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And Then Forgot to Tell Us Why...

A Look at the Campaign
against River Blindness
in West Africa

David Wigg • Foreword by Jimmy Carter



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World Bank
Development
Essays

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*God in His wisdom made the fly,
And then forgot to tell us why.*

—Ogden Nash

David Wigg

Foreword by Jimmy Carter

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Credits for Photographs and Illustrations

The photograph on the cover shows a girl who will *not* get river blindness as a result of the campaign described in this book. Photo by Art Kaufman. Courtesy Merck & Co., Inc.

Page 2: World Bank. Page 4: World Health Organization. Page 6: World Bank.
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The People behind This Essay

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Foreword

River blindness is a devastating disease that is the third leading cause of blindness in Africa. Eighty million people are at risk of infection; 18 million are actually infected; 1 million are sight impaired; and more than 350,000 are blinded by this parasitic disease that has historically attacked the poorest people in the most rural areas of twenty-seven countries in Africa and six in Latin America.

For generations, children have grown up resigned to a life of eventual blindness leading their blinded elders through the community on either end of a long wooden stick, waiting for the darkness to come.

Often, the most fertile, arable communities, lying along the rapid flowing rivers that provide the breeding sites for the black fly vector, would be deserted because of widespread fear of disease. The negative impact on economic and social development as communities migrated to overpopulated, arid regions was enormous.

And Then Forgot to Tell Us Why ... is the story of river blindness told in a powerful and very personal way. However, this is not a story of despair, but rather one of great hope. It is the story of the West African Onchocerciasis Control Program, a model of what can happen when "development" works as it should.

It is also the story of what is possible when genuine, effective international collaboration takes place. The World Bank, World Health Organization, the United Nations Development Programme, and the Food and Agriculture Organization have been cosponsors of the Onchocerciasis Control Program since 1975. In addition, the donor community, the affected countries and their people, a coalition of nongovernmental organizations, and many others from the private sector have worked together closely and successfully across the onchocerciasis-endemic world.

Moreover, the campaign against river blindness shows how a major international corporation can change the lives of millions of people in the developing world by stepping beyond

the confines of narrow, short-term self-interest and accepting a broader, global responsibility. In this instance, Merck & Co., Inc., set a high standard for the corporate world by deciding in 1987 to donate Mectizan “for as long as needed to as many as need it” free of charge. Mectizan, given simply, once a year, eliminates the morbidity from river blindness, including loss of vision.

And therefore, *And Then Forgot to Tell Us Why ...* is the story of a disease once described as “an ancient scourge” that is finally being tamed. Villages, once deserted, are now flourishing. And children, once resigned to darkness, are now growing up free for the first time, able to look toward the future.

JIMMY CARTER
Atlanta, Georgia
April 6, 1993

We sat in the ample shade of a majestic tree watching them arrive. The four blind men, at intervals one after the other, made a grand entrance—almost Shakespearian in its drama and timing. One almost expected them to break into verse and rail against an unjust fate.

They felt the edges of the benches carefully before they sat down, never once faltering or losing their dignity. A slight touch on their forearms by a visitor was all that was needed for each of them to raise his hands in welcome, and then offer a firm handshake, a smile full of warmth, and a gracious greeting in French.

“All of them were in the old village and became blind,” said the village chief who sat with us. He wore a clean white robe that fell to his ankles and a white Muslim skullcap. “Most of the old people there died blind.” The old village was old Samandeni, some distance away and close to a river. It was now abandoned—its mud huts roofless and crumbling.

There was a pause. The African heat was as heavy as a blanket despite the shade, numbing the mind and even making the bones protest. The children, silent and watchful, flicked flies away from their faces. Then a blind woman—led in by a friend holding one end of her stick—joined us. She settled without fuss into a seat to one side, and so kept a deferential distance from the men.

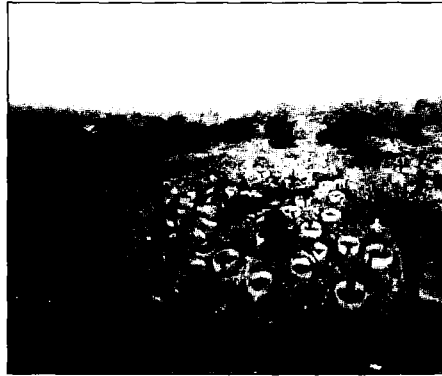
One of the blind men was the chief’s own brother, Lassana Sanou, a tall, gaunt man with a little white beard and long tribal marks on his face that stretched from the corners of his mouth to his ears and temples. One eye was closed, the other just a white blur. He had once worked in a garage in Bobo-Dioulasso, the second largest town in Burkina Faso, which lay a few kilometers away to the southeast. A drum fell on him and

he lost the sight in one eye. But the other eye became blind slowly—over a long period, inexplicably. He was lucky, he said, because his brother and married daughters looked after him. He now spent his time making medicinal brews from plants.

“How do you recognize the plants you need?” I asked.

He leaned forward on his stick. “I can touch them and feel the difference,” he replied, as if the answer were obvious.

Another of the blind men, Salia Ouattara, was much younger than the rest. His father and mother both died blind. The blind



The ruins of a village in Guinea that had to be abandoned as more and more people became infected with river blindness.

woman in the group, Sata, was his older sister. The family had all lived in the now-deserted village and had fled when they realized what was happening to them there.

“It’s bad enough for anyone to live much of their life sightless,” I said to

the woman, “But isn’t it doubly bad for a woman?”

She looked confused at first when her brother repeated the question in the Bobo language, but then lowered her head and spoke rapidly.

“For a blind person, whether a man or woman, the suffering’s the same. If a young woman is blind and unmarried, she won’t get a husband. I got married before I became blind, but my husband died. My brother became blind when he was young and so couldn’t get a wife. We’re both supported by our families—for food, for everything. It’s terrible.”

The shade had shifted, and now the full sun was on her. She was guided to another seat, even further away, and remained sunk in her own thoughts.

“They didn’t know why they were becoming blind in the old village,” the chief explained. “They thought some devil was against them. They implored their fetishes to protect them. Their ancestors told them to give food to the fetishes. So they killed chickens and sheep as a sacrifice. But they still kept on going blind.”

“Then one day,” he continued, “some French doctors came to the village and told them the cause—it was because they were being bitten again and again by blackflies. They used to go down to the river to fetch water and to wash, and they were bitten there. So they decided to leave the old village by the river and move here. Then helicopters came to kill the blackflies, dropping pesticide in the rivers. The children born here in the new village aren’t sick, aren’t blind.”

“Now that the deserted village is safe, do any of them want to move back to their old huts?” I asked.

“No, they’re still afraid. The memory’s terrible. They remember the suffering. They know that it’s safe there now, but they don’t want to go back.”

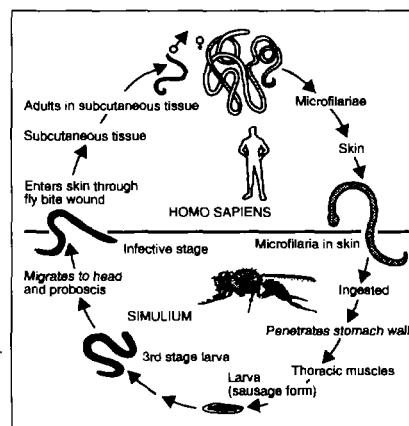
A Pernicious Disease

It’s not an evil spirit’s act of malevolence, but a pernicious disease, an ancient scourge, called onchocerciasis or, as it’s more commonly known, river blindness. The villains are a repulsive worm called *onchocerca volvulus* and its partner-in-crime, the tiny but aggressive hump-backed blackfly, which carries the disease from one person to the next. A century ago, naturalists, presumably with a sense of humor, gave the blackfly the name: *simulium damnosum*. The damnable part probably referred to its bite rather than its ability to pass on a blinding disease, a talent not fully understood at the time.

After they enter the skin of a human through the bite of an infected female blackfly, the parasites mature from larvae into threadlike adult male and female worms which live in nodules—ugly bumps—under the skin. The females can grow to 50 centimeters in length, while the much thinner males may grow to a mere five centimeters. These adult worms (or macrofilariae) mate, giving birth to millions of infant worms. The females may live for as long as fourteen years. The infant worms escape through the walls of the nodules and migrate to all parts of the human body—they have even been found in tears, sputum, urine, and vaginal secretions. They may either die after living for up to thirty months or be ingested by a

female blackfly when she needs a meal of blood and then, after evolving into another stage, be taken off to be transmitted to another human when the blackfly takes another meal. The cycle of misery continues.

The infant worms in the human body cause havoc. Their presence and death cause rashes and itching. Over the years the skin becomes swollen and thickened, and there's often



Life cycle of onchocerca volvulus.

depigmentation leaving white patches (these are known graphically and all too accurately as “crocodile skin,” “lizard skin,” and “leopard skin”). Sometimes there's genital swelling, loss of weight, and debilitation. But the worst is yet to come. With repeated infections over the years, the disease becomes more and

more severe. Eventually the infant worms get into the eyes and cause, with their deaths, “chronic sclerosing keratitis.” In other words, the victim becomes blind.

The blackflies need fast-flowing water to breed, where there's plenty of oxygenization. So it's usually the poor villagers who live near rivers, where they fish or wash or collect water, who are the victims—hence the name “river blindness.” Children start to become seriously infected when they're old enough to walk to the fields. Teenagers with severe infections are unlikely to marry because no one wants a son or daughter-in-law who'll probably become blind. They may look old when they're only twenty. Their life expectancy may be reduced by fifteen years—significant when the average may only be about fifty. Life's a desperate struggle anyway without having to face it weakened and sightless and becoming a burden on struggling families.

The villagers leave their homes, abandoning fertile valleys with their rich soil, and move to poorer, drier land, which soon becomes over-used. It was not uncommon to find valleys uninhabited for several kilometers on each side of a river. Not only is there personal pain, but also unwanted migrations and an even harsher struggle for food.

And it's Africa—yet again—that's the hardest hit. The endemic area is a broad swath running almost continuously from Senegal in the west to Ethiopia in the east and then south to Angola and Malawi. In the rest of world it's found in small pockets in Yemen and in Central and South America. About 85 million people were at risk of infection worldwide, the World Health Organization estimated in 1987, 18 million were infected, 1 million had sight problems, and 350,000 were blind.

And in Africa it's the savannah lands of West Africa which are the most affected in the world—that area of grasslands and shrubs and trees between where the Sahara stops and where the coastal rainforests begin. Here the basin of the Volta River—covering parts of the seven countries of Benin, Burkina Faso, Côte d'Ivoire, Ghana, Mali, Niger, and Togo—provides the blackfly with ideal places to lay its eggs. If the disease were to be attacked, it obviously had to be here. But how?

Two Breakthroughs

In the 1970s the drugs used to try and kill the adult worms in the body had horrific side effects, and no new, safer drug was then on the horizon. And the blackflies couldn't simply be eradicated. There were millions of them, and they could fly vast distances—a flight range of 400 kilometers is one estimate. What was needed to prevent pessimism and even defeat was a breakthrough—a workable idea that could then be backed by a vast international effort.

It came when two French scientists, who'd been working for years in Burkina Faso (then known as Upper Volta), came up with what seemed a simple solution. Attack the blackfly when it was most vulnerable—at the larval stage when it's clinging to sticks and rocks in the rivers. If the blackflies could be controlled over at least fourteen years—the time an adult worm lives in the human body—then theoretically the parasite reservoir in the human population would die out. If that happened the blackfly could return, bite, and cause annoyance, but there wouldn't be any disease to pass on. And the person they convinced in 1972 that this would work was Robert

McNamara, then president of the World Bank.

When he was visiting Ouagadougou, the capital of Burkina Faso, he and his wife chartered a small plane and flew to Bobo-Dioulasso to meet the Frenchmen. One of them, Dr. René Leberre, an entomologist with the World Health Organization (WHO), reminisced about the meeting in a recent newsletter published by the River Blindness Foundation, a nonprofit organization based in Houston, Texas. "To convince someone like Mr. McNamara wasn't easy when you're a Frenchman in the middle of nowhere. But it was a golden opportunity."

"One couldn't help being concerned about onchocerciasis," Mr. McNamara said in an interview in the same newsletter. "Because in one sense it's the worst of all kinds of diseases: it



Dr. René Leberre examines a man blind from onchocerciasis.

maims but it doesn't kill. You had people going blind, yet not dying. And in that kind of society where people are living on the margin to start with, it's a horrifying thing for both the individuals and their associates." He had just organized an international effort to finance the Consultative Group on International Agricultural Research—it was inaugurated in 1971—and he got that going by bringing the Food

and Agricultural Organization (FAO) and the United Nations Development Programme (UNDP) into association with the World Bank. "It was a new organization but it was already showing signs of success. I thought that maybe we could follow the same pattern for the river blindness problem."

The effort had to be over an extended period—the lifetime of the adult worm in the human body. This was then believed to be twenty years (it was later determined to be fourteen years). "Nothing like that had ever been done before," McNamara said. "We asked WHO and UNDP to join with us and brought together a group of interested parties—both the nations of the infected areas and potential donors. It was a very tight organi-

zation. It never did develop a big bureaucracy, and we were able to get the commitments for long-term financial support from various governments." It was a bold stroke for the World Bank to involve itself in a health program on this large a scale.

The program was launched in a carefully defined area in the seven West African countries in 1974 with four more countries—Guinea, Guinea-Bissau, Senegal, and Sierra Leone—joining in 1986. It proved to be successful in a big way. The WHO is the executing agency, and the other three sponsoring agencies are the World Bank, UNDP, and FAO. The World Bank leads the fund-raising, manages the funds, helps monitor the operations, and takes the lead in developing the lands that are opened up. Then came the second breakthrough.

A drug called ivermectin—which goes by the trade name of Mectizan—was tested and found effective, safe, and suitable for mass distribution. It didn't kill the adult worms, but it did kill the infant worms and so halted the remorseless path to blindness. The Onchocerciasis Control Program is now a stunning success; a victory Africa, and the rest of the world for that matter, badly needs, as it's buffeted by sad statistics about such unrelenting diseases as AIDS and malaria.

The program has virtually eliminated river blindness as a public health problem in the original seven-country area. By 1992, more than 30 million people were protected from the disease. The generation in the eleven African countries born since 1974, numbering about 9 million, faces no risk of getting the disease. About 1.5 million people who were seriously infected have fully recovered, and it's estimated that 150,000 have been saved from going blind. The river valleys are opening up again for new settlement—about 25 million hectares of arable land. This may be seen, when the histories are written, as one of the twentieth century's great medical triumphs, to be heralded, when discussing programs which attack one particular disease or groups of diseases, in the same paragraph as smallpox eradication and immunizations for children.

And the cost of all this? The total cost since 1974 is \$340 million, according to Bruce Benton, the World Bank's coordinator. The plan now is to wind the program down by the end of the century. He estimated it will then amount to about \$580

million. "On a per capita basis," he added, "the cost in constant 1985 dollars is 54 cents per person a year protected over the life of the program. And that doesn't count in the returns of increased labor productivity from preventing people from becoming debilitated and going blind, and the potential production from the 25 million hectares of arable land which is being liberated from oncho infestation."

A New Kind of African Leader

The man who heads this control program in West Africa, Dr. Ebrahim M. Samba, possesses limitless energy. A hurricane of motion, he leans over his desk and pushes his face forward to make a point. He jumps up to stab at a wall map with his finger. He jabs a buzzer and demands yet another document from a secretary. (One of many of the program's boasts is its openness or, to use the technical term, "transparency"; a session with Dr. Samba, ending with a lapful of documents, is "transparency" with a vengeance.) He organizes and cajoles his staff from a small, modest office in his headquarters in Ouagadougou (the address is Che Guevara Avenue, reflecting one era in Burkina Faso's revolutionary past) with military precision, tempered by intelligence and a broad sense of humor.

His colleagues, both Africans and non-Africans, may accuse him of being sometimes over-blunt and a touch autocratic, but they always end up praising his honesty, his dedication, and the sheer forcefulness of his character. Perhaps a strenuous struggle played out over many years in hostile terrain against an odious disease needs a tap of the general's baton. He is being called a new kind of African leader—on top of the latest Western technology, rushing off to Washington, Rio de Janeiro, Geneva, or Rome for yet another meeting, self-disciplined, and a whiz at management.

He didn't expect to get the job of director when it came open in 1980; he said he had never even heard of the word "onchocerciasis." "There's none in the Gambia," he told me. He was director of the Gambia's medical services when the call came and he felt that he had reached his professional peak at

home. It was time for a change.

He was one of nine children. His parents were peasants who lived in a village not far from Banjul, the Gambia's capital. "I've been very lucky in my life. People just pick me up and make me part of their family," he said. When he was a student at the University of Ghana, Kofi Busia, a sociology lecturer there who later became Ghana's leader, took him into his family. When he went on to study further in Dublin, Liverpool, and Edinburgh in the 1950s, he was "adopted" by Eric Sherwood-Jones, a Liverpool doctor, and his family.

"I became a son of that family, so I stayed there every holiday," he said wistfully, bringing out faded photographs and old letters. "They're wonderful. How could they adopt someone they didn't know? " They're now in their seventies and he will soon be sixty, but he calls them "my mum and dad." When he visited them last year he had a cold, so they spoiled him, he said, by lending him pullovers. "It's nice to be a baby sometimes. They're mine and I'm theirs."

He had made an impact at the WHO representing the Gambia and was selected by the World Bank, WHO Geneva, and WHO Brazzaville to take over the control program from Marc Bazin, who had been director for four years and who went on to become prime minister of Haiti in 1992. Dr. Samba found the going tough at first. Not only did he know nothing about river blindness, but he couldn't speak French. He had to administer a staff that was then of about 1,000 representing thirty-one nationalities.

There were resignations. He had to sort out personality clashes. He went around his area to get to know all the villages and all the staff and then called a council of war to plan the next stage of the campaign. Now, he said, he's completely identified with the program. "We are ahead of schedule," he said. "Because at the time the program started in 1974, the plan was to complete the seven countries. The idea was to control the disease so that it would no longer be a problem of public health and socioeconomic development in twenty years. And we've done it in sixteen years. In part of the area we have almost eradicated the disease—and that's a bonus."

I asked him, thinking of Marc Bazin, whether he would ever

consider a political career.

“My president once said to me that you’re the only one who would give me sleepless nights if you stood against me,” he replied with a smile. “If you want to write to me, just write Dr. Samba, Gambia. You don’t have to write an address or anything. I’ll get it. If you go to Gambia and say that Dr. Samba is my friend, no taxi-driver will charge you.”

He has just, however, received a year’s extension of his appointment—it’s yearly after the age of sixty—and he doesn’t give any sign of slowing down or losing enthusiasm for medicine or really wanting to be diverted into politics. “It’s great. I enjoy this program, as you can see. One of the beauties of this program—there’s plenty that’s really positive.” He added mischievously: “Some of the donors say that if Samba leaves, they won’t give any money.”

The Africans I met who worked under him—the program is now reduced because of its successes to about 550 staff, of whom 97 percent are Africans—were equally committed. Both Dr. Hyacinthe Agoua from Benin (trained in Paris and Toulouse) and Dr. Albert Akpoboua from Togo (trained in Quebec and Liverpool), for example, who guided me through days of careful explanation in Burkina Faso and Mali, are intelligent, thoughtful men of great character and generosity of spirit.

“Dr. Samba and I are healthy because we were born in villages. There were no antibiotics then, so only the strong survived,” Dr. Agoua said as we drove through the velvet darkness of the African night, on our way to Bamako, the capital of Mali. Now in his early fifties, he claimed he had only once been sick—a fever that his mother cured with the help of leaves. He was also, like Dr. Samba, given to loud outbursts of enthusiasm and dramatic expressions.

A large snake suddenly appeared in the car headlights, sprawled across three-quarters of the road, as if it was making for the other side or perhaps just seeking the cool of the tarmac. It was impossible for the driver to miss it. “That snake. No serum. One bite means death,” he shouted, as we squashed it. He then returned, without pause for breath, to tales of his boyhood.

Other Tropical Diseases

The optimism, efficiency, and hard work that impresses any visitor watching this campaign is more understandable when one looks at the pessimism that often overclouds the struggle against other tropical diseases. About 500 million people suffer from all tropical diseases, the WHO reports, and the result is more misery than anyone wants to imagine. These diseases can cause agonizing ulcers, disabling anaemia, grotesque deformities of the face and the limbs, blindness, irreversible brain damage, and painful death. The result is often the interruption or even halting of economic development. Although tropical diseases cause about one half the world's illness, the WHO claims they receive only about 3 percent of medical research funds.

Prospects of controlling malaria and schistosomiasis (or bilharzia) are getting worse. Malaria infects 270 million people and takes a heavy toll, particularly among children. The mosquitoes are increasingly developing resistance to insecticides, and the malaria parasites are developing resistance to standard drugs such as chloroquine. One only had to travel up and down the Thai-Cambodian border during the 1980s to see that malaria was causing more devastation among the guerrillas and the refugees than the war that was raging in Cambodia itself. Attempts to develop new regions, such as in the Brazilian Amazon, may lead to new malarial breeding sites. Schistosomiasis, spread by freshwater snails and causing debilitating illness in millions, is spreading because of new dams and irrigation schemes.

Some tropical diseases are being fought with some degree of success. Although leprosy is declining because of drugs, it is still being spread, it's believed, by the discharge from the noses of infected people. Chagas Disease, spread by large blood-sucking "assassin" bugs, leaves damaged hearts and intestines; it's incurable but in Brazil it's being reduced by controlling the insects. African trypanosomiasis (or sleeping sickness), spread by the tsetse fly, is often fatal if untreated, but in Uganda it's being controlled with insect traps.

But now there's AIDS. So when there are some breakthroughs, even if qualified—they should be trumpeted.

The War against the Blackflies

The war against the blackflies is going well. The battle had to be waged, as the two French scientists argued so brilliantly, when the blackflies are immobile larvae. And here was another lucky break. The breeding sites are easily spotted—just look for the fast-flowing and churning water, where the female blackflies, seeking the oxygenization, have to lay their eggs. That's why river blindness, for example, is not found in the Gambia. "By the time the Gambia River flows into the Gambia country it's almost at sea level, very slow. I explored the Gambia extensively. This disease doesn't occur in areas where rivers flow slowly," Dr. Samba explained.

The eggs are laid in batches of 200 to 800, deposited just below the surface of the river. Because they are sticky, they cling onto tree branches, the stems of plants, and rocks. They hatch within two days, and the larvae either stay clinging to the twigs or stones or drift in the current. They need to eat, so they filter small particles from the water and extract the nutrients as they pass through the digestive tract. This is the moment to strike.

If larvicide—a pesticide that will kill the larvae—is put into the rivers and streams at this stage, it will get into the guts of the larvae and kill them. This vulnerable larval stage only lasts between eight and ten days, and even becomes as short as five days when temperatures rise. So the spraying must be done once a week—this is the basic strategy of the control program and must continue year after year until an area is declared "clean." The larvae that escape this assault become pupae, don't feed, and after two to four days turn into blackflies. The carefree males feed serenely on the juices of plants and bother no one. The females go looking for blood—which means trouble.

This vast spraying operation—now covering an area of 1.3 million square kilometers (more than twice the size of France) and treating about 50,000 kilometers of rivers—must be done mostly from the air. One helicopter can spray more in an hour than a ground team can do in a week. And ground teams can't get to many breeding sites by road all year round.

Spraying from the Air

The speck in the distant sky rapidly grew bigger, and then the helicopter swept low over the traffic which sped over Bamako's smart new bridge across the Niger. Supporters of the victorious politician, Alpha Oumar Konare, had painted the word "votez" on the road surface near a number of posters that implored: "Alpha avec vous." Mr. Konare had just swept into office and was soon to be sworn in as Mali's first freely elected president since independence from France in 1960. The old dictator, Moussa Traore, thrown out of power in March 1991 in a violent outburst that killed many, was in detention and waiting for trial. It was a time of great democratic expectations for Mali.

Gerry Casman, the American pilot, brought his helicopter to about fifteen feet above the red soil of the river bank, paused, and then moved rapidly forward across to the far bank, shooting a spray of larvicide downward. It left a white line in the greenish, slow-moving water.

As the river was divided by a small island, he stopped spraying for a few seconds while he hopped over it. The white line had dispersed before it moved down to a section of faster moving water just in the front of the bridge. It was a simple, single drop of 17 liters. It was easy to do a wide river like the Niger with few obstacles. Elsewhere, it was usually much more hazardous. Sometimes the pilots treated an area "the size of the hood of a truck" and had to swoop down into winding, narrow gorges and canyons, always on the lookout for hazards such as wires and the tops of trees.

"We put all the wires on the maps," said Assi Ake, an air operations officer from Côte d'Ivoire who was working alongside Gerry Casman on this trip, pointing to some marks.

Once, there had been an accident. In the village of Wayan in Burkina Faso, the old men told me how in the late 1970s a pilot making a demonstration run had failed to see a telephone wire. The aircraft didn't crash, but some people watching on the ground were injured and one boy was "half-scalped." Dr. Agoua remembered it well. "I read it in our weekly reports," he said. "The boy was taken to hospital and recovered."

"It must be difficult flying in these conditions," I said to

Gerry Casman. The pilots have to cover thousands of square miles with no easily identified checkpoints to guide them to remote streams, and are often out of radio contact with the bases.

“It comes with the job,” he replied laconically. “A helicopter is a working tool. Getting down close to the water and getting between the trees, comes with experience. There’s no single factor that’s extremely difficult. This weather’s great now—it’s June, just beginning the rainy season. We have isolated thunderstorms which we can easily avoid. But in the dry season—from November to April—you have a constant haze that comes off the desert, over this entire section of West Africa. Visibility’s two to five miles.”

He went on: “So, the high heat, the dust, the language barrier, the food is different, our overnight accommodations aren’t sometimes the best so getting a good night’s sleep is difficult in some places. That improves bit by bit. When you put everything together then you have a difficult job. But it’s manageable. Flying a helicopter and treating isn’t for every pilot, but most competent pilots could catch on and do the job.”

He’s an ex-military pilot—including a tour of duty in Vietnam in 1969—from Montana and California, now starting his third year as chief pilot in this operation for Evergreen International Aviation Inc. He does it because the work is interesting, pays well, and is a way of “giving something back to the people.”

The U.S. company won the aerial spraying contract when the program first started in 1974, lost it to the Canadian Viking Company, and then won it back in June 1986. Donna Nelson, a spokeswoman for Evergreen, which is based in McMinnville, Oregon, said that they had just renewed the contract for three years from January 1993. They use twelve McDonnell Douglas Hughes 500 helicopters, two Turbo Thrushes, and a Cessna 206. They hire between twenty and forty pilots and mechanics (“most are Americans right now,” said Casman, but there are also some Canadians, Chileans, Peruvians, and Portuguese) depending on the time of the year. And they operate out of two bases—Odienne in Côte d’Ivoire and Kara in Togo.

Because the work is dangerous, dirty, and difficult, the crews must be courageous, conscientious, and highly competent. So the spraying was contracted out to specialized companies. The control program wisely realized that it didn't have the expertise itself, and that it could keep better control and demand a higher quality of work if the work was in the hands of private companies.

Odienne—the base for the Western region—is not one of the world's great pleasure centers. Evergreen's management admit that off-duty life "is difficult in the primitive conditions, heat and humidity, with no supermarkets, cinemas, sports, television, or other public entertainment available," but assure the world that its crews "are committed to the natives and the program." Gerry Casman calls Odienne "basic."



*Aerial spraying
for river
blindness.*

"There're a couple of restaurants with bars," he said with a smile. "Nothing fancy. One of those is about to close. There was a disco that got pretty wild. We used to go there occasionally but it went so far downhill that we stopped going." When the crews first moved there, "electricity was operated on generators and the water system was barely adequate," but "it gets a little better each passing month." They get short breaks for rest and recreation, taken in places such as Abidjan on the coast to the south. Every six months, they take three weeks off, Gerry Casman heads off back to the States or to Europe.

The base was previously at Bobo-Dioulasso—a town still marked by the old French colonial presence, and one the pilots and mechanics found congenial. A town with an ornate railway station and substantial white houses with brown shutters, their walls awash with bougainvillea. A town of tidy traffic circles, where strollers can saunter with easy aplomb down cool streets lined each side with tall trees whose branches almost touch in the middle. A town where there's a Sunday buffet at

the “Bar Gogo at Bobo” and where the barstools are shaped like bongo drums. (In Ouagadougou, most of the trees have been cut down for firewood, leaving a city that’s little more than a clutter of drab buildings exposed to the harsh sunlight.)

But as the spraying operations moved westward, the base had to be moved. Odienne was chosen because of its location. “There’s no other place that’s logical,” Gerry Casman admitted. “Even if you moved it 100 miles, that’s one hour to and back extra ferrying. We run close to \$1,000 an hour to operate these”; he nodded at the helicopter parked on the tarmac behind him. “That’s with fuel. They don’t cost that in the States. It’d be half that. And we’re looking at air-freighting all our parts. A lot of expense. During the dry season it’s hard on the engines. We get half the time on them that we should.”

And then there’s landing in remote dump sites to take on fuel and larvicide. I came on one of these dumps outside the deserted village of Old Sanakoro, near the dry bed of the River Fie, a short distance from Mali’s border with Guinea. The dump was in a clearing, and consisted of drums of water as well as fuel and larvicide, painted in different bright colors, and brought there by truck from Bamako. Here the pilot would have to find a patch of level ground to land and then, after checking that nothing was stolen, roll and lift the heavy drums. He might have to do this five, six, or seven times a day.

It was noon and nothing moved in the heat except one nondescript butterfly. The villagers had fled in the early 1970s because, as elsewhere, so many were becoming blind. Many had settled in new Sanakoro. They believed then that the river water itself was somehow the cause of their tragedy, not realizing, until told by doctors, that it was the blackflies they should have feared. Nothing was left now except the stark, circular walls of their huts. A tree had grown up inside one, pushing against the sides and starting to topple it.

Theft from the dumps is frequently a problem, Gerry Casman said. Villagers might use the fuel for cooking or for running diesel engines. Normally it was not all taken, just a small amount out of one drum. But he remembered one occasion when “they took three to four drums and stranded the pilot for most of the day.” If things got too bad, a ground

crew would come out and move the dump, or get someone to watch over it, or have a word with the village chief. The chief would then “explain to the people that this is for their village. It’s to prevent river blindness. If they steal, it’s like stealing from themselves.”

No one doubts that the Evergreen pilots not only have a grueling job, but also that it’s crucial. Dr. Bernhard Liese, the World Bank’s Director of Health Services, went so far as to say: “The spraying is the core operation, going on week after week. They do the job. If it wasn’t for the diligence of the pilots, the program might fall apart.”

Using Satellites

It was on a bridge over the Black Volta River that Dr. Agoua pointed out an automatic hydrological station, fitted with a teletransmission beacon. It was perched on a long base that stretched down to the riverbank. It’s essential to know in advance how much larvicide to use to avoid under- and overdosing. More than a hundred transmitters beam data—the depth of the river, for example—to the Argos and Meteosat satellite systems and then to ground stations. There computers predict the water flows, identify the appropriate larvicide and how large a dose is needed, and show the most cost-effective spraying routes between the larvicide storage dumps and the breeding sites. Its success has excited water experts.

“We are seeing climatic instability worldwide which is creating problems,” Geoffrey Matthews, a water and environmental engineer with the World Bank, said. “We need a system which will enable us to predict better the day-to-day movement of water throughout the world. This new technology for gathering hydrological data is made for the job.” It could be used, for example, to warn of flooding, to help two countries who share a river decide on how to share its water, especially during a drought, and to let the captains of cargo ships know when river levels will be high or low. “The realization of the usefulness of this technology only became apparent through this river blindness program. It’s been a catalytic experience,” he added.

Spraying from the Ground

But some ground treatment is still necessary. I went with Dr. Akpoboua and one of his staff to check an area not far from Bamako. This stretch of the Niger River basin was “clean” but it had to be checked periodically. On the bank we filled three ordinary watering cans—exactly like those used to water flowers in a garden—with a larvicide called pyraclofos and clambered into a tiny flat-bottomed boat. The boatman started the outboard motor and we pattered slowly upstream.

The sun had come up that morning white and hazy, and now the heat turned every thought into sediment that lay uselessly in the bottom of one’s brain. Low shrubs marked both banks, as well as a few islands in midstream. A scrawny bird rose sluggishly out of the water as we disturbed it. Three little boys, indifferent to our mission, fished in a thin craft. Sometimes our boat shuddered as it scraped rocks on the river bottom. The sun seemed to rob everything of color—it was as if it had bleached the landscape. There’s not much grandeur about this part of Africa; it all seems to have gone into the character of its people.

We stopped the engine near a narrow channel between two islands where the water was forced together and moving swiftly. The doctor and his assistant, the one dressed in a smart safari suit, the other in neat shirt and trousers, clambered out. The water almost came up to their thighs. No special clothing was needed for this operation, except plastic gloves. They waded away to look for larvae just beneath the water level. After about twenty minutes they returned. They had found nothing. If they had found anything they would have carried it back to the laboratory.

The boatman, who had spent the time diving under the water and then gracefully reemerging at some distance away after terrifyingly long intervals, swam back and restarted the engine, and we moved further upstream.

We headed close to one bank. The ground treatment was a simple operation. The assistant just took one of the watering cans and poured it slowly overboard as we moved across the

river, leaving a thin, milky trail of white behind us. At the far bank, we turned round and repeated the operation. One stretch—from the bank to about twenty-five yards out—was given a third dose. Because of the direction of the current, extra larvicide sprayed here would have a good chance of reaching some known breeding sites.

Monday Morning Briefings

The staff sat around the table in the Bamako house that serves as the center for the Western Operational Area, listening as their colleagues reported in on the radio. It was the weekly Monday morning briefing. It was all calm, crisp, and efficient, with the air conditioner keeping at bay the quick buildup of the morning heat outside. The orderliness of the entire control program is often in contrast to the noise and chaos and colorfulness of the life in the streets and villages outside. As Dr. Samba put it: “In our office two plus two equals four. But in the villages two plus two can mean anything.”

A sign on one wall read: “OCP Western Zone. Treatment maps and entomology results—weekly.” Stretches of river on one map were marked in different colors—corresponding to the larvicide to be used; green for bacillus thurengiensis H-14, black for phoxim, red for temephos, and orange for pyraclofos. Occasionally a staff member would get up and write on a map with a marker.

Dr. Akpoboua was in command and fired questions back and forth in French to some of the centers in the western area. (The following week Pierre Guillet, a French scientist in charge of the area, returned from France and took over the control seat.) How many flies had been captured? How many flies were found to be infected? When he spoke to Sierra Leone, Dr. Akpoboua broke into English. Treatment had been suspended in some areas there. On the Rokel River the number of flies was quite high. The decision was made to hold off larviciding to allow teams to go in and do some tests. “We want to find out whether the larva is sensitive to the chemical we want to use before we start,” he explained.

Reinvasion: The Return of the Blackflies

A major concern remains that of “reinvasion.” The blackflies are expert travelers: they can travel some eighty kilometers in twenty-four hours, and with the help of winds can even migrate several hundred kilometers from one river basin to another. From the start, some blackflies outside the program area were biting infected people and then flying into the program area and so introducing new infections. The only answer to that was to widen the area of operations and start spraying in “extension areas” to the west and to the south.

This was begun in 1986 – 87, and now the original area is fully protected. But spraying will have to continue in these western and southern extension areas until they are brought fully under control. In the western extension area spraying may have to continue, however, until the year 2002, and some experts worry that the threat of reinvasion is sometimes underplayed.

War and Revolution

West Africa is much troubled by political instability and war. The civil war in Liberia has affected operations in that part of West Africa. Mali had its bloody upheaval in 1991, and Burkina Faso has had six coups d'état since its independence from France in 1958, the last in 1987. And Mali and Burkina Faso went to war with each other for a week in December 1985 over a slab of what seemed, to outsiders anyway, unpromising territory. That's been resolved, and the main road crossing between the two countries is now as it should be—sleepy and unthreatening. Just the usual grins of welcome from the border guards that greet “oncho” jeeps everywhere.

As one would have guessed, Dr. Samba and his colleagues tend to see wars and coups as minor nuisances. An expert who works in another part of Africa commented: “The control program seems to have sailed through rather like the Red Cross.” Despite these “nuisances,” cooperation between the

various West African governments—essential as the blackflies are obviously blind to artificial national borders—has been good, and the control program’s existence has strengthened these regional bonds. Cooperation on one project leads to cooperation on others—another bonus.

Resistance to the Larvicide

The worries for any doctor or scientist or ecologist who is waging war on harmful insects is that they will eventually develop resistance to an insecticide or that the insecticides will damage the environment. The first larvicide used against the blackfly was temephos, and from early in the program tests began on alternatives. The first resistance to temephos came in 1979 – 80 but was confined to just a small area in the south of Côte d’Ivoire. A second larvicide, chlorphoxim was used, followed by bacillus thuringiensis, known as B.t H-14. This third larvicide, a biological agent rather than a chemical is the one now the most widely used and seems to be immune to resistance, although it meant extra cost at first. It’s bulky, so a larger helicopter had to be contracted. Resistance, to temephos again, started spreading rapidly in 1987 from Côte d’Ivoire to Mali and became generalized throughout most of the program area. New products were tested, which led to permethrin, carbosulfan, and pyraclofos. Now all six are used in rotation to fool the blackfly. “The least toxic we use in the dry season when there’s less water,” Dr. Samba said. “The most toxic we use in the rainy season when there’s lots of water and when it’s washing away. The cheaper ones we use a bit more often. Resistance is no longer a problem because we never use the same pesticide for more than six weeks.”

Others are more cautious. Resistance remains the specter that hangs over everything, said Kenneth W. Cummins, a professor at the University of Pittsburgh who is a member of the Ecological Group, an independent watchdog committee made up of international experts. Permethrin is a very toxic larvicide, so it’s very effective and “we need it,” he said. “It’s a quick kill.” There has been no resistance yet but that if that happened, “that

would be a worry.”

The answer is a constant search for new larvicides. The Ecological Group screens these carefully. Two compounds it recently looked at, for example, were rejected because they simply weren't effective enough against the blackflies. Three others were given the go-ahead to be tested in the rivers. And the group approved more research with the chemical companies on improved versions of carbosulfan and pyraclofos.

Protecting the Environment

The Ecological Group's main job is to see what impact the larvicides have on the ecology of the rivers. The group was set up at a time when insecticides such as DDT were being heavily criticized. Reporting to them, and constantly sending them evidence, is an ecological unit within the control program headquarters in Ouagadougou, as well as national ecologists from each of the countries involved. So far, the picture has been bright. “The bottom line is that none of these pesticide products are harmful to the environment,” Dr. Samba said. “The donors insist on that, the African governments insist on that. From the point of view of the ecology, we're very friendly.”

The ecological unit is run by Laurent Yameogo, a young hydrobiologist from Burkina Faso, who is studying at the Musée National d'Histoire Naturelle in Paris. He conducts laboratory and field tests on organisms such as fish, invertebrates, and plants to see whether a new larvicide is relatively safe. Then, when it's used regularly as part of the spraying operations, it's monitored over many years to see if there's any accumulation. For all six larvicides, the results have so far shown “no accumulation,” he said.

“Is there one of the six you worry about?” I asked him.

“We're worried about permethrin and carbosulfin. We're not sure there's not a long term effect on aquatic life. We haven't monitored them for a long enough time. They're new products.”

“When will we know?”

“It's too early to say. We have monitored them both for five

years, and there's no impact shown on fish yet."

The Ecological Group lays down strict rules and makes tart comments. After one fish monitoring operation, the group, meeting at their thirteenth session in Bobo-Dioulasso in January 1992, declared that although the analysis "had not proven any insecticidal impact on the fish populations, it should not be automatically assumed that there had been no impact. For example, very small fish could have been killed without their demise being detected." The hydrobiologists were told to do a follow-up analysis.

Professor Cummins called the control program unique in the world, as it was the only one that had such an ecological group attached to it. The early organizers had good vision. They realized that, because the Africans harvested the river, the situation was highly sensitive, and they had insisted on this outside independent watchdog. "The environmentalists feel more comfortable with the program because they feel they have a friend in court," Professor Cummins said. He has served with the group since the mid-1970s and had been on the verge of resigning many times, simply to allow someone else the pleasure of taking his place. But, he explained, "it's hard to drop out. Something exciting is always happening. And those West African countries are wonderful."

He adds two points of caution to the general optimism about the program being completely environmentally friendly—to be supercautious is, after all, his job. Whereas scientists know minute details about the "targeted" blackfly, identifying all the "non-targeted" species is extremely difficult. Most effects are monitored at the family level, which could mask a lot of changes going on at lower taxonomic levels. It would be similar to saying that it doesn't matter if the lion is affected as long as the tiger, cheetah, and house cat remain since they're all in the same family, is how Professor Cummins graphically explains it. "We may have overlooked something."



A child leading an adult victim of river blindness.

The other concern is that sometimes the fauna are regularly replenished from untreated tributaries. These tributaries go untreated with larvicides because blackflies don't breed in them because, possibly, the water doesn't flow swiftly enough. So perhaps the species caught in the main, treated rivers, examined and declared "clean," have come down from the tributaries. "We need an independent study to monitor the tributaries," he said.

The Vector Collectors

To find out how many blackflies in an area are infected, first catch some. Not an easy task—especially as it has to be done week after week. All sorts of schemes have been tried to trap them but only one really works—human bait.

The "vector collectors" as they are called among the anglophones or, among the more flippant crowd, "flyboys," are hired to sit on the riverbanks, roll up their trousers to expose their legs and wait for the blackflies to bite. The blackflies have a preference for lower limbs and shady spots, and get really aggressive when the weather is cloudy and at dawn and dusk. When one settles, a vector collector traps it in a test tube, before it has time to take a mouthful of blood and before the bite causes severe itching.

A cork goes on the test tube, wet cotton is wrapped around it to keep the fly cool and alive, an entry is made on a record chart, and eventually it's taken back with all its captured comrades to the laboratory and stored in the refrigerator to await dissection.

The "vector collectors" work in teams of two, and stay on the catching site from seven in the morning until six in the evening. One acts as bait for an hour, then rests for an hour while the other one takes over. The sites are carefully chosen—they should be near where the flies breed, close to villages, and be accessible throughout the year.

We found two vector collectors on a site at Selingue in Mali at midmorning. They had spread mats about ten yards from the river in a spot shaded by drooping trees. A roll of bread, a

teapot, and some music tapes were bundled at one side. One of them, taking his hour off, woke up as we clambered down the bank. The other, acting as bait, sat working. His legs were well exposed and a test tube was at the ready. Nothing was happening, but that was to be expected. The area was presumed to be fly-free; this was just a check.

“Is this their full-time job?” I asked Dr. Akpoboua.

“This is their main job. They’re employed for that. They go out on Sundays and they catch from Monday to Thursday and on Friday come back to town.”

“How many vector collectors do you have?”

“We’ve 11. Among those, we have some drivers who also catch flies.”

“Are you happy with your work?” I asked the man on the mat.

“I like it well enough,” he replied.

“Isn’t it boring?”

“It’s work,” he said with a shrug. He would like to get involved in other aspects of the program, he added, which would mean different training. His basic training was only in fly catching.

“How long have you been a vector collector?”

“Sixteen years.”

I gasped. “And how many flies have you caught?”

He grinned. “I couldn’t tell. It’s so many.”

“How much do you get paid?”

“It’s 86,000 CFA a month” was the reply. That was equivalent to US\$344 (at \$1 = 250 CFA), not a bad wage in Mali. When the control program is taken over by the national governments—a process known as “devolution”—their employers will no longer be the WHO. That’ll probably mean less money.

“They’re worried about that,” Dr. Akpoboua said. “But they’ll probably want to continue. They won’t give up because of that. They’ll want to keep their jobs. Things in Bamako are difficult.”

Is this work too hazardous? If they do it for as long as 16 years, aren’t they at some risk? Because they swoop quickly before the flies bite their legs, “they are at no risk of contracting onchocerciasis and going blind,” World Health, the WHO’s official magazine, stated. “This has been shown by careful

medical examination of the personnel so engaged since the program was first launched.”

Under the Microscope

Back in the laboratory in Bamako, Dr. Akpoboua peered down a microscope at a blackfly caught not in Selingue but in an area on the Baoule River. “*Similium damnosum*” has several varieties, and six are found in the control program area. Three are found mainly in the forest zones and don’t generally appear to be responsible for blinding onchocerciasis. Two are in the savannah areas, and one is found in both forest and the savannah. The control effort concentrates on these last dangerous three.

The first test on our dead blackfly was to see whether it was a forest or a savannah form. One way was to look carefully at the veins on the wings. In the forest form they are dark, in the savannah they are pale. As expected, the specimen was savannah. “We might find some forest forms,” said Dr. Akpoboua, “but it would be rare.”

Then we looked to see if the blackfly was nulliparous (it had not laid any eggs), or parous (it had laid eggs). The blackfly in some areas gets the blood she needs to lay her eggs—she can drink one milligram—from cows or horses, but her preference is for humans. After mating she goes hunting for this bloodmeal. After three to five days, she lays her eggs. Less than 24 hours later, the fly takes another bloodmeal and a new cycle begins. She may do this five or more times in the course of her short life. We looked at the ovaries under the microscope. The ovaries are more elastic if they are older—if you pull them apart they come back together again, the doctor explained, while young ovaries break immediately. This specimen was obviously parous.

Now to find out whether it was infected. With two needles we pulled apart the head, the thorax, and the abdomen. Infected parasites in the head are more dangerous and the ones to look out for. We tore the head apart but there was nothing to be seen. We dissected the thorax and something suddenly moved on the slide. It was worm-like and squirmed about.

Dr. Akpoboua made a pronouncement: “It’s too fat. Too thick. It’s not oncho. It’s some kind of protozoa.” As expected, the fly was harmless and became a statistic to be sent to the weekly Monday radio briefings where decisions were made whether to spray, where to spray, what to spray, and how much.

The War against the Worms

If the war against the fly is now going well, what about the war against the worms? Veterans look back to the bad old days of the late 1970s when pessimism was rife—not only was the blackfly showing resistance to the larvicide, but research into finding a suitable and safe drug to kill the worms in the human body seemed to be going nowhere. The main drugs used then were diethylcarbamazine (DEC) and suramin.

The former has been around for more than thirty years. It is taken orally and is a microfilaricide—it aims to kill the infant worms. It has to be taken for ten to fourteen days and causes severe side effects. The latter is even more toxic. It’s taken intravenously once a week for five to seven weeks and aims to kill both the infant and the adult worms. Reactions include rash, peeling of the skin, diarrhea, damage to the kidneys, and sometimes death. These were drugs the villagers were none too keen on taking. Then came ivermectin.

A New Drug: Ivermectin

The drug was developed in the United States by Merck Sharp and Dohme Research Laboratories, from a culture obtained from Japanese soil samples. It was found to be effective against parasites in cattle, horses, sheep, and hogs. It is now also used to fight canine heart-worm. In the veterinary field, ivermectin continues to be, as one researcher put it, “a money-spinner.” Could the drug be used against parasites in humans?

Clinical trials during the 1980s proved that it killed the infant worms—the adult worms were not affected—and that

side effects were minor. Also, only one or two of the little white pills needed be taken once a year—an important benefit because of the immense difficulty of giving out and monitoring any drugs in tropical countries.

But—there are always “buts” in medical science—the drug cannot be given to pregnant women, women who are breast-feeding, children under the age of five, and severely ill patients. After treatments in a community, some infection is left, enough to allow the disease to continue to be transmitted by the blackflies. It’s not the perfect answer, but it’s a strong weapon to be used and it gave a tremendous boost to the campaign. It prevents blindness—the old men who are blind can’t get their sight back, but the next generations are free of that terror. It also relieves a lot of suffering. The next question was money.

Free—For as Long as It’s Needed

Initial costs of ivermectin put it at least \$3 a tablet, Dr. Samba said, which was too expensive for his needs. But then, Merck and Company of Rahway, New Jersey, which manufactured the drug, announced to the astonishment of everyone, that it would give the drug free to developing countries for as long as it was needed. Dr. Samba believes this was simply a pure, generous gesture by Dr. P. Roy Vagelos, the company’s chairman. He and his wife had seen a film showing the devastation of river blindness in West Africa, and made the decision. “He gave his word and kept it,” Dr. Samba said, even though his board was initially against the idea as were other drug companies who complained that it would spoil the market. The company has got tremendous publicity out of the gesture, Dr. Samba said, “and this is fine.” There may have also been tax advantages, he added, but they are being extremely generous.

One expert said that Merck was faced with the difficulty of marketing a drug in a part of the world where the people obviously couldn’t pay for it. The decision was made in frustration. Another expert said that basically Merck’s motives were honorable ones and that the decision was made on “what was right and just.” If there was disagreement on the board, then

the doubters were just doing their job, which was to protect the company's interests.

When the company made the formal announcement in 1987, it said that Merck recognized a "unique situation in which the drug was needed only by people who couldn't afford it." As to cost of research and development, "obviously many millions had been spent on research on human use" and "if there are tax advantages, Merck will take advantage of them, but the company does not expect them to be significant."

This radical decision does raise the issue of whether this gesture might have established a precedent—will it be repeated by other drug companies if they are faced with similar circumstances in the developing world? And, more controversially, if drugs are given out free to the desperately poor in the developing world, why can't they be given free to the poor in rich nations?

Art Kaufman, a Merck spokesman, explained that originally the company didn't intend to give the drug away, but it did want to make sure that everyone who needed it, received it. No government offered help. So the decision was made to make it free. One argument against was that Africans might think that the developed world was trying to dump worthless drugs on the developing world. This was obviously not the case, as the drug works. To approve mass distribution programs of ivermectin, a Mectizan Expert Committee was set up, funded by Merck, based in the Carter Presidential Center in Atlanta and chaired by Dr. William Foege, the center's executive director, who was one of the main players in the eradication of smallpox. This committee's goal is to get the drug to six million people by 1993.

Mass Distribution

With the welcome news of Merck's gesture, the control program started the mass distribution of the drug in heavily infected villages.

Teams—from the control program itself, or from national governments or nongovernmental organizations—go into villages, explain the drug, give out the pills (washed down with a sip of water preferably on an empty

stomach), and record who took it. The drug may be free but its distribution and monitoring are costly. They used to weigh each person, explained Dr. D. Sangare the coordinator of the distribution based in Bamako, and give out pills or half-pills according to the person's weight. Now it is simply one pill for those between five and fifteen years of age, and two pills for those over fifteen. Wastage is very low, Dr. Sangare said. The drug can be kept at room temperature for about two years. In 1990 he estimated that there was a 3 percent loss, the next year "none were thrown away."

Some refused to swallow it, usually because they had taken the previous drugs with their terrible side effects. "We give health education lectures in the village to try and change their minds, but if they're adamant there's nothing more you can do," he said. However, Dr. Sangare added, what usually then happened was that those who took the drug felt better, worked better, and had an appetite. Next year when the mobile teams returned to a village, those who had refused previously "were now the first to rush forward."

They keep careful records. He pointed on a chart to two small settlements in Guinea where the villagers were reluctant to cooperate, not only because of bad experiences with the previous drugs but also because they complained that the skin snips hurt. In a skin snip, a piece of skin is cut away and examined, and the numbers of infant worms are recorded. (Because of the possibility of HIV transmission, the WHO has laid down guidelines about sterilizing the equipment.) Not only can it be painful but the wound sometimes gets infected. Whereas here, he said pointing to a third village, people realized the benefits and cooperated. "All we need to do is somehow to send the people from the third village on a visit to the other two villages, to spread the word," commented one observer.

Some Side Effects

The side effects of ivermectin are mild. About 1 percent who take it have reactions such as headaches, dizziness, rash, or itching. They're more likely in children under fifteen and on the first occasion when it's taken. Dr. Michel Pacque, a Belgian with ten years'

experience in Africa, worked for three years on studying the side effects. He's now a consultant with Sight Savers, formerly the Royal Commonwealth Society for the Blind, and trains the villagers to give out the drug. "Rarely do we see someone who has to stay home for a day from work," he said. "Of 100 people who have side effects, about 80 percent will take the drug willingly the next year."

Resistance to the Drug

Resistance to ivermectin by the worm might be, however, a real concern. It has been detected in worms "of veterinary importance," a progress report to the Expert Advisory Committee, the second independent review body (it watches over the scientific and technical part of the program) said in June 1992, which "may be relevant to the possibility that ivermectin resistance will occur in human onchocerciasis." And this, Dr. William Campbell, a principal figure in the drug's research, said is generally causing some pessimism among the experts, although he pointed out that there was a minority opinion that said forcibly that resistance wasn't going to be a problem. One of those minority voices is Dr. David Denham, a senior research fellow at the London School of Hygiene and Tropical Medicine. It took sixteen years—from 1938 to 1954—for a different worm in Australian sheep, for example, to develop resistance to a different drug, and that drug was given every six weeks, he said. Ivermectin is only given once a year, and he said that he was prepared to go so far as to say that resistance would "never happen."

The hunt for a new drug—a macrofilaricide, one that will kill the adult worm—continues, although as Dr. Campbell pointed out, again there's a difference of opinion how critical it is to develop it. He put it that it "would be nice to have." Dr. Denham, who has spent a "lot of time looking for one," said it was an extremely difficult task and that he was pessimistic. Clinical trials have taken place in Hohoe, Ghana, and the Expert Advisory Committee is looking at Enugu, Nigeria, as an alternative or additional site. The committee says cautiously that good collaboration with one drug company in the past

year “has resulted in progress with two potential macrofilaricides.”

Could a vaccine ever be developed? If it could, it’s a long way off. The Edna McConnell Clark Foundation of New York is putting money into research, and in 1991 the late Dr. Bruce Greene of the University of Alabama Medical School reported: “Although there is no unequivocal evidence of protective immunity in humans, there are precedents in animal filarial diseases that support the belief that development of a vaccine may be an achievable goal.”



Villagers wait in line to receive the drug Mectizan.

Time and time again as I traveled into the villages, people would come forward and praise ivermectin. There would usually be the gathering under the tree, the friendly handshakes all round, sometimes bowls of a muddy drink made from millet flour passed from lip to lip, formal introductions greeted with applause, and then the “talks.” A story

about how the village came to be. Then perhaps the need for a new well, a new plough, seed, fertilizers, rain, or even lessons in how to read and write. Then tales of the terrible blindness and the miracle of the white pill.

A political meeting was in progress when we arrived in Pendie and Badala, two villages adjoining one another in Burkina Faso. The villagers were listening attentively and politely. After explaining to the political organizers that we weren’t there to compete for the crowd’s attention, we strolled a short distance away to the shade of a neighboring clump of trees and talked to two old men. They remembered when “a lot of people became blind before being old” in the two villages but now, after the helicopters came to spray, they could work in the field without worrying about the blackflies.

One of the old men, dressed all in white with a white scarf

round his shoulders, held a walking stick in one hand and an umbrella in the other. His eyes had become weak, but after taking ivermectin four times his eyes are now much better, he said. He was lucky, he added. Some women with their children, their clothes making pleasing splashes of color against the tawny landscape, gathered round us to listen. She used to scratch a lot, one of them said, and she couldn't see well but since taking ivermectin the scratching stopped and her eyes were much better.

Many people in the villages all over the area I traveled wanted more ivermectin or wanted to make sure they could get it. It often had to be explained that either they no longer needed it because the area was now free from the disease, or that only one or two doses were needed annually. Some clinics in these "clean" areas kept supplies in case infected visitors, for example, from Côte d'Ivoire in the south, come through.

Fewer Women Are Infected

The usual image of river blindness is of a boy leading a blind man with a stick—a blind man rather than a blind woman. And fewer women are infected. I asked Mamadou Doumbia, the 80-year-old blind chief of New Sanakoro, a village in Mali, why this was. His hut was bare except for a fly-whisk leaning against the wall, a kettle, two chests, a box on a pile of bricks and a mat on the earth floor. He had sat motionless, his head in his hands, while I talked to the other elders who squatted inside and around the entrance. The question was shouted to him—he was almost deaf—and translated into Bambara. He suddenly came alive. The chiefs of these villages may be blind but they never lose their status and prestige, or their personal dignity.

The reason was that women didn't go as often to the river—they had wells in their villages. The men farmed near the river and also went fishing, so more were exposed to the blackflies. The old chief had fled Old Sanakoro in 1974. His sight and that of many of his generation was gone, but the villagers still worried about their young. They had heard of ivermectin but no one had been given it, and they was anxious. This area was

no longer a high risk area, Dr. Akpoboua had to explain again, so mass distribution of the drug was unnecessary. It was available at clinics for visitors who might be infected.

The meeting ended with those standards of courtesy common all over Africa—with the hopes that we had a safe journey back to Bamako, and an invitation to come and see him again. Always the villagers were as kind to strangers as they were tender with each other. A chicken, held by its legs, was brought into the hut, squawking and fluttering in futile protest. It was a tradition that a meal was cooked for visitors, the chief said. As this was not possible—we had to go on our way to other villages—he wanted us to have this bird as a gift.

Unsightly Nodules and Patches

In one village I examined some nodules—those bumps under the skin where the adult worms congregate. They're usually found around the hips and on the rib cage, but can also appear on the head and legs. An old man showed me a lump on his neck, about two centimeters in size. Sometimes they can grow to over five centimeters. This lump rolled easily between my fingers. The old man laughed and, making a joke of it, insisted I feel the lump over and over again. Others then wanted to show off their lumps. Dr. Agoua examined them gravely. They weren't all worm-filled nodules. One was a lipoma, he said, and the other on a young boy was probably an injury.

Sometimes these nodules are given mysterious and false powers. In Rapadama near Ouagadougou, the village storyteller was summoned to tell us the tale of how the neighboring village of Tanturi completely disappeared. In the meeting-house—"peace is not a word but an act" was scrawled on one wall—the elders had gathered and sat on a row of benches and seats. One young woman served drinks while another breast-fed her child. The performance was long and graphic. The storyteller swept his arms back and forth to get dramatic effect. He held the audience's attention completely, although most must have heard the story many times before.

Their ancestors had told them, he began, that a village had sprung up many years ago around a waterhole not far from the

river. At this hole the hunters used to smoke the meat of antelopes or other animals they caught. Eventually the people of Tanturi, as they named the village, developed nodules. Some argued that these should be removed. But the traditional healers told the men that if the nodules were removed they would become sterile.

“In Africa to tell a man he’s sterile is terrible,” explained Dr. Agoua translating the tale. Using his deep, expressive voice to full effect, he matched the storyteller in drama. “So they preferred to keep their nodules so as not to become sterile. Most of them became blind. So, he concluded his voice rising with a flourish, “they abandoned the village and that’s how Tanturi disappeared completely.”

The village of Dioko was reached by an hour’s bumping across sandy tracks and dry riverbeds. Here was another courageous community and another blind chief—Coulibaly Ngolo, resting at noon in his hut. Birds swooped out of the roof as we entered. A bundle of bones was tied above the doorway. He told a similar story. By his side was a man whose shins were a mass of white patches. Rolling up his trouser-legs, he showed the extent of the disfigurement. He had scratched and scratched and had permanent skin damage; he had not taken ivermectin. He was obviously heavily infected, Dr. Akpoboua said, but had never had eye problems. For some reason he escaped blindness. Some people didn’t proceed to the later stages of the disease, the doctor said. These were odd cases.

Devolution: When the Control Program Is Handed Over

At some stage the control program will make its exit from the scene, leaving an area liberated from the disease. But there’ll still be work to do. There will have to be checking to make sure the disease stays under control. There will be ivermectin to give out or, it’s hoped, another more powerful drug that will kill the adult worm. It will be more than just maintenance.

Up to now, the West African governments themselves have played only a small role. Those efficient international WHO teams with their highly trained staffs, their whirring helicop-

ters and fleets of jeeps, their microscopes and wall charts, their seminars and research papers arrived, fought the disease and raised the funds. The villagers are grateful—the boys, wiry as panthers, grin, wave, and shout “oncho, oncho” when a jeep with its familiar markings bounces into view—and so are the governments, whether democratic or not.

Burkina Faso’s head of state recently embraced Dr. Samba—“the francophones embrace, we anglophones don’t,” the doctor explained—and whispered in his ear that this program had contributed more to his country than any other in its history. But soon the government must take over. This “devolution,” which covers other diseases spread by vectors as well as river blindness, worries some experts. Because the control program is so efficient, one European expert commented, the countries in which it worked had been spoiled. They would have a difficult time meeting the challenges, and he wondered whether they could afford to do it. Budgets are already stretched, and governments have other priorities. Medically, there’s always malaria, while AIDS has yet to show its full fury in this part of Africa.

One of the great bonuses of the control program is that more than 400 Africans have been trained—in entomology, public health, epidemiology, and computer science, for example. Many who now work for the control program will simply transfer to their national teams. A Malian in the control program will work for the Malian Ministry of Health—although it might be at a lower salary and be less secure and there may be political pressures that weren’t there before.

But there remains the question of management skills. “Africa is rich,” argued Dr. Samba. “The resources are here, but the management is poor. That’s what Africa lacks.” And management skills are exactly what make the control program and Dr. Samba’s leadership so outstanding. “People work hard in this program,” he said, something an observer can confirm. “We’ve created a work ethic.”

Several countries have important-looking “First Steps to Devolution,” papers that ring with rich and determined phrases. Financed by a World Bank project, Burkina Faso’s seems to be the most advanced. “The doctors are trained,”

Pierre Guillet, the French scientist with the control program in Bamako, said. "The nurses are more or less available, money is there, the plan is ready. All the ingredients are there. I don't see any strong reason why devolution in Burkina Faso shouldn't be successful. Its example will be quite useful."

In Mali, "the new government is committed to carrying on the work," Isaka Niambele, the country's national river blindness coordinator, said. Money would be scarce, however, and Mali might need help to train personnel and to buy equipment. One foreign expert said that national governments were without doubt going to find it all very difficult and that perhaps the answer was to find nongovernmental organizations that would be long-term partners, providing help with technical support as well as raising funds from sources who will inevitably soon begin to show signs of "donor-fatigue."

Passing on the Knowledge

At the heart of devolution is training—passing on all this knowledge. Dr. Yiriba Bassan, an entomologist, is, like so many of the African experts I met in the control program, an enthusiast. A feeling that victory is in sight, in a field where victories are few, creates rushes of adrenalin. He was patiently explaining the methods of identifying the blackfly to two Guineans who would sit by his side for two months in his Bamako laboratory and then return home. A Malian who trained in his own country and in Marseilles and then for five months at the British Museum, Dr. Bassan personally selects some of the trainees who come from neighboring countries. He tests them using "a sort of game." He showed me a series of what seemed like identical drawings—two giraffes were one example. After closer examination, the two drawings differed in a few minute details. Entomologists have to be able to spot tiny differences, swiftly and accurately. "There's no room for mistakes in this work," the doctor said.

A group of trainees had just been selected from Sierra Leone and would be in Mali soon. At the top of the list was Elizabeth Musa, the first woman selected. Her marks were startlingly

high. When the chosen candidates are offered places, the doctor said, they are told not to accept unless they can endure the tough conditions. Sometimes the candidates were good in training and then, when they returned home to start work, they lacked the necessary seriousness. "They have to like the fieldwork. And they have to identify correctly," he said.

Yet he demanded more from them than just being superb technicians. They had to realize how heavy their responsibility would be—protecting their own people from a return of river blindness. He said with some passion: "For me it's an obligation to prepare them. For them it's an obligation to succeed." To let everything that the control program had achieved collapse was not possible, not imaginable. "They have to succeed," he said again, lowering his voice this time. "It's a moral obligation."

When the national governments do take over, what will happen to the control program? Will it just be disbanded, its job done? Or could it somehow be used to fight some other disease? Dr. Samba thinks it can.

Malaria is too big a problem, he admits, but the control program machinery, its experience, its workers, could be used to eradicate guinea worm, for example, or try to control schistosomiasis. One American expert agreed. Cynics argue, he said, that devolution isn't in the control program's interests; on the one hand, it means that the staff have to work themselves out of a job and give up their good salaries. But on the other hand, the staff was loyal and saw the program as a unique source—it was run by Africans for Africans and was a beacon of success on the continent. It had taken years to build up. It was reasonable, he said, for the staff to ask: "Why should it all be tossed away? It could surely be switched to fight some other disease."

Resettling the Abandoned Lands

It's not difficult to see what the control of river blindness has done for a country such as Burkina Faso. Drive a few kilometers east from Ouagadougou to the White Volta River and the villages hum with activity.

Men pump the handles of smart-looking wells while the women carry the water home in round pots on their heads. Saplings of neem, eucalyptus, and mango trees stand in bunches to be planted in no-longer-exhausted soil. With money earned from millet, cotton, and yams, the villagers build pharmacies where they sell drugs and contraceptives and send their young to the capital for courses such as management training. The old men have time to sit around with strangers and gossip about the past. About the time, say, when they were serving with the French army in Viet Nam, where, as one said: "There were so many bombs at night in Dien Bien Phu, so many lights, that you thought it was the daytime." And, said another with lingering loyalty: "Viet Nam didn't beat France—it was zero-zero."

Drive a few kilometers north-west out of Bobo-Dioulasso and the luxuriant ricefields stretch in all directions, neatly divided by drainage canals. "Recently Burkina Faso exported food, whereas in the 1970s it was the subject of food aid," Dr. Samba said. "The development of these river basins wouldn't have been possible without this river blindness control program. Burkina Faso's agricultural production, the latest report says, "increased more than 6 percent a year during most of the 1980s due primarily to a 5 percent annual increase in cultivated lands in the formerly river-blindness-endemic regions of the country."

In Mali, too, drive south from Bamako to the Selingue lake and dam on the Sankarani River, and there you see extensive fields of millet and rice and tobacco. Fishermen haul up their catch to the market, where women, in multicolored dresses and turbans, haggle over the price, gossip, and cuddle their crying infants, and where local restaurants serve up the tasty "capitaine" fish with mounds of rice. "We have controlled the flies to such an extent that the people are coming back to farm and to fish," Dr. Akpoboua said proudly. The fertile river valleys are possibly West Africa's best hope for increasing agricultural production," Mr. William Draper, the Administrator of UNDP, said. "This program is an excellent example of poverty alleviation at the grassroots."

Nigeria—Just Beginning the Fight

If the accomplishments in the control program area are real, what about the rest of Africa? What about Nigeria, a country now of about 115 million people which because of its sheer size has the greatest number of people infected—at least 7 million, about a third of the world total? There's no special control program for river blindness in Nigeria. Here the disease is just beginning to be fought.

There's virtually no larviciding in Nigeria—mainly because there are so many rivers and so many breeding sites and, as the forests tend to grow right down to the riverbanks, helicopter flying is difficult. Mass spraying would be incredibly expensive. But another factor suggested by some Western experts was that Nigeria, which was going through an oil boom when the control program started, simply wanted to run its own campaign. Also, the smaller countries that did join the control program, and have since greatly benefited, didn't want to be overwhelmed by Nigeria's size and power.

One nonprofit organization that, although involved in many countries, is concentrating on Nigeria is the River Blindness Foundation based in Texas. Its mission is to help get ivermectin to all who need it. The foundation is the brainchild of Dr. William Baldwin, dean of the College of Optometry at the University of Houston, and John Moores, formerly chairman of BMC Software in Texas. It aimed to help get the drug to 2 million Africans in 1992.

Working with them is Donald Easum, who was U.S. ambassador to Burkina Faso and Nigeria and then headed the African-American Institute. The foundation is pushing for state-wide distribution in Nigeria so that hundreds of thousands of pills can be given out efficiently. So far about 700,000 pills had been given out, which was, he said, "not a lot." They were trying to coordinate not only with the government but also with the International Eye Foundation, Africare, Sight Savers, and UNICEF.

Some of the obstacles they had met was the temptation of a few Nigerians to hoard ivermectin, sell it when it should be free, or even counterfeit it. In one case the Nigerian press

reported that pills were on sale for the equivalent of \$10 each. People took the pill because it made them feel good. There was even a rumor that the pill was an aphrodisiac, which was of course untrue. A weakness among the voluntary organizations, he said, was that perhaps everyone was too eager to get something started, to get results, and tended to put to one side the question of future responsibility. "We don't do the transfer of financial responsibility soon enough," he said.

The doctor who now watches East and Central Africa for the foundation is Dr. Brian Duke, an Englishman with a lifetime of work on tropical diseases in Africa, but particularly river blindness. He had the disease in 1969—he described it as starting with "an itchy rash of spots over my right hip bone"—and, as this was before ivermectin was developed, he took suramin intravenously once a week for seven weeks. He has worked in the past for WHO and for the Armed Forces Institute of Pathology in Washington, and when clinical trials of ivermectin began, acted as liaison between WHO and Merck.

The only place outside the control program area where the disease had been controlled was in Kenya in the 1950s—it was only an isolated area, he said, and DDT was used to kill the flies. He has reported to the foundation that the worst area of blinding onchocerciasis remaining in Africa is in northern Cameroon, southwestern Chad, and northwestern Central African Republic, and distribution programs are being worked out with each of the governments. He's "reasonably optimistic" that the people who need ivermectin can be persuaded to take it. I asked him whether there was any evidence that taking ivermectin was harmful. Four annual doses was the most people had taken, he replied, and there was no evidence yet of any long-term harmful effect.

Not So Serious Outside Africa

River blindness isn't only present in Africa, but elsewhere its force is less severe. In the Americas, the Pan American Health Organization has set its sights on eliminating the disease by the year 2007 by using ivermectin. In Mexico there are small areas in the states of

Oaxaca and Chiapas and a few in Guatemala. Most of the sufferers are Indians who go to work in coffee plantations at higher levels where the rivers flow faster and the blackflies breed. Dr. Rene LeBerre calls them people who are “at the end of the track.”

More river blindness is found in the River Macay basin in Colombia, and another area is not far away in Ecuador. In Venezuela there are areas near the coast as well as in the far south near the sources of the Orinoco River, extending over the border into Brazil where it attacks the Roraima Indians. On the Arabian peninsular it can be found in southern Yemen.

Why Does It Work?

So, why is it that this disease is coming under control? Why is the control program a success, to such an extent that some experts, whose experience has of necessity bred a hard skepticism, are even asking sotto voce whether this “scourge of humanity since recorded history” as former WHO director-general Dr. Halfdan Mahler called it, can actually be wiped out? First and foremost, the scientists came up with answers that worked—a cunning plan to kill the blackfly larvae and an easily administered drug that at least could kill the infant worms. But the campaign could easily have floundered along the way—there were other factors.

The campaign had a realistic and well-defined objective—the campaigners knew what they had to do, how long it would take, and exactly where. The strategy was under control from the start, and the management and staff are competent, hard-working, and honest. It took—like most worthwhile things in life—faith, persistence, and guts. A twenty-year commitment was needed—a long haul for many doubting donors, but with the World Bank as nag, cheerleader, guardian of the coffers, and kindly sergeant-major, they stayed the course. The Bank’s role in keeping the donors informed and committed gives them a degree of confidence unique to international programs of this size.

In February 1992 they gathered in Washington and penned proud signatures to the fourth phase (1992–97). This is to cost

\$175 million, and 90 percent of that has already been pledged. Some of the donors agreed to give more if it was necessary, and other countries thought that they too might like to join in. Success, as always, breeds success.

And the battlefield was clearly marked—albeit extended somewhat when the extension areas were added to try and solve the question of reinvasion. Other requests for extensions were rejected. When Côte d’Ivoire politicians wanted the program area to reach down to the forest areas of the country, the answer was a firm No. The mandate was to control the blinding form of the disease in savannah areas, the Expert Advisory Committee concluded, and that’s what is should remain. And the program uses the best technology available. It uses, for example, those aircraft, run by experienced private companies, and those smart beacons transmitting data toward the heavens and back.

In addition, there’s plenty of autonomy, so the program is flexible and can react quickly to crises, such as signs of resistance to the larvicides. Dr.

Samba reports to representatives of the donors and the participating countries, who comprise the governing board (the Joint Program Committee), through a steering committee (The Com-



An entomologist with the onchocerciasis control program examines larvae.

mittee of Sponsoring Agencies) on which the WHO and the World Bank are the key players. Both committees are functionally independent of the WHO and its executive board. Executing responsibility is separated from fiscal responsibility. The World Bank can tap many sources of funding, avoiding a conflict that the WHO might have between its global priorities and the needs of the program.

And the whole effort has those two alert, independent watchdogs—the Expert Advisory Committee and the Ecological Group—to reassure everyone, to keep politics at bay, and to keep the donors donating. Katherine Marshall, the head of the

Sahelian Department at the World Bank, put it all down to “cooperation, patience, persistence, concern for people, and results on the ground.” She added: “This is clearly a mammoth multicountry and multidonor effort that shows that regional cooperation and donor coordination can work well.”

Foreign aid is not, as some critics charge, always useless; it is not always an opportunity for the corrupt to be corrupt. Here’s a shining example of foreign aid that works and brings the best benefit of all—better health, and therefore a better life, to the poorest of the world’s poor.

As we were about to get up from our seats to leave New Samandeni, one of the old men, who had remained silent before, suddenly asked if he could now address us. A triangular straw hat, tied under his chin, obscured the upper half of his face. When he spoke he was almost apologetic. It was as if he felt uncomfortable talking about himself and delaying our departure for a few seconds.

“I can still see a little,” he said. “I can see you now. My eyes have stopped growing weaker.” He just wanted, he said, everyone, everywhere, to know that he was thankful for all their help and concern.

THE ANCIENT SCOURGE called onchocerciasis or river blindness as recently as 1987 threatened 85 million people worldwide with blindness, mostly in Africa. About 18 million were infected, 1 million had sight problems, and 350,000 were blind. This essay tells the story of perhaps one of the twentieth century's great medical and development triumphs: the campaign that is virtually eliminating river blindness.

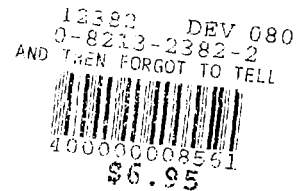
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