

# The Little Dragon of Medina

George W. Kelley, Jr.

WHEN MOSES AND THE NEWLY liberated Hebrews paused by Mount Hor near the Dead Sea, “the Lord sent fiery serpents among the people and they bit the people” (Numbers 21:6). Today, nearly four thousand years later, this serpent is still “biting” nearly 50 million persons every year in the Middle East, Central Africa, and India.

Scholars of medical history have concluded that the “fiery serpents” that scourged the children of Israel were probably guinea worms, humanity’s longest nematode parasite, *Dracunculus medinensis*, whose scientific name means “little dragon of Medina.” Females of these worms live in the deeper layers of the skin. An outline of their form can be followed along the serpentine bulge that winds like a varicose vein over the surface of the skin above the worm. When this worm becomes gravid, her digestive system and reproductive glands atrophy and are replaced by an expanded tubular uterus—a packet containing more than three million coiled, first-stage nematode larvae. At this time, the worm secretes substances that cause a burning, itching, weeping sore to form over the opening of the worm-filled uterus providing an escape hole for her three million offspring. This burning sore and the long meandering outline of the worm beneath the skin give the condition its name, “fiery serpent.”

According to the biblical account, the Lord directed Moses to make a talisman in the shape of one of the serpents wrapped about a pole. Individuals afflicted with the fiery serpent would be relieved of their sufferings when this charm was brought into their presence. This presence. This mystical nostrum imitates the ancient,

George W. Kelley, Jr., is professor of biological sciences, Youngstown State University, Youngstown, Ohio 44555. He received his M.S. degree in zoology from the University of Kentucky (Lexington) in 1950; and his Ph.D. degree, also in zoology, from the University of Nebraska (Lincoln) in 1953. Kelley worked for Eli Lilly International Corporation as a specialist in parasitic diseases from 1964 through 1967. He joined the faculty at Youngstown State in 1967. In addition to his many contributions to the National Association of Biology Teachers, Kelley is active in a number of other professional associations, including AIBS and the American Society of Parasitologists. He is a member of Sigma Xi, Phi Kappa Phi, and serves as a consultant-evaluator for the North Central Association of Colleges.



FIGURE 1. An ancient Persian woodcut shows that extracting guinea worms was the principal task of early Arabian physicians.

and present, method of slowly extracting guinea worms by rolling them upon a stick. Figure 1, an ancient Persian woodcut depicts the activities in an Arabian physician’s operating room where a guinea worm is being removed in this manner.

Perhaps the association of snakes and the healing cult originated with this surgical procedure of winding the fiery serpent upon a stick. We find a snake wrapped about a staff as the emblem of the society of Aesculapius who were ancient Greek medical practitioners. The symbol of Aesculapius is a single snake twisted about a staff similar to the charm that Moses devised in the Sinai Desert. The Caduceus, the modern symbol of the medical profession, has no traditional relationship to the ancient medical cult of the serpent, however; this winged staff with two entwined serpents represents the wand of Mercury, the Greek god of commerce and thievery.

We can imagine that as guinea worm extractions were



FIGURE 2. Activities at a step-well in India. Larvae spew into the water when persons with guinea worm sores step into the well. When cyclops eat these tiny worms, the larvae develop into infective cysts that will become adult worms when they are swallowed in a drink of water.

the principal operation of ancient surgeons in the Middle Eastern countries, the worm (a serpent to primitive people) wrapped upon a stick became the signpost of the surgeon's shop, just as images of loaves marked the bakery and shoes designated the cobbler's shop. Perhaps Moses's snake on a staff wasn't really meant to have magical powers but was instead used as a signpost to mark the abode of the individual who could treat the irritating malady.

*Dracunculus* still flourishes in the Middle East, Central Africa, and India. This year approximately 50 million farmers will suffer from its debilitating effects. Upon discovering the meandering ridge outlining the body of the worm that is developing beneath the skin, the victim surely feels despair, dreading the approaching period of pain and disability. The appearance of the worms is loosely synchronized with the planting season, which means that those affected persons probably will be stricken at the very time their services are needed to provide food for the community.

### Life Cycle of *Dracunculus*

The life cycle of *Dracunculus* exploits the life style of its victims, poor rural people who do not have sanitary water systems. The victims become infected when they ingest a copepod (cyclops) that has, in turn, ingested *Dracunculus* larvae. The larvae enter the water supply when an infected person with a guinea-worm ulcer wades in the reservoir to obtain relief from the searing pain of the worm's secretions or to dip a supply of drinking water.

The newly liberated larvae are attractive food for cyclops. The ingested larvae penetrate the crustacean's gut wall to enter the hemocoel (body cavity) where they grow and molt twice changing into the infective stages that will grow into an adult worm when they are eaten by a human. The larvae harm the cyclops, and the copepods cannot tolerate more than four worms in their bodies. Cyclops with infective larvae are slowed down by their parasites, and they sink to the bottom of the pond where they are easily captured when household water is dipped from the open reservoir. Because cyclops are microscopic in size, they are unknowingly swallowed in contaminated drinking water.

The enclosed larvae punch their way to freedom while their cyclops carriers steep in the digestive juices of the stomach. They are now ready to begin a year-long period of wandering and growing in their human host. A quick trip through the acid environment of the stomach ends when the larval worms, now approximately 0.6 mm long, are spurted into the duodenum. They burrow into the wall of this section of the small intestine and remain there for thirteen hours. From the intestinal wall, the larvae move into the mesenteries to wander about for the next twelve days. On about the fifteenth day, they migrate into the muscular wall of the abdomen and chest.

The next phase of their journey takes them into the connective tissues beneath the skin under the armpits and in the pelvic region. About this time, between 15 and 22 days after ingestion, the larvae molt for the third time becoming juvenile females and males having all the characteristics of fully grown worms in a miniature condition.



FIGURE 3. A patient with nearly one-half of his guinea worm removed from his heel.

Males are still present three months after ingestion, but by this time they have inseminated the females. The males die by the seventh month, having served their purpose.

When they are eight months old, the females leave their sites beneath the skin in the armpits and resume their wanderings, usually toward the legs. They are nearly two feet long now, and their progress can at times be followed by observing the convoluted outline of the worm beneath the skin. From ten to fourteen months after beginning her trip, the female becomes fully mature. To get her teeming brood started on their way, the worm secretes poisons that cause an itching, fiery blister to form on the skin over the terminal end of the egg sac. The secretion of the worm as she dissolves the escape crater for her brood may cause her human carrier to have a fever, skin rash, dizziness, upset stomach, and asthma.

## Treatment

Each household has its preferred concoctions of leaves, roots, and vegetable oils for relieving the intense itching and burning symptoms, but none are very effective. The language of the people of Rajasthan Desert of northern India reflects the multiplicity of these folk treatments with the expression *ek naru sahasra daru*, which translates as "one guinea worm, a thousand remedies."

Applying water to the blister temporarily stops the burning and itching. Water also causes the blister to rupture and release thousands of larvae. The parasite thus stimulates its host to perform an act that releases the larval stages of the parasite into water where it has a chance of contacting its intermediate host, cyclops. This process is a remarkable biological adaptation that ensures the continuation of the *Dracunculus* life cycle. The parasite is usually situated on the foot or forearms, thus facilitating the release of the larvae into the water.

After the blister bursts, it becomes a running, raw sore encircled by a red ring of inflamed tissue. A tip of the tubular uterus of the female worm can be seen protruding from the pus at the center of the sore. This tube spews forth larvae each time water is applied to the sore. After a few days, all of the larvae have been expelled, and the body of the worm extrudes from the center of the sore. The spent body can now be carefully pulled forth at the rate of 5 cm daily. The extracted segment of the worm becomes leathery as the air dries it. This dried residue is wrapped upon a small stick. Five centimeters are wound up each day until the entire 60-cm worm has been extracted. If the worm is pulled too hard, her body may break beneath the skin and cause the ulcer to become very inflamed, swollen, feverish, and painful. Barring complications, the worm will have been wound around the stick and the sore will have healed within four weeks after the blister was detected. Shortly

after the worm starts oozing out of the sore, the burning and itching subsides, and the following two weeks are usually without pain or disability.

## Complications

Uncomplicated sores of *Dracunculus* are painful for a week or two and inconvenient for another two weeks, but secondary bacterial infections can cause abscesses, inflamed lymph glands, inflamed joints, arthritis and rigid joints, leading to long periods of forced inactivity.

Victims of guinea worms have a high risk of getting tetanus. The spores of tetanus bacteria are extremely resistant and live for many years in the soil. These spores enter the guinea worm ulcer where the anaerobic conditions stimulate their emergence and multiplication. All guinea worm patients should be vaccinated against tetanus.

## Who is Infected?

Guinea worms infect rural, impoverished and uninformed persons in Asia, the Middle East and Central Africa. More than five million persons in India suffer from this parasite annually. In the Indian state of Rajasthan, approximately 10% of the population is infected. Several years ago, a study of five villages in the Susana zone of Portuguese Guinea (since 1974 an independent republic called Guinea-Bissau) revealed that nearly one of every four inhabitants became infected each year. Life style has changed very little in this area, and in all likelihood, the incidence of infection is still nearly 25%.

The worm may be diminishing in the Arab countries where it has persisted since antiquity—remember, it received its name, the little dragon of Medina, because it was so well known in the Islamic countries. *Dracunculus* was previously widespread in Saudi Arabia, but does not exist there today because of modernization. The worm formerly infected many persons in the Persian Gulf region of Iran, also, but the recently acquired oil wealth has enabled the Iranian government to replace their ancient water systems with up-to-date facilities and thereby eliminate the worm.

Infection with *Dracunculus* remains widespread because it is difficult to change the daily habits of people. Water from tube wells, piped water, and deeply dug wells are often rejected by uneducated rural people. Pumping water from tube wells is hard work. Users frequently must buy well water from vendors, or must themselves make the additional effort to draw water from deep wells with a rope. Local inhabitants prefer to wade into the communal pond and dip a pitcher of water just as their parents, grandparents, and great-grandparents have done season after season. These people find it difficult to relate the running sores on their feet and the way they obtain their water supply to a sore that may develop a full year in the future.

Because *Dracunculus* infects persons in remote rural areas, its economic effects are difficult to assess. In many regions of Africa and India, the incidence of infection is usually highest during the planting season. Those incapacitated with sores of *Dracunculus* cannot work in the fields and their absence reduces the production of desperately needed food. Over half of the inhabitants (53%) of four villages near Ibadan, Nigeria, had guinea worms during March, 1966, and nearly half of the working-age patients (those 15 to 40 years of age) in this group missed at least two and one-half months of work because of the sores and secondary bacterial infections.

The worm is most prevalent in regions where food production is minimal and malnutrition widespread. Starvation can only be prevented if the maximum production of food is maintained. Considering that each infected individual is incapacitated for four weeks or longer, the toll on the productivity of the population is astounding. Children and older inhabitants may suffer from starvation as a consequence of the reduced harvest.

The guinea worm demonstrates that though the world entered the technical age over 200 years ago, many of its inhabitants still suffer from Stone Age diseases.

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## Evolution of Evolution

Would it be too bold to imagine, that in the great length of time, since the earth began to exist, perhaps millions of ages before the commencement of the history of mankind, would it be too bold to imagine that all warm-blooded animals have arisen from one living filament which the Great First Cause embued with animality...and thus possessing the faculty of continuing to improve by its own inherent activity, and of delivering down those improvements by generation to its posterity, world without end!

Erasmus Darwin  
(Grandfather of Charles Robert Darwin)