# CONTROL OF TROPICAL DISEASES

# ONCHOCERCIASIS

RLD HEALTH ORGANIZATION

# CONTROL OF TROPICAL DISEASES

# DRACUNCULIASIS

WORLD HEALTH ORGANIZATION
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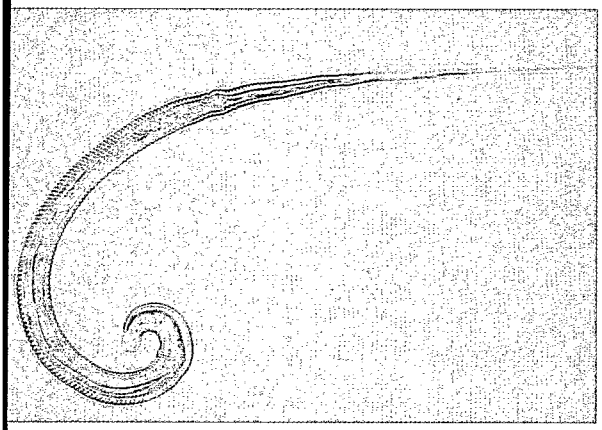
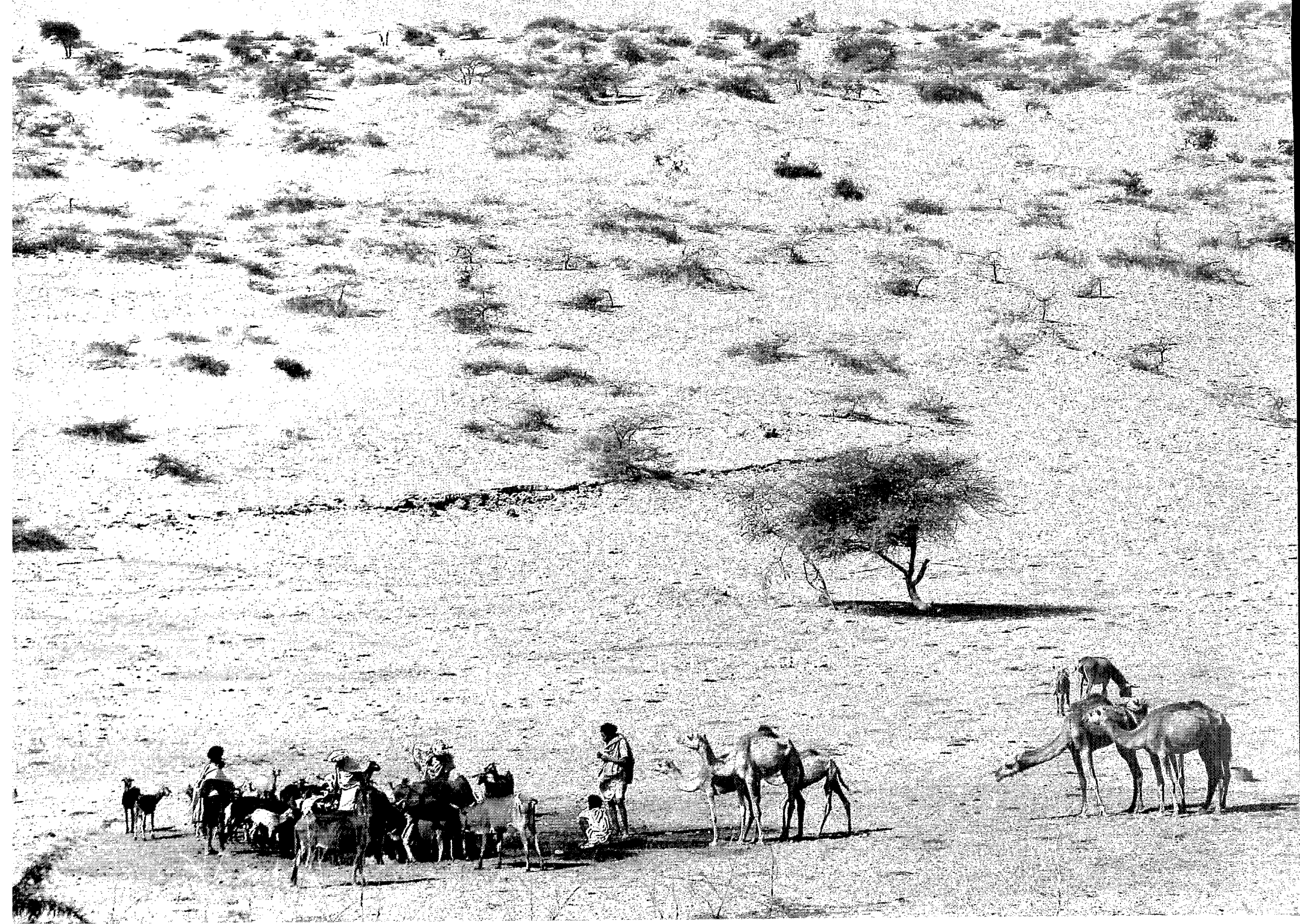
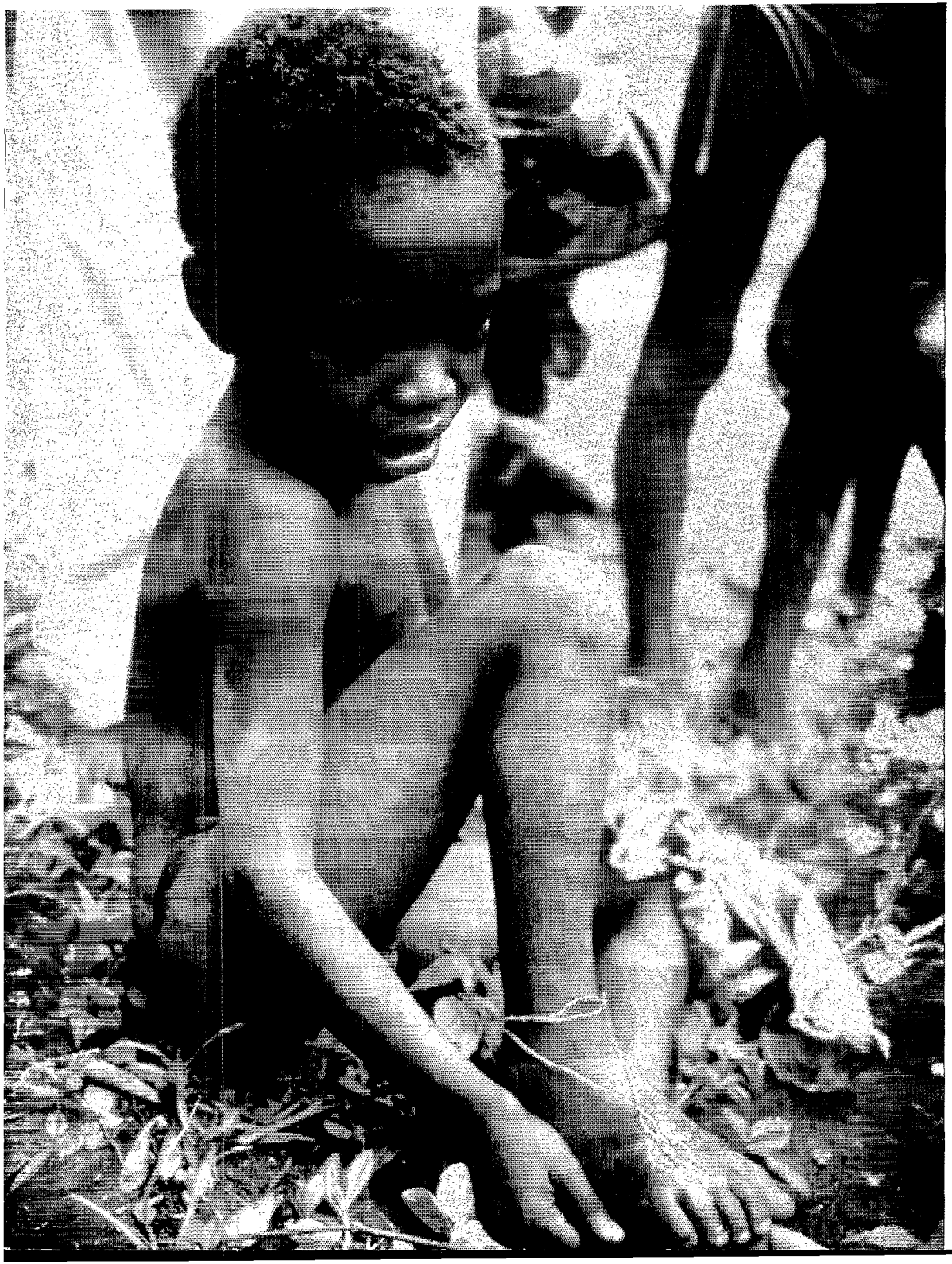


*Dracunculus medinensis* embryo:
pattern of distribution in water.

# DRACUNCULIASIS





# THE DISEASE

Nine out of ten people living in the depressed areas of Africa south of the Sahara and of the Indian subcontinent still have nothing else to drink but meagre quantities of impure water, thus exposing themselves to serious diseases such as the appalling dracunculiasis.

This parasitic disease causes dreadful suffering and **disability** among the world's most deprived people. The disease reappears each year during the agricultural season, handicapping farmers, mothers and schoolchildren already weighed down by harsh living conditions and often existing just above survival level. Families affected by the disease experience great loss: their food stocks and savings gradually dwindle away, they are no longer able to participate in vaccination campaigns and the children's schooling increasingly suffers. Gradually worn down by penury, these underprivileged people find themselves trapped in a vicious circle of poverty and disease.

Dracunculiasis is a disease caused by the parasitic worm *Dracunculus medinensis* or "guinea worm". This round worm is the largest of the tissue parasites affecting humans. The adult female, which carries from 1 to 3 million embryos, can measure up to 1 metre in length and 2 mm across. The parasite migrates through the victim's body causing severe pain, especially in the areas around the joints. The worm eventually emerges (from the feet in 90% of cases), causing an intensely painful oedema, a blister and then an ulcer. When the worm perforates the skin, intolerable pain is accompanied by fever, nausea and vomiting.

In the majority of cases, the female *Dracunculus* emerges via the feet.

P. 3. Precious surface water on the southern edge of the Sahara being carefully collected during the Mauritanian rainy season. If drunk unfiltered, the water can be the cause of dracunculiasis.

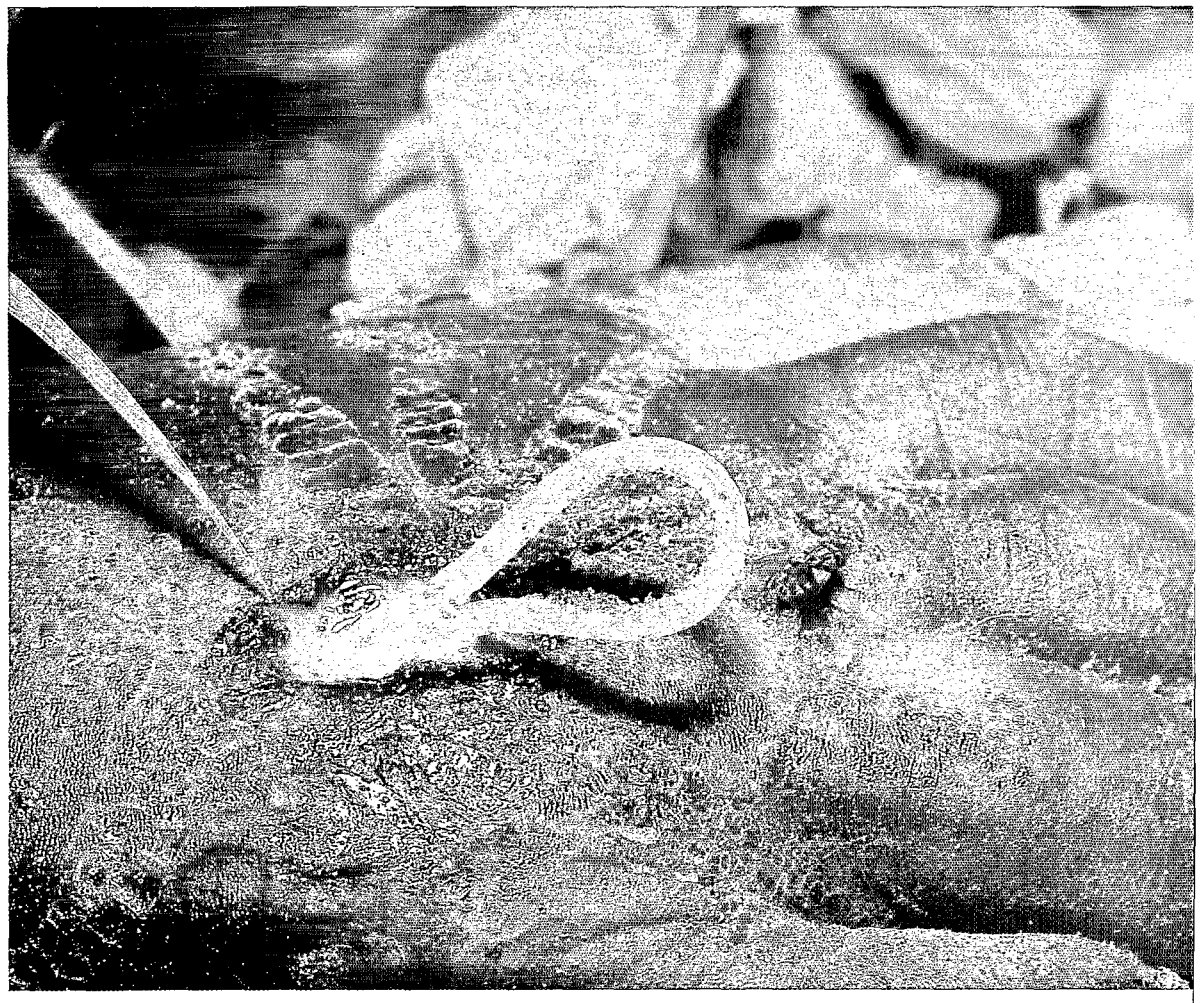
The worm's eruption through the skin of the ankle joint, the instep, or worse, the sole of the foot, causes unbearable pain. Once the ulcer forms, the pain persists, but is less acute. Partial or total disability can last from several weeks in isolated cases up to, in most cases, several months.

Water is rare in endemic countries; the one stagnant source is used to supply the domestic requirements of an entire community. When an infected person steps into the local water hole, the terrible burning sensation caused by the emerging worm is relieved. As well as relieving the sufferer's pain, the cool water also induces a contraction of the female worm at the base of the ulcer causing the sudden expulsion of hundreds of thousands of embryos.

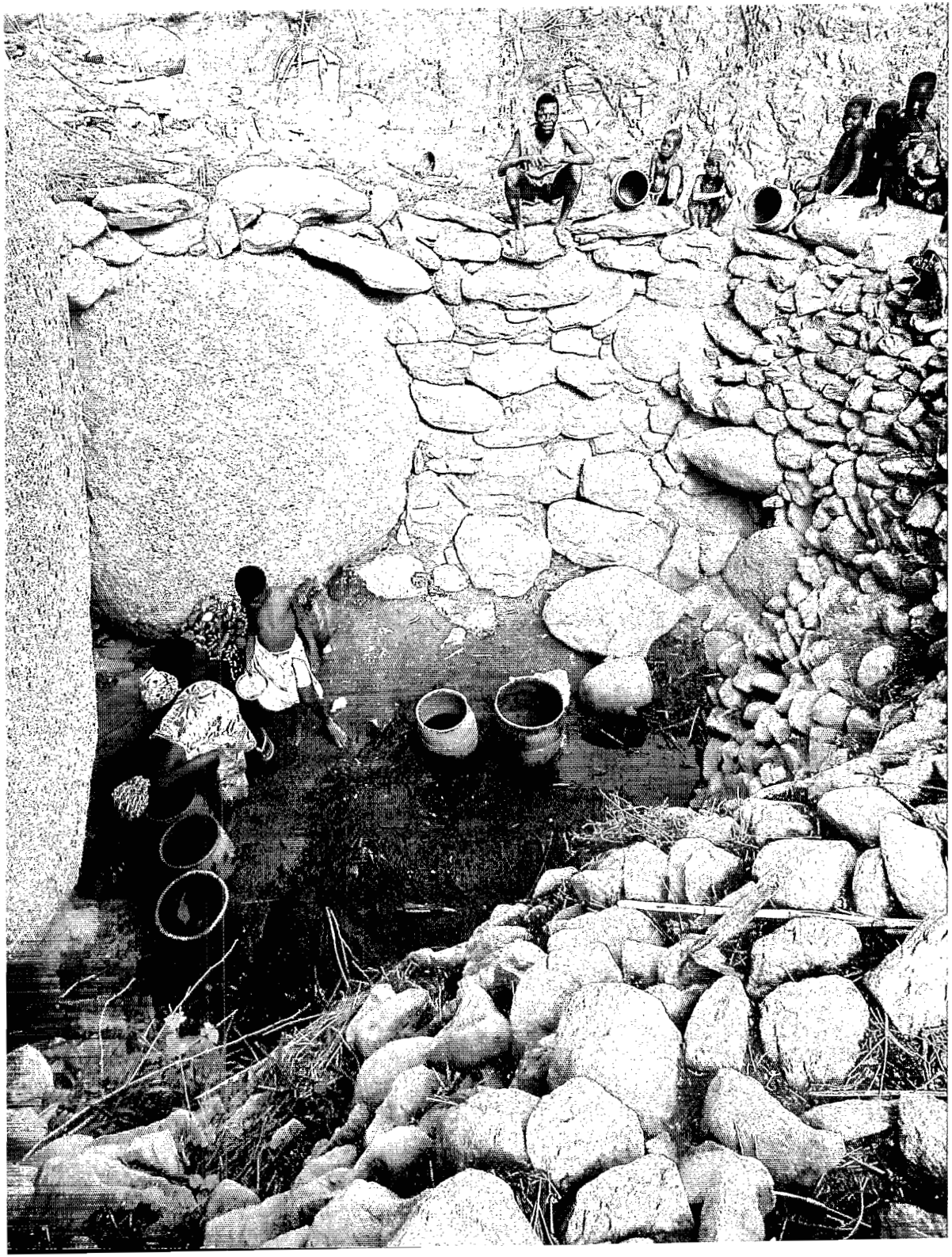
During a period of from one to three weeks, the water source will be contaminated by thousands of these embryos, released each time a lesion is immersed. If the now totally empty worm is not carefully extracted from the patient's body, it dies and becomes a source of bacterial infection.

In the best case, elimination of the worm will make the patient disabled for a period of 2 to 4 weeks, but healing is no guarantee of immunity against further infection.

Frequently, however, the patient remains sick for several months, mainly because:
- several worms are expelled successively,
- the migration and emergence of the worms occur in sensitive parts of the body, e.g. the soles of the feet,
- serious secondary bacterial infection frequently sets in subsequent to the accidental rupture of the worm.



Because dracunculiasis is transmitted by drinking water, adults and children alike can fall victim to it.



When embryos of the guinea worm are released in stagnant water holes they are swallowed by a voracious predator – the cyclops. This crustacean is so named because of the large eye-shaped mark on the front of its cephalothorax, associating it with the Cyclops of Greek mythology. These minute crustaceans, measuring from 0.5 to 2 mm in length are found in zooplankton throughout the world's oceans.

**The cyclops acts as an intermediate host** without its intervention the cycle would be broken. The embryonic parasite punctures the digestive tract of the cyclops and makes its way to its abdomen where, over a period of approximately two weeks, it is transformed into an infectious larva. The cyclops, which can only accommodate a single larva, itself becomes a victim of the parasite. Once infected, it has trouble swimming, its behaviour changes, and it eventually sinks to the bottom, where 1 to 3 weeks after the larva reaches the infectious stage, it dies.

**Dracunculiasis can only be contracted by drinking water containing infected cyclops.** The cyclops are destroyed when they come into contact with human gastric juices, and the infectious larvae are liberated. The larvae puncture the intestine of the drinker and enter the tissues. Three months later when they reach maturity, the young male and female worms couple. As long as the worms remain confined to the deep tissue surrounding the lymph glands, they do not present a problem to the carrier.

One year after the water containing the infected cyclops has been consumed, the fully-grown female worms start to migrate through the infected person's body, giving rise to the characteristic symptoms of dracunculiasis.

The only source of drinking water in a village, severely affected by dracunculiasis, in the granitic hills of the Zou district of Benin.

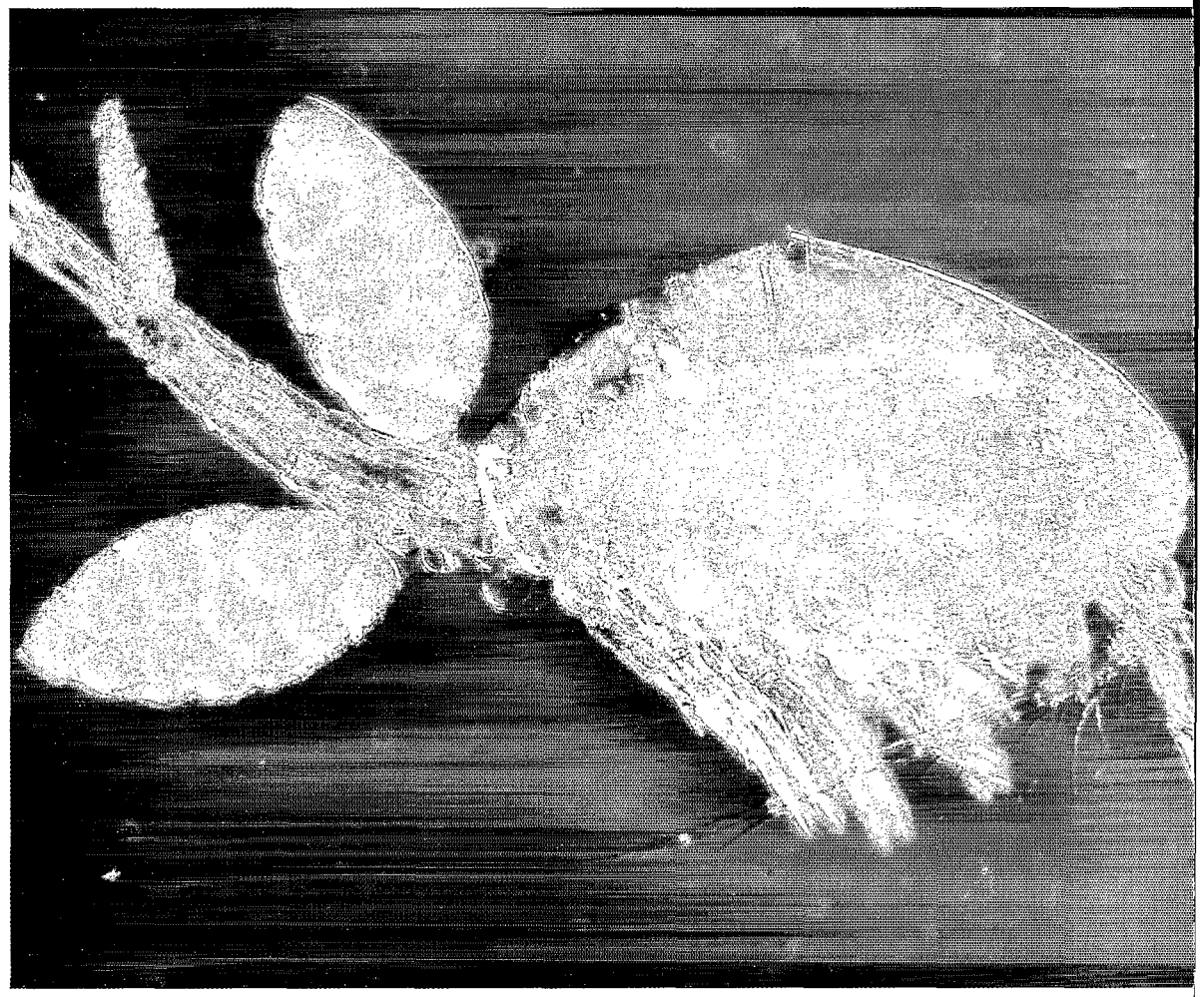
The female worm then releases millions of embryos which, in water, become the prey of the cyclops. Inside the cyclops they are transformed into infectious larvae. The drinking water becomes a further source of contamination, the transmission cycle is completed, and millions of impoverished men, women and children become further victims to the disease.

No drugs are currently available to prevent or heal this parasitic disease – the only disease exclusively associated with unhealthy drinking water. Dracunculiasis is, however, extremely easy to combat and should no longer be prevalent.

Dracunculiasis is a vulnerable disease; man alone is responsible for maintaining its fragile transmission cycle. It is therefore possible to permanently curtail transmission by applying simple measures. Some elementary steps include:

- **systematic filtering** of drinking water derived from shallow unprotected wells or from surface water. Finely-meshed cloth or, better still, a filter made from a 0.15 mm nylon mesh, is all that is needed to filter out the cyclops from the drinking water.
- the **construction** of copings around well heads or the installation of bore hole wells with pumps. This would prevent not only dracunculiasis but also diarrhoeal diseases.

If these measures are accepted and then administrated by village communities, the ultimate goal will be achieved: the **eradication of dracunculiasis.**



The cyclops, an elegant crustacean copepod responsible for the transmission of dracunculiasis, was so named because of the large bright red eye-shaped mark on the front of its cephalothorax.

# IMPORTANT DATES

Ever a subject of curiosity because of its apparently supernatural aspects, dracunculiasis has been documented since early history:

- In the 15th century BC, the first known mention of the disease is found in the "Turin Papyrus" which refers to the ancient Egyptian myth of the sun god Ra. A recent pathological examination of an Egyptian mummy clearly identified a calcified worm as *Dracunculus medinensis.*
- In the 14th century BC, the closing verses of three stanzas of a poem in the Sanskrit book Rig-Veda, attributed to Vasistha, allude to the guinea worm:

  *"Let not the sinuous worm strike me nor wound my foot".*
- In the 11th century AD, Abou Ali ibn Sina (known in the West as Avicena) gives detailed descriptions of the disease, its treatment, its evolution and the complications caused by the worm being ruptured during extraction. Dracunculiasis occurred frequently in Persia during this period.
- From the Middle Ages through to the 18th century there were many varying opinions as to the nature of the "fiery serpents" – believed to be anything from exposed nerves to dead tissue. It was the celebrated Swedish naturalist, Carolus Linnaeus who first suggested that they were in fact worms.
- In 1870, Alexei P. Fedchenko became aware of the life-cycle of *Dracunculus medinensis* and identified the cyclops as its intermediate host.

The Persian physician and philosopher *Ibn Sina,* known in the West as *Avicena* (980-1037 AD) provided the first scientific description of the clinical symptoms of dracunculiasis. Nation's Park, Teheran.

– By the end of the 19th century, the scientific community had become well aware of how the disease was transmitted and had started to advocate suitable protective measures.

– Between 1926 and 1931, dracunculiasis was totally eradicated from Uzbekistan following a series of effective health education, water purification and carrier control programmes in Boukhara and the surrounding areas. No recurrence of the disease has been recorded in this region since 1932.

– In the 1970s, dracunculiasis was eradicated in Iran.

– In 1984 dracunculiasis was eradicated in the Indian State of Tamil Nadu, by 1989 in Gujarat, and by 1991 in Maharashtra.

During the 1980s, the World Health Organization gave its backing to United Nations coordination mechanisms and, in collaboration with its Member States, drew up a list of attainable goals for the International Water Supply and Sanitation Decade. One of these goals was the **eradication of dracunculiasis.**

This objective has been partially achieved. It was recently estimated that the incidence of dracunculiasis has dropped from 10 to 15 million cases per year at the beginning of the 1980s to the present low figure of 1 million cases.

The Member States of the World Health Organization have requested that every effort be made to interrupt transmission of dracunculiasis before 1995. Once transmission ceases, there will be a three year monitoring period. If during this time no further cases are detected, WHO will issue an eradication certificate.

A picturesque method for extracting worms, as imagined by M. Poussielgue of Florida in the 19th century.



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Le ver de Guinée (voy. p. 386). — Dessin de A. de Neuville d'après M. Poussielgue.

# THE CURRENT SITUATION

Dracunculiasis is now prevalent in **18** developing countries, of which 16 are in Africa, including 10 which are among the world's least developed countries (LDC).[1]

Following the implementation of eradication programmes in India and Pakistan (the only Eurasian countries still affected by dracunculiasis), this endemic disease is well on the way to being eliminated in both countries.

- **India** launched its programme in 1984. The number of recorded cases has dropped successively from 39 792 in 1974 to no more than 1081 in 1992. In Rajasthan, the State with the highest number of recorded infections, worms are surgically extracted just before they emerge.
- In **Pakistan,** a cash incentive system and the isolation of detected patients has prevented the propagation of the latest cases. Compared with 1988 when 2400 cases were recorded, only 23 cases were detected in 1992, and it is hoped that the disease will be totally eliminated by 1993.

The situation is creating much greater concern in the 16 countries in Africa south of the Sahara.

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(1) The least developed countries (LDC) are currently made up of 47 countries, representing a population of over 550 million. This group of countries is the weakest segment of the international community. In 1990, the gross domestic product (GDP) of the LDC was between $US 473 and $US 567 per inhabitant per year.

In farming hamlets, often remote from the village, farmers have no choice but to drink poor quality water thus exposing themselves to the risk of dracunculiasis.

In 1992, in order to speed up the eradication process, the WHO/ UNICEF Interagency Technical Team set up the Programme for the Eradication of Dracunculiasis in Africa.

**Ghana** and **Nigeria** conducted their first national-scale screening campaigns in 1989 and 1988 respectively. Effective control measures produced the following results:

- the number of cases in **Ghana** dropped from 179 556 in 1989 to 33 464 in 1992. More than 90% of endemic villages are now reporting new cases every month.
- **Nigeria** reduced the annual incidence from 653 492 cases in 1988 to 183 169 cases in 1992.

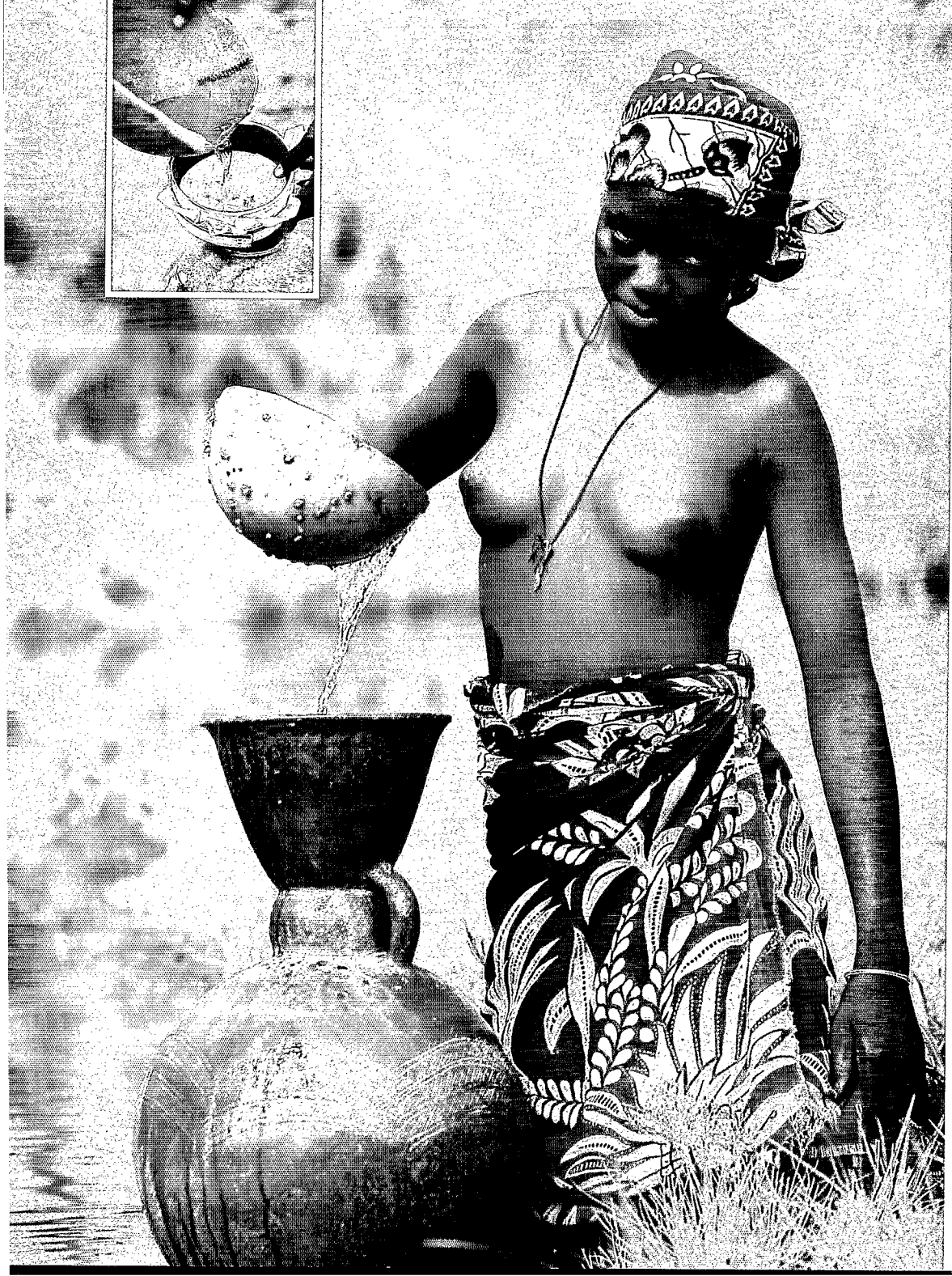
**Cameroon** is close to having totally eradicated its only active focus in Mayo Sava. The number of cases has been reduced from 871 in 1989 to 127 in 1992. The epidemiological situation in Cameroon is now similar to that of Pakistan in 1991.

**Benin, Burkina Faso, Côte d'Ivoire, Mauritania, Niger** and **Togo** are recording very positive results in the wake of localized control programmes. These countries still need to extend measures to cover all transmission foci.

In **Mali,** extensive efforts are being made, and the country is adopting, in 1993, a National Programme. The programme is backed by the Guinea Worm Eradication Intersectorial Committee under the direction of its chairman, General A.T. Touré. A sharp reduction in the number of cases is expected during 1994.

**Chad, Ethiopia, Kenya, Senegal, Sudan** and **Uganda** are now implementing the first phases of their campaigns.

Dracunculiasis disables a large number of farmers at the beginning of the rainy season, the peak period of agricultural activity.



# ACTION

All 18 endemic countries, now well aware of the social and economic problems imposed by the disease, hope to see dracunculiasis eradicated by the end of 1995.

In order to accelerate the WHO-coordinated eradication process in each country, the following strategies need to be developed, improved or reinforced:

a) **community surveillance methods.** Community eradication strategies are based on an inexpensive disease monitoring system; the cornerstone of this control action is the creation of village development committees. During the eradication effort, one active committee member is responsible for:
- providing notification of all new cases,
- health education,
- the distribution of filters,
- patient care.

The Mauritanian practice of assigning this role to a female villager has proved to be particularly effective.

b) **the supervisory network for eradication activities.** A present weakness of the system is that village eradication activities are being supervised by health personnel attached to sub-districts, the most peripheral sector of the health administration. Each village needs to be supervised monthly and integrated into the advanced strategy of the extended vaccination programme. This type of network is already installed in Ghana.

When there are no protected water sources, the only way to fill the container is by entering into the water. The use of a simple cloth filter would prevent the transmission of dracunculiasis.

c) **filtration of suspect drinking water.** When the consumption of surface water cannot be avoided – as is the case for nomadic pastoralists and farmers scattered throughout farming hamlets and camps – the only remaining prevention method is to filter drinking water through a piece of cloth or, better still, a nylon gauze with a calibrated mesh.[1] The extension of this type of measure relies on it being accepted and understood by the population.[2]

d) **rural development policies on water supplies.** The drilling of borehole wells or any other system aimed at supplying clean water to highly endemic villages leads to an immediate reduction in the incidence of dracunculiasis and other diseases. Special efforts need to be made to provide low cost installations which can be maintained by the villagers themselves.

e) **surveillance and patient care.** As countries get closer to eradicating the disease, the cost per case prevented substantially increases and the interest in dracunculiasis as an important public health issue diminishes. Effective strategies aimed at isolating cases and extending surgical extraction would reduce unitary costs and speed up the transition from the "very low endemicity" stage to the actual "eradication" stage.

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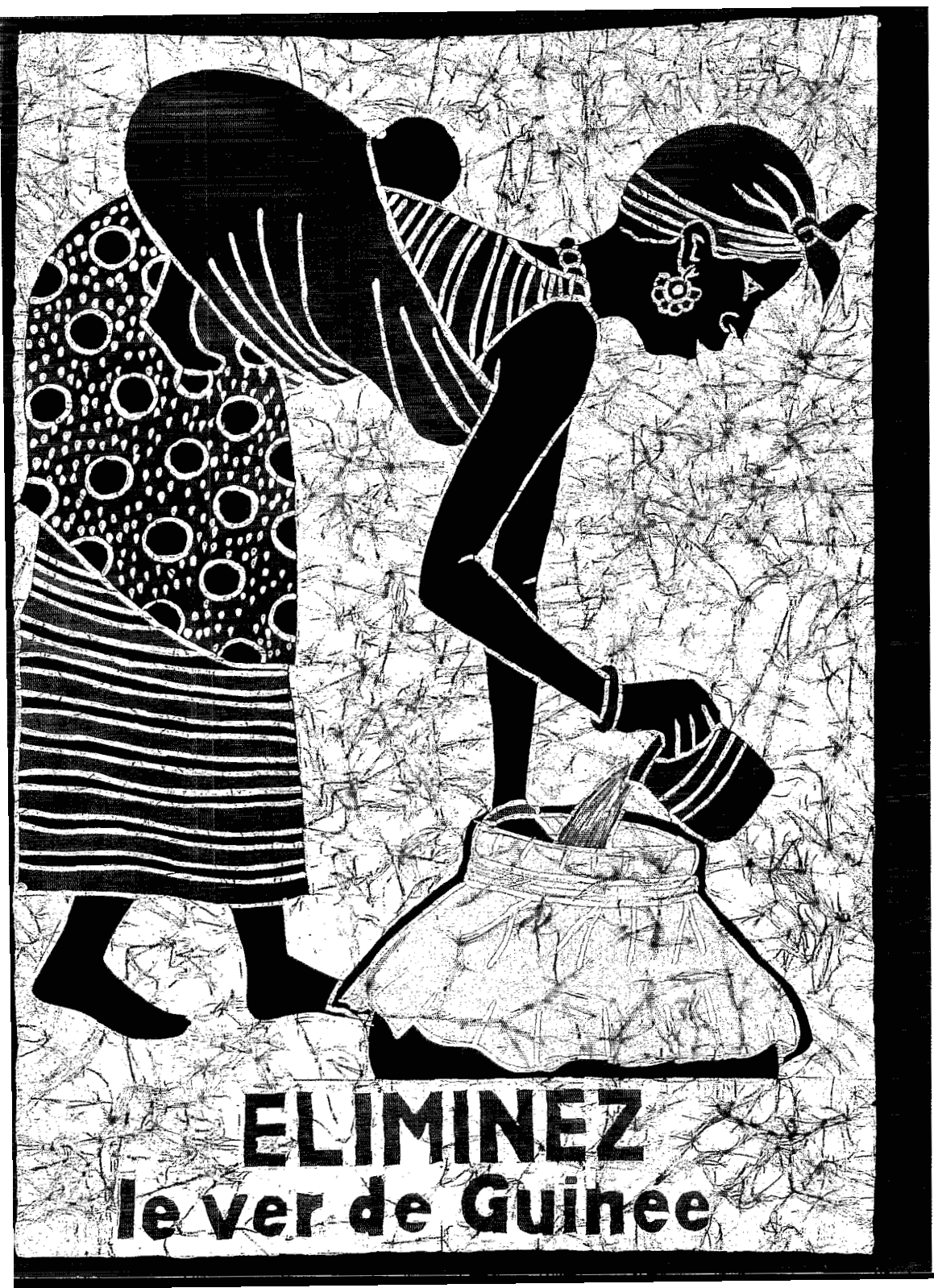
(1) The Global 2000 Foundation supplies nylon gauze free of charge to requesting endemic countries.
(2) Substantial progress has been made in health education and the mobilization of women in rural areas. WHO together with the World Bank, the UNDP, UNICEF, Global 2000, USAID, the Peace Corps and a large number of non-governmental organizations are actively setting up coordinating bodies at village and regional level.

Once villagers have access to high quality drinking water, the spectre of dracunculiasis disappears.




f) **vector control.** The use of the temephos Abate®[1] allows for the safe and effective treatment of water sources by eliminating the cyclops. Assessment and monitoring activities need to be continued in order to improve local strategies and ensure that the product is effectively used.

g) **mapping of endemic villages.** Many endemic villages and hamlets do not appear on available maps. The progress of the eradication process can be monitored and logged by satellite – the Geographical Information System, GIS – providing rapid and precise data on the position of unmapped villages and waterholes.

h) **official eradication certification.** Until 1999, the World Health Organization will be called on to verify that dracunculiasis is no longer being transmitted and to certify its eradication in at least 69 countries. A list has been drawn up of countries and regions with a past record of human dracunculiasis. The list covers 4 groups of countries:

i) – 18 countries in which transmission was endemic during the 1980s;
ii) – 9 countries in which transmission was endemic between 1940 and 1980;
iii) – 40 countries in which the disease was likely to have been prevalent before 1940;
iv) – 2 countries – Korea in 1926 and Japan in 1986 – where only two indigenous cases without any endemic transmission have been reported during the last sixty years or so.

For the first two groups, a three-year monitoring period will be required to ensure that the disease has not reappeared among the native population. For this purpose, it will be necessary to use either:

Togolese artists produced this batik to decorate the WHO office in Lomé.

– the operational surveillance networks of the extended vaccination programme or of other programmes, or
– new structures which, in addition to dracunculiasis, can be used to monitor other diseases.

For the 40 countries in group iii), special attention must be paid to adjacent countries mentioned in groups i) and ii), to prevent the risk of dracunculiasis being introduced. This calls for the isolation of patients and meticulous checking of imported cases to ensure that they do not become the source of new active transmission foci.

A cultural approach in these countries will enable a better understanding of the way in which the disease is perceived. For example, it is helpful to identify the vernacular terms used to describe the guinea worm, the disease, the symbolism attached to the sickness, etc. The collective memory of the village, which has its source in the oral tradition, can be drawn on to obtain detailed information on the history of the disease and the names of former victims.

The cases in the two countries mentioned in group iv), Korea and Japan, could be considered as insignificant. Only 2 cases have come to notice over the last 60 years, and these were probably caused by animal parasites. The infrastructures of both countries are equipped to immediately alert WHO in the unlikely event that similar cases reappear.

On a world scale, the estimated cost to the World Health Organization of certifying dracunculiasis eradication up to the year 2000 is estimated at $US 1.5 million per year.

In 1992, only four cases of dracunculiasis were recorded in the Sind Province of Pakistan. This was the result of an information campaign offering a reward of 1000 rupees for each patient accepting to be hospitalized for treatment.

Dracunculiasis is the only parasitic disease that can be totally eradicated. On an operational level, four conditions must be met:
- motivation and commitment on the part of political leaders in the concerned countries;
- an effective community surveillance system;
- a change in behavioural patterns in regard to drinking water;
- the availability of adequate funding.

The battle has not yet been won. A lesson having been learnt in dealing with the eradication of smallpox, it is now clear that very high costs are involved in eradicating the last traces of an endemic disease.

Towards the end of the eradication process, in order to ensure that no further cases of dracunculiasis exist, WHO will be obliged to offer substantial monetary rewards to any person coming forward with an emerging guinea worm. This system proved effective in the smallpox eradication programme – the reward of $US 1000 offered by WHO for any confirmed case of smallpox was never claimed!

The great variety of traditions in village life is reflected in the different shapes of the containers used as reservoirs of drinking water. This diversity in shape must be taken into account for the rational adaptation of cloth filters.

The fight against dracunculiasis is part of the fight against poverty. ►

# CONCLUSION

The international community is providing aid to countries in order to equip them to put an end to this inacceptable social and economic scourge. Top-ranking politicians are giving their support to eradication programmes in the vast majority of endemic countries. Regularly-held discussions are enabling international organizations, multilateral and bilateral cooperation agencies and non-governmental organizations to coordinate their activities. More importantly, rural communities are actively participating in all aspects of endemic disease control and integrating control measures into the objectives of village development committees.

The efforts undertaken in these countries are rapidly rewarded with spectacular results. The measures to protect water supplies, for example, have had a massive impact on the populations; to **protect water is to protect life.**

Participation in this challenge goes much further than fighting disease – it is also an effective contribution to the fight against poverty. And the cost is negligible when compared to potential benefits.

All the endemic countries are now committed to the irreversible process of dracunculiasis eradication. Success is within reach. It can be easily achieved, but only through the sustained efforts of all social and economic development partners to work together in one final burst of solidarity.

◀ This well which was fitted out and installed by the villagers will help to interrupt the transmission of dracunculiasis.

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