

Sight for Sore Eyes

A bright spot in an otherwise dismal prognosis for sub-Saharan Africa: Simple measures against trachoma, a bacterial infection that causes deformed eyelids, are saving the vision of millions.

By James A. Zingeser



Scarified brows are a form of body decoration for a woman of the Shilluk tribe, in southeastern Sudan, but the scars on her corneas that have rendered her blind are the result of infection by the bacterium *Chlamydia trachomatis*. In such patients, blindness cannot be corrected.

News from the Republic of the Sudan seems to be relentlessly grim. Just one year ago, there was real hope that one of the world's longest-running civil wars was about to end. Negotiations between the Sudan People's Liberation Army and the Khartoum government were going well, and Ugandan rebels operating in the south, along the Uganda-Sudan border, were on the run. Then, in 2004, the peace talks stalled as a bloody conflict exploded in the Dārūr region, in the west; meanwhile the rebels continued their terrorist activities in the south. All of this in Africa's largest country, where

the harsh environment—from the Sahara in the north to the tropical swamplands of the south—helps to lock millions of people in an infernal cycle of poverty and disease.

The vast majority of Sudanese live in a state of extreme deprivation and are terrorized by an appalling array of infectious maladies, most of which they are ill prepared to combat. Yet, they struggle on and not without reason for hope: many diseases that have brought misery to millions for centuries turn out to be treatable and even preventable by the smart and dedicated application of modern medicine and public health.

Recently, in the heat and pounding rains of Malakal, a town in southeastern Sudan, a tall, elderly woman guided by a child approached a Sudan Trachoma Control Program team for help. The woman bore decorative facial scars—testimony to her Shilluk tribal heritage. She also bore other scars that testified to a life of poverty and neglect—the scars of trachoma. Both of her eyes were leathery and completely white, with no visible corneas or pupils. The program nurse gently spoke with her in Shilluk to explain that surgery

might relieve some of her pain, but could not restore her vision. For this woman, the campaign to eliminate this blinding disease had arrived too late.

But blindness from trachoma is completely preventable, and the Sudan campaign brings hope that today's children may grow up free from such devastating effects.

Trachoma is an infection caused by certain strains of the bacterium *Chlamydia trachomatis*. The symptoms first appear as conjunctivitis, an inflammation of the conjunctiva, the layer of tissue that lines

the inside of the eyelids and extends over the adjacent edges of the eyeball up to the margins of the cornea. In its earliest stage, most commonly seen in boys and girls under the age of ten, it looks at first like an unremarkable case of "pink eye." Close examination of the soft tissue inside the upper eyelids, however, reveals follicles—round whitish, pinhead-size aggregations of lymphoid cells that have gathered to fight off invading bacteria—that are characteristic of the disease.

That stage may lead to intense inflammatory trachoma, in which the conjunctiva becomes noticeably thickened, and small blood vessels within it become engorged, making it progressively redder. For reasons still unclear, as many as 10 percent of patients go on to develop severe, chronic stages of trachoma. With repeated bouts of infection, scars develop on the inner side of the eyelids, and as the scars constrict, they pull inward on the skin around the margins of the eyelids. The constriction of the skin rotates the eyelashes progressively closer to the cornea. The condition in which the eyelashes are permanently turned inward, so that they actually touch the eyeball, is called trichiasis. When the intumed lashes grate on the cornea, the trichiasis is painful and dangerous.

One obvious and traditional treatment is simply to pluck out the offending eyelashes. But that turns out to be a poor way to treat the problem, because it leads to short, broken eyelashes that are even more abrasive to the cornea. The body then "repairs" the damaged cornea with opaque scar tissue, which blocks light from entering the eye. If scarring blocks a substantial part of the pupil, the opening to the interior of the eye, the result is permanent blindness. Blindness from trachoma is not treatable, not even in the best of circumstances, because the tissue and blood supply around the cornea are so severely damaged that a corneal transplant would have a high risk of failure. As bad as that is, the blinded person still gets no relief from the pain, because the intumed eyelashes continue irritating the cornea.

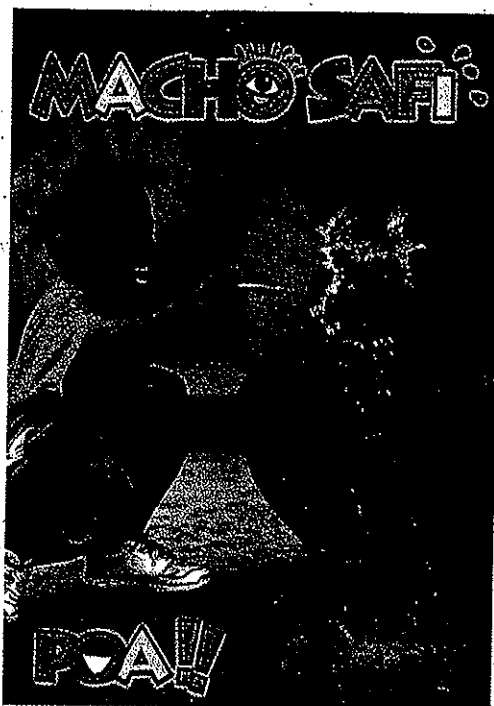
Apart from being a personal tragedy, trachoma can spell disaster to families or even entire communities in regions where trachoma is highly endemic, such as sub-Saharan Africa. Children with impaired vision

may not be able to attend school or do household chores. Sighted children are frequently needed as caretakers; in afflicted communities they are often seen guiding blind adults instead of attending school. Blinded adults can do only limited kinds of work; they can contribute little to farming or childrearing.

Trachoma is most widespread in sub-Saharan Africa, but it is also a serious problem in the Middle East, Central Asia, and Southeast Asia. Pockets of the disease also occur in impoverished areas of Latin America and even in Australia. Some 6 million persons have been blinded by trachoma, making it the world's leading cause of preventable blindness. The World Health Organization (WHO) estimates that some 150 million people are infected with the bacterium that causes the disease, and more than 500 million are at risk of infection.

Yet trachoma is a needless scourge. It is, at base, a disease of poverty and isolation, a disease of poor hygiene, poor sanitation, and lack of health-care services. One need not cure poverty to fight trachoma; it can be prevented largely through simple improvements in personal and environmental hygiene: helping people keep their children's faces clean, and ridding the environment of the flies that cluster around people's eyes. Miracles can be accomplished with clean water, easily constructed latrines, and a reasonable level of community health care and education.

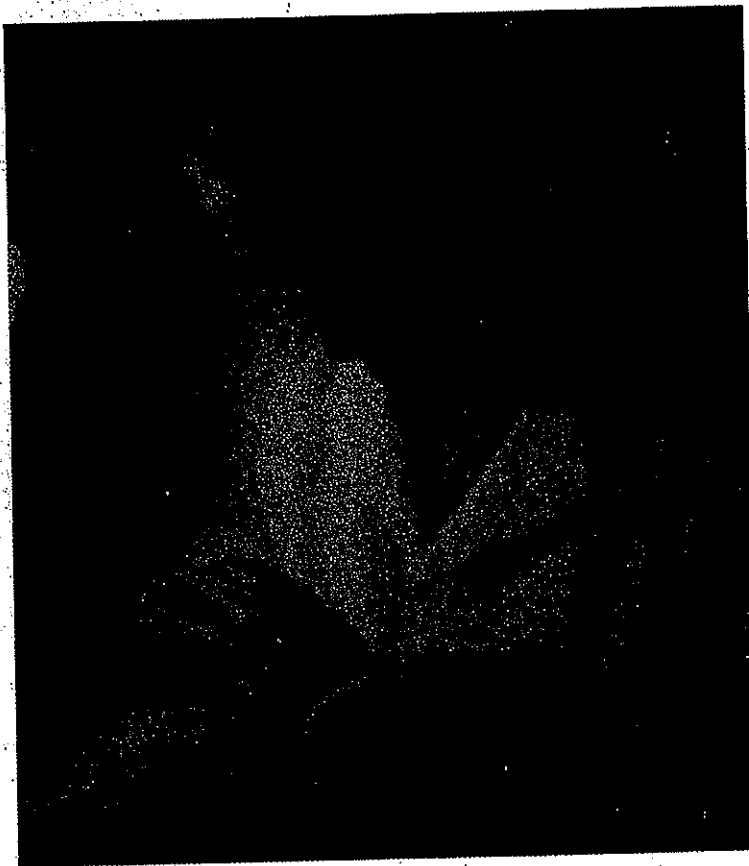
The genus *Chlamydia*, which includes the tra-



Posters designed for Tanzania by the International Trachoma Initiative help promote part of a strategy for combating trachoma known by the acronym SAFE (surgery, antibiotics, facial cleanliness, and environmental improvement). The Swahili text on both posters means "Clean Eyes—Cool!"



choma bacterium, comprises bacteria whose reproductive strategy and small size at one time led people to consider them viruses. One species, *C. psittaci*, causes psittacosis (so-called parrot fever), a respiratory infection transmitted from birds to people. Another, *C. pneumoniae*, causes a kind of pneumonia. And *C. trachomatis*, in addition to including strains that cause trachoma, has other strains that are responsible for sexually transmitted cases of urethritis and epididymitis in men and cervicitis, urethritis, and pelvic inflammatory disease in women (the last is a leading cause of infertility in the industrialized world).



Surgeon operates on a Moroccan patient's eyelids, deformed by trachoma infection, to realign the eyelashes. Left untreated, the eyelashes rub painfully against the cornea, eventually scarring it and leaving the patient blind.

The strains of *C. trachomatis* that cause trachoma are passed from person to person through eye and nose secretions. The bacterium's strategy for spreading is a textbook example of successful adaptation. The irritation from inflammatory trachoma in children leads to copious secretions from the eyes and nose. Epidemiological studies suggest that children readily pass those secretions to family members and peers in many simple, insidious ways, such as on fingers, clothes, shared bedding and towels. Eye and

nose secretions also attract moisture-seeking flies, which appear to transmit the bacteria as well.

Consistent with these means of transmission, trachoma is primarily a disease of women and children. In most populations women are as much as three times more likely to develop trichiasis than men are. Most public health experts believe the reason for the imbalance is that women are the primary caregivers of children and are therefore reinfected repeatedly.

Trachoma was described as a clinical disease thousands of years before the bacterium was first isolated and identified. An illness resembling trachoma appears in a compilation of Chinese medical texts probably written down in their present form at least two millennia ago and traditionally believed to date from the time of the Emperor Huang Ti (the twenty-seventh century B.C.). The Ebers Papyrus from Egypt, dating from about 1550 B.C., includes prescriptions for trachoma. In ancient tombs Egyptologists have discovered what were probably tools for treating trachoma by plucking eyelashes. Evidence of trachoma has even been found in mummies.

In later antiquity many important Greek physicians, including Hippocrates and Galen, refer to trachoma and its treatment in their writings. The first record of the word *trachoma* is attributed to Dioscorides in A.D. 60; the term derives from the Greek for "rough eye," an apt description. From the eighth until the fourteenth centuries A.D., Arab ophthalmologists were the primary source of information on trachoma. They understood that the disease was contagious and distinguished between acute and chronic stages.

Soldiers in the Napoleonic campaigns of 1798 through 1802 encountered trachoma in Egypt, where it was called "military" or "Egyptian" ophthalmia. On their return they brought it to western Europe, where its spread was fueled by the crowded and unhygienic urban conditions fostered by the Industrial Revolution. In 1805, in response to a huge epidemic of Egyptian ophthalmia, the surgeon John Cunningham Saunders founded the London Dispensary for Curing Diseases of the Eye and Ear, the world's first specialist eye hospital.

Across the Atlantic, trachoma proved to be such an important public health concern that in the late nineteenth and early twentieth centuries, U.S. immigration officials refused entry to people suspected of having the disease. With improvements in hygiene and sanitation, trachoma disappeared from U.S. cities, and by the late 1950s, the last of the nation's trachoma hospitals had closed their doors or had been converted into general eye hospitals. Nevertheless, pockets of trachoma continued to exist even into the 1960s, par-

ticularly in impoverished Native American communities of the Southwest.

The transmission and ecology of the disease have dictated the priorities of the public health community: to develop strategies for controlling the disease in underdeveloped and underserved populations. In 1987 WHO recommended simplified standards for assessing trachoma infection, so that examinations could be performed not only by ophthalmologists but also by nurses and other health-care workers using widely available instruments (a portable light source and magnifying lens). The WHO protocol thus made it possible to survey the geographic extent and severity of the disease.

A turning point came in 1996, when the Edna McConnell Clark Foundation, based in New York City, sponsored a meeting at WHO headquarters, bringing health professionals, medical researchers, and philanthropic donors together. The result was a concrete plan for eliminating blindness caused by trachoma, with a strategy applicable in every village in the world, no matter how poor or how isolated. The strategy was called "SAFE"—an acronym for surgery (to correct trichiasis), antibiotics (to treat inflammatory trachoma and reduce *C. trachoma* in the environment), facial cleanliness, and environmental improvement (to prevent transmission of trachoma).

The surgery is a simple procedure for realigning the inturned eyelashes of trichiasis patients. It can be done by nurses in village health centers or anywhere else (a classroom, for instance) that can be cleaned and properly equipped.

Antibiotics provide a second line of attack. Throughout the 1980s the standard treatment was to apply tetracycline ointment topically on the eyes twice a day for six weeks. But the treatment, besides being lengthy, was messy and uncomfortable; its success was only limited. Subsequent research on the antibiotic azithromycin showed that a single oral dose of the drug is as effective as six weeks of the topical therapy. In November 1998, the pharmaceutical company Pfizer Inc., based in New York City, in collaboration with the Clark Foundation, launched the International Trachoma Initiative to manage a long-term donation of Zithromax, Pfizer's brand of azithromycin.

To further promote trachoma control, WHO created a new working group, the Alliance for the Global Elimination of Blinding Trachoma by the Year 2020 (known by the acronym "GET 2020"), which held its first meeting in 1997. Early on, the alliance recognized that none of its partners was committed primarily to supporting the improvement of local hygiene, the *F* and *E* of the SAFE strategy. One of

the alliance members approached the Carter Center, founded by former president Jimmy Carter and his wife Rosalynn Carter, to help in that role. My affiliation with the Carter Center led to my own participation in the project.

The Carter Center had already demonstrated its ability to manage a similar effort, coordinating a successful program to reduce the incidence of guinea worm disease, primarily in sub-Saharan Africa. As its name implies, that illness is caused by a parasite; it is transmitted solely through infected drinking water. For my colleagues and me at the



Health worker in Tanzania checks women for signs of trachoma. More women than men are victims of the disease, probably because they are in greater contact with infected children.

Carter Center, joining the alliance actually offered a solution to a dilemma: how to redirect the efforts of the workers and volunteers, whose progress in combating guinea worm disease was (happily) threatening to leave them without a job to do. In 1998 and 1999, the Carter Center began working with governments and partner organizations in Ethiopia, Ghana, Mali, Niger, Nigeria, Sudan, and Yemen to control trachoma.

The first step in combating trachoma is to survey



One oral dose of the antibiotic azithromycin will clear the eyes of a Sudanese girl of trachoma infection. An earlier kind of antibiotic treatment—a regimen of daily applications of eye ointment—was cumbersome and was not well tolerated by young children.

the extent and severity of disease where it is endemic. Such baseline studies can yield surprising results. For example, it had long been assumed that in arid, dusty environments, the irritation to people's eyes due to the dryness and dust would increase the risk of transmitting the bacterium. In Sudan, however, there proved to be high levels of infection both around Wadi Halfa, a desert settlement on the nation's northern border, and around Malakal, a town in the humid, lush south. One of the most disturbing findings in the Malakal area was that children as young as five years old were afflicted with trichiasis.

Epidemiological surveys are fine for measuring the prevalence of a disease, or the relative importance of risk factors such as age and lack of access to clean water. But such baseline data do not necessarily show why the risk factors exist—or how to change them. Why, for instance, aren't children's faces kept clean? (Some tribes think washing children's faces is unhealthy.) Why are there no latrines—or, if there are, is there some cultural reason they are not used or maintained? (In southern Sudan, the soil is waterlogged and latrines collapse.) What do people think causes

the disease? (We found that some people believe trachoma can be caught by looking at the eyes of someone who is infected with the disease.) To seek answers to such questions, the Carter Center made sociological surveys in Ghana in 1999 and in the South Gondar zone of northern Ethiopia in 2001.

A related cultural concern we had was to identify the best channels for communicating with a particular community. In Ghana, for instance, the popular medium of radio is so cost-effective in reaching isolated rural areas that most trachoma control programs provide financial and technical support for radio programming and short broadcast messages. Program supervisors, however, reported that villagers who had heard jingles and radio spots about trachoma control often did not understand the content of the messages. In response, the Ghanaian trachoma control workers organized radio listening clubs, each with about twenty-five members. Each club is given a windup radio, and the club members meet to listen to broadcasts about trachoma control and then discuss them. Guided by a facilitator, club members begin by learning the jingles and slogans by rote, and then move on to translating

the messages into sustainable community changes.

Cultural understanding is not the only approach to trachoma control. Where flies are a problem, for instance, an effective measure is to eliminate fly-breeding sites, such as human feces left uncovered on the ground. In 2002 Niger's National Blindness Prevention Program and the Carter Center began promoting latrine construction in the country's Zinder region, where trachoma is well entrenched. Each village and household that would benefit from a new latrine supplied much of the labor and materials for digging it and building its enclosure. The local economy also paid local masons for their work. The only things supplied by the national program were training for the masons, and the tools, cement, and iron rebar for their work. By the end of the year, 1,282 latrines had been completed by such community-based projects.

The latrine program also included community-based (as opposed to school- or clinic-based) education to promote regular face and hand washing and more frequent washing of clothes and towels. Not surprisingly, the demand for soap grew, but that led

to a new problem: commercial soaps in the Zinder region are expensive and, often, not even available.

The solution was to revive the neglected craft of soap making. Early in 2003, the first group of thirty women from ten villages in rural Zinder got a two-day training session in the traditional production of soap. The women learned how to make soap from readily available materials: soda (made by filtering ashes through water), animal or plant oil, and water. The mixture is heated over a low fire, then formed into shape and cooled. Soap made this way is affordable in the poorest of villages, and it can even be sold to generate outside income.

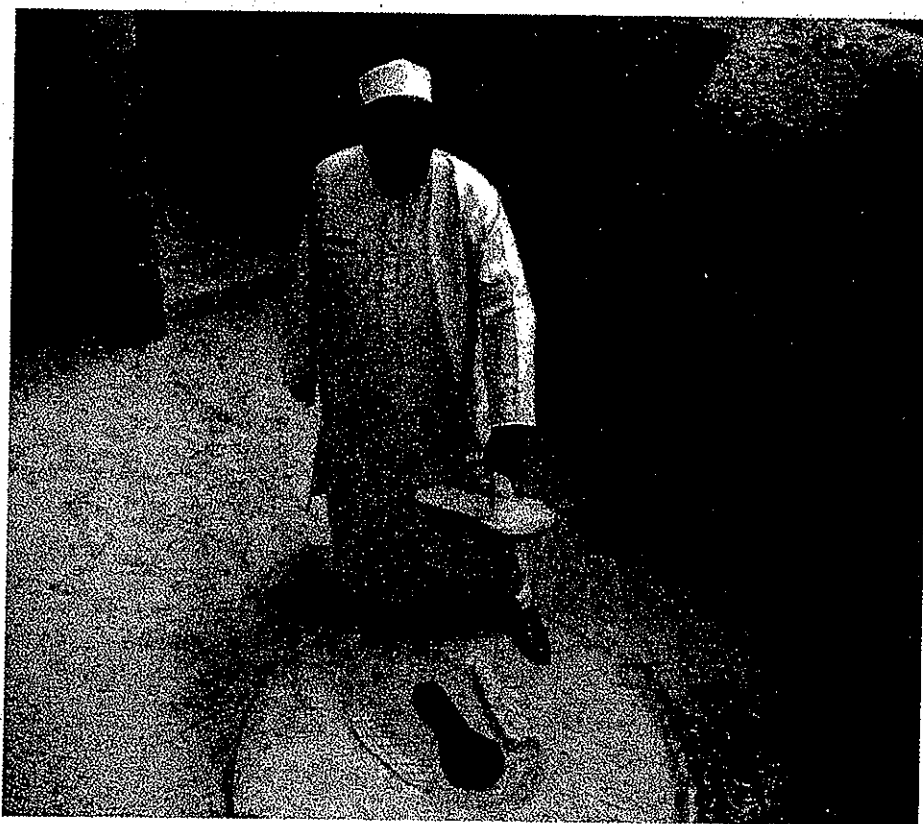
While prevention and hygiene are being pursued, those who already suffer from trachoma must be treated as well: the S (for surgery) and A (for antibiotics) are essential tools of the overall strategy. In 2002, in the South Gondar Zone of Ethiopia, the Amhara Health Bureau trained nineteen surgeons in the treatment of trichiasis and supplied them with a hundred new surgical kits. From 2002 through 2003, a total of more than 10,000 trichiasis patients received corrective surgery—a healthy number, but still less than 30 percent of the estimated backlog of patients needing surgery in that zone.

As for antibiotics, even the war zones of southern Sudan show cause for hope. In both opposition- and government-controlled areas, as well as in camps for internally displaced persons near Khartoum, nearly 200,000 Sudanese were treated with azithromycin in 2002. To do so, health workers sometimes had to undertake “hit-and-run” treatment campaigns to avoid being caught in combat. Still, according to a follow-up survey made that same year, all the villages that had implemented the SAFE strategy for at least two years underwent a statistically significant drop in the prevalence of trachoma infection among children.

Dedicated health workers from the government of Sudan and Sudanese health-care workers in non-governmental organizations (NGOs) continue to promote the SAFE strategy in some of the most isolated and impoverished places in the world. In 2003, one NGO working in western Dārūr was forced to abandon trachoma control activities when fighting

erupted there. In 2004, two NGOs working near Malakal were evacuated owing to mounting insecurity. And yet the program continues to expand and improve. This past September, teams from the Sudan Trachoma Control Program in both the north and south reported they were on track to deliver more than 680,000 azithromycin treatments in 2004 to people at risk for the blinding effects of trachoma, proof that not all the news from Sudan is grim.

The ultimate goal of the SAFE strategy is to eliminate the threat of blindness caused by trachoma by the year 2020. Meeting that goal alone would save millions from untold misery, but it would also bring enormous side benefits. Improved personal and environmental hygiene could have a substantial positive impact on diarrheal, respiratory, and several par-



Newly constructed latrine is inspected by an environmental engineer in the Zinder region of Niger. Properly used and maintained, the humble facility will help combat trachoma by reducing the numbers of flies, which spread the disease-causing bacterium when they seek moisture from people's nose and eye secretions.

asitic diseases. Nurses and eye-care workers who have sharpened their skills with the training needed to do eyelid surgery would improve the general quality of eye care and health services. Most important of all, demonstrating to villagers that they can take charge of bettering their own health and lives can give them the hope they need to break the cycle of poverty and disease once and for all. □