

March 28, 2000 (*New York Times*)

Suspects in 'Blitzkrieg' Extinctions: Primitive Hunters

By WILLIAM K. STEVENS

Over the last 40,000 years, as anatomically modern but primitive hunters spread around the world, species after species of big animals vanished from the earth in their wake.

"Blitzkrieg" has long been scientists' favorite image for these spasms of biological destruction.

Nowhere, perhaps, was the extinction more striking than in New Zealand, where an entire class of large flightless birds called moas, 11 species and an estimated 160,000 individuals in all, once lived. New evidence now suggests that it may have been the most rapid extinction ever brought about by primitive people.

Some moas were about as big as turkeys, but others were awesome ostrichlike creatures, the largest weighing more than 500 pounds and standing 10 feet tall.

Skeletons show that they were built remarkably like some dinosaurs. They had never encountered anything like the stone-age Polynesians who colonized their islands in the late 13th century, and the big birds presumably had no fear of them; a hunter probably could have just walked up and killed one at will.

So by the time the ship of British explorer James Cook first brought Europeans to New Zealand in 1769, every last one was gone.

The conventional view has been that the Polynesians, ancestors of today's Maori people, hunted and otherwise drove the moas to extinction in a thousand years or so.

But now scientists say evidence from the early Polynesian settlements, plus new calculations based largely on the birds' reproduction profile, indicate that on the scale of geological time, the extinction was lightninglike, requiring 160 years at most and, probably, considerably less. The scientists say the destruction of the moas, by club and snare, was the fastest extinction of big animals -- what scientists call megafauna -- so far.

It was apparently even more rapid than the swift rate at which some scientists believe large creatures like mammoths, mastodons, camels, ground sloths and giant beavers were exterminated by prehistoric hunters in a North American blitzkrieg about 13,000 years ago. The cause of those extinctions has been hotly debated and remains unsettled.

The extermination of the moas "is probably the clearest instance of the extinction of a whole fauna of large animals" in a short time by hunter-gatherers, said Dr. Richard N. Holdaway, the chief author of the new study, which appears in the current issue of the journal *Science*.

A paleobiologist specializing in the biology of extinctions, Dr. Holdaway runs a private research company called Palaeocol Research in Christchurch, New Zealand.

His co-researcher was Chris Jacomb, curator of archaeology at the Canterbury Museum in Christchurch.

With some exceptions, experts say, large-scale extinction of big animals generally coincided with the arrival of early modern humans in places where they had never been.

This did not happen in Africa, they theorize, because people and other animals evolved there together, and African animals were therefore not so naïve about humans.

One of the most rapid extinctions was in North America, where not just big plant-eaters but also the predators that depended on them -- including saber-toothed cats, short-faced bears, cheetahs, maned lions and bigger versions of today's wolves -- are believed to have vanished in perhaps 400 years.

Three possible causes have been advanced for this extinction episode. Two are related to the blitzkrieg hypothesis: that humans swept across the continent from Siberia in a "killing front" that moved perhaps 100 miles in a decade, and that the animals were killed by diseases carried by people and their dogs from Siberia.

The third hypothesis says that rapid climate change played the critical role.

For New Zealand, Madagascar and many Pacific islands, few would deny that the first arriving humans caused mass extinction, said Dr. Jared Diamond, an ecologist at the University of California at Los Angeles, who wrote a commentary on the new study in *Science*.

The only questions, he said, are how fast the extinctions were and whether hunting was the only cause.

For New Zealand, he said, the new study "shows that moa extinctions were very fast and were mainly by hunting."

Several lines of evidence have led to this conclusion.

First, based on revised radiocarbon dating of charcoal and other materials in campsites of the Maori ancestors, the earliest arrival of Polynesians in New Zealand has now been placed in the 13th century rather than 1,000 years ago, as previously thought.

Second, archaeological analysis of the dismembered remains of moas in the campsites indicate that none were killed after the 14th century.

Now Dr. Holdaway and Mr. Jacomb have calculated the likely rate at which the moas disappeared.

The moas' reproductive profile was a key to the analysis: They were long-lived and slow to mature and breed.

They laid only one or two eggs at a time and raised perhaps one chick a year. If they were killed at even a low rate, they would not be able to reproduce fast enough to keep up.

In their calculations, Dr. Holdaway and Mr. Jacomb assumed conservatively that the first Polynesian colonists numbered only 100 people, that their population grew at only 1 percent a year, that they did not eat moa eggs or destroy moa habitat and that they killed only one female per week per 20 people.

Even so, the time to extinction was no more than 160 years.

Less conservative assumptions -- and more likely ones, in Dr. Diamond's view -- yielded even shorter times to extinction.

There is "no way of interpreting this record other than that it had to happen virtually overnight," said Dr. Ross MacPhee, a mammalogist at the American Museum of Natural History in New York, who has extensively studied ancient extinctions. Further, he said, the evidence makes a "really very impressive" case for hunting as the prime cause.

If that is true, he said, "this is easily the best instance of overkill, of blitzkrieg, on the record."

But Dr. MacPhee has long found it hard to believe that in general, a few hunters with primitive weapons could wipe out entire species, and he is the leading proponent of the idea that disease was mainly responsible.

He expressed skepticism that New Zealand's early hunters could have tracked down every member of every moa species, especially the smaller ones and those that might have lived in hard-to-get-at places in the islands' rugged mountains.

Also, he suggested, it would have been harder and more time-consuming to find moas as their numbers diminished; and as the more favored bigger birds disappeared, the hunters would have abandoned the chase as not worth the effort.

"At the end of the moas' tenure in New Zealand, people would have been doing virtually nothing else" than hunting them, he said.

It is more likely, he said, that the people turned to other food sources, like seals and seafood, before all the moas were gone.

The point is illustrated by a smaller, well-known survivor of the New Zealand blitzkrieg, a small flightless bird that has a low reproduction rate but is hard to find: the kiwi.

But the fact is, Dr. Holdaway and Dr. Jacomb wrote, "even minimal levels of human hunting pressure caused an irreversible decline in the moa population." The results of their study, Dr. Holdaway said, "reinforce the view that people with even the most basic technologies -- fire, clubs, snares -- can have major environmental effects."

The moas are in any case long gone.

"Yes, this was a blitzkrieg," Dr. Diamond wrote in *Science*. "Yes, a few people could and did kill every moa."

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March 30, 1999 (*New York Times*)

Unlikely Tool for Species Preservation: Warfare

By WILLIAM K. STEVENS

Perhaps no exploration in American history has more famously combined intrepidity with scientific enterprise than the two-year expedition of Lewis and Clark from the Mississippi to the Pacific two centuries ago. The ecologist Daniel B. Botkin, in a 1995 book, called it "the greatest wilderness trip ever recorded."

But how pristine was that Western wilderness of 1804 to 1806? The answer depends on how one conceives of the nature of nature, and it has basic implications for present-day conservation policy.

Fond tradition pictures the plains and mountains of the Lewis and Clark era as a nature untouched by humans and apart from them: a sort of original realm of the wild, undisturbed and eternal.

Many experts, however, have long since abandoned that vision. Today they see humans as longtime major players in nature's grand drama, and American Indians among the main ecological actors of the old West -- not only in the days of Lewis and Clark but for thousands of years before that.

Now, citing as evidence the marvelously detailed journals of Captains Meriwether Lewis and William Clark, some scientists are proposing that even Indian warfare played a critical ecological role, by regulating and maintaining both the numbers and distribution of bison and other big animals of the West before descendants of Europeans settled it.

Basically, according to this "war zone" theory, Indian hunters were so proficient that in an individual tribe's homeland, populations of big game like bison and elk seriously declined and in some cases disappeared.

But in several big buffer zones between warring tribes, where hunters were loath to spend much time lest their enemies attack them, big game found more safety and flourished.

These no-man's-lands functioned, in effect, as game preserves and may have kept the plains bison and other big animals from being hunted to extinction well before Europeans arrived.

Not everyone agrees wholly with the theory.

But the spotlight it casts on humans' impact on the pre-Columbian landscape also highlights one of the major conceptual problems facing present-day efforts to restore and conserve "natural" ecosystems: What target should be aimed at? Should the goal be to maintain nature as nearly as possible in the state it was in before the ancestors of the Indians came to America many millenniums ago? Or to its state just before Europeans appeared on the continent? Or to some other state altogether?

The war-zone theory is laid out in the February issue of the journal *Conservation Biology* by Paul S. Martin, a paleoecologist at the University of Arizona, and Christine R. Szuter, editor in chief of the University of Arizona Press.

Dr. Martin says the theory could partly explain why bison, elk, deer and bears escaped the fate of other, even bigger North American animal species that became extinct 13,000 years ago. These included, among others, mammoths, mastodons, camels, giant sloths, tapirs and predators that depended on them, like giant short-faced bears, a giant wolf called the dire wolf and the saber-toothed cat.

The bison is the largest surviving life form in North America, and Dr. Martin is the chief advocate of the view that the earlier vanished species of megafauna, as they are called, were hunted to extinction in a continentwide "blitzkrieg" lasting several centuries by human hunters who had migrated to North America from Siberia 15,000 years ago or more.

"The land had been stripped of most of its native megafauna through human influence" long before Lewis and Clark appeared on the scene, Dr. Martin and Dr. Szuter write.

And except for the influence of humans, they say, much larger populations of the surviving bison, elk and deer would have greeted the white explorers.

Other scientists contend that the ancient megafauna were extinguished by climatic change or disease, or by a combination of factors. Be that as it may, it is abundantly clear that Indians and their ancestors, called paleo-Indians by scientists, transformed the landscape and ecological relationships of the Western Hemisphere, with both positive and negative effects.

Indians rearranged the land with earthworks, farm fields, houses, towns and trails.

As top predators, the impact of their hunting on many species rippled through pre-Columbian ecosystems.

Indians also set frequent fires for one reason or another, and many pre-Columbian forests were more open and parklike as a result.

In the West, the Indians' fires helped create, renew and maintain grassland ecosystems.

Grasses with deep roots flourished, and the tender new shoots that sprang from them after the fires provided ideal forage for bison. The ecological loop came full circle when the Indians killed the bison, the underpinning of their hunter's way of life.

The idea that Indian warfare created game sanctuaries in buffer zones between tribes has been proposed by a number of authorities.

In the 1960's, Harold Hickerson, an anthropologist, found that in the 18th and 19th centuries, a contested zone varying from 15,000 to 35,000 square miles separated the Chippewa and Lakota in Wisconsin and Minnesota.

Indians did sometimes steal in to hunt there, but usually, Mr. Hickerson wrote, "in constant dread of being surprised by enemies." Deer were abundant in this tract until the two Indian nations made peace and hunting intensified in the zone.

In 1995, Elliott West, a historian at the University of Arkansas, identified contested zones of the central Plains that in the early and mid-1800's covered huge stretches of what are now Colorado, Kansas and Nebraska. There, he wrote in a 1995 book, "The Way to the West" (University of New Mexico Press), bison were "spared the full devotion" of Indians who were occupied contending with each other.

"The buffalo, in short, got a break," he wrote.

Similar zones have been identified, Dr. Martin and Dr. Szuter report in the article in Conservation Biology, between the Iroquois and Algonquins around Lake Champlain and in the upper Amazon River basin between forest tribes.

Now, citing the Lewis and Clark journals, Dr. Martin suggests that in their era, a great wedge of territory stretching for 46,000 square miles across the eastern two-thirds of what is now Montana, between the Missouri and Yellowstone Rivers, was an important war zone.

This region, he and Dr. Szuter wrote, "is commonly regarded by historians, biologists and TV producers alike as the very essence of 'wild' America." But in fact, they wrote, the plenitude of bison and other game there "reflected the status of the area as a buffer zone," where "war parties of various tribes or nations were ever at hand, and anyone hunting, processing and drying meat" might be killed by enemies.

The abundance of game in that region was clearly detailed by Lewis and Clark, says Dr. Martin.

And Clark, in one journal passage, writes, "I have observed that in the country between the nations which are at war with each other the greatest numbers of wild animals are to be found."

By contrast, there were no comparable buffer zones west of the Rockies -- and little big game, even though there was plenty of food for bison, elk and deer.

Dr. Martin's interpretation is that the trans-Rockies Indians simply hunted the big game until it disappeared. Consequently, the Indians there lived mainly on fish and roots.

Lewis and Clark's men found these unsatisfactory; unable to find enough big game to sustain themselves, they cooked and ate horses and dogs that they bought from the Indians.

The upshot, wrote Dr. Martin and Dr. Szuter, is that neither the scarcity of game west of the Rockies nor the abundance of it in the war zone to the east was "truly natural, that is, falling outside human influence or control." The meaning for conservation efforts, they wrote, is that "the West in the time of Lewis and Clark was long past any purely 'natural' condition that might serve as an absolute benchmark for planners."

For his part, Dr. Martin advocates the establishment of some nature preserves where the pre-Indian natural world might be re-created as closely as possible.

African or Asian elephants, for instance, might stand in for the extinct mammoths, enabling scientists to see something of how the pre-human North American landscape functioned ecologically.

One dissenter from the Martin-Szuter view is Dr. Botkin, an ecologist at George Mason University in northern Virginia and president of the Center for the Study of the Environment, a nonprofit research organization in Santa Barbara, Calif.

He wrote the 1995 book, "Our Natural History: The Lessons of Lewis and Clark" (Grossett/Putnam).

While there may have been more bison in war zones than elsewhere, Dr. Botkin said, Dr. Martin seems to assume that the ecology of the plains remained static.

In fact, said Dr. Botkin, the bison were highly migratory, and would probably have migrated in and out of war zones.

On a more fundamental level, he says, the Martin-Szuter paper implies that humans are a force outside nature, that their impact is unnatural and therefore undesirable. On the contrary, Dr. Botkin says, humans are an integral part of nature, one of many forces that have long kept the natural world in a constant state of flux.

There have been many states of nature in the past; for instance, many parts of North America have been covered by forests, grasslands or ice in different eras, and the assemblages of animals living there have varied accordingly.

The transformations wrought by Indians created yet other versions of nature.

Varying states of nature, said Dr. Botkin, constitute a "set of designs" from which today's conservation planners can choose in deciding what model to use as a standard for conservation and restoration projects. The durability of a particular design is not necessarily relevant, he said: If one wanted to pick the most durable design of the last few hundred thousand years in North America, "you go back to ice."

Therefore, he said, the state of nature encountered by Lewis and Clark is as valid a model as any of a number of other versions that have come and gone over the eons -- and is probably the one most Americans today would prefer.

The larger point, he said, is that "there is not a single truth about what's natural." The main value of the Martin-Szuter view, he said, is that it "points up that the discussion of what is natural is alive and well, and that it's not yet resolved."

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November 16, 1999 (*New York Times*)

Historians Revisit Slaughter on the Plains

By JIM ROBBINS

MISSOULA, Mont. -- The wanton slaughter of millions of bison in the 19th century by white hide hunters, abetted by a military intent on subjugating Indians, is probably the most famous conservation horror story in United States history.

The problem with this tale, a growing number of scholars and historians say, is that it is not true. As portrayed in a number of new books, the real story of the decline of the buffalo involves a significant change in climate, competition for forage and cattle-borne disease. Another major factor, the authors say, were Indian tribes, empowered by the horse and gun and driven to hunt buffaloes for the profits that came from hides and meat.

"What most people don't consider in their 'Dances With Wolves' version of history is that Indians were involved in the market," said Dr. Dan Flores, the A.B. Hammond professor of Western history at the University of Montana. "They were cashing in on buffalo in the 1840s as their principal entree into the market economy, and very few species are able to survive when they become a commodity."

White hunters who killed buffaloes by the millions in the 1870s and 1880s played a major role in the demise, said Flores, but only as the coup de grace. "The hide hunters are not off the hook," he said. "They share the burden of the final mop-up. But without their involvement, the buffalo would probably have only lasted another 30 years." That is because their numbers had been so greatly reduced by the other factors.

The buffalo studies are part of a continuing debate about the role of Indians in Western history. In "The Ecological Indian" (W.W. Norton, 1999), for example, Shepard Krech III, an anthropologist at Brown University, argues against the romantic image of the Indian as the first environmentalist. When Indians had had the means and the motive, he says, they abused nature for profit.

Flores, whose work on buffalo has appeared in *The Journal of American History* and elsewhere, is writing a book on bison under contract with Yale University Press. And Dr. Drew Isenberg, an assistant professor of history at Princeton, has a book called "The Destruction of the Bison: An Environmental History, 1750-1920," which will be published by Cambridge University Press in April.

Not everyone subscribes to the new wave. Dr. Vine Deloria Jr., a professor of history at the University of Colorado at Boulder and a member of the Standing Rock Sioux, finds the revisionism preposterous. "It's nonsense," he said. "The Indians did not make any appreciable dent in buffalo numbers in the Northern Plains. It's anti-Indian stuff."

Indians were involved in the buffalo market, scholars generally agree. Their acquisition of horses and guns made buffalo hunting much easier. As steamboats started plying the Missouri River into the heart of buffalo country in the 1840s, hide hunting by the Kiowa, Blackfeet, Sioux and other Plains tribes soared.

For the first time, there was a way to haul the bulky robes back East, where they became popular as a covering during cold weather travel and for leather goods. Indians found they could trade the robes for firearms, lead balls, gunpowder, blankets, textiles, pots and pans and whiskey.

Isenberg estimates that before the 1840s, 60,000 Plains Indians were killing half a million bison a year for sustenance. After the robe trade began in the 1840s, that total went over 600,000 a year, "clearly into unsustainable range," he said.

While white hunters killed more buffaloes (their total throughout the West is estimated at four million), Flores argues that Indians concentrated their killing on buffalo cows, which had more tender meat and were much easier to skin and treat, resulting in severe damage to the herds' reproductive capacity.

Environmental factors play large roles in newer histories of the West. For example, Flores says that the study of tree rings, or dendrochronology, suggests that Indians were so effective in decimating the buffalo because climate had already weakened and diminished the herds.

From the 1500s to the mid-19th century, a period known as the little ice age, tree rings show that the climate in the West was much colder than normal. That favored the grasses buffaloes eat, and they flourished. When a long, widespread drought ended the little ice age in the mid-1800s, the grasses changed and the bison population crashed just as the tribes began market hunting.

At the same time, Flores said, buffaloes began having to compete for forage with horses that were brought by the Spaniards to North America in the 1500s and later went feral. By the 1800s, Flores estimates, two million horses were sharing the range with the buffalo.

Flores and the others also differ from their predecessors in their use of Indian sources. Many bands of Indians, for example, kept a record of events, often symbols painted on bison robes. The Northern Plains tribes kept winter counts of buffaloes on buffalo hides, while the Kiowa, in the south, kept calendars.

"The symbol for 'many buffalo,' a circle with a dot in the middle, appears numerous times from 1800 to 1840 in the Kiowa calendars," Flores said. "But after 1840 it appears only once."

Such counts are crucial to the debate over who or what killed off the bison, but all sides agree that estimates are a tricky business.

In the past, historians estimated bison numbers at 40 million to 60 million, sometimes as many as 75 million. But Flores has tried to calculate how many buffaloes the range could support by analyzing 1910 census data on cattle, and has concluded that in good years the range could hold only 20 million to 24 million.

After the little ice age, at the time of the Civil War, buffalo numbers may have been as low as 10 million to 12 million, he said.

But his calculations have been criticized by Deloria, who says that comparing fenced-in livestock with free-roaming buffaloes is an inappropriate comparison.

Dr. Calvin Luther Martin, who taught history at Rutgers and lived with Eskimos for two years on the Alaskan tundra, also disagrees. Martin, the author of a new book on Indian life, "The Way of the Human Being" (Yale University Press), argues that to judge Indians by contemporary environmental standards "is patent foolishness."

The Indians were caught between two different worlds and two different realities, Martin said. "They don't translate into each other," he said, adding that Indians had no concept of being wasteful.

And the claim that competition with horses would have affected the buffalo has also been criticized by Dr. Valerius Geist, an ecologist who is an emeritus professor of environmental science at the University of Calgary in Alberta. Geist, author of "Buffalo Nation: The History and Legend of the North American Bison," noted that bison had evolved on the prairie with other large mammals. "Flores is a historian playing ecologist," Geist said.

Finally, the new bison scholarship also casts doubt on another major tenet of buffalo history: that the destruction of the herds was a conspiracy between the United States Army and hide hunters who did the killing.

"I don't think there was a conspiracy by any means," Isenberg said. "The army was happy to see hide hunters, but they were not commanding them to kill bison."

Flores traces the notion of a conspiracy to the memoir of a Texas buffalo hunter named John R. Cook, called "The Border and the Buffalo." According to the book, the Gen. Philip H. Sheridan, the Indian fighter, urged the Texas Legislature not to pass a law that would protect the buffaloes remaining there and instead to create a bronze medal for the hunters "with a dead buffalo on one side and a discouraged Indian on the other."

Flores said he had found no record of Sheridan's speech to the legislature and believed it was apocryphal. The notion of a conspiracy, he said, has become fact through repetition.

Flores said he had recently discovered letters in which Sheridan wrote that he was concerned about the demise of the buffalo. After hearing in October 1879 about the killing of thousands of buffaloes by hide hunters near Miles City, Mont., Sheridan sent a telegram to Washington, saying, "I consider it important that this wholesale slaughter of the buffalo should be stopped."

Isenberg denies that the new work on the buffalo is anti-Indian.

"It's romantic to imagine Indians as always living in harmony with nature," he said. "But they are people who did many things right and who also made mistakes. If you want to see them as a real people and not a romantic notion, then you have to look with a clear eye at these kinds of things. None of us have any animus toward Indians."

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July 10, 2000 (*New York Times*)

Pygmies Wonder if Oil Pipeline Will Ease Their Poverty

By NORIMITSU ONISHI

MABOLO, Cameroon -- Behind the hills next to this Pygmy village in the Central African rain forest, a pipeline is to be built in a few years to carry oil to the Atlantic coast, where it will be shipped to the West.

The pipeline, which the World Bank endorsed in June after heated debates, will be a huge project, costing \$3.7 billion. It represents a big, risky test for the bank and for African development policies. Historically, the oil exploitation in Africa has generated ruinous corruption or long-running wars, not wealth for nations and their citizens.

In this village, there are both doubts and hopes. "I don't know where the oil is coming from and where it's going," said the village chief, Marc Nzie. "I only know it will pass behind those hills. If they stay behind those hills, then it's no problem. We won't hunt there anymore. We'll go the other way."

But he said that in this village, which is without electricity, "if the pipeline is going to pass behind those hills, they have to give us light."

Even before the World Bank voted on June 6, the pipeline drew a level of opposition in the West unusual for an African project. Human rights and environmental groups had joined forces with residents here and in neighboring Chad, the two countries the pipeline would cross.

The underground pipeline is to start in southern Chad, a landlocked desert nation where oil was discovered three decades ago but where civil wars and unrest have prevented exploitation, leaving it one of the poorest countries.

"We were very interested in working with Chad to find a way of exploiting these oil resources in a way which would channel these benefits for the poor and to make a difference in terms of poverty," said Callisto Madavo, the World Bank's vice president for sub-Saharan Africa. "The stakes are very high. We should be able to pull this thing off. But I wasn't born yesterday. There are risks, and I wouldn't underplay them."

Before the 665-mile pipeline ends, in Kribi, it will have to cross the Sahel in Chad, the savanna and mountains of northeastern Cameroon and the virgin rain forests in the south, where the canopy of trees is broken only by loggers and Pygmy villages like this one.

To reach this village near the pipeline route, a traveler has to follow a footpath that breaks off a dirt road and winds through the forest up and down muddy hills and across creeks to Mabolo, a village of 13 mud huts. On one morning, heavy rains had dissuaded the men from going into the forest to hunt. Many sat together in an open area.

A knock on the chief's door found him on a bamboo bed, suffering from malaria. Mr. Nzie, in his 50's, is renowned as a healer, but he had been unable to rid himself of a persistent case of malaria. He calls it "Kabila," after President Laurent Kabila of Congo, whom the Rwandans and Ugandans, who are supporting the rebels, have been unable to oust for two years.

The chief's eldest son, Louis Bitouti, 27, who was building a toy truck, said many younger Pygmies hoped to get jobs from the pipeline.

"Why not?" asked Mr. Bitouti, who like other Pygmies here uses his grandfather's name as his last name. "I want to be rich like everyone else. If I lose my father here, how will I live?"

The villagers founded Mabolo five decades ago, they said, and with about 50 inhabitants it was one of the biggest Pygmy villages in the region. Although Pygmies are traditionally nomadic hunters, the villagers have become somewhat sedentary, continuing to hunt deep in the forest but also growing cassava and yam.

In this country of 14 million people, the Pygmies, the indigenous rain forest dwellers, number perhaps 100,000. They have remained without formal schooling, and few speak French, the language of the former colonial rulers.

The dominant ethnic groups in Cameroon often discriminate against the Pygmies. Many Pygmies have been forced out of their home areas by logging companies and security forces, several human rights studies report, including the State Department report on human rights in Cameroon in 1999.

A peaceful people, the Pygmies have, perhaps inevitably, become a focus of those opposed to the pipeline. The Pygmies may be the most vulnerable and have the most to lose.

Under the plan, the World Bank will give \$200 million in loans to the Chad and Cameroon governments. The amount is small, given the cost of the project, which will be borne mostly by the oil companies involved in the joint venture, Exxon Mobil, which would have 40 percent; Chevron, another American company, 25 percent; and a Malaysian company, Petronas, 35 percent.

The World Bank support is far more important to the companies than its financial contribution. Many diplomats in the region say they believe that the companies would have withdrawn and that Chad would have turned to other partners, perhaps Libya, if the bank had not voted yes.

In the last quarter of a century, the western African coast between Nigeria and Angola has become one of the hottest spots for oil exploration. But the Western multinational companies have come under increasing criticism for their practices, especially Royal Dutch Shell in Nigeria and Elf Aquitaine in Gabon and the Congo Republic, whose capital is Brazzaville.

"There is not one example in Africa where oil has led to development," said Samuel Nguiffo, secretary general of the Center for the Environment and Development, a leading environmental organization here. "Look at Nigeria, Angola, the two Congos, Gabon. They all have an overabundance of oil, and what do they have to show for it?"

"We can even say that the exploitation of oil has retarded their development. What are the chances that things will be any different in Chad or Cameroon?"

In an interview in the capital, Yaoundé, where he was visiting officials, Mr. Madavo said he was aware of the history of oil here. He said he was also aware that Chad had a poor human rights record and that Transparency International, an organization based in Berlin that studies corruption, had ranked it the most corrupt country for two years.

"It's very, very important that the World Bank, as an economic institution, not become so risk averse that it would only do the sure thing," he said.

Early in June, the bank decided to proceed with the biggest project that it has been associated with in Africa. In Washington, officials at the State and Commerce Departments backed the plan. Their counterparts at the Agency for International Development and the Environmental Protection Agency, concerned about how the oil revenues would be spent and the pipeline's environmental effects, opposed it.

Under the agreement with the bank, Chad agreed to a spending plan for its oil revenues, with 80 percent for education, health, social services, rural development and infrastructure; 10 percent to

be kept in a trust for the future; and 5 percent earmarked for development in the oil-producing region of Doba. The last 5 percent would be discretionary.

In Chad, where 80 percent of the seven million inhabitants live on less than \$1 a day, the oil revenues would amount to up to half of the national budget. Oil money is widely expected to start flowing in four years and to last for 25 years, for a total of \$2 billion. The government has pledged to respect its part of the bargain.

"There will not be any place for predators of oil revenues," President Idriss Deby said in a speech after the bank had voted. "We will make sure that every centime from oil will produce a positive effect in the life of every Chadian family."

The money that Cameroon would derive is estimated at \$500 million, or 3 percent of the national budget. Concerns in this country center more on the ecological effects, because many environmental group contend that the huge oil companies have used substandard controls while exploiting oil in places like the Niger Delta in Nigeria.

Didier Amougou, an official at Planet Survey, a Cameroonian environmental organization, said groups like his had shifted from opposing the project to trying to ensure that it would be properly built and managed. He said his group would also try to make certain that those affected by the construction would receive fair compensation, especially the Pygmies, who are dominated by Bantus in the rain forest.

"To the Pygmies, we are the white men," said Dieudonné Mbuel, 37, a Bantu, explaining how the Bantus had seized most of the rain forest from Pygmies.

Mr. Mbuel, who lives in a nearby Bantu village, Madoungou, said he had received \$500 from the joint venture because the pipeline is expected to pass through his land. He expected more.

"You see this mango tree?" he asked, standing in the thick of the forest and pointing to a tree taller than the others. "They'll have to compensate me for that."

None of the Pygmies interviewed have received any compensation, although some are eventually supposed to under the agreement.

Not too far away, in Ndamayo, Jean Bikanda, a Pygmy, said he did not believe that he would ever receive any money for the pipeline. Several months ago, loggers ripped through the forest, creating a road just in front of his house. He received no compensation, he pointed out.

Asked his age, Mr. Bikanda stood up in his hut and opened a nylon bag that was hanging in a corner. He took out his identity card, which most people in Cameroon have. But he was one of the few Pygmies interviewed who had one. Born in 1938, the card read, "Profession: Chasseur." Hunter.

The prey that Mr. Bikanda hunts -- rats, porcupines, rabbits, boars and antelopes -- fled deeper into the forest because of the loggers, he said. "Maybe we will get work from this pipeline," he added.

"Maybe this will be good for Cameroon."

But his son Pierre Mbang, 34, said: "Work is good, but the forest is our life. Work is good, but it will end."

The son was unsure what to make of the World Bank decision. "That's where all the money in the world is kept," he said of the bank, reinforcing the distance between bank decisions and life on the ground.

Mr. Madavo, the bank vice president, who is from Zimbabwe, was hopeful. "If it succeeds," he said, "wouldn't that be wonderful for a story to be written 20 years from now, that on an issue where there was a lot of doubt and skepticism, that the World Bank stood up, did its homework, supported something that made a tremendous difference to Africa? I would love to be alive to see that."

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February 16, 2003 (*New York Times*)

Logging Jobs Benefit Pygmies, but Imperil Their Forest Home

By THE ASSOCIATED PRESS

POKOLA, Congo Republic (AP) — For Pygmies logging the rain forests of central Africa, the chain saw's whine signals the promise of work — and threatens a way of life.

As the Congo Republic's timber industry picks up after years of ruinous civil war, international logging companies are cutting swaths deep into the heart of the huge Congo basin.

The boom puts the Pygmies in a wrenching dilemma: tree by tree, the jobs it gives them are destroying the forest home where they have lived for millennia.

"It's out of a need to survive that I work with the timber companies," said Bekou, a Pygmy logger. "Our life is impossible outside the forests."

Loggers say they offer jobs and schooling, and want to save Pygmy culture. But the Pygmies say each tree felled means less leafy cover for the striped antelopes they hunt and brings them closer to losing their heritage.

"Our only hope is that our forests not be totally destroyed," said Daniel Kaya, one of about 160 Pygmies working for the Swiss-German company Congolese Industrial Wood, known by its French acronym, CIB.

The Congo basin holds about one-fourth of the world's tropical forests and is the largest stretch of unbroken forest in the world aside from the Amazon. Each year, logging eats up 3,125 square miles of lush woods, an area twice the size of Rhode Island.

It is already changing the way of life for the Pygmies, believed to be the earliest inhabitants of central Africa. While many survive by hunting and gathering deep in the jungle, others have already left the forests in search of jobs.

"Today, we need to travel great distances, or simply emigrate, to find something to eat," said Florent Bekou, another Pygmy who works for CIB.

Between 5 and 10 percent of the Congo Republic's 2.9 million citizens are Pygmies, many of whom stand less than 5 feet tall. Over the centuries, the legendary hunters retreated deep into the jungle to keep away from more powerful Bantu tribes.

During the 1990's, three civil wars devastated the Congo Republic and silenced the chain saws in the jungles. An insurgency still rages in the south, but as peace spreads through the north, so do the lumber companies.

In recent years, logging companies have contributed about 7 percent of the country's foreign earnings, second only to the oil industry.

"In the long term, the situation risks becoming critical for the population, because all the forest in the northern Congo Republic has already been assigned to the logging companies," said Paul Elkan, an official for the United States-based Wildlife Conservation Society based in the Congo Republic.

The logging has denuded swaths of the forest, and conservation groups say it endangers rare animals including gorillas, whose numbers have dwindled to only a few thousand in the Congo Republic and Rwanda.

But conservationists say companies are trying to help the Pygmies and reduce the environmental damage. Selective logging allows companies to fell choice trees without denuding whole tracts of woodlands.

In January, the United States announced a four-year, \$53 million donation to help protect the forests in the Congo basin. France has offered a similar amount.

In July 2001, about 100 square miles of the Congo Republic's rain forest were declared protected land in an agreement reached by government officials, the Wildlife Conservation Society and CIB, the largest logging company in the country.

But that is not much compared with the size of the entire basin — 840,000 square miles. It spans parts of Cameroon, Central African Republic, Congo, Equatorial Guinea, Gabon and the Congo Republic.

Pygmies make up about 10 percent of CIB's work force of 1,600 here, said Patrick Geffroy, a top company official in Pokola, 720 miles north of the capital, Brazzaville.

The company has built housing for its employees, although many Pygmies have shunned it in favor of their own huts — squat shelters of sticks, leaves and mud. CIB has also built a school in Pokola, with about 1,100 pupils, although only two are Pygmies, Mr. Geffroy said.

The company is trying to help protect Pygmy culture, he said.

"The Pygmies have remarkable artistic talent," he said. "When they sing in the open air with their clear voices, you think that you are in front of the best cathedral chorus in Europe.

"They are human beings who have the right to live in their natural space."

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November 18, 1997 *(New York Times)*

New Clues Show Where People Made the Great Leap to Agriculture

By JOHN NOBLE WILFORD

The greatest thing before sliced bread, to reverse the cliché, was bread itself. The first cultivation of wild grains, that is, turned hunter-gatherers into farmers, beginning some 12,000 to 10,000 years ago. In the transition, people gained a more abundant and dependable source of food, including their daily bread, and changed the world forever.

Archaeologists and historians agree that the rise of agriculture, along with the domestication of animals for food and labor, produced the most important transformation in human culture since the last ice age -- perhaps since the control of fire.

Farming and herding led to the growth of large, settled human populations and increasing competition for productive lands, touching off organized warfare. Food surpluses freed people to specialize in crafts like textiles and supported a privileged elite in the first cities, growing numbers of bureaucrats and scribes, soldiers and kings.

Excavations at more than 50 sites over the last half-century have established the Fertile Crescent of the Middle East as the homeland of the first farmers.

This arc of land, broadly defined, extends from Israel through Lebanon and Syria, then through the plains and hills of Iraq and southern Turkey and all the way to the head of the Persian Gulf. Among its "founder crops" were wheat, barley, various legumes, grapes, melons, dates, pistachios and almonds. The region also produced the first domesticated sheep, goats, pigs and cattle.

But questions persist: Where in the Fertile Crescent were the first wheat and barley crops produced? What conditions favored this region? Why was the transition from hunting and foraging to farming so swift, occurring in only a few centuries?

New genetic studies suggest possible answers. They pinpoint the Karacadag Mountains, in southeast Turkey at the upper fringes of the Fertile Crescent, as the site where einkorn wheat was first domesticated from a wild species around 11,000 years ago.

Moreover, they reveal that cultivated einkorn plants, as botanists had suspected, are remarkably similar genetically and in appearance to their ancestral wild varieties, which seems to explain the relatively rapid transition to farming indicated by archaeological evidence.

A team of European scientists, led by Dr. Manfred Heun of the Agricultural University of Norway in Ås, reported these findings in the current issue of the journal *Science*. The researchers analyzed the DNA from 68 lines of cultivated einkorn wheat, *Triticum monococcum monococcum*, and from 261 wild einkorn lines, *T.m. boeoticum*, still growing in the Middle East and elsewhere.

In the study, the scientists identified a genetically distinct group of 11 varieties that was also most similar to cultivated einkorn. Because that wild group grows today near the Karacadag Mountains, in the vicinity of the modern city of Diyarbakir, and presumably was there in antiquity, the scientists concluded, this is "very probably the site of einkorn domestication."

Knowing the site for the domestication of such a primary crop, the scientists said, did not necessarily imply that the people living there at the time were the first farmers. "Nevertheless," they wrote, "it has been hypothesized that one single human group may have domesticated all primary crops of the region."

Archaeologists said that radiocarbon dating was not yet precise enough to establish whether einkorn or emmer wheat or barley was the first cereal to be domesticated. All three

domestications occurred in the Fertile Crescent, probably within decades or a few centuries of each other. It was a hybrid of emmer and another species from the Caspian Sea area that produced the first bread wheat.

Dr. Bruce D. Smith, an archaeobiologist at the Smithsonian Institution and author of "The Emergence of Agriculture," published two years ago by the Scientific American Library, praised the research as another notable example of new technologies' being applied in trying to solve some of archaeology's most challenging problems. The einkorn findings, he said, made sense because they "fit pretty well with archaeological evidence."

Not far from the volcanic Karacadag Mountains and also to the south, across the border in northern Syria, archaeologists have exposed the ruins of pre-farming settlements and early agricultural villages that appear to have existed only a few centuries apart in time. Sifting the soil turned up seeds of both wild and cultivated einkorn wheat. The ruins of Abu Hureyra, an especially revealing Syrian site on the upper Euphrates River, contained firm evidence of einkorn farming more than 10,000 years ago.

The European research team also pointed to this archaeological evidence as supporting its conclusion that the domestication of einkorn wheat began in the Karacadag area.

But some archaeologists may not readily accept the new findings. They have their own favorite areas where they think the first steps in plant domestication took place, and these happen to be to the west and south of the Turkish mountains.

Mud-brick ruins at the edge of an oasis in the Jordan River valley near Jericho have often been cited as from the world's first known farming village, occupied by an ancient people that archaeologists call the Natufians.

Dr. Frank Hole, a Yale University archaeologist who specializes in early agriculture, thinks the major center for early plant domestication was more likely in the corridor running north from the Dead Sea to Damascus.

Its Mediterranean-type climate, dry summers and mild but wet winters, which prevailed at the time of agricultural origins, would have favored the growth of annual plants like barley and both einkorn and emmer wheat. The Jericho site produced early evidence of barley cultivation.

Commenting on the new research, Hole said in an interview that "the location of domestication can't be determined by the present distribution of the wild plants." For example, einkorn does not grow wild today around Abu Hureyra, though excavations show that it must have more than 10,000 years ago. So it cannot be assumed, he said, that wild einkorn was growing in southeast Turkey at the time of domestication.

But Dr. Jared Diamond, a specialist in biogeography at the University of California at Los Angeles, disagreed, noting that the Karacadag Mountains supported "stands of wild einkorn so dense and extensive that they were being harvested by hunter-gatherers even before einkorn's domestication."

An experiment more than 25 years ago by Dr. Jack Harlan, an agronomist at the University of Illinois, demonstrated the likely importance of wild einkorn in the diets of post-ice age hunter-gatherers in the region and what might have encouraged them to domesticate it. Harvesting wild einkorn by hand in southeastern Turkey, Harlan showed that in only three weeks, a small family group could have gathered enough grain to sustain them for a full year.

In reaping the wild grain over a few decades, or at most three centuries, the hunter-gatherers unwittingly caused small but consequential changes in the plants. The new DNA analysis showed

that an alteration of only a couple of genes could have transformed the wild einkorn into a cultivated crop.

In the wild, brittle stems hold the einkorn grains to the plant, making it easier for them to scatter naturally and reseed the fields. But natural mutations would have produced some semi-tough stalks that held the seeds more firmly in place.

People cutting the plants with sharp stone sickles would have selected the stalks more laden with grain, and these would be stored as next year's seed stock. Birds would be more apt to consume the dispersed grain from brittle stalks, leaving less of it to germinate.

As Diamond pointed out, repeated cycles of harvesting and reseeding wild einkorn stands "would have selected automatically for those mutations." Those changes included plumper, more nutritious grains in denser clusters that cling to the stem until ripe, instead of scattering before they can be harvested.

"These few, simple changes during einkorn's domestication," Diamond wrote in a separate article in *Science*, "contrast sharply with the drastic biological reorganization required for the domestication of Native Americans' leading cereal, maize, from its wild ancestor."

This difference alone, he said, "helps explain why densely populated agricultural societies arose so much earlier and developed so much more rapidly in the Crescent than in the New World."

It was several thousand more years before maize, or corn, would become a cultivated crop in central Mexico. There were no native wild wheats and barley in the Americas that might have led to an earlier introduction of agriculture there.

Such circumstances based on geographic location have often been critical in the timing and pace of cultural and economic development for diverse societies, as Diamond argued in *"Guns, Germs, and Steel: The Fates of Human Societies,"* published earlier this year by W.W. Norton.

Nothing in the new einkorn research seems to alter current thinking about the timing and climatic circumstances for agriculture's genesis in the Fertile Crescent.

With the end of the ice age 14,000 to 12,000 years ago, retreating glaciers left the world warmer and wetter than before. Greater rainfall in many temperate zones nourished a spread of vegetation, including many grasses like wild wheat and barley.

This attracted concentrations of grazing animals. Hunter-gatherers converged on the grasses and animals, in many cases abandoning their nomadic ways and settling down to village life. Such conditions were particularly favorable in the Middle East.

Then followed a brief return of colder, drier weather more than 11,000 years ago and lasting a few centuries. Dr. Ofer Bar-Yosef, an archaeologist at Harvard University, thinks the stresses of coping with the Younger Dryas, as the dry spell is called, contributed to the beginning of plant domestication.

With the sudden dearth of wild food sources, hunter-gatherers began storing grain for the lean times and learning to cultivate the fields for better yields. In any case, the earliest evidence for agriculture so far comes from the period immediately after the Younger Dryas.

In his book on early agriculture, Smith of the Smithsonian wrote, "Even in the absence of such an external pressure, gradual growth in their populations and expansion of their villages may have encouraged or necessitated a variety of economic changes, including experimenting with the cultivation of wild grasses."

Whatever the factors behind its origins, Diamond said, agriculture took a firm hold in the ancient Middle East because of the diversity of plants and animals suitable for domestication. The first farmers, he said in the journal article, quickly assembled "a balanced package of domesticates meeting all of humanity's basic needs: carbohydrate, protein, oil, milk, animal transport and traction, and vegetable and animal fiber for rope and clothing."

Eurasian geography probably favored the rapid spread of agriculture out of the Middle East and throughout much of the two continents. Referring to a thesis developed in his book, Diamond pointed out that the west-east axis of the Eurasian land mass, as well as of the Fertile Crescent, permitted crops, livestock and people "to expand at the same latitude without having to adapt to new day lengths, climates and diseases."

In contrast, the north-south orientations of the Americas, Africa and the Indian subcontinent probably slowed the diffusion of agricultural innovations. And that, Diamond contends, could account for the head start some societies had on others in the march of human history.

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July 3, 2003 (*Wall Street Journal*)

Kazakhstan's Eden of Apples May Also Be Their Salvation

Scientist Sees a Stock That May Yield Hybrids Largely Resistant to Disease

By STEVE LEVINE

Staff Reporter of THE WALL STREET JOURNAL

ALMATY, Kazakhstan -- Driving a sport-utility vehicle on a dirt road, Aimak Jangaliyev notes the Tien Shen Mountains surrounding him. "These are Adam's gardens," he says with a wave. Then he suddenly halts. "Look there! There they are!"

The 89-year-old scientist points to some trees. Unremarkable in appearance, they are anything but. Thousands of years ago, scientists say, the first apples as we know them today appeared in the Tien Shen, and these are their descendants.

The survival of the original apple is not a mere historical footnote. Mr. Jangaliyev is one of the many leading experts who believe that Kazakhstan's primeval forests may one day help to save the \$50 billion-a-year global apple industry.

For those who don't know that the apple industry is in need of Kazakh assistance, the problem goes back some 6,000 years. That's when fruit naturally similar in quality to store-bought American varieties appeared around present-day Almaty, which means "Father of Apples" in the Kazakh language. Travelers passing through spread the fruit east and west, thus making apples a popular fruit. But the proliferation ultimately wreaked genetic havoc. Today, about 90% of the apples eaten around the world are the ultimate offspring of just two parent trees, scientists say, producing a gene pool so shallow that awful apple scourges have resulted: apple scab, cedar apple rust and fireblight, not to mention powdery mildew. Factor in bad weather and increased competition from China, and the U.S. apple industry has lost \$1.7 billion in the past seven years, says James Cranney Jr. of the U.S. Apple Association. U.S. apple growers, he says, are "in a recession, if not a depression."

Apple diseases are a rarity in the never-cultivated trees of the Tien Shen, where a plethora of apple genes developed over several thousand years of isolation from the rest of the world's apples. Today, experts are looking for apple salvation in the forests here, which are vigorously defended by Mr. Jangaliyev, Kazakhstan's pre-eminent apple expert. "This is a unique resource for the planet," says Herb Aldwinckle, an apple expert at Cornell University, the main U.S. repository of apple knowledge. "We have found that the native apples of Kazakhstan have a wealth of disease resistance," he says.

Mr. Jangaliyev was raised an orphan here after his father died and Soviet authorities exiled his mother to Russia. He became interested in apples in the 1930s, when a college genetics professor sent him to study the mountain forests. When Stalinist repression and famine struck, the professor dispatched him to safety in a Moscow scientific institute, where in 1941 he defended a doctoral dissertation on the diversity of Kazakhstan apple genes. Back in Almaty after fighting in Europe alongside U.S. allies in World War II, he studied apple genes in relative obscurity. Like the rest of the Soviet Union, Almaty was largely shut off from the rest of world.

All that changed in 1989. That's when Mr. Aldwinckle, the Cornell professor, wangled a rare visa to Kazakhstan. Mr. Jangaliyev met him at Almaty Airport and, a few get-acquainted vodka shots later, the two men were off on a four-week apple connoisseur's tour. Mr. Jangaliyev showed his first Western visitor thousands of acres of wild apple forests that are home to *Malus Sieversii*, the apple variety that scientists say is the forefather of most apples eaten around the world. What they didn't see was much disease, even though none of the trees appeared ever to have been treated with chemicals. What they did see were apples that "closely resembled what we buy in the market," says Mr. Aldwinckle.

When Mr. Aldwinckle returned to Cornell with Kazakh stems and seeds, he triggered a world-wide sensation. Hearing of the trip, German apple experts complaining about apple scab and apple rust asked whether they, too, could test Mr. Jangaliyev's apple genes. South Africans wanted to know whether the genes might spell an end to woolly apple aphids. The U.S. Agricultural Research Service, which sponsors some Cornell apple research, organized a string of follow-up tours. "It was the experience of my life," says Taaibos Human, a South African breeder who went in 1995.

The interest stemmed from how most staple fruits and vegetables spread over history, originating in one place -- radishes in China, for instance, and cranberries in North America. Scientists believe that by going to a fruit's place of origin, they can find genes that developed over the intervening centuries, and from them they can produce super-resistant hybrids.

In the case of apples, among the places they reached after leaving Kazakhstan was America, ultimately producing the Red Delicious and Golden Delicious varieties, which are the parents of about 90% of the apple hybrids people eat, scientists say. The Red Delicious was hybridized into the Fuji and the Empire, and the Golden Delicious into the Gala, the Jonagold, the Mutsu, the Pink Lady and the Elstar, says James Luby, an expert at the University of Minnesota.

Varieties may be tastier than Delicious, but inbreeding has promoted diseases that have become ever harder to contend with. Growers cater to consumers put off by the slightest imperfection, so U.S. farmers spray their apples against pests and disease about 10 times a year, on average. South African growers spray up to 50 times annually. With many health-conscious consumers demanding unsprayed fruit, growers have sought ways to prevent disease that don't involve pesticides.

Scientists see Kazakh apple genes as a way to produce disease-resistant apples that don't need nearly as much spraying. A new hybrid wouldn't suffer the fate of today's apples anytime soon, scientists believe, because it would have Kazakhstan's time-ripened disease protection. But pulling that off will be harder than it sounds. Scientists say they'll need 25 years or more to produce a successful new variety. That's how long it takes to grow and test a hybrid before going to market.

The pace of the work makes Mr. Jangaliyev impatient. "Mount your horses," he says, ordering passengers into his SUV for a tour of laboratories and breeding farms he supervises.

Mr. Jangaliyev's current preoccupation is safeguarding the forest as a natural incubator of newer genes resistant even to currently unknown apple diseases.

Soviet authorities cleared most of the apple forest that once choked Almaty and, since the 1991 Soviet breakup, Kazakhstan's oil wealth has spawned more forest-clearing for luxury cabins. The result is that the forest has shrunk to about 10,000 acres today from about 125,000 acres in the 1940s, according to the United Nations. That especially angers Mr. Jangaliyev, who spies a clear-cut hilltop where someone has built a house. "Why on earth does he need a villa?" he asks.

He has little tolerance for people who don't cherish the forest. "Nothing," he says, "is more valuable than a gene."

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November 26, 2003 (*Wall Street Journal*)

Unable to Tap Power of the Nile, Ethiopia Relies on Fuel Carriers

By ROGER THUROW

Staff Reporter of THE WALL STREET JOURNAL

ADDIS ABABA, Ethiopia -- Late every afternoon, as the sun begins to set, the traffic thickens on the roads coming down from the forested hills around this capital city. Not with cars, but with as many as 15,000 women carrying bundles of branches, leaves and twigs weighing between 70 and 100 pounds.

Their pace is a slow, stooped trot, propelled by the weight of the load balanced on their shoulders. The bundles are more than 6 feet wide -- wider than the women are tall. By the time the women reach the city markets, it is dark and they have covered as many as 10 miles on foot. If they are lucky, they will receive top price for their bundle: about 70 cents.

These are Ethiopia's women fuel-wood carriers, and their backbreaking labor is one of the legacies of the inequitable Nile River politics of the region. Although Ethiopia has some of the best hydropower potential on in Africa, mainly on the cascading Blue Nile River, only a tiny fraction of it has been developed because of political animosity over who should use the Nile waters. Less than 10% of the country is electrified, and for many customers the cost is so great that they ration use.

Thus, biomass fuels such as wood, charcoal and cow dung account for more than 90% of the country's final energy consumption. In electrified Addis Ababa, the women's branches, leaves and twigs provide about a third of the wood-fuel supply, most of which is used for cooking.

Ethiopia has proposed a number of hydropower projects to the Nile Basin Initiative, which would increase the supply of electricity and likely lower the cost. That, in turn, would damp the demand for biomass fuel and for the fuel-wood carriers. While fuel-carrier jobs would be lost, the wider electrification of the country would likely spur economic development and create other, more lucrative jobs.

"I pray that all women fuel-wood carriers would find other means of employment," says Etenesh Ayele, 36 years old, the head of the Former Fuelwood Carriers Association. She carried wood for nearly 10 years, beginning as a teenager and stopping only when the association began teaching skills such as weaving, woodworking and food preparation to the fuel-wood carriers.

The World Bank and an Ethiopian government agency are trying to organize the carriers so they can arrange truck transport and retail depots for their bundles, as well as negotiate bulk sales and better prices. The Bank is also trying to round up donor support for the former carriers association, which hopes to expand its skills workshops and help more women find new work.

For the moment, though, many of the carriers are like Abonesh Haile, who says she is "20 or so" and has been carrying for seven years. She has one child and her parents to support. Broken bones from falls are common, she says. Still, she is picking up sticks every morning at 8 a.m. and by 4 p.m. she is making her way back down the hill. She would like to join the ranks of the former carriers at the association, but she says, "There are no other jobs."

Nor are there other modern fuel alternatives, at least not yet. "If you don't improve the life of the people," says Gebremedhin Haderea, manager of the biomass inventory project in the ministry of agriculture, "the use of biomass fuel will continue."

And so will the stooped deliveries of the women fuel-wood carriers.

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July 25, 2002 (*New York Times*)

To Fuel the Mideast's Grills, Somalia Smolders

By MARC LACEY

MOGADISHU, Somalia — Before it ends up in a grill somewhere in the Middle East, searing lamb or beef, Somalia's "black gold" travels a perilous road from acacia forests in rural areas to one of the country's busy ports.

Charcoal is perhaps the biggest export of this rugged country, so collapsed that statistics are among the many things hard to come by. Once, acacias covered vast swaths of Somalia's south and central regions; today, the forests are devastated. Despite an official ban on the export of charcoal, truckloads of it clog the dangerous roads to port bound for Saudi Arabia, Yemen and the United Arab Emirates.

"Because of the lack of a central authority, illegal deforestation has become big business," said Abdulkadi Yahya Ali, director of operations at the Center for Research and Dialogue in Mogadishu. "It's a lucrative way for gangs to make money. They are making money from the collapse of a state."

Abukar Abdi Osman, the environmental minister for the makeshift government in Mogadishu, declared an end to charcoal exports when he took office this year. His predecessor had done the same thing last year, to little avail.

"It's not good for the country," Mr. Osman declared. "We now have sand covering areas where there used to be forests, and there is less ground for livestock to graze."

The minister, member of a government whose control does not even extend throughout the capital, has resorted to taxing charcoal shipments, a step that he says will eventually allow him to seize the trucks and ships that carry charcoal and arrest the dealers getting rich from it.

As it is now, Mogadishu's main charcoal market operates less than a mile from the hotel that Mr. Osman uses as his offices. The market is a grimy place, where Somalis born with dark brown skin turn completely black during the workday from the dusk of the coal.

The workers separate large shards, which will bring top dollar, from the tiny pieces. And they load truck after truck, often piling the charcoal so high that the bumpy roads inevitably cause bits of black gold to fall to the road.

The charcoal trade is one of many assaults on Somalia's environment. Toxic wastes were dumped into many rivers years ago by foreign companies unafraid of government regulators. Wildlife, once plentiful in Somalia, has been killed with such abandon that there is believed to be relatively little left. But Mr. Osman's crew of six, charged with monitoring a country about the size of Texas, is barely able to identify the extent of the environmental devastation, never mind do anything about it.

The former government of Siad Barre, which fell in a coup in 1991, had banned the export of charcoal, and imposed stiff enough penalties on violators that few made a living off the trade.

Even in the early days of Somalia's descent into chaos, when Gen. Muhammad Farah Aideed controlled parts of the south of the country in the early 1990's, he continued to ban logging.

But after he died in 1996 and his son, Hussein Muhammad Aideed, replaced him, charcoal exports soared, driven by the simple logic of economics: a bag of charcoal that sells in markets here for \$4 fetches \$10 or more in Arab countries that have banned their own production of charcoal for environmental reasons.

A decade ago, the United Nations estimated that 14 percent of Somalia was covered with woodland. Some experts say that figure may now be as low as 4 percent. As for charcoal production, the United Nations estimates that 112,000 metric tons were produced in 2000, of which 80 percent went abroad. Exports of charcoal may have overtaken those of bananas, once a major source of foreign currency for Somalia.

Livestock exports have long been hindered by a ban imposed by various Arab countries on camels, sheep, goats and cattle, ostensibly because of concerns over animal health. So, instead, Somalia sells the charcoal with which Arabs grill their meat.

Somalia is rugged, with little arable land. It is believed to be rich in iron ore, tin, bauxite and uranium, perhaps even in petroleum and natural gas reserves.

For now, though, charcoal is Somalia's only precious material, and it allows thousand of low-paid laborers to make a living.

"It's very dangerous, but it's how I survive," said Hassan Ali Farah, showing a stump where his left thumb used to be, chopped off in an ax accident, and a nasty burn on his chest, the result of a charcoal fire that went awry.

Another danger that workers like Mr. Farah face are the land mines scattered through the Somali countryside in years of war.

Most of the charcoal profits go to the traders and the faction leaders who control access to the forests. To these men, environmental damage is of secondary concern.

"It's one of the main businesses in the country," said Ali Gulied Mahed, 58, a middleman who was standing beside several dozen fully loaded trucks at Mogadishu's main charcoal market.

To men like him, the economics are simple: the trees are free and the labor is cheap. A ship laden with 100,000 sacks of "black gold" has \$1 million in cargo, a haul that is typically traded for the many goods that Somalia lacks.

To turn trees into charcoal, workers dig a huge pit, bury the wood and set it ablaze, but only limited oxygen is allowed into the fire. What results are shards of charcoal.

Although most of Somalia's charcoal is sent overseas, it remains the main cooking fuel for Somalis. Throughout the country's previous export bans, local use has always been permitted.

But in the past, axes were used to fell the trees. Now that charcoal has become a big business, forests buzz with the sound of chain saws.

"The charcoal problem is really a symptom of the far greater problems we're facing," said Mr. Ali of the Somali research institute. "These are armed, irresponsible guys who are ruining the land because they want to eat."

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