one furnace pit only three species are represented: an older, wet-forest type; a secondary tree that colonizes the fringe of the forest; and a tree with soft, light wood that today is commonly used to make beer boats (large vessels resembling dug-out boats that are used to brew beer). In a nearby furnace from the same era we found a similarly limited mix of mahogany, two other forest species now uncommon in East Africa, and two very common swamp species. Clearly the variety of forest species formerly common to the environment was no longer available. Large remnant trees were used, but the iron smelters were now consistently venturing into the swamps to obtain supplementary fuel.

We may conclude that over the several centuries after the first practice of iron smelting along the coastal hills, the environmental plenty of moist forests diminished to the point that iron smelters were obliged to use only a few remnant moist-forest species and some secondary regrowth and were ranging farther afield to exploit the swamps for supplementary fuels. The human industrial record thus gives a clear picture of the spatial form that forest clearance took and its precise expression in the range of species eliminated from the landscape. From it we can also estimate the scale of early forest exploitation for both land clearance and industry, until forests were eliminated from the coastal valleys and ridge tops and ironworkers increasingly sought out other suitable fuels.

Palynology

To obtain an alternative view of the vegetational history of the central westlake coastal zone we developed pollen histories by analyzing core samples taken along several east-west transects from the drier central depression to the moist ridges next to Lake Victoria: we thus gleaned evidence from the lakes as well as the swamps between the north-south ridge systems. Because Lake Ikimba lies in the rain shadow of the coastal ridges, vegetation today tends toward grasslands, patches of woodland, and woodland savanna. The production of storms over Lake Victoria and their very particular vectors over westlake would suggest that the precipitation pattern in the eastern part of the region has not altered significantly over the past 2500 years.

One sample taken from the eastern part of Lake Ikimba (basal core deposits radiocarbon-dated to 1685 BP, ca. AD 265) shows an erosional horizon that began as a catastrophic environmental event (Laseski 1983). The deposition in the lakebed of limonite nodules from the hillsides above and east of the lake suggests that land there had been severely degraded, perhaps even stripped of protective shrub and grass cover, which meant that high-velocity erosion carried nodules into the lake. This episode occurred at approximately AD 450–500 and provides a definitive environmental marker. Lower deposits (prior to this erosional event) show, first, a decrease in arboreal pollen, apparently related to deforestation, and then a decrease in nonarboreal pollen. This marked and rapid pattern of environmental degradation is particularly indicated by the fall in nonarboreal pollen, which indicates widespread alteration of low-lying vegetation and shrubs, presumably owing to agriculture.

I believe that these changes, along with the severe erosion, resulted from Early Iron Age cultivation and settlement in this zone to the east of Lake Ikimba. Thus far we have no evidence that iron production was widely practiced there. Archaeological survey around Lake Ikimba shows a shorter settlement history during the Early Iron Age than along the coastal swamps. From dating evidence for the area between Lake Ikimba and the coastal zone, one can reasonably project initial Iron Age settlement in the Ikimba Basin at ca. AD 300–400. The spread of Early Iron Age agriculture and technology to the woodlands of the central basin would have posed a different array of adaptive problems compared to the moist-forested coastal ridges and the well-watered central plateau. Land clearance would have occurred at a much more rapid rate in the woodlands, a phenomenon that may be reflected in the severe erosional episode of AD 450 to 500.

Further understanding of human-land relations can be gained from the history of evergreen forest genera, especially *Podocarpus*. According to conventional wisdom, *Podocarpus* usually occurs in drier montane forest conditions. Yet the predominant forest type in the northern part of westlake today is the *Baikai-Podocarpus* forest, found on the alluvium flats of the Kagera and Ngono rivers and filling large tracts of seasonally flooded swamps that extend south from the Uganda border. These forests contain *Podocarpus milanjiamus, Podocarpus usambarensis,* and *Ilex mitis*—species usually restricted to montane forest. In seasonally swampy locales these trees are mixed with a matrix of typical medium-altitude species (Langdale-Brown, Osmaston, and Wilson 1964:75). In these special environmental circumstances *Podocarpus* pollens mark climax swamp forest in the northern part of the region, a condition that has remained constant

since prehistoric times. In our core sample from Lake Ikimba, *Podocarpus* pollen declined slightly before AD 400, then recovered, then nearly disappeared about 700, the end of the Early Iron Age in this area. Collateral evidence for change in ridge-associated species over the same period (ca. AD 300–700+) shows a process of forest clearance parallel to that observed in southwestern Uganda: first the valley bottoms, then the slopes, and finally the ridge tops (Hamilton, Taylor, and Vogel 1986).

The other most notable period of environmental change around Lake Ikimba came in the early to middle second millennium. Archaeological survey has recovered evidence of reestablished settlement on the hills along the eastern edge of the swamp south of Ikimba ca. 1200 to 1400, about the same time that shrubby species took hold in the swamps, apparently after the swampy forests were cleared. An increase in grasses and nonarboreal pollen and a corresponding decline in arboreal pollen during the mid-second millennium also suggest increased clearing of the land around the lake, if not in the swamps. This period would have been approximately the time (documented in local oral traditions) when peoples with large numbers of cattle arrived from Ankole in the north and from Karagwe to the west.

Another record of vegetational history comes from Kiizi, three kilometers north of Kemondo Bay between the two largest ridges along Lake Victoria, the first area to be settled during the Early Iron Age (Laseski 1983). The Rugomora Katuruka site—first used for iron production ca. 500 BC and occupied as a Bahinda capital in the mid-seventeenth century—overlooks this core-sampling locale from a hilltop to the east. Numerous Early Iron Age industrial sites (including KM2 and KM3, mentioned above) appear five to ten kilometers south within the same basin; several have yielded dates around 200 BC. For a six-hundred-year phase of diminished human activity beginning ca. AD 600 we have found no archaeological evidence for iron production along the coastal ridges, but populations with characteristic Early Iron Age pottery continued to inhabit the margins of Lake Victoria until at least the eleventh century.

The Kiizi core gives a more sensitive reading of cultural developments over its upper (later) half, where we can see the opening of land to more intensive exploitation. Moisture-loving forest trees declined rapidly. Grasses increased significantly, and shrubby trees in the swamp gave way to *Miscanthidium* grass near the coring site. This suite of changes indicates a direct encroachment into the swamps by Iron Age peoples, probably between AD 1200 and 1500.

The parallels between the upper cores from Kiizi and Lake Ikimba

suggest that similar processes of change were simultaneously at work in both areas. These were undoubtedly linked to cultivation, iron smelting, and the coming of larger cattle herds to the region. I feel confident that we can attribute the mid-second-millennium forest clearance, particularly in the swamps, to iron smelting during the Late Iron Age, when the swamps provided one of the few sources of fuel in those densely settled landscapes.

Synthesis and Interpretation

This first attempt at a vegetational history of the coastal zone of westlake yields some important insights into how early populations remade the landscape. We have been able to assess the first impact of Iron Age peoples in the Lake Ikimba area quite successfully. During the Early Iron Age the southern margins of the unique "montane" swamp forests were gradually cleared until woody shrubs and grasses prevailed, but the most profound changes occurred around Lake Ikimba. In that area initial agriculture apparently had a severely degrading effect. The consequences can be read in a major erosional event and in the subsequent abandonment of the area. The causes of human depopulation in this area cannot be definitively attributed, but analogies drawn from similarly stressed environments in East Africa today indicate that severe malnutrition leads to high susceptibility to a broad spectrum of diseases. We have no specific archaeological evidence that disease was the direct cause of population decline in westlake, but the region's history over the most recent century strongly suggests that human disease is a common response to conditions of ecological stress.

Following the Early Iron Age at Ikimba there was an apparent regeneration of both swamp and other forests. The increasing populations of the Middle Iron Age and earlier Late Iron Age began an exploitative process that eventually led to profound vegetational changes. These changes were met by management practices hinged to ritual protection of certain tree species, as well as the ritual mystification of certain sectors of the landscape, so exploitation could occur only under special ritual-political sanction. I consider these cultural factors below. Under the present heading we may only point to a set of general processes—increased use of forests for iron production, clearance of forests for agriculture and settlement, and the coming of large numbers of cattle to the region—as the major causes of this second significant transformation of the landscape, which was under way by AD 1400 to 1500. Deforestation during this later era became so widespread that the conditions for the development of adaptations to depleted forests were certainly present.

The clearest indication of technological adaptation to the radically transformed landscape is the change in the fuel used in the bottom of the smelting furnace. The shift from tree charcoal to charred *Miscanthidium* grass is linked to increasingly scarce forest resources. *Miscanthidium* grass replaced a succession of forest trees and then woody shrubs in the swamps. In our analyses it appears first on the periphery of swamps in areas most accessible to iron smelters working there. The physical hallmarks of this change are the imprints of swamp reeds in the frozen prehistoric slags. As noted earlier, *Miscanthidium* grass offered two distinct advantages: it was an annually renewable resource, and it provided an ideal charred, ashy matrix with a high carbon contact area particularly suited to the reduction technique used in the region's iron smelting technology at that time (Schmidt and Avery 1978).

IDEOLOGY AND LANDSCAPE TRANSFORMATION

The most difficult challenge in constructing the historical ecology of any prehistoric region is to integrate the interplay of cultural systems with the physical environment. It is clearly easier to construct relationships that prevailed between the productive economy and the landscape, the transformations that these relations induced, and subsequent adjustments and adaptations. The task quickly becomes more difficult, and "middle range" approaches more complex, when we arrive at structural questions such as organization of production and look to the superstructure for understanding of the ideologies that regulated production. One distinct advantage in the equatorial Bantu-speaking areas that practice iron smelting is that the existing cross-cultural systems of organization and ideology enable us to construct a more reliable context for prehistoric landscape transformation and management (or mismanagement).

Political Economy and Symbolic Mystifications

Our endeavor to explore the social relations of production and to probe the ideology that regulated exploitative practices naturally began by decoding belief systems that have governed the use of natural resources and affected perceptions of the landscape. In westlake the obvious starting point is the Kaiija tree shrine (situated within Katuruka village), the region's most important symbolic space associated with political legitimacy and with iron production. In Bantu-speaking Africa these two domains form an identity.

Both are invariably linked such that chiefs and kings, invested under esoteric rituals conducted by ironworkers, are given iron emblems of power that symbolically tie authority to reproduction, both sexual and agricultural—an interdependent domain.

A key observation to unlocking this code lies in the meaning of the name of the shrine tree, Kaiija: derived from *luiija,* "anvil" or "forge," it means "Place of the Forge." It is no coincidence that the shrine tree stands next to an Early Iron Age forge (now excavated and dated to 500 BC). The forge and the tree derive mutual meaning from their contiguity. The most important conferral of meaning, however, comes from a myth attached to the same place, that King Rugomora Mahe of the early Bahinda dynasty once built an iron tower there, which eventually collapsed, killing many of its fabricators. The iron tower, the forge, and the tree share a bundle of interrelated symbolic meanings rooted in the material past.

Kaiija is a commemorative shrine that connotes the origins and importance of iron working in the region's culture. The ancient, pre-Bahinda myth and the forge share a great antiquity, which may explain why the site fits so neatly into Bahinda ideological representations that link the dynasty to the ancients. A double metonymy comes into play: Bahinda occupation of the site in the seventeenth century incorporated the shrine and its related myth within the Bahinda palace boundaries, at the same time that Bahinda history became contained within a much broader and more powerful domain of iron-working symbolism. A legitimizing mystification occurred whereby reference to any part of Rugomora Mahe's history on the site evoked common images of the larger ancient, symbolic whole and made Bahinda association with and control of iron working seem natural.

Bahinda political manipulation of the symbol systems that originated in iron production occurred in a period of radical change in the social and political orders that marked the ascendancy of cattle-keeping people from the north over indigenous folk who produced iron and traditionally held political authority. These events, in the seventeenth century, unfolded approximately two hundred years after the cattle keepers had arrived in westlake. This was also a period of ecological stress. Deforestation of the region was well underway, exacerbated by the presence of cattle, which prevent secondary regrowth.[4] Iron production, traditionally controlled by indigenous clans who also believed in the ancient Bacwezi gods, was apparently already subjected to regulation and taxation by a central authority under the aegis of an alliance of indigenous groups identified with rainmaking. Other similar changes gripped the related kingdom of Kiziba just south of the Uganda border, where Bacwezi priests were challenged by a

new cult of affliction sponsored by the new royal house (Schmidt 1978). In this instance the new dynasty colonized areas of wealth (and iron production) by establishing rival cult centers based in confiscated estates.

In both these kingdoms the new royals and their cattle-keeping allies controlled a precious commodity, manure, that was essential for maintaining human activity in a degraded environment. Cattle manure, with mulch and green manuring, could sustain continued agricultural production and settlement. What developed was the transfer of rights over land in exchange for cattle and their manure, as well as a "legitimate" centralized control over industrial production. Bahinda seizure of the Kaiija shrine was a keystone in that dynasty's control over indigenous industry. The symbolic harnessing of the industrial economy meant royal hegemony over the productive economy.

The Symbolic Transformation of the Productive Landscape

The transformations described thus far lead us naturally to an exegesis of the iron-working symbolism attached to the general landscape. One important aspect was first opened to us through conversation with the young men who worked as our assistants. As we daily drove through the village on the next ridge west of our Katuruka site, they would guffaw, "We've arrived at Katerero!" Katerero is the place on which King Rugomora Mahe's mythical iron tower is supposed to have fallen. I eventually learned that *katerero* (from *okutera,* "to hit") means "beating, beating," a sexual practice in which the man taps or beats his penis on the woman's clitoris to draw forth significant amounts of vaginal secretion, called *kiizi.* This is the first phase of intercourse, preparatory to *kanyinya,* "pushing, pushing" (from *akinyinwa,* "filling up").

A much deeper understanding of local place names attached to the landscape around the mythical tower began to emerge with these revelations. When the iron tower, a cosmic phallus, collapsed on Katerero, it replicated the same motion as human *katerero.* This relationship affirms the iron tower as a symbol of human procreation. As an *axis mundi* it also unites a mythic, heavenly image with earthly, human reproduction. Iron is central both to this symbolism and that of agricultural productivity (see below).

Other place names in the surrounding landscape further amplify the symbolic meaning of the Kaiija shrine and its iron tower. The mythical iron tower is said to have been constructed at the western end of Katuruka, overlooking the contiguous village of Kiizi, which takes its name

from a stream that originates not far from the supposed base of the tower and then passes through the village center. Thus the Kiizi that flows from beneath the beating iron-tower/phallus is, through metonymy, symbolically the *kiizi* (vaginal fluid) generated by *katerero*. Katerero itself is located across the swamp from Katuruka on a high hill to the north of a low saddle, a unique geographical feature on the shoreline that stands between Lake Victoria and an enormous interior swamp. The saddle is named Kanyinya (*kanyinya*, "pushing, pushing," "filling up"). As one moves down from Katerero, one moves into the saddle at Kanyinya. The topographical structures and movement between places replicate the stages of the sex act and the movement of the phallus through them.

A Symbolic Armature in the Productive Economy

The iron tower, with all the attributes of a phallus, is a symbol of both human procreation and the production of iron. It unites both domains and also symbolizes their interdependence. Iron is also central to the production of food: prosperity in industrial production is directly translated to agricultural well-being, which in turns leads to the capacity of society to reproduce itself and provide labor for the industrial and agricultural sectors. Exaction of tribute and monopoly over the wealth that results from such a technology are obviously important, in very pragmatic terms, to the development of centralized political authority. With an eye toward such realities, the groups that traditionally held direct control of iron production at least in part maintained that control through an esoteric technological and ritual repertoire. The ritual that surrounded iron production was exceedingly complex. It mystified the technological process to such a degree that its adepts appeared to enjoy mastery not merely over specialized technological knowledge but also over human fecundity. This mystification protected the special interests of the iron-working clans that controlled the economy.

Aside from its significance as a symbol of human and economic fecundity, the iron tower also relates to the cultural phenomenon of iron working in other crucial ways. It provides an etiological explanation for the origins of iron working (see Schmidt 1983). At the Kaiija shrine it is directly connected with archaeological evidence for ancient iron working. And it belongs to a broader and fabulously rich symbolism that arises from the process of iron smelting, a profoundly transformational phenomenon that alters a natural substance, earth, through fire into life-giving cultural matter, iron.

While engaged with the iron-smelting furnace, each smelter is in a highly virile state. He has reserved his sexual energy, via taboos that prevent sexual intercourse, for exclusive devotion to the furnace in order to produce as much iron as possible. His first sexual responsibility is to the furnace; for example, he must not sleep with his wife during the smelting season.

The taboo of greatest consequence, however, is that menstruating women must be prevented from contact with any part of the smelting furnace, ore, or apparatus. Contact with a menstruating woman would pollute the smelting process and result in its failure (that is, the smelt will not be productive). Menstruation, a state opposite to fertility, is the height of sterility, for menstrual blood suspends fecundity. The contiguity to the furnace or its ingredients of anyone in a sterile condition transfers that attribute to the furnace. The ritual taboos thus insure that a state of fecundity will prevail in the domain of the furnace. They are primary contextual indications that the furnace is perceived as both female and ideally fecund.

These ritual taboos mask deeper material relationships. In westlake, as in other neighboring Bantu-speaking cultures, knowledge of iron working, as well as the considerable economic wealth and political power that it produced, was traditionally confined to patrilineages. Passed on under conditions of great ritual secrecy from father to son within specific clans, this knowledge was endangered by the presence of women who had married into the line from non-iron-working groups. Principles of production—along with the wealth and power thus conferred—could be lost to other groups if these women witnessed smelting or otherwise learned its secrets (either of natural resources or of master technology) and then talked with their kinsmen. Hence the taboo that the smelter must not sleep with his wife during the smelting season had material as well as symbolic implications, for a man in the arms of a loving wife is more inclined to let trade secrets slip than one who keeps his own company. And in this sense the various taboos against female contact with the smelting process likewise protected critical economic trade secrets.

We know that a wide variety of African cultures practice rituals in which special blood sacrifices are conducted prior to the smelt or small pits are dug in the bottom of the furnace pit to receive special offerings that insure a successful smelt or protect the smelt from those who would do it harm. In westlake such practices include special rituals for inserting into a hole at the bottom of the furnace pit a white, semenlike liquid called *empuri,* a remedy usually given to sterile women to make them capable of bearing children. Extensive archaeological evidence points to the applica-

tion of similar rituals over the past two millennia, which indicates great continuity in the belief systems embedded in iron production.

Other ritual practices were linked directly to resource acquisition. In Kiziba kingdom iron smelters carefully performed blood sacrifices to Irungu, the Bacwezi god who oversees the resources of the hinterland (such as clay, iron ore, and charcoal). Consultations with Bacwezi diviners who supervised these affairs led to a flow of payments from iron smelters to the religious overseer. After smelting, a portion of the product was also paid to the king. Thus a regulatory system, a kind of checks-and-balances, arose between the local ritual authorities—indigenous Bacwezi diviners and priests—and the taxing central authority.

Any attempt to devise a historical ecology of westlake must come to terms with these social relations of production as well as the effects of ideological systems and their role in constructing successive landscapes. Over time, particularly during the most recent three centuries, for which more diverse historical documentation is available, we can observe processes of landscape transformation mediated by complex belief systems, sometimes in competition, but sharing the fundamental perceptual posture that the natural environment is in the service of the reproduction of culture. This fundamental symbolic armature, I believe, may be linked with some of the more profound ecological changes in the area.

For example, the introduction of central taxation in the seventeenth century, along with local ritual regulation of forest resources, meant a decrease in the profit margin in iron smelting, especially as critical resources such as wood became scarce during the nineteenth and twentieth centuries. By the early twentieth century many Kiziba smelters found forest resources insufficient and relocated to Kianja to the south. There they found a different landscape north of Lake Ikimba, a place without an ancient history of iron smelting, without large stands of swamp forests, and without an indigenous ritual system that regulated hinterland forest exploitation. The forests were small, secondary riverine growths not far from villages and were under the management of local heads of clans, who ultimately had to account to the king in matters involving outside exploitation.

Insights can be similarly gained from the social contexts of smelting. Smelters operate in the domain of Irungu, the Bacwezi god of the hinterland who controls such resources as iron ore and forests. The most important ritual performed by the Kiziba smelters was the construction of a spirit house for Irungu and a blood sacrifice to propitiate his spirit. They also assumed the role of *muharambwa* for their furnaces.

The primary ritual figure in matters concerning Irungu in a traditional

Haya village, the *muharambwa* was a respected elder who controlled allocation of resources within Irungu's domain. He was distinguished by his apparel: he wore a woman's raffia skirt (*kishenshe*). Besides interceding with Irungu, he ritually blessed the women's hoes to ensure their productivity.[5] But most important was his power to bless women so that they might bear children. He was the most powerful public ritual official concerned with matters of female fertility. Thus the smelters not only operated in the domain of Irungu, but each dressed as (in a way, became) a *muharambwa,* ritually acting out a liminal role as both husband and midwife to the furnace. Though Bacwezi diviners may have partly controlled resource extraction by iron smelters, their influence appears to have been partly neutralized, at some junctures, by the independent ritual role playing of smelters who assumed the guise of Irungu's representative during the actual work.

The social dominance of the smelters and their exploitative posture can be further understood from other contexts, particularly their songs. Some songs have considerable symbolic content and clearly indicate that the furnace is a womb—a widespread motif among Bantu-speaking iron smelters. One example is "Emondo," replete with esoteric metaphors, which is commonly sung during the regular smelt.

Call	*Response*
The 'Mondo	Has flowed (with the current)
The 'Mondo	Has flowed (with the current)
The 'Mondo	Has flowed (with the current)
Beware! The Spotted one may eat you!	
The 'Mondo	The Spotted One may eat you!
The 'Mondo	The Spotted One may eat you!
The 'Mondo	The Spotted One may eat you!
Oh, you women scooping up the water	
Do stop my emondo for me.	
Oh, you women scooping up the water	
Do stop my emondo for me.	
The 'Mondo	It has flowed (with the current).
The 'Mondo	It has flowed (with the current).

The song is filled with sexual metaphors that refer to human reproduction. The *emondo,* a small aquatic mammal similar to an otter, is an image widely used in sexual symbolism—in this instance as a metaphor for flowing semen during sexual intercourse. (This too has its place in the sexual landscape near the iron tower and Katerero: Kemondo Bay, the major body of

water that lies between Katerero and Kanyinya, is the "place of the flowing semen"). The Spotted One is *kagondo,* a generic term for spotted animals such as the leopard, serval cat, or indeed the *emondo* itself. In this context the word is a metaphor for the penis. The phrase *Yakulya kagondo* literally means that the animal might eat you, but its implications are enriched by the metaphorical use of "eat," which can also mean to make love to a woman. The call to the women downstream, who are scooping up water, metaphorically means that the semen is headed their way—and they are enjoined to stop it, to catch the *emondo.*

The reproductive metaphor that links iron production to agricultural production and to reproduction of labor sets a perceptual context that governs the most fundamental exploitative activities. The belief that reproduction of culture hinges on iron production is the engine that also drives the exploitation of forest resources, powered by the same symbolic elements. During the production of charcoal, for example, as the fire burns down and dousing begins, the smelters set a spell on their effort:

> Say the following:
> "I am digging a well
> For killing the charcoal
> So that it may not burn away
> So that all may be happy
> And not complain that things are not well
> That is as it should be
> So that we may make those who bear breasts reproduce
> Even the mudfish may come from it
> Even the fishtraps may come into it."

The dousing, the final phase of charcoal making, entails throwing water up from a ditch or "well" that has been dug around the burning platform in the swamp. The charcoal is destined for the inside of the furnace, "So that we may make those who bear breasts reproduce"—the allusion here is to the smelting furnace, not to women. Another key metaphor is the reference to the mudfish, that is, the lungfish, which because of its "breasts" represents women in Haya culture. As the smelters squelch about in the mud, they are in the "reproductive domain" of the breasted ones (lungfish), a symbolic meaning that continues with the placement of the resulting charcoal inside the female furnace.

Beneath the particulars of this exegesis lies my main point: that fundamental exploitative activities such as iron smelting, which consumed

an enormous proportion of forest resources in westlake, were conducted as elaborate, sacred rituals that reaffirmed the very essence of the human experience—the reproduction of labor, the regeneration of life. The integration of this belief system with industrial activity established an abiding perception of the landscape as an abundant, sustaining, and responsive mother.

TOWARD A SYNTHETIC HISTORICAL ECOLOGY

Did the universal ideology of renewable fertility and its integration into industrial production, as an integral part of the division of labor, contribute to the inexorable degradation that we witness in the environmental record? The other component of this ideological equation would be the regulatory systems that conserved resources through the checks and balances provided by sacrifices and payments to Irungu's priests, as well as the ritual protection of many forest species located in villages and managed as shrines. The application of religious-political sanctions against those who disturbed trees that functioned as ritual locales effectively preserved and assured the management of countless groves of mature forest species both within and outside villages.

The seizure of the Kaiija shrine by the Bahinda royals marked an important new period of centralized management of sacred shrines and other forest resources. The patronage of the central state was essential in maintaining a cadre of ritual officials who oversaw and managed forest products. Also, via a land tenure system of estates awarded to loyal subjects, either Bahinda or indigenous, the state controlled agricultural surplus and labor, both essential to the expensive upkeep of numerous ritual officials and their retainers scattered across the landscape.

The introduction and subsequent widespread acceptance of Christianity during the first half of the present century brought a major change in the delicate balance of ritual management. Most of the traditional priests invested with protection of the shrines and the forests either converted and abandoned their roles or died without passing on their traditional authority. The kings, now Christian too, no longer maintain caretakers at the royal ancestral shrines, many of which have been converted to agricultural land. Similarly, the sacred significance once attached to groves dedicated to the Bacwezi gods has gradually eroded, sometimes to the point where shrine trees have been cut to make way for much-needed crop expansion.

As recently as forty years ago this behavior would have been met with outrage and severe punishment.

Syzygium guineense, the wood preferred during the first quarter of this century for iron-smelting charcoal, is locally known as *muchwezi*—the singular form of the name for the ancient religious-political groups that once controlled iron working in the region. (In recent times Kiziba smelters likewise preferred it.)[6] Ordinarily one expects to find *Syzygium guineense* in riparian forests, but in westlake it now occurs only in remote stands of swamp forests. Deforestation over the past four centuries has increasingly restricted options and may have focused preference on a dominant species with the requisite chemical properties. Or perhaps centralized regulations may at some point have required smelters to exploit a species outside of day-to-day demand. In any case the long-term shift from omnivorous use of multiple species in the Early Iron Age to use of a very limited range of species during periods of diminished forests and then to use of only one species in recent times represents a significant, large-scale change in the landscape.

In sum, the values and religious-political sanctions that once checked unbridled exploitation have passed into distant memory. In their place has arisen a system of forest management based on village and regional authority, an uneven scheme with overlapping and ill-defined responsibilities that promotes corruption and widespread abuses. The few remaining secondary forests are fast disappearing, and the remnant groundwater forests of the large swamps are being exploited as never before. Within the villages some trees are specifically planted along farm boundaries and cropped for building poles and firewood. During the late colonial period and the first decade of independence (that is, the years following World War II until the 1960s) people were actively encouraged to start small plantations of eucalyptus on fallow land; these plots have indeed become alternative sources of fuel and building poles, but they are now being cut without replanting.

These events are occurring in a perceptual universe still guided by belief in reproductive abundance. Yet for many decades it has been clear that the limited distribution of good soils, a system of partitive inheritance, the decrease in the practice of fallow agriculture owing to competition with plantations for open lands, and dense cattle and human populations do not allow continued expansion of Haya villages along the coastal ridges (Reining 1967; Schmidt 1978). A once finely balanced agricultural system has come under stress as fallow lands have been converted to tea (and smaller tree) plantations, resulting in shortened fallow cycles and decreased production. Established farms cannot support further division, and for several

decades young people have been forced to settle on marginal interior land or seek their fortunes in other districts or regions. Those who elect to stay and try to cultivate the poor soils on fallow land at the periphery of permanent villages risk low productivity and family malnutrition.

These and other interrelated causes have created an agroecological system that long ago reached its carrying capacity. Outmigration has been one solution; Haya men and women have been leaving westlake in significant numbers since World War I. This departure was the natural culmination of declining productivity in the region, linked to human disease and the rinderpest cattle epidemic of the early 1890s. The decimation of the herds, whose manure was essential to the agricultural system, would have had a lasting impact on soil fertility (Kjekshus 1977). This severe environmental stress was accompanied by famine and smallpox. With the almost complete elimination of herds from the landscape, bush encroached from the east, bringing with it the ravages of tsetse flies and trypanosomiasis, further suppressing the regeneration of herds and decreasing the carrying capacity of the once productive agricultural zone. The disease and outmigration seen in the twentieth century is an outgrowth of the collapse of an agroecological system deprived of essential inputs.

One notable feature of this decline was the departure of thousands of young Haya women to urban centers in East Africa in search of work, often as prostitutes. British colonial officials despaired of halting this constant traffic; sometime in the 1920s one baldly admitted (in a Bukoba District report) that he was powerless to prevent yet another lake steamer, loaded with young women, from leaving.[7] Many women eventually returned, some to invest in their own land. But often they brought with them the ravages of syphilis and other sexually transmitted diseases.

The pre–World War II syphilis epidemic in westlake was a terrible scourge and contributed to very low population increases during the 1930s (Kaijage 1989). Fertility rates in the postwar period were generally low for East Africa (Reining 1967) but are not linked to high rates of syphilis infection. Widespread administration of antibiotics ultimately saved the Haya from catastrophic disease rates and reversed the decline in population. But subsequent decades have seen a continuation of the pattern of outmigration for economic opportunity and better land, which still includes a flow of prostitutes away from and back to westlake.

The region's arable land is very limited and sells at exorbitant prices. The only option remaining to many is colonization of land with low fertility and marginal rainfall, usually in the drier central basin. The prospect for young women is grinding agricultural work and poverty. Alternative

urban "opportunities" seem undeniably attractive in this context of overpopulation and impoverished lifestyles, a syndrome that began in earnest one hundred years ago but whose genesis goes back two thousand years or more.

Out of this milieu has arisen the latest danger to westlake populations, the AIDS epidemic. Like the earlier syphilis epidemic, AIDS has decimated the reproductive populations of many westlake villages, particularly those on the coastal ridges. By the late 1980s seropositive rates were running as high as 41 percent among some age groups (Lwihura 1988). Tens of thousands have died, and massive socioeconomic disruption prevails. The tragic paradox is manifest: in a culture whose central system of meaning is derived from human reproduction, the act of human procreation now threatens the very existence of the cultural system. Nowhere else in the world is the threat of cultural extinction from disease so real. We are compelled to ask how the historical ecology of the region might figure in this phenomenon.

As the Haya bury their dead, a palpable fatalism grips their communities. Death has been an omnipresent part of life, but now it is immediate and appears inevitable before the natural life cycle is complete. Many indulge in promiscuity, reckoning that because they are fated to die soon they might as well have a good time now. This attitude accelerates the transmission of AIDS, and widespread suicide, often at the first sign of any common symptom, adds to the crushing despair. Scientists have searched for some—any—explanation of why it is precisely here, and just across the border in Uganda, that the epidemic has taken such a cruel toll. The war with Uganda in 1979 and the concomitant high concentration in the area of prostitutes from all around East Africa have been cited among the possible causes for both the localization and the high rates of transmission (Kaijage 1990).

That AIDS may be more readily transmitted by uncircumcised males must also be acknowledged as a contributing factor (Bongaarts et al. 1989). Clinical studies have shown that HIV thrives within the moist environment of the uncircumcised prepuce and passes easily through if that membrane is torn; or it is stored and later transmitted to a partner (Simonsen, Cameron, and Gakinya 1988). Some Tanzanians have questioned, and I join them, whether the practice of *katerero,* the beating of the penis against the female genitals, might tear the prepuce as well as the female membranes, thus increasing the probability of viral transmission.

All these speculations, however important, cannot be isolated from other issues of sexual behavior and must not be allowed to obscure the

reality that westlake is in the midst of a health crisis of staggering proportions.

In the past, social relations of production led to the differential acquisition of power and wealth by those who controlled critical knowledge of the westlake region's iron-working technology. That knowledge was protected by ritual mystification of the industrial process and sustained by a central symbolic armature of belief in unlimited reproductive capacity. The social relations of production promoted by this ideology ultimately led to severe degradation of the region's ecological system. Adaptations—in the form of both technological change and, eventually, institutional adjustments under centralized authority—nevertheless enabled a dynamic cultural system to thrive on the changing landscape for some centuries. In the latter case, the centralized state intervened in the relations of production through taxation and through new regulatory devices that employed religious-political sanctions to balance and to counter a dominant exploitative ideology.

Any historical ecology of westlake must address the rapid culture change that began at the opening of the twentieth century. The coming of Christianity undermined the fragile ecosystem by dissolving systems of restraint and management that had been vested in religious authorities in the employ of the state. That historical ecology must also recognize the historical effects of the ideologies that have driven exploitation and justified social control over the productive economy since prehistoric times, as well as the unfolding of a religious-political revolution in the seventeenth century that imposed a new order in the relationship between nature and culture. This ethnohistoric approach to human-land relations introduces cultural perspectives into environmental history and provides important insights into the relative success—over long periods—of different exploitative and management systems, some of which may provide guidelines if not blueprints for the future.

Notes

1. The area is also called Buhaya, after the Bahaya or Haya people who live there.

2. I have used the first-person plural throughout this paper to refer to the cooperative team of scientists under my guidance who have contributed to the synthesis of ideas presented here. The interpretations are solely my own.

3. Recent research into the history of forest clearance and environmental degradation in southwestern Uganda (Hamilton, Taylor, and Vogel 1986) shows intriguing patterns of forest clearance, some as early as 4800 BP. Any interpretation of the pollen record that claims that this forest loss was caused by early cultivation must be viewed with great caution. Such an interpretation is not confirmed by any archaeological evidence for agricultural settlements in the area. Hamilton and Taylor's pollen diagrams from the Ahakagyezi

swamp do show that clearance of the lower slopes and valleys was probably under way by 2800 BP and that the valley forests had been completely cleared by 2200 BP. We agree that this deforestation can very likely be attributed to cultivation, most probably by Bantu-speaking peoples. Whether they were iron producers remains an open question.

4. Note that this was the second serious phase of deforestation in the landscape within a thousand to twelve hundred years. As indicated in earlier discussion, the deforestation east of Lake Ikimba ca. AD 450–500 bears similarities (decline in arboreal pollen, then in nonarboreal pollen) to patterns we see in the area again by the mid-second millennium.

5. For further information on the liminal state of the *muharambwa* see Cory and Hartnoll (1945:266).

6. During experimental smelting in 1976, 1979, and 1984 the smelters of Kiziba required this species and identified it as the species used in the 1920s.

7. White (1990) documents the accumulation of wealth and the transfer of this wealth to westlake by Haya prostitutes beginning in the 1930s. However, it is apparent that outmigration for prostitution was well established at least a decade earlier.