It was more than two decades ago that former President Jimmy Carter saw his first case of Guinea Worm, the flesh-burrowing parasite that for centuries has caused agony in poor, remote parts of the world. But Mr. Carter recalls that moment—an image forever seared in his mind—as if it were yesterday.

It was 1988, and Mr. Carter and his wife, Rosalynn, were visiting Denchira, a village outside of Accra, Ghana, where almost half the 500 residents were suffering from Guinea Worm. One of them, a young woman who appeared to be cradling an infant, caught Mr. Carter’s eye.

“When I got close to her, I realized it was not an infant she was cradling, but her swollen right breast, and a Guinea Worm was coming out of her nipple,” Mr. Carter says. “It was shocking to me.”

“It’s nauseating to see, and it’s difficult to sleep at night knowing that diseases like this are totally unnecessary,” he adds.

Unnecessary, debilitating and neglected. These are the kinds of diseases that the Carters have made it their mission to tackle at the Carter Center, the Atlanta-based non-profit they founded in 1982.

At the outset, Mr. Carter says it was a daunting mission—a far cry from his original plan to make the Center a place for world leaders to negotiate peace treaties. But it was also one that he and Mrs. Carter believed could eliminate untold suffering in otherwise forgotten parts of the world.

“We quickly realized that neglected diseases are truly neglected,” Mr. Carter says.

There is no medication or vaccine to prevent Guinea Worm, and the only way to treat it is to pull it slowly from the body—a painful process that can take up to a month. “When a Guinea Worm is coming out of a small child, they weep and scream through all their waking hours,” Mr. Carter says.

In 1986, when the Carter Center set out to eliminate Guinea Worm using health education and water filtration cloth, they drafted a working list of infected villages. The total? Approximately 3.5 million cases, located in 23,600 villages in 20 countries in Asia and Africa. To eradicate the disease, the Carters knew they would have to visit every single village. Last year, 3,200 cases of Guinea Worm remained in four African countries.

They are determined to eradicate Guinea Worm in their lifetime. If they succeed, it will be the second infectious agent, after smallpox, to be eradicated.

“If you leave one spot—deep in the jungle or far in the desert—you leave a potential breeding ground for Guinea Worm,” Mr. Carter says. “I’m emotional about it, because when we started out it was such a difficult and thankless task.”

Guinea Worm is not the only global health battle the Carters are waging. The Center fights trachoma, schistosomiasis, lymphatic filariasis, malaria and river blindness—all by using health education and simple, low-cost methods. To fill what the Carters call “vacuums” in global health, the Center works only in areas that major health organizations have not reached.

These places are often in hard-to-reach, poverty-stricken regions of the world, making for a demanding travel schedule for the former First Couple. Still, friends and co-workers say they show no signs of slowing down. And when they do travel, they make a point of hitting the ground with the Carter Center’s volunteers.

“They really are in some of the most remote, destitute villages on earth,” says Donald Hopkins, Director of Health Programs and of the Center’s campaign to eradicate Guinea Worm. “Their empathy is something everyone can see. You can also see their stamina, and their passion for these problems.”

Mrs. Carter mentions the men, women and children who have clasped their hands, or looked into their eyes, and expressed thanks. “Every time I go to Africa I get so tired that I say I’m not going to do it again,” she says. “But then something so wonderful happens that I can’t miss a trip.”

What are they most proud of? For Mrs. Carter, it’s the work of the Carter Center’s Mental Health Task Force; for Mr. Carter, it’s the power to transform the lives of people in forgotten places—often with something as simple as a little knowledge and a water filter cloth.

“It’s incredible to visit a place that is horribly afflicted by Guinea Worm, and just a year later, to go back and see there are no cases at all,” he says. “We’ve found that if we give the right tools, they are able to take care of an affliction on their own that’s been around for thousands of years. They are just as well-intentioned, ambitious and hard-working as we are.” — MOLLY KNIGHT RASKIN