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Workshop on Opportunities for Control of Dracunculiasis

CONTRIBUTED PAPERS

Washington, D.C.
June 16-19, 1982

Sponsored by

Board on Science and Technology
for International Development
Office of International Affairs
National Research Council
United States of America

In collaboration with

World Health Organization
Geneva, Switzerland

NATIONAL ACADEMY PRESS
Washington, D.C. 1985

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These proceedings have been prepared by the Board on Science and Technology for International Development, Office of International Affairs, National Research Council, for the Office of the Science Advisor, U.S. Agency for International Development, Washington, D.C., under Grant No. DAN-5538-G-SS-1023-00.

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PREFACE

Dracunculiasis (guinea worm disease, Medina worm, dracontiasis) is one of the oldest parasitic diseases known to man. Since biblical times, this disease has caused human suffering and has impeded economic development in rural areas of Africa, India, and the Middle East. It is only recently, however, that it has been the subject of sustained research or control efforts. Dracunculiasis owes its neglect largely to the fact that it does not kill, but temporarily disables inhabitants of remote rural areas. The elimination of this crippling disease will result in a dramatic improvement in the health, agricultural productivity, and general well-being of millions of affected people living in endemic areas of the developing world.

Fortunately, international awareness of dracunculiasis has increased in the last few years, stemming from initiation of an eradication program in India and the advent of the International Drinking Water Supply and Sanitation Decade (IDWSSD). The steering committee for the Decade has endorsed the idea of using dracunculiasis control as an indicator of the Decade's impact on health in endemic regions. In May 1981, the World Health Assembly adopted a resolution on the IDWSSD which mentioned dracunculiasis in the following context:

> The Decade presents an opportunity to eliminate dracunculiasis . . . as a public health problem in affected areas, where the prevalence of the disease could serve as a uniquely visible and measurable indicator of progress for the Decade. (WHA Resolution 34.25, May 22, 1981)

INTERNATIONAL WORKSHOP

In 1982, in response to expressions of interest from international and domestic agencies, the National

Research Council's Board on Science and Technology for International Development (BOSTID), in collaboration with the World Health Organization, convened an international Workshop on Opportunities for Control of Dracunculiasis.* This workshop was organized by the BOSTID advisory committee on health, biomedical research, and development and was held June 16-19, 1982, in Washington, D.C. Financial support from the Office of the Science Advisor, U.S. Agency for International Development, made the workshop possible.

The papers contained in this volume were prepared by participants in the workshop, and were either presented at the gathering or served as background documents for its deliberations. They describe the following aspects of dracunculiasis: parasite life cycle and clinicopathology, epidemiology, control methods, control programs, and social and economic aspects of the disease. Each paper was edited by a consultant to BOSTID.

A bibliography that lists the known literature on dracunculiasis is being published simultaneously with this collection of papers. It was kindly furnished by Dr. Ralph Muller, director of the Commonwealth Institute of Parasitology, Great Britain.

Approximately 30 experts in parasitic diseases, vector biology, epidemiology, communicable disease control, health education, and sanitary engineering took part in the dracunculiasis workshop. Participants included two WHO staff members from Geneva and one from the WHO regional office in Brazzaville, Congo Republic, a representative from the Organisation Centrale contre les Grandes Endémies (OCCGE) based in the Ivory Coast, and nationals from Ghana, India, Nigeria, France, Togo, Great Britain, and the United States.

At the workshop, these participants were asked to:

- Review current knowledge of dracunculiasis--its epidemiology, surveillance, control, and economic impact

- Assess the economic, social, and administrative feasibility of mounting dracunculiasis control efforts in conjunction with primary health care and water and sanitation projects

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*See: National Research Council, 1983. Opportunities for Control of Dracunculiasis: Report of a Workshop. National Academy Press, Washington, D.C.

- Review alternative methods for control, with special emphasis on their cost-effectiveness

- Identify basic, field, and operational research needed to develop, implement, and evaluate control activities.

The published Report of the Workshop and these Contributed Papers have accomplished these objectives. They demonstrate the basis for the broader objective of eliminating dracunculiasis as a public health problem, through intensified campaigns in endemic areas. This objective can be achieved, just as health organizations and governments worked together during the past decade to achieve a world free of smallpox. In every age, our concepts of health grows broader. In every age, we uncover a formerly unrecognized form of oppression that can be prevented. Now is the time to dedicate our energies toward the liberation of mankind from the suffering caused by dracunculiasis, thereby contributing to nobler and more fulfilling lives for all.

Myron G. Schultz
Workshop Chairman

CONTENTS

OVERVIEW

OPPORTUNITIES FOR CONTROL OF DRACUNCULIASIS: TRANSMISSION AND EPIDEMIOLOGY

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Dracunculiasis (also known as guinea worm disease or dracontiasis) is a parasitic disease that develops in humans who drink water containing a macroscopic crustacean (Cyclops, a water flea) that has been infected by the larvae of Dracunculus medinensis. This disease is scattered throughout the rural communities of India and Pakistan,[1] the Middle East,[2] and parts of Africa,[3-7] where it is estimated that 10-48 million cases occur annually, affecting 1-6 percent of the total rural population.[8]

The actual number of dracunculiasis cases occurring per year is unknown because official statistics grossly underestimate the extent of the problem. Dracunculiasis is not a notifiable disease in endemic areas. Because most patients are from rural areas, they are likely to have poor access to clinics and to prefer traditional treatment methods.

Diagnosis of dracunculiasis is made on the basis of a unique clinical presentation--a long, string-like worm protruding from a shallow skin ulcer, usually found on the lower leg. This condition is well known to residents of endemic areas, and information about its occurrence can be collected in retrospective surveys. Cryptic forms of the disease are less readily identified in surveys,[9] and microscopic examination for larvae is impractical under field conditions.

In endemic areas, dracunculiasis is a major health problem because it incapacitates many farmers,[3] with periods of total disability usually ranging from 6 weeks to 3 months.[4] Because the peak case rates often coincide with the major agricultural activities of clearing land and planting or harvesting, this disease is a major cause of agricultural work loss in many areas.

Since dracunculiasis is transmitted entirely by contaminated drinking water, the disease can be completely eliminated by the provision of safe water supplies. Its control or elimination will be an indicator of progress for the International Drinking Water Supply and Sanitation Decade of the 1980s.[8]

TRANSMISSION CYCLE AND POTENTIAL FOR ERADICATION

Humans become infected with this disease when they drink unfiltered water containing cyclops infected with D. medinensis larvae. After ingestion, the cyclops are digested and killed by gastric juices in the stomach and the larvae are freed to penetrate the intestinal wall. The male and female worms mate about 3 months after ingestion. The male worms then die at about 6 months of age and are absorbed or encysted. The gravid female worms live in the connective tissue. At about 8 months, the female worms usually move down to the lower limbs. Ten to 14 months after initial infection, the female worm, ready to emerge and reproduce, secretes a toxic substance that eventually produces a painful ulcer. When the ulcer through which the gravid female is protruding is exposed to water, the larvae are released, thus renewing the entire cycle.

Dracunculiasis occurs in areas where surface water temperatures are above 19°C, a requirement for complete development of the larvae in the cyclops. Because Dracunculus larvae do not possess a boring apparatus, only large predatory cyclops strains that can ingest larvae become infected. These types, which occur in West Africa, the Middle East, and India, propagate best in stagnant surface water. Thus, communities that depend on ponds, cisterns (Iran), and stepwells (India) for drinking water have the greatest risk of infection. Water becomes contaminated when individuals with guinea worm infections wade in to obtain water or bathe their ulcers to relieve pain.

Infection with Dracunculus does not confer immunity, and there is no effective treatment or prophylaxis.[10,11] Residents in endemic areas are reinfected year after year. Case rates show a marked seasonal recurrence because of the availability of water with infected cyclops and because the female worm requires approximately 1 year to mature and release larvae in the water that will lead to the following year's infection.[5]

Because the transmission of dracunculiasis is well understood, the cycle may be interrupted at several points, making the disease itself potentially eradicable. Several features of the disease are helpful in its control. First, endemic foci are well demarcated and control efforts can be directed at specific geographic sites rather than a large geographic area. Second, infection of humans with contaminated drinking water often occurs at a specific time of year, particularly during the middle or late dry season. This peak in case rates is related to a lack of alternative water sources during the dry season, consumption of large quantities of contaminated surface water, and denser concentrations of infected cyclops. Finally, because of the pain and disability caused by dracunculiasis, victims and their communities are most willing to cooperate with programs designed to eliminate this problem.

In Ghana, dracunculiasis transmission has been interrupted both by piping safe water and by treating surface ponds with the larvicide temephos (Abate). A recent history of health services in Ghana[12] describes dracunculiasis as being commonplace in Accra, the capital city, until piped water was made available in the early 1900s. By 1930, the dracunculiasis cycle had been interrupted in several rural villages because of the introduction of safe water. In northern Ghana, however, dracunculiasis remains a major public health problem. In 1955, there were an estimated 100,000 annual cases out of a population of 800,000, and in the early 1970s, dracunculiasis transmission was finally interrupted in one village when the drinking water pond was treated with Abate.[6]

CONTROL STRATEGIES

Control strategies for dracunculiasis must consider:

- The geographical areas most affected
- The transmission season in the different endemic areas
- The population groups at greatest risk of acquiring dracunculiasis
- The reliability of the available information and any means of improving baseline and monitoring (i.e., surveillance) information
- The research needed to answer behavioral, epidemiologic, and operational questions.

Geographic Distribution

West Africa, Ethiopia, the Nile Valley, Saudi Arabia, Iran and the Middle East, and Pakistan and India are endemic areas for dracunculiasis because water supplies are poor, the appropriate cyclops species are present, and the water temperature is above 19°C. Previous foci in the West Indies and northeastern South America are no longer active because of improved economic conditions and better water supplies.[1] In some communities where dracunculiasis had not occurred previously, travelers or immigrants from endemic areas are introducing the disease.[3]

Seasonality

Water sources in tropical areas vary with the season. During the rainy season, which lasts 2-3 months, surface ponds fill and overflow into small streams. Villagers collect roof water in barrels and water pots. During the dry season, however, these sources are expended and shallow surface ponds are used. By the end of the dry season, the volume of pond water becomes quite low, so that the density of cyclops is increased. Seasonal rains interrupt the transmission of dracunculiasis because the increased water volume and turbidity act to reduce the density of cyclops. Rainfall characteristics are important indicators of the likely transmission periods.[5] In areas where wells or cisterns are used, cyclops tend to persist in larger numbers and transmission periods may be longer.

The natural or artificial ponds used as sources of drinking water in the savannah areas of Africa and in the Sind Desert area of Pakistan also provide centers for transmission. In areas with an average rainfall of less than 65 cm concentrated into 3-4 months of the year (e.g., Chad, northern Ghana, Niger, northern Nigeria, Senegal, Sudan, Uganda, Upper Volta), water is obtained from safe bored wells for most of the year when the ponds are dry. Thus the maximum incidence of infection occurs during and after the end of the rainy season, particularly when water levels become low in the ponds. Infection is markedly seasonal in these areas, and patent guinea worm disease is confined to less than 5 months of the year, peaking during the harvesting season at the end of the rains. In savannah areas of Africa with an annual rainfall of more than 150 cm, as in southern Ghana, the Ivory Coast, southern Nigeria, and Togo, ponds contain water all year round and infection may be apparent in humans for up to 8 months of the year. Even here, however, most cases of dracunculiasis occur in the latter half of the dry season and extend to the main planting season after the early rains. There are few cases during the rainy season because there is considerable surface water.

When drawwells are used as the only source of water, transmission of guinea worm is not commonly found. Stepwells, however, which provide the main source of drinking water in many rural areas of India, are ideally suited for Dracunculus transmission. The steps that lead down into the water permit immersion of the affected limbs of those dipping a water container into the well. These areas of India have a transmission pattern similar to that found in the humid areas of West Africa. Peak transmission occurs toward the end of the dry season before the major rains in June or July.

In southern Iran where large covered cisterns are used, the water rarely dries up completely. Dracunculiasis occurs principally when the cisterns are half full, and it is absent for the 2 months before the rains begin. There is little transmission of dracunculiasis during the rainy season when the cisterns are full. While field studies should be conducted to characterize local transmission patterns,[13] information about overall rainfall patterns and usual water sources during the dry season can be used to time drinking water treatment programs.

Population Groups at High Risk

In southern Ghana, the peak infection rates of adult male farmers probably result from their heavy seasonal farming activities and their increased consumption of contaminated water.[3] In communities that use a common source of water, females are infected as often as males. Infants and toddlers are rarely infected because they are breast-fed.

Information Requirements

Available reports do not give a clear picture of the extent of dracunculiasis. A review of the reports published over the past 10 years about dracunculiasis revealed over 40 that dealt with case reports or drug trials, six special studies largely involving investigation of a specific area for just a 1-year period, and only one article that showed an effort to develop a continuing, periodic surveillance to provide accurate baseline data about dracunculiasis.[14] Official statistics based on ambulatory diagnostic registers or hospitalization information markedly underreport the actual incidence of dracunculiasis. In one population survey, less than 1 percent of villagers experiencing dracunculiasis attended a clinic for treatment.[3] Although dracunculiasis tends to occur in rural areas that lack protected water supplies, underreporting also persists even when numerous cases occur in communities adjacent to large cities.

Several factors may make surveillance difficult, such as a lack of established surveillance policy or procedures or inadequate resources to initiate and maintain a surveillance program.[15] A standardized data base is also important to allow comparison between different regions of a country.[16]

The potential users of surveillance information should help plan the information requirements, which may require coordination between the various government ministries involved. A helpful classification of the level of surveillance feasible in a given setting and the appropriate activities has been described in a monograph published by the World Health Organization.[15]

In October 1979, a program to eradicate dracunculiasis in India was initiated with the collection of baseline data. Questionnaires were sent to directors of health services in all states and union territories to determine the extent of this infection. The first estimate tentatively identified 726 villages or hamlets comprising a population of 1.8 million. To confirm this information, paramedical survey workers then visited each village in the endemic states and union territories, where they found the disease to be more extensively distributed than the questionnaires had indicated. More than 7,500 villages or hamlets with a population of 5.9 million were revealed to be affected by dracunculiasis.

India is planning to take several steps in this program to eradicate dracunculiasis, including: (1) continued, semiannual monitoring of all affected areas; (2) surveying water sources to determine priorities for providing improvements; (3) educating communities about the hazards of unsafe water sources, mode of transmission of dracunculiasis, and personal hygiene necessary to prevent and control the disease; and (4) training health officers and distributing an operational manual on eradication of guinea worm disease. With this strategy it is hoped that this disease can be eliminated in India by December 1985.[17]

Research Agenda

The answers to a number of questions would allow the educational, operational, and surveillance components of a dracunculiasis control program to become more effective. At the individual or community level, research is needed to clarify the relationships among water-related behavior,[18] perceptions about causation and personal susceptibility,[19] and exposure risk[20] to dracunculiasis transmission. Such information will facilitate the design of health education programs that enable residents to avoid water contamination or use field water treatment techniques. The current level of dracunculiasis awareness is another issue. For example, less than 5 percent of western Nigerian farmers described dracunculiasis as a problem related to contaminated drinking water.[21] Health education activities could also be directed more effectively if it were known who is transmitting dracunculiasis (i.e., affected resident adults or children, travelers, or recent immigrants).

The popular concept of community self-help, particularly in rural areas, may be oversimplified and may divert program attention away from administrative and political realities.[22] For example, information about the impact of dracunculiasis on agricultural productivity and crop losses would encourage governments to make dracunculiasis control a higher priority and would assist the responsible ministries in setting program goals.

Pilot program research is needed to clarify which control approach will yield the greatest health benefits.[23] Epidemiologic information about the location of endemic foci and the seasonality of transmission are basic requirements for allocating overall program resources to achieve efficient coverage and timing objectives. For example, the addition of an organophosphorus larvicide effective against cyclops (temephos at a concentration of 0.5-1.0 mg/liter) to pond water at 4-week intervals during the transmission season can interrupt the dracunculiasis cycle.[5] Potential disease areas (i.e., drinking water sources and water-related behavior make the community at risk) should also be identified and monitored periodically to recognize newly introduced dracunculiasis.

More effective information systems are clearly needed to provide ongoing epidemiologic information as a basis for planning and periodically monitoring the results of dracunculiasis programs. The available patient-related statistics are inaccurate because affected persons rarely seek care at clinics. Furthermore, official statistics based on passive data collection often show unexplained rate variations or missing data.[24] Continuing data collection to determine disease trends, outbreaks, and control program impact requires significant administrative, manpower, and other resources, as well as community cooperation in providing information. Based upon the setting and available resources, different intensities of surveillance and related resource requirements can be planned.[15] The promising two-phase data collection program used in India and just described is yielding valuable information.[14] If baseline data about current dracunculiasis transmission areas were available, control program resources could be applied more efficiently.

REFERENCES

1. Reddy, C. R. R. M., Narasaiah, I. L., and Parvathi, G., 1969. Epidemiological studies on Guinea-worm infection. Bull. W.H.O., 40:521-529.

2. Sahba, G. H., Afraa, F., Fardin, A., and Ardalan, A., 1973. Studies on dracontiasis in Iran. Am. J. Trop. Med. Hyg., 22(3):343-347.

3. Belcher, D. W., Wurapa, F. K., Ward, W. B., and Lourie, I. M., 1975. Guinea worm in southern Ghana: Its epidemiology and impact on agricultural productivity. Am. J. Trop. Med. Hyg., 24(2):243-249.

4. Kale, O. O., 1977. The clinico-epidemiological profile of guinea worm in the Ibadan District of Nigeria. Am. J. Trop. Med. Hyg., 26:208-214.

5. Muller, R., 1979. Guinea worm disease: Epidemiology, control, and treatment. Bull. W.H.O., 57:683-689.

6. Lyons, G. R. L., 1973. The control of guineaworm with Abate: A trial in a village of North-West Ghana. Bull. W.H.O., 49:215-216.

7. Scott, D., 1960. An epidemiologic note on guinea-worm infection in North-West Ashanti, Ghana. Ann. Trop. Med. Parasitol., 54:32-43.

8. Centers for Disease Control, 1981. Guinea worm targeted for elimination as part of international clean water decade. MMWR, 30:14-15.

9. Wurapa, F. K., Belcher, D. W., and Ward, W. B., 1975. A clinical picture of Guinea worm disease in southern Ghana. Ghana Med. J., 14:10-15.

10. Belcher, D. W., Wurapa, F. K., and Ward, W. B., 1975. Failure of thiabendazole and metronidazole in the treatment and suppression of Guinea worm disease. Am. J. Trop. Med. Hyg., 24:444-446.

11. Kulkarni, D. R., and Nagalotimath, S. J., 1975. Guinea-worms and metronidazole. Trans. R. Soc. Trop. Med. Hyg., 69:169-170.

12. Patterson, K. D., 1981. Health in Colonial Ghana: Disease, Medicine, Socioeconomic Change, 1900-1955. Crossroads Press, Waltham, Mass.

13. Scott, D., 1965. Epidemic Disease in Ghana. Oxford University Press, London.

14. Rao, C. K., Paul, R. C., Sharma, M. I. D., and Kumar, S., 1981. Guinea worm disease in India--Current status and strategy of its eradication. J. Commun. Dis., 13:1-7.

15. WHO, 1976. Surveillance of Drinking Water Quality. WHO Monograph No. 63. World Health Organization, Geneva, Switzerland.

16. Van Damme, J. M. G., 1981. Strategies for water supply systems in developing countries. Sci. Total Environ., 18:307-315.

17. Centers for Disease Control, 1981. Program to eradicate dracunculiasis--India. MMWR, 30:549.

18. Dunn, F. L., 1979. Behavioural aspects of the control of parasitic diseases. Bull. W.H.O., 57:499-512.

19. Ward, W. B., Belcher, D. W., Wurapa, F. K., and Pappoe, M. E., 1979. Perception and management of Guinea worm disease among Ghanaian villagers. A framework for differential health education planning. Trop. Geogr. Med., 31:155-164.

20. Kloos, H., and Lemma, A., 1980. The epidemiology of Schistosoma mansoni infection in Tensae Berhan: Human water contact patterns. Ethiop. Med. J., 18:91-98.

21. Oyemade, A., and Olugbile, A., 1977. Assessment of health needs of agricultural workers in Nigeria. Public Health (Lond.), 91:183-188.

22. Feachem, R. G., 1980. Rural water and sanitation. Community participation in appropriate water supply and sanitation technologies: The mythology for the decade. Proc. R. Soc. Lond., 209:15-20.

23. Feachem, R. G., 1981. The water and sanitation decade (editorial). J. Trop. Med. Hyg., 84:47-48.

24. Centers for Disease Control, 1981. Guinea worm (dracunculiasis) and the International Drinking Water Supply and Sanitation Decade. MMWR, 30 (16):194-195.

PARASITE LIFE CYCLE AND CLINICO-PATHOLOGY

LIFE CYCLE OF *DRACUNCULUS MEDINENSIS*

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The seemingly rather bizarre life cycle of the guinea worm, *Dracunculus medinensis*, is actually very well adapted for transmission of a parasite that utilizes an aquatic intermediate host and that occurs principally in arid or semiarid environments.

The mature female worm is about 70 cm long and 0.2 cm wide and lives in the subcutaneous connective tissue of the human host. When ready to emerge, the anterior end of the worm provokes the formation of a painful burning blister in the human skin. The blister bursts, usually after immersion of the affected portion of the body in water, and the worm is exposed in a shallow ulcer. Following rupture, numerous first-stage larvae are forcibly expelled into the water in a milky stream by the contraction of the muscles of the worm and of the host. Estimates of the number of larvae contained in the uterus of a single worm range from 1.4 to 3 million. Not all of the larvae are released at once, and the anterior portion of the worm becomes flaccid and dries up after removal from the water. When the host enters water again, more larvae are released through the broken end of the worm; this process can be repeated a number of times.

Few studies have been undertaken to ascertain how many times larvae can be released and over what period of time. In a study of five patients in Nigeria, this author found that an average of 0.5 million larvae were released upon first immersion in water, and that no larvae were expelled for more than a 2-week period thereafter. In an experimental infection in a rhesus monkey, about 104,000 larvae were released upon first emergence; 26,000 three days later; 10,000 the next day; and only 1,000 a week later.

The period of release of larvae could be important in controlling transmission of the disease. For instance, various benzimidazole drugs reportedly reduce inflammation as well as the time required for complete emergence of worms from an average of 4-6 weeks to 2-3 weeks, although these drugs do not appear to affect the viability of the contained larvae.[1] The studies described above indicate that such treatment with drugs would not significantly reduce the number of larvae reaching water.

INFECTION OF CYCLOPS SPECIES

First-stage larvae are 640 um long by 13.4 um wide and have a long pointed tail; they remain active in pond water for up to a week. Experiments have shown, however, that they are not capable of infecting cyclops for longer than 5 days at 24°C. The larvae thrash actively in the water similarly to free-living aquatic nematodes and are ingested by carnivorous species of Cyclops. While six species of Cyclops have been found naturally infected in various parts of the world,[2] C. leuckarti and C. hyalinus are important species in all endemic areas, particularly in many habitats in India.[3] At least another 10 species, however, are potential intermediate hosts, and some have been infected experimentally.

Once inside a cyclops, the larvae penetrate head first through the gut wall to the hemocoel in 1-6 hours, depending principally on the temperature. The larvae molt twice inside the cyclops and can reach the infective third stage in 14 days with a temperature above 21°C. Below 19°C, they do not appear capable of reaching the infective stage at all (Table 1).

TABLE 1. Number of Days Required for D. medinensis Larvae to Develop in Cyclops

Authority	Species of Cyclops	Temp. (°C)	First Molt	Second Molt	Infective Stage (Presumed)
Fairley & Liston (1924)[4]	C. leuckarti	24	?	?	12-15
Moorthy (1938)[5]	C. leuckarti	32	5-7	8-12	14-20
Onabamiro (1954)[6]	C. nigerianus	25-27	5	9	12
Muller (1971)[2]	C. leuckarti	19	-	-	-
		21-24	8	12	14
		25	6-8	8-10	14[a]

a Demonstrated by experimental infections; animals could not be infected at 9 or 12 days.

Cyclops often ingest many larvae, but this results in high mortality when the larvae molt. The great majority of naturally infected cyclops contain only one third-stage infective larva (in 1951, Onabamiro[7] found that 12 percent contained two larvae). The third-stage larva is approximately 450 um long and 14 um wide and has a short bifid tail. All stages of cyclops can be infected, but the nauplii and copepodid stages are likely to have become adult by the time they contain infective larvae, although in some cases inhibition of development has been reported.

In the laboratory, Sharma and Wattal found that uninfected female C. leuckarti lived for a maximum of 158 days,[8] while Muller found that infected cyclops lived for less than 50 days.[9]

Cyclops that contain third-stage larvae become sluggish and sink almost to the bottom of a pond or stepwell.[6] This is usually given as a partial explanation for increased transmission of the disease in the dry season when water levels are low in endemic areas that have a high annual rainfall.

Although there have been no studies of the level of infection necessary in cyclops to maintain transmission, Moorthy and Sweet found 5 percent infection in C. leuckarti during the height of the transmission season in a stepwell in Karnataka State, India.[10] Onabamiro has reported a similar figure for C. nigerianus in a pond in southwest Nigeria.[7] To be meaningful, however, such studies must differentiate infective larvae in cyclops, and they must be carried out over a period of time because of the sporadic nature of larval input into the water and the high mortality of recently infected cyclops.

HUMAN INGESTION

When cyclops containing infective larvae are ingested in drinking water, they are killed in the stomach of the host. The contained larvae are activated and, in experimentally infected cats, freed larvae can be found in the lumen of the duodenum 4 hours after infection. Larvae are killed in 18 hours, however, by 0.05 percent HCl (maximum stomach acidity is about 0.22 percent HCl). This can be contrasted to Trichinella, a nematode whose larvae are ingested in meat, which can withstand 0.2 percent acid pepsin for 24 hours. This may mean that Dracunculus larvae must pass through the stomach quickly. High gastric acidity has also been given as a possible explanation for the disease resistance often found in some people using a contaminated water source, although this has not been borne out by clinical investigations.[11,12]

In experimental animals, larvae penetrate the duodenal wall by 13 hours after infection, are found migrating along the abdominal mesenteries by up to 12 days, and are present in the abdominal and thoracic muscle planes at about 15 days. The larvae do not grow during this period,[13] but there is probably a molt between 15 and 21 days. The developing worms then migrate to the connective tissues of the axillary and inguinal regions, and mating occurs between 80 and 100 days after infection (R. Muller, unpublished data).[14,15] The males usually then move deeper between the muscle fasciae, die after about 6 months, become encysted, and sometimes calcify. The females move down to the extremities, usually to the lower legs, between 8 and 10 months after infection. The uterus is filled with developing eggs by 8 months and with first-stage larvae by 10 months. The gut becomes flattened and nonfunctional, and the whole worm is filled by the uterus containing larvae.

The female worms become potent between 10 and 14 months after infection (in 1971, this author reported a mean of 340 days in nine experimentally infected rhesus monkeys),[2] although occasionally adult female worms have been reported from young babies. A number of female worms never reach the surface, becoming encysted and eventually calcified or they are absorbed. All such worms that this author has examined from monkeys have been unfertilized. Sita Devi and colleagues found that 29 percent of supposedly uninfected villagers from an endemic area showed the presence of worms in a roentgenogram.[12] In the older literature, it has sometimes been reported that female worms can occasionally survive in the body for 2 years but there is no good evidence for this.

ROLE OF RESERVOIR HOSTS

The role of reservoir hosts in the transmission of D. medinensis has not been clearly established. Infection has been reported from a wide range of mammals from many parts of the world,[2] but it is not always clear whether the worms belong to the same species (for instance, the widespread parasite of wild carnivores in North America has been named D. insignis, although there is little to distinguish it from D. medinensis) or whether the occasional animal cases reported in endemic areas, usually from dogs, are just isolated accidental infections from a human source.

While there is no evidence that dracunculiasis is a zoonotic infection or has ever been transmitted from an animal to man (apart, presumably, from the occasional human cases reported from the United States), the possibility that infection could be reintroduced into an area from which it has been eliminated provides additional support for the need to provide safe water supplies as the most satisfactory method of control or eradication.

REFERENCES

1. Muller, R., 1976. The pathology of experimental Dracunculus infection and its relevance to chemotherapy. Pp. 133-148 in: E. J. L. Soulsby, ed., Pathophysiology of Parasitic Infection. Academic Press, New York.

2. Muller, R., 1971. Dracunculus and dracunculiasis. Adv. Parasitol., 9:73-151.

3. Sharma, S. K., and Wattal, B. L., 1981. Faunistic studies on Indian cyclops with special reference to Delhi region. J. Commun. Dis., 13:8-15.

4. Fairley, N. H., and Liston, W. G., 1924. Studies in the transmission of Dracunculus medinensis: A negative experiment. Indian J. Med. Res., 12:93-103.

5. Moorthy, V. N., 1938. Observations on the development of Dracunculus medinensis larvae in cyclops. Am. J. Hyg., 27:437-460.

6. Onabamiro, S. D., 1954. The diurnal migration of cyclops infected with larvae of Dracunculus medinensis (Linnaeus), with some observations on the development of the larval worms. W. Afr. Med. J., 3:180-194.

7. Onabamiro, S. D., 1951. The transmission of Dracunculus medinensis by Thermocyclops nigerianus, as observed in a village in south-west Nigeria. Ann. Trop. Med. Parasitol., 45:1-10.

8. Sharma, S. K., and Wattal, B. L., 1981. Laboratory studies on the biology of Mesocyclops leuckarti (Claus). J. Commun. Dis., 13:115-120.

9. Muller, R., 1972. Maintenance of Dracunculus medinensis (L.) in the laboratory and observations on experimental infections. Parasitology, 64:107-116.

10. Moorthy, V. N., and Sweet, W. C., 1936. Guinea worm infection of cyclops in nature. Indian Med. Gaz., 71:568-570.

11. Gilles, H. M., and Ball, D. A. J., 1964. Guinea worm infection and gastric function. Ann. Trop. Med. Parasitol., 58:78-82.

12. Sita Devi, C., Sankaraiah, D., Narasaiah, I. L., Reddy, C. R. R. M., and Rao, V., 1969. Role of gastric acidity in guinea-worm infection. Indian J. Med. Res., 57:1850-1855.

13. Muller, R., 1968. Studies on Dracunculus medinensis (Linneaus). I. The early migration route in experimentally infected dogs. J. Helminthol., 42:331-338.

14. Moorthy, V. N., and Sweet, W. C., 1938. Further notes on the experimental infection of dogs with dracontiasis. Am. J. Hyg., 27:301-310.

15. Onabamiro, S. D., 1956. The early stages of the development of Dracunculus medinensis (Linnaeus) in the mammalian host. Ann. Trop. Med. Parasitol., 50:157-166.

CLINICAL AND THERAPEUTIC ASPECTS OF <u>DRACUNCULUS</u> <u>MEDINENSIS</u>

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CLINICAL PICTURE

Dracunculiasis (guinea worm disease) rarely occurs in humans before the age of four, after which the incidence steadily increases, to become highest in the young adult. The incidence is seasonal in many areas, especially in India. Infection with a single worm is usual, but multiple infection is not uncommon. There is no racial or other immunity, and reinfection is frequent, even in the already infected subjects.

The mature female worm is usually present in the connective tissues of the human limbs and trunk. In 90 percent of all cases, it most commonly presents itself on the surface of the body in the feet, ankles, and lower limbs, but it may also emerge from the trunk (especially the back in water carriers) and arms--rarely the head and neck. It has also been reported in the orbit. The worm may often be visible or palpable for its whole length in the subcutaneous tissue.

The worm does not give rise to clinical signs until near the point of discharge of larvae. The active stage of the infection is accompanied by both general and local signs and symptoms. A few hours before the appearance of the worm at the surface of the skin, some local erythema and tenderness may develop over the area in which the pointing will occur. In some cases there may be general effects, sometimes severe in nature, but for the majority the local lesion tends to develop without any general reaction.

In severe cases there may be generalized pruritus, sometimes accompanied by scattered urticaria. There may also be nausea, vomiting, and watery diarrhea. In some cases dyspnea may appear and lead to attacks resembling asthma. These general reactions vary greatly in intensity and incidence from patient to patient and locality to locality. They subside as a rule by the time the local lesion has ruptured and the ejection of larvae has commenced.

The adult female worm secretes a toxic substance which causes a local inflammatory lesion infiltrated with eosinophils, monocytes, and polymorphonuclear leucocytes. The patient usually complains of deep-seated, stinging pain in the site in which the worm is reaching the surface. A papule or group of papules (which later coalesce) forms rapidly and enlarges over the course of 1 or 2 days, becoming slowly more indurated. The central region becomes raised and eventually forms a vesicle that soon ruptures, leaving a superficial ulcer large enough to admit a probe. The head of the worm is often visible within this ulcer.

If the ulcerated lesion is douched with water, a drop of milky fluid wells up in a few seconds. After an interval of about an hour, further douching will have the same effect. This fluid contains a myriad of active larvae ejected from the uterus of the worm in response to the stimulus of water.

Discharge of larvae will continue intermittently whenever the affected part is exposed to water until the worm has discharged its full load of larvae, which may take up to 3 weeks. The tissues about the presenting head of the worm become indurated, edematous, reddened, and very tender. These reactions, which may involve wide areas around the worm, are probably allergic. Even in the absence of secondary infection, walking may be very difficult and the patient is compelled to give up work.

In the case not complicated by secondary infection, the local lesion will heal completely about 4-6 weeks after its appearance. Secondary infection is, however, the rule and may lead to serious and unpleasant complications.

It is possible that the mature female never reaches the surface of the body and is absorbed without a marked reaction on the part of the host; or calcification of the worm may occur and be detected on radiological examination.[1] It is, however, often the case that a secondary infection develops and leads to abscess formation so that the first indication of the infection may be the discovery of fragments of the worm in the abscess contents. Such secondary infections may involve deep structures, including tendons, the periosteum, and bones, and may be accompanied by severe or even fatal septicemia.

In some areas, a large proportion of patients (in parts of India, over 20 percent) suffer from joint lesions perhaps caused in some instances by a toxin liberated from the worm. These lesions vary from painful reddened swellings to advanced pyogenic infections followed by fixation and deformity. The majority of such lesions occur in the ankles and knees. The aspirated fluid is usually brownish in color and contains pus cells and fragments of the worm; in the wall of the cavity a foreign body giant cell reaction is usual. In some cases the aspirated fluid is sterile, and at arthrotomy the entire adult worm is seen in the joint.[2] A coiled-up worm has also been observed in an abscess cavity in the pericardium, causing constrictive pericarditis.[3] Changes in joints are believed to occur occasionally without secondary infection.

An eosinophilia may occur in the early stages of infection prior to the liberation of the embryos or with damage to the parasite. Paraplegia as well as quadriplegia due to an extradural abscess have also been described,[4,5,6] as well as scrotal, vesical, and renal lesions.

TREATMENT

The patient should rest if possible with the affected part elevated. The local lesion must be kept as clean as possible and the secondary infection treated using conventional methods. A tetanus toxoid injection should be given when indicated.

Niridazole, administered 25 mg/kg daily for 10 days, was found effective in a Nigerian study,[7] but Kulkarni and Nagalotimath, in 160 randomly selected patients in India,[8] and Belcher and colleagues,[9] failed to show any beneficial effect using metronidazole or thiabendazole. Gaitonde and associates have assessed the comparative efficacy of levamisole, bitoscanate, and mebendazole.[10] Unfortunately, none of the drugs seemed to have any effect on developing worms, while only mebendazole at a dosage of 100 mg twice a day for 7 days resulted in significant symptomatic improvement. The possible mode of action of a number of drugs on dracunculiasis has been reviewed by Muller.[11]

REFERENCES

1. Reddy, C. R. R. M., Sivaprasad, M. D., Parvathi, G., and Chari, P. S., 1968. Calcified guinea worm: Clinical, radiological and pathological study. Ann. Trop. Med. Parasitol., 62:399-406.

2. Reddy, C. R. R. M., and Sivaramappa, M., 1968. Guinea-worm arthritis of knee joint. Br. Med. J., 1:155.

3. Kinare, S. G., Parulkar, G. B., and Sen, P. K., 1962. Constrictive pericarditis resulting from dracunculosis. Br. Med. J., 1:845.

4. Reddy, C. R. R. M., and Valli, V. V., 1967. Extradural guinea-worm abscess: Report of two cases. Am. J. Trop. Med. Hyg., 16:23-25.

5. Donaldson, J. R., and Angelo, T. A., 1961. Quadriplegia due to guinea worm abscess. J. Bone Jt. Surg., 43-A:197.

6. Mitra, A. K., and Haddock, D. R. W., 1970. Paraplegia due to guinea-worm infection. Trans. R. Soc. Trop. Med. Hyg., 64:102-106.

7. Oduntan, S. O., Lucas, A. O., and Gilles, H. M., 1967. Treatment of dracontiasis with niridazole. Lancet, 73.

8. Kulkarni, D. R., and Nagalotimath, S. J., 1975. Guinea-worms and metronidazole. Trans. R. Soc. Trop. Med. Hyg., 69:169-170.

9. Belcher, D. W., Wurapa, F. K., and Ward, W. B., 1975. Failure of thiabendazole and metronidazole in the treatment and suppression of Guinea worm disease. Am. J. Trop. Med. Hyg., 24:444-446.

10. Gaitonde, B. B., et al., 1979. Comparative efficacy of three antihelmintic drugs in the treatment of guinea worm infection. Bull. Haffkine Inst., 7(1):20.

11. Muller, R., 1971. The possible mode of action of some chemotherapeutic agents in guinea worm disease. Trans. R. Soc. Trop. Med. Hyg., 65:843-844.

EPIDEMIOLOGY

EPIDEMIOLOGY OF DRACUNCULIASIS IN INDIA

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DISTRIBUTION

Dracunculiasis (guinea worm disease) has existed in India for the past several centuries. However, attention was first drawn to this disease as a public health problem by N. R. Stoll, who estimated in 1947 that 25 million people were living in endemic areas of India as opposed to 23 million in the rest of the world.[1] In 1955, based on questionnaires returned by the health services directors of each Indian state, Singh and Raghavan reported the occurrence of guinea worm disease in 11 states inhabited by about 5 million persons.[2] In 1967, Patnaik and Kapoor estimated, also based on reports received from the state health services directors, the existence of 12 endemic states with an average annual incidence of about 15 cases per 100,000 population.[3]

Recognizing that guinea worm disease could be eradicated with the existing resources, the National Institute of Communicable Diseases (NICD) set out in October 1979 to delimit the problem on the basis of questionnaires circulated to all directors of health services of the 31 states and union territories of India. These questionnaires were returned by the middle of 1980, and they revealed that seven states and one union territory had reported the presence of guinea worm cases between the years 1977 and 1979. Follow-up confirmation showed that 728 villages in 139 blocks of 47 districts in 7 states reported active guinea worm cases from 1977 onward,[4] affecting a population of 1.8 million. All the reported cases from the Union Territory of Goa were later found to be imported from the State of Karnataka, and Goa was deleted from the list of endemic areas.

Subsequently, three active searches of every village or hamlet in the known endemic districts were organized for December 1980, May-June 1981, and October-November 1981 to estimate as accurately as possible the number of affected villages or hamlets. Each of these searches added to the numbers. According to the latest available information, guinea worm disease is found in 80 districts spread over seven endemic states (Figure 1). The actual number of districts, villages, and population affected are given in Table 1. The states of Orissa, Uttar Pradesh, Punjab, West Bengal, and the Adaman and Nicobar Islands, which were reported endemic earlier by Patnaik and Kapoor,[3] are free from the disease. These states are being reexamined, however, to exclude any guinea worm focus.

MEASUREMENT OF DISEASE FREQUENCY AND TRENDS

Measurement of the incidence of dracunculiasis remains important for its eradication. The short duration of the illness, the distribution of cases year-round, the ease of identifying cases, and a reliable history of the period of onset of the disease make incidence measurement convenient, provided that periodic visits are made to the affected communities.

Under the eradication program, two 1-week village searches for the total number of cases of guinea worm disease are planned annually. Further, all PHCs district primary health centers (PHCs) will be searched simultaneously in the same period each year.

The national estimates reported earlier[1-3] appear to be based on prevalence data. Special studies undertaken at different points in time to determine the annual incidence have not been evaluated to determine the degree of error. Data provided by medical institutions for this disease do not reflect its incidence as patients rarely seek treatment unless there are complications. However, these data as well as those collected through inquiries at fairs, festivals, schools, and markets can help cross-check the information collected by an active search to detect any affected village that may have been missed.

Review of the endemic areas and the extent of the population exposed to risk as reported in 1947,[1] 1955,[2] 1967,[3] and 1979[5] shows shrinkage in the extent of the affected areas. An analysis of reports on isolated investigations performed at different points in time also reveals a reduction in the intensity of infection.

Since the population has increased considerably during the last 30 years and the methods of collection of data vary, it is not possible to compare the earlier data with that collected later. A natural decline has been observed, however, in specific areas examined at different points in time. A study undertaken in 1964 in an endemic district revealed a reduction in the number of

TABLE 1 Guinea Worm Disease Endemicity in India as of March 31, 1982

	Total				Affected			
State	No. of Districts	No. of[a] PHCs	No. of Villages	Population (000s)	No. of Districts	No. of[a] PHCs	No. of Villages	Population (000s)
Andhra Pradesh	23	324	27,221	53,404	5	36	585	1,052
Gujarat	19	218	18,275	33,961	11	46	315	505
Karnataka	20	175	26,826	37,043	7	55	722	1,170
Madhya Pradesh	45	458	70,883	52,132	20	113	2,879	2,895
Maharashtra	26	296	35,778	62,694	11	85	932	686
Rajasthan	26	232	33,305	34,103	23	128	5,140	5,858
Tamil Nadu	15	374	15,735	48,297	3	5	9	10
TOTAL	174	2,077	228,023	321,634	80	468	10,582	12,176

[a]PHCs = primary health centers.

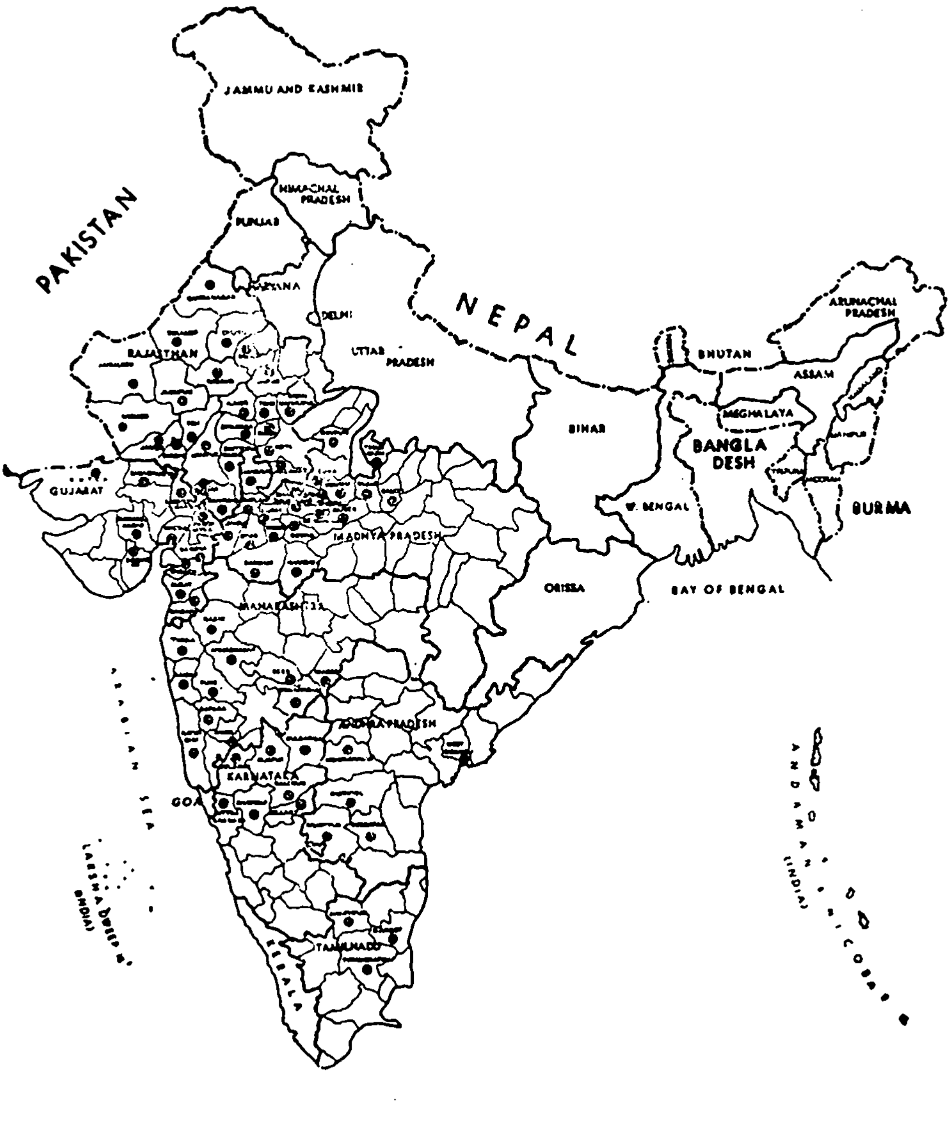

FIGURE 1 Endemicity of guinea worm disease, India, 1981.

guinea worm-affected villages when compared to earlier reports available from the district health office.[6] Subsequent reexamination of these villages in 1978[5] revealed a marked decline in incidence during the 15-year period, although no organized control measures were initiated and no additional safe water sources were installed. Health education on the relationship of guinea worm disease to consumption of tank water--information passed on through the survey questionnaire--apparently played a part. Provision of safe water through development activities during the last 35 years, and knowledge and practice of personal prophylaxis in some communities, have perhaps also contributed to the reduction in the numbers and intensities of infection.

SOURCES OF WATER SUPPLY

The consumption of drinking water from stepwells, tanks, or ponds is always associated with guinea worm disease, but the disease does not exist or spread when drawwells are the only source of water. For groups who must depend only on unsafe water sources, the incidence remains the highest.

In one NICD study, no correlation was observed between the relative proportion of available safe and unsafe water sources and incidence of the disease. In areas with both safe and unsafe water sources, it has been reported that people consuming water from safe sources also come down with the disease, although the incidence is less. Such people are exposed to unsafe water away from their homes.

In one of the searches in Madhya Pradesh, 71 villages or hamlets with only safe water sources reported cases of dracunculiasis. An epidemiological investigation of such a situation will be undertaken in the future to determine whether these cases were indigenous or imported. It is very unlikely that spread of disease occurs in villages with only safe water sources.

Marked seasonality is characteristic of this disease in all the affected areas. Areas with tanks or ponds as drinking water sources have, however, more marked seasonality, with peak transmission times in the summer months of April, May, and June.[2,5,6,7] In areas using stepwells as water sources, cases occur year-round, although the summer peak is clearly observed. The seasonality is associated with the yearly exposure to unsafe sources because safe sources dry up, consumption of a larger quantity of water, and greater density of the crustacean cyclops (vector for this disease) per unit of water due to low water levels in tanks and shallow water in ponds.

Both sexes and all stages of cyclops (water fleas) act as the vectors for this disease. Only development--no multiplication--of the parasite occurs in cyclops. Some species of cyclops encountered in India include Mesocyclops leuckarti, Mesocyclops hyalinus, Eucyclops agilis, Tropocyclops prasinus, Ectocyclops phaleratus, and Paracyclops fimbriatus.[8] There is no difference in the distribution of species or densities between the guinea worm endemic states and those free from guinea worm disease.

PATHOLOGY

Guinea worm disease is nonfatal except when the rare complication of tetanus occurs. Disability persists, however, from the time of blister formation until expulsion of the worm--an average of 4-6 weeks. In some instances, complete emergence of the worm takes as long as 6 months. Less than 1 percent of the cases end in permanent disability.

In 95 percent of the cases, the worm emerges around or below the ankle.[6] Usually two to three worms emerge from an affected individual in a season, although the emergence of 7-10 worms has been reported. Worms are expelled more often consecutively than concurrently. In one study, only one out of 10 patients had a single worm in a year.[6] The number of worms and their time of emergence are related to the intensity of infected cyclops and the duration of their presence in the water sources.

ECONOMIC LOSS FROM DRACUNCULIASIS

Dracunculiasis most frequently affects adult men of the rural poor during the summer months when intensive agricultural activities are under way. Children below age 2 remain free of the disease, and the incidence is usually very low in toddlers.[6] Incidence increases with age and reaches a plateau beyond 35 years.[5,6,7]

An estimated 12.2 million people live in endemic villages in India. Based on the available data, at least 4 percent of the endemic population is estimated to suffer annually from guinea worm disease. Since only 34.5 percent of the rural population is economically active[9] and wages for about 70 days are lost due to disability every year, it is estimated that the 488,000 cases of guinea worm disease occurring annually (4 percent of 12.2 million), of which 168,360 of the affected are economically active (34.5 percent), result in the loss of about 11.7 million man-days annually in India.

RESERVOIRS

Humans appear to be the only reservoir of this infection. Natural infections in cats and dogs in the affected villages are observed occasionally, but regrettably, no follow-up of these animals has been made. Experimentally, dogs and cats have been infected with Dracunculiasis medinensis. The absence of reports about the occurrence of natural infection in animals from areas where the disease has disappeared during the last 20 years and the failure of this disease to reappear in communities freed from this disease suggest that animals have no role in its spread to humans.

REFERENCES

1. Stoll, N. R., 1947, This wormy world. J. Parasitol., 32(1):1.

2. Singh, J., and Raghavan, N. G. S., 1955. Dracontiasis in India: Its public health importance and control. Bull. Nat. Soc. Ind. Malar. Mosq. Dis., 5:141-161.

3. Patnaik, K. C., and Kapoor, P. N., 1967. Incidence and endemicity of guinea-worm in India. Indian J. Med. Res., 55:1231-1242.

4. Rao, C. K., Paul, R. C., Sharma, M. I. D., and Kumar, S., 1981. Guinea worm disease in India: Current status and strategy of its eradication. J. Commun. Dis., 13:1-7.

5. Rao, C. K., Russel, S., Sharma, S. K., Gopalan, I. V., Apparao, M. C., and Narasimham, M. V. V. L., 1979. Dracontiasis in West Godavari district--Andhra Pradesh, J. Commun. Dis., 11:37-40.

6. Rao, C. K. and Reddy, G. V. M., 1965. Dracontiasis in West Godavari and Kurnool districts, Andhra Pradesh. Bull. Ind. Soc. Malar. Commun. Dis., 2:275-295.

7. Paul, R. C., Mathur, A. B. L., Pal, S. P., and Rao, C. K., 1981. Guineaworm disease in selected rural areas of Dungerpur district of Rajasthan. J. Commun. Dis., 13:207.

8. Sharma, S. K., and Wattal, B. L., 1981. Faunistic studies on Indian cyclops with special reference to Delhi region. J. Commun. Dis., 13:8-15.

9. Office of Register General, 1981. Census Book of India. Office of Register General, New Delhi, India.

EPIDEMIOLOGY OF DRACUNCULIASIS IN NIGERIA

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INTRODUCTION

This paper is based on data derived from (1) articles published in scientific journals, and (2) information extracted from a brief questionnaire posted in 1982 throughout the 19 states of the Nigerian federation.

Apart from an isolated report by Ramsay[1] in 1935 in which he conducted field trials of an intradermal test for the diagnosis of dracunculiasis (guinea worm disease) in northern Nigeria, all other epidemiological surveys reported in the medical literature have been conducted in the southwestern part of the country. This can be attributed to two factors. First, the disease appears to be more prevalent in southwestern Nigeria, which is largely in the rain forest belt, than in any other part of the country, apart from a "hyperendemic" zone in the Abakaliki district of Anambra State in eastern Nigeria. Second, systematic disease surveillance is more likely to originate from centers of higher learning staffed with scientists who have the expertise and motivation that impel them to publish their findings in scientific journals, and such higher educational institutions are concentrated in southern Nigeria. Ibadan University, from which over 90 percent of all published works have emanated, is not only the chief university but is also situated in the middle of a guinea worm disease endemic area.

The questionnaire mailed in March 1982 was designed primarily to determine the extent of dracunculiasis and its seasonality throughout the country rather than its intensity. A total of 538 questionnaires were sent to (1) all the chief health officers and heads of epidemiological units in all the ministries of health of the 19 states of the federation; (2) all doctors (post-internship) undergoing the compulsory 1-year national youth service (NYSC) and deployed to the 19 states of the federation; (3) all the residency (post-NYSC) doctors undergoing specialist training at the University College

Hospital (UCH), Ibadan; and (4) all the graduates and diplomates of the African Regional Health Education Centre of the Department of Preventive and Social Medicine, UCH, who have returned to their home states.

The response to the questionnaire has been very encouraging and many useful data on the geographical distribution of dracunculiasis have been obtained. At the time of writing this paper, returns have been received from all 19 states and completed questionnaires continue to arrive daily.

EPIDEMIOLOGY

Geographical Distribution

Dracunculiasis has been reported in 18 of Nigeria's 19 states: Anambra, Bauchi, Bendel, Benue, Borno, Cross River, Gongola, Imo, Kaduna, Kano, Kwara, Niger, Ogun, Ondo, Oyo, Plateau, Rivers, and Sokoto. The only state that is apparently free from the disease is Lagos (location of the capital city Lagos), which is tucked away in the extreme southwestern corner of Nigeria.

A more detailed breakdown of the distribution of guinea worm disease by local government areas is not possible presently, although it can be affirmed that the disease is endemic in all the 24 local government areas of Oyo State which has been extensively surveyed over the years.

Using data obtained from the questionnaire, Nigeria's 19 states can be broadly divided into the following groups on the basis of estimated prevalence: high--Anambra, Ondo, and Oyo; medium--Imo, Kaduna, Kwara, Ogun, and Sokoto; low--Bendel, Benue, Borno, Gongola, Kano, Niger, Plateau; occasional--Bauchi, Cross River, and Rivers; nonexistent--Lagos. This grouping is, however, very tentative and subject to modification that subsequent specific surveys might reveal.

Effect of Climate and Water Sources on Incidence

Climatic Factors

In considering the effect of climate on incidence, three fairly distinct but overlapping climatic belts can be recognized:

1. The rain forest belt, including the swamp forest strip, extends from the Atlantic coast to a point approximately 8°N in the west and 7°N in the

east, and embraces most or all of the Anambra, Bendel, Cross River, Imo, Lagos, Ogun, Ondo, Oyo, and Rivers states.

2. The guinea-savanna (middle) belt extends from the northern edge of the rain forest belt to a point roughly corresponding to latitude 10°N and embraces most or all of the Benue, Gongola, Kwara, Niger, and Plateau states and the southern half of Kaduna State.
3. The sudan-savanna (sub-Sahelian) belt extends from the northern edge of the guinea-savanna region to the northern border of Nigeria roughly on latitude 13.5°N, and embraces most or all of the Bauchi, Borno, northern Kaduna, Kano, and Sokoto states.

Reliable epidemiological data on the seasonal incidence of the disease are available only in connection with the rain forest zone, and Oyo State in particular, where the peak incidence is between October and March.[2,3] This period coincides with the dry season when the water level in ponds, which are mostly perennial, is at its lowest (Figure 1). Data obtained thus far on the guinea-savanna and sudan-savanna regions from the questionnaire survey indicate that most cases of the disease are seen between the months of November and July and between May and October, respectively. These periods coincide, in the two climatic zones, with the rainy season when water is available in seasonal ponds. Almost year-round, the occurrence of infection in the middle belt zone is in keeping with the mixed or transitional nature of the climatic conditions, which is between the two extremes of the tropical rain forest and the sub-Sahelian region.

There is a close correlation between the incidence of dracunculiasis in a community in a given year and the amount of rainfall in the preceeding year. In the rain forest belt, heavy, prolonged precipitation in one year, resulting in a relative abundance of surface water, often presages a lower incidence of infection in the following season. In contrast, a prolonged period of drought is often accompanied by increased transmission and a higher incidence of infection in the following season. The same dynamics of transmission, but the other way, would be expected in the more arid savanna regions.

Water Sources

Transmission of infection is almost exclusively confined to rural populations that depend on surface water

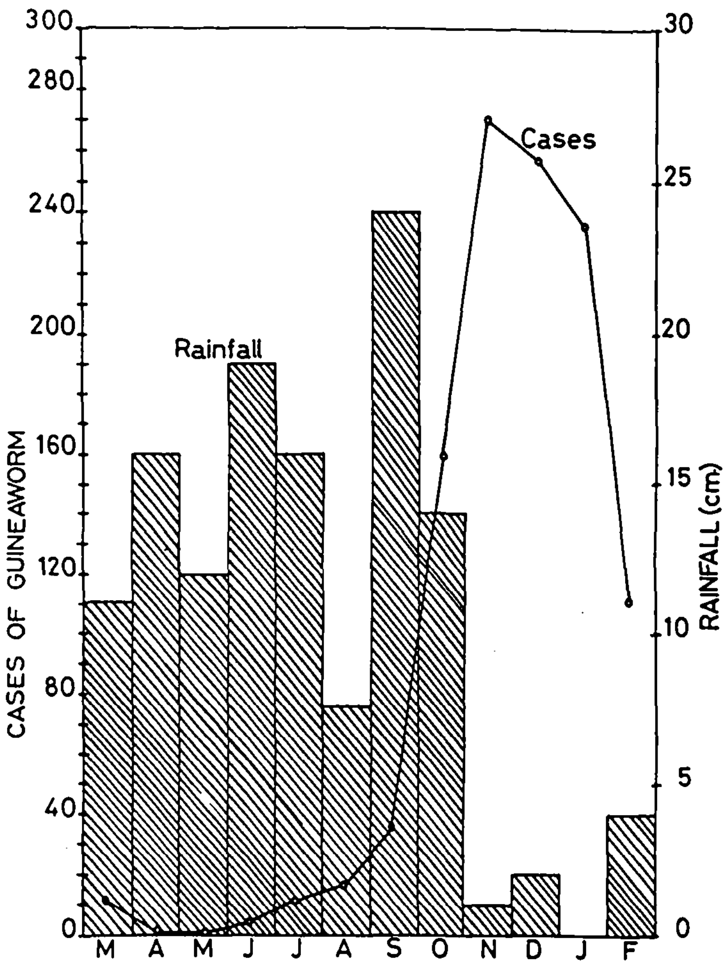

FIGURE 1 Monthly variation in the incidence of guinea worm disease in the Ibadan area (1971-1975) according to the average rainfall (1970-1974). Source: O. O. Kale.[2] Reproduced with the permission of the American Journal of Tropical Medicine and Hygiene.

as their main and often only source of a domestic water supply. Sources of water can take the form of hand-dug water holes, ponds, sluggish brooks, and streams that flow seasonally, as well as in a few cases sanitary open shallow wells.[2] All these water sources have one thing in common: to obtain water, one must wade into the water or, in the case of shallow wells, one can easily contaminate the water source. There are no stepwells or ground-level water "tanks" for the collection of rainwater as are seen in India. Communities or households that can collect and store sufficient rainwater during the rainy season to see them through the worst part of the dry season have substantially reduced risks of exposure to infection.

Since the freshwater crustacean cyclops is an obligatory intermediate host in the life cycle of Dracunculus medinensis, it must be assumed that all bodies of water from which infection is acquired by humans contain these crustaceans. The available records show, however, that this crustacean has only been sought and examined in the southwestern parts of Nigeria.[3-7]

Communities that have access to a regularly treated municipal water supply, such as most urban centers, or to sanitary wells and bore holes, or that live near a large river that flows year-round are free of infection. The provision of piped water and sanitary wells to communities where the disease has been hitherto highly endemic has resulted in total interruption of transmission and eradication of the disease. It must be emphasized, however, that unless the supply of water is regular, the infection may reoccur. The following case illustrates this point.

In 1965, piped water was introduced into the Ibarapa district, including the most populous town in the district, Igboora (population about 25,000), as well as the neighboring town of Idere (population about 7,000), some 12 km east of Igboora. Within 2 years, the incidence of guinea worm disease in Igboora, which had an annual average incidence rate of 13 percent, had diminished virtually to zero. The few cases that occurred after 1967 were found among farmers who drank water from infected ponds located on their farms while at work. A few cases also resulted from consumption of infected surface water in neighboring villages.

In Idere the picture was quite different. Although communal standpipes were located throughout the town, water seldom flowed at any time of the year from those taps that were in the northern half of the town which was at a higher elevation. Thus after 1968, there was a sharp geographical delineation in the town's distribution of dracunculiasis cases; incidence in the southern half of town was virtually nil, while a high incidence (34 percent in 1975) was recorded every year in the northern half where people continued to depend on traditional sources--ponds and water holes--for drinking water.[8]

This pattern continued until 1979 when an almost total cessation in pumping piped water to the entire town the preceeding year resulted in a sharp increase in overall incidence throughout the town. It reached epidemic proportions in 1980 and 1981, with as many as 42 percent of the population being afflicted in the latter year.

The increased demand for water in Igboora, which received electricity in 1978, coupled with the grossly sporadic and less efficient pumping of water from the waterworks at Eruwa, located about 20 km south of Igboora, effectively deprived the town of Idere, further down the distribution line, of the little piped water it had been receiving. Thus the mere provision of municipal standpipes without an adequate supply of water is not a guarantee against infection. Similarly, unless the populace, particularly the farmers, can be persuaded to carry potable water obtained from the city with them to their farms, dracunculiasis will persist in the community.

In all other towns and villages in the Ibarapa district such as Igangan, Tapa, and Aiyete, to which piped water was not extended, the annual incidence of disease has remained at the pre-1965 level.

A dramatic reduction in the incidence of infection in 16 out of 17 villages in the Ibadan district of Oyo State has also been reported following periodic yearly treatment of infected cases.[7] This reduction has been attributed to a shorter duration of infection and reduced contamination of water sources by infected persons consequent to treatment. Infective skin lesions have been bandaged and kept out of drinking water to prevent its pollution. The persistence of cyclops in water that villages draw for drinking purposes means, however, that a resurgence of transmission could occur if "imported" cases with active lesions gain direct bodily access to the pools of water. In other words, these villages are "guinea worm receptive areas," since the conditions for resumed transmission persist.

Transmission of Infection

The most extensive and detailed studies on the transmission of dracunculiasis in Nigeria were conducted in the late forties and early fifties by Onabamiro,[3,4] who identified the various species of cyclops that acted as natural intermediate hosts of D. medinensis. Onabamiro's studies showed that in the town of Iwogye, in what is now Ogun State in the rain forest belt of Nigeria:

- Transmission of infection occurred only in the dry season.

- Of the eight species of "carnivorous" cyclops found to be naturally infected with D. medinensis, only the female Thermocyclops nigerianus (Keifer), the density of which was highest in the dry season, was responsible for transmission of infection to the populace.
- No Th. nigerianus were found in pools containing waterlilies and substantial green algae.
- The infection rate of Th. nigerianus at the height of the dry season was 5.1 percent.
- The greatest density of infected cyclops was found in the shallow end of the pond where villagers waded in to draw water.
- There were an average of 152 cyclops and an average of 9.5 D. medinensis larvae in every 5 liters of water at the water-drawing spot.
- In a typical guinea worm zone in southwestern Nigeria, the average man swallows in 1 year between 72 and 200 infected cyclops with the pond water he drinks.

Reservoir of Infection

Man is the only known natural reservoir of D. medinensis infection in Nigeria. The role, if any, of vertebrate animals in the transmission of infection has not been studied in Nigeria and is not known.

Frequency of Infection in the Human Host

The overwhelming majority of the adult males in guinea worm endemic parts of Nigeria are hoe and cutlass farmers. Women participate in such varied occupations as farming, petty trading, and processing farm products into marketable forms.[2]

The age and sex distribution of persons infected with guinea worm among a study population of 8,200 from 17 villages north of Ibadan between 1971 and 1975[2] is shown in Table 1 and the age- and sex-specific attack rates are illustrated in Figure 2. The overall prevalence was 13.5 percent with a range of 4.0-32.8 percent. The highest incidence in both sexes occurred in the 40-49 age group (32.8 percent for males and 27.2 percent for females), and there is another peak as well for the 10-19 age group. In another study,[9] the same two age-specific peaks of infection were recorded; however, that of the 10-19 age group was much higher than that of the 40-49 age group. Generally, nevertheless, the two sexes are infected about equally, a finding that coincides with those from other countries, notably India.

TABLE 1 Age and Sex Distribution of Persons Infected with Guinea Worm Disease in 17 Villages North of Ibadan, 1971-1975

	Males Infected			Females Infected			Total Infected		
Age (years)	No. in Group	No.	%	No. in Group	No.	%	No. in Group	No.	%
0-4	724	42	5.8	728	16	2.2	1,452	58	4.0
5-9	664	79	11.9	615	42	6.8	1,279	122	9.5
10-14	481	106	22.1	396	90	22.7	877	196	22.3
15-19	353	48	13.6	410	74	18.0	763	122	16.0
20-29	783	37	4.7	988	132	13.4	1,771	169	9.5
30-39	489	90	18.4	495	79	16.0	984	169	17.2
40-49	290	95	32.8	235	64	27.2	525	159	30.3
50+	318	64	20.1	231	48	20.8	549	111	20.2
TOTAL	4,102	561	13.7	4,098	545	13.3	8,200	1,106	13.5

SOURCE: O. O. Kale.[2] Reproduced with the permission of the American Journal of Tropical Medicine and Hygiene.

The Ibadan survey[2] also showed that significantly more boys than girls were affected, but that there was no difference in occurrence of the disease between children (16 years) and adults.

There is no evidence that protective immunity is acquired after infection, and repeated infections occur often among those continually exposed. The suggestion that gastric acidity plays a role in susceptibility to infection[10] has not been confirmed.[11] Epidemiological data from Ibadan strongly indicate that exposure, through the ingestion of infected water, is the major determinant of infection.[2]

Clinical Aspects

As reflected in all surveys taken where dracunculiasis is endemic, in southwestern Nigeria most guinea worms emerge from the lower limbs (89.6 percent by Onabamiro,[4] 93.4 percent by Muller,[12] and 93.6 percent by Kale[2]).

The average number of worms per affected person (worm burden) is a measure of the intensity of infection. Studies in southwestern Nigeria have shown that the average worm burden varies from 1.2 to 2.5.[2,4,12,13] This parameter is important in determining the level of endemicity of infection, a subject that is discussed later in this paper.

A variety of complications arising from guinea worm infection have been reported in Nigeria.[2,11,12,14-17] These include secondary bacterial infection leading to cellulitis, pyomyositis, and tetanus; arthritis (both septic and aseptic); tendon contractures; epidydimoorchitis; and inguinal adenopathy. Most of the arthropathic complications occur in relation to the feet and ankle joints.[2]

The average duration of infection (from eruption of the blister to emergence of the worm) is 5-8 weeks.[2] The period of incapacitation ranges from 3 weeks to 9 months, with an average of about 3 months, which often coincides with the farmer's planting season.

Using three suggested grades of disability,[19] Kale's study[2] in the Ibadan district between 1971 and 1975 showed that out of 1,106 cases, 57 percent were mildly disabled; 31 percent, moderately disabled; and 12 percent, severely disabled. The duration of infection can be shortened, and the degree of disability reduced significantly by chemotherapy.[19-21]

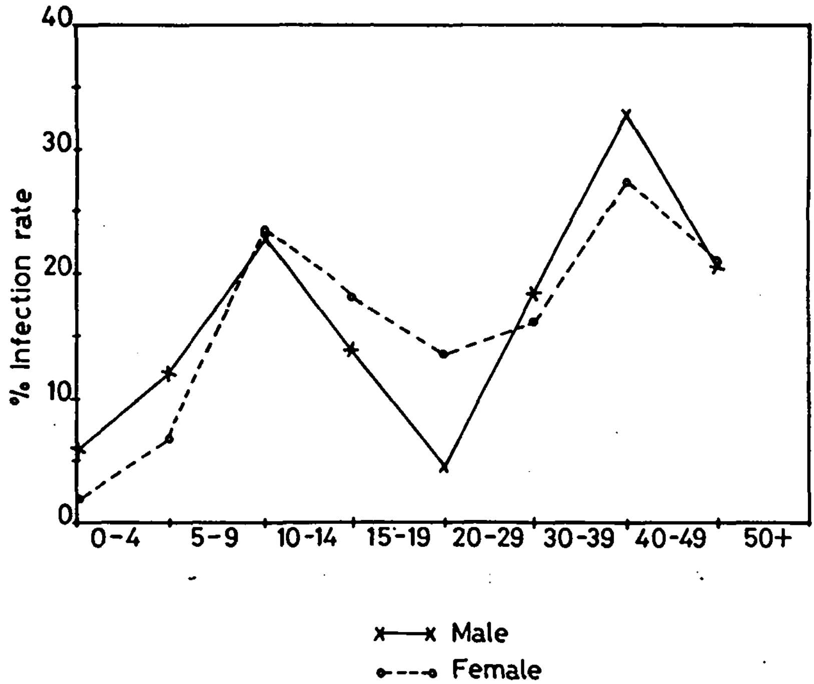

FIGURE 2 Age-specific incidence of guinea worm disease by sex in 17 villages north of Ibadan, 1971-1975. Source: O. O. Kale.[2] Reproduced with the permission of the <u>American Journal of Tropical Medicine and Hygiene</u>.

DEGREE OF ENDEMICITY OF DRACUNCULIASIS

The interaction of this parasite with man can be expressed in terms of prevalence, incidence, and intensity. These depend on a number of ecological and biological factors, most of which have been cited in this paper. In this connection, this section highlights one of the most important aspects of the epidemiology of dracunculiasis, which is of considerable relevance to the achievement of the objectives of this workshop but which has received little or no attention in the past.

One of the fundamental principles of comparative epidemiology is that there should be a set of valid parameters for assessing the impact of a health problem (in this instance a disease process) on the community under study. This would make it not only possible to make direct comparisons between different population groups, but also to monitor secular trends more accurately, irrespective of whether they evolve spontaneously or result from a specific intervention.

To the best of this author's knowledge, no attempt has been made to describe different and specific levels of endemicity of dracunculiasis, although a number of published articles have used such expressions as "hyper-endemic" or "low" or "high endemicity" with respect to dracunculiasis without a quantitative definition of what these expressions represent in terms of the epidemiological profile of the disease.

A review and analysis of data accumulated from epidemiological surveys conducted in Oyo State over the past 12 years are now being undertaken.[22] Preliminary inspection of the data suggests that there are three valid parameters by which the degree of endemicity of dracunculiasis in a given community can be defined: incidence rate, worm burden, and risk of infection. These indices reflect such diverse but interrelated and relevant aspects of the epidemiology of the disease as the spread of infection in the population (i.e., the size of the human reservoir); the intensity of infection among those affected; and the probability of becoming infected.

For a disease like dracunculiasis which has such a marked seasonal variation in incidence and little carry-over of infection from one season to the other, the incidence rate is more sensitive than the prevalence rate for measuring the impact of the disease. Indeed, it has been suggested that the incidence rate is a more fundamental measure for assessing the impact of a disease on a given population and comparing this impact among two or more subpopulations with different distributions of certain characteristics of exposure.[23]

The intensity of infection with dracunculiasis is reflected in the worm burden. The lower the worm burden (i.e., the average number of worms harbored by the infected person) in a community, the less the intensity, and vice versa.

The risk or probability of infection is a more complex index to estimate. It is a function of the incidence rate during the follow-up period and the length of that period.[24] The risk parameter is subject to such variables as the frequency of infected human contact with water sources, enabling D. medinensis larvae to be discharged into water containing cyclops; the population density of cyclops that are capable of transmitting infection; the proportion of water sources that contain infected cyclops accessible to the population at risk; the rainfall pattern; and the volume and pattern of consumption of water by individuals in the community.

The most appropriate parameter for measuring risk in dracunculiasis is the mean age at which 50 percent of the study population was first infected. The mean age of first infection has been shown to be lower in guinea worm disease endemic areas where it was only recently introduced.[10,25-27] The alternative of using the proportion of infected children below a given age (e.g., 10 years) in the population was rejected as being less sensitive and reliable.

The three selected parameters just described are closely related and embrace all the important variables that affect the epidemiology of the disease in a given population. When the Ibadan data are subjected to analysis using these three parameters, three distinct although overlapping levels of guinea worm endemicity can be defined:

1. A level of hyperendemicity, where the annual incidence rate is consistently above 20 percent, the average worm burden is over 1.9 per affected person, and the mean age of first infection is below 10 years.
2. A level of hypoendemicity, where the annual incidence rate is consistently below 5 percent, the average worm burden is below 1.5, and the mean age of first infection is above 15 years.
3. An intermediate level of mesoendemicity, where the annual incidence rate is between 5 and 20 percent, the average worm burden is between 1.5 and 1.9, and the average age of first infection is between 10 and 15 years.

These figures are very tentative and are subject to revision when all the data have been fully analyzed. A similar analysis of data from other countries would be valuable in determining whether the principles underlying this exercise are universally applicable and the effectiveness of the parameters proposed here.

Agreement must be reached on what criteria to use in diagnosing this disease; few published reports have given the precise criteria used for making a diagnosis. There is no doubt that surveys using strict confirmatory parasitological diagnosis cannot be compared directly with those that permit use of more subjective criteria or those based on sero-reactivity or skin sensitivity tests. Some working guidelines already exist.[18]

REFERENCES

1. Ramsay, G. W. St. C., 1935. Observations on an intradermal test for dracontiasis. Trans. R. Soc. Trop. Med. Hyg., 28:399-404.

2. Kale, O. O., 1977. The clinico-epidemiological profile of guinea-worm in the Ibadan district of Nigeria. Am. J. Trop. Med. Hyg., 26(2):208-214.

3. Onabamiro, S. D., 1951. The transmission of Dracunculus medinensis by Thermocyclops nigerianus as observed in a village in southwest Nigeria. Ann. Trop. Med. Parasitol., 45:1-10.

4. Onabamiro, S. D., 1952. The geographical distribution and clinical features of Dracunculus medinensis in south-west Nigeria. W. Afr. Med. J., 1:159-165.

5. Onabamiro, S. D., 1954. The diurnal migration of cyclops infected with larvae of Dracunculus medinensis (Linnaeus), with some observations on the development of the larval worms. W. Afr. Med. J., 3:180-194.

6. Onabamiro, S. D., 1956. The early stages of the development of Dracunculus medinensis (Linnaeus) in the mammalian host. Ann. Trop. Med. Parasitol., 50:157-166.

7. Kale, O. O., 1982. Fall in incidence of guinea-worm infection in western Nigeria after periodic treatment of infected persons. Bull. W.H.O., 60:951-957.

8. Akpovi, S. U., 1982. Putting paid to guinea worm infection. African Health, 4(4):23-25.

9. Barber, 1966. Igboora--A Town in Transition. Oxford University Press, Ibadan, Nigeria.

10. Scott, D., 1960. An epidemiological note on guinea-worm infection in north-west Ashanti, Ghana. Ann. Trop. Med. Parasitol., 54:32-43.

11. Gilles, H. M., and Ball, P. A. J., 1964. Guinea worm infection and gastric function. Ann. Trop. Med. Parasitol., 58:78-82.

12. Muller, R., 1971. Dracunculus and dracunculiasis. Adv. Parasitol., 9:73-151.

13. Kale, O. O. The Worm Burden in Dracontiasis. (In preparation)

14. Lauckner, T. R., Rankin, A. M., and Adi, F. C., 1961. Analysis of medical admissions to the University College Hospital, Ibadan. W. Afr. Med. J., 10:3-12.

15. Cowper, S. G., 1966. A review of helminthiasis in the western region of Nigeria with special reference to the Ibadan area. W. Afr. Med. J., 15:3-11.

16. Greenwood, B. M., 1968. Guineaworm arthritis of the knee joint. Br. Med. J., 1:314.

17. Osoba, A. O., and Oyediran, A. B., 1977. Guineaworm inguinal adenopathy. Br. J. Vener. Dis., 53:63-64.

18. Kale, O. O., 1977. Clinical evaluation of drugs for dracontiasis. Trop. Doct., 7:15-16.

19. Kale, O. O., 1974. A controlled field trial of the treatment of dracontiasis with metronidazole and niridazole. Ann. Trop. Med. Parasitol., 68(1):91-95.

20. Kale, O. O., 1975. Mebendazole in the treatment of dracontiasis. Am. J. Trop. Med. Hyg., 24:600-605.

21. Kale, O. O., Elemile, T., and Enahoro, F. Controlled comparative clinical trials of thiabendazole and metronidazole in dracontiasis. Ann. Trop. Med. Parasitol. (In press)

22. Kale, O. O., and Oyejide, C. O. Parameters for Determining the Levels of Endemicity in Dracunculiasis. (In preparation)

23. Miettinen, O., 1976. Estimability and estimation in case referent studies. Am. J. Epidemiol., 103:226-235.

24. Morgenstern, H., Kleinbaum, D. G., and Kupper, L. L., 1980. Measures of disease incidence used in epidemiologic research. Int. J. Epidemiol., 9:97-104.

25. Lyons, G. R. L., 1972. Guineaworm infection in the Wa district of north-western Ghana. Bull. W.H.O., 47:601-610.

26. Belcher, D. W., Wurapa, F. K., Ward, W. B., and Lourie, I. M., 1975. Guinea worm in southern Ghana: Its epidemiology and impact on agricultural productivity. Am. J. Trop. Med. Hyg., 24(2):243-249.

27. Wurapa, F. K., Belcher, D. W., and Ward, W. B., 1975. A clinical picture of Guinea worm disease in southern Ghana. Ghana Med. J., 14:10-15.

BIBLIOGRAPHY

Abolarin, M. O., 1981. Guinea worm infection in a Nigerian village. Trop. Geogr. Med., 33(1):83-88.

Adekolu-John, E. O., 1979. A communication on health and development in the Kainji Lake area of Nigeria. Acta Trop., 36:91-102.

Akpovi, S. U., Johnson, D. C., and Brieger, W. R., 1981. Guineaworm control: Testing the efficacy of health education in primary care. Int. J. Hlth. Educ., 24(4):229-237.

Edungbola, L. D., 1980. Water utilization and its health implications in Ilorin, Kwara State, Nigeria. Acta Trop., 37:73-81.

Gilles, H. M., 1964. Akufo: An Environmental Study of a Nigerian Village Community. Ibadan University Press,
Ibadan, Nigeria.

Lucas, A. O., Oduntan, S. O., and Gilles, H. M., 1969. Niridazole in guinea worm infection. Ann. N.Y. Acad. Sci., 160:729-739.

Oduntan, S. O., Lucas, A. O., and Gilles, H. M., 1967. Treatment of dracontiasis with niridazole. Lancet, Pp. 73-75.

Oluwande, P. A., 1975. Pilot studies on simple water schemes in an endemic area of guinea worm infection. J. Soc. Hlth. Nigeria, 10:17-22.

Onabamiro, S. D., 1950. A technique for studying infection of Dracunculus in Cyclops. Nature, 165:31.

Onabamiro, S. D., 1956. The effects of hetrazan (banocide) diethylcarbamazine on the larval form of Dracunculus medinensis. W. Afr. Med. J., 5:64.

Padonu, K. O., 1973. A controlled trial of metronidazole in the treatment of dracontiasis in Nigeria. Am. J. Trop. Med. Hyg., 22:42-44.

CORRELATION BETWEEN BIO-CLIMATIC VARIATIONS AND THE TRANSMISSION OF DRACUNCULIASIS

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Dracunculiasis (guinea worm disease) is typically considered an endemic and epidemic disease that occurs around water sources in the hot and dry zones of Africa only during the rainy season. Many dry season cases, however--even a maximum frequency--have been reported by numerous investigators.

This paper examines the correlation between bio-climatic variations and incidence of dracunculiasis transmission in francophone West Africa, specifically in a number of Sahelian zones (northern Upper Volta and northern Mali), savanna zones (Upper Volta, northern Ivory Coast, and Togo), and forest zones (southern Ivory Coast). Data for this analysis were taken from reports issued by the general health departments of the Ivory Coast, Upper Volta, and Mali, and from the results of a survey conducted in the Republic of Togo by Amoussouga and reported in 1977.[1]

SAHELIAN ZONE

In this zone annual rainfall is less than 600 mm. The correlation between maximum rainfall and maximum transmission frequency is quite clear. Figures 1 and 2 show that in Mali the maximum rainfall (registered in Bamako in 1977) corresponds to the maximum average number of cases reported between 1972 and 1977 in the rainy season, when ponds are filled with water. In the dry season, when the ponds dry up, particularly in northern Mali, water supplies are taken from very deep wells (20 m) which are protected because of their depth against any kind of contamination. The residual pond waters also found in Mali during the dry season result in year-round disease transmission.

Similarly, in Upper Volta maximum transmission also occurs in the rainy season (see Figures 3 and 4). This phenomenon is more striking in the northern part of the country in the region of Dori, and far less visible in the savanna zone in the south of the country.

SAVANNA ZONE

In the savanna zone, the maximum number of cases occurs between the beginning and the end of the dry season. It varies, however, according to region, the amount of rainfall, whether ponds dry up too early or too late, and the persistence of the ponds themselves. In the savanna regions, except in a few areas, the intensity of disease transmission is lowest at the end of the dry season when the ponds have completely dried up.

In the sudanian zone of Upper Volta, which has an annual rainfall of from 600 mm to 1,000 mm, maximum intensity of disease transmission shifts from the rainy season to the beginning of the dry season, and minimum intensity coincides with the end of the dry season.

In the sudano-guinean savanna zone of Upper Volta, Togo (see Figures 5 and 6), and the Ivory Coast, the annual rainfall is above 1,000 mm and, in general, there is a maximum intensity of transmission in the dry season, either at the beginning (e.g., in the region of Bobo Dioulasso in Upper Volta and the region of Korhogo in the Ivory Coast) or at the end (e.g., in the region of Odienné in the Ivory Coast and the subdivision of Bassari in Togo). In Bondoukou (eastern part of the Ivory Coast), the two peaks of maximum intensity of dracunculiasis transmission coincide with the two dry seasons.

In the savanna zone, there is maximum intensity of transmission in the dry season: at the end of the rainy season and the beginning of the dry season in the sudanian zone, and at full dry season and the end of the dry season in the sudano-guinean zones. Intensity is lowest in the rainy season and depending on the isohyets, at the end of the dry season.

FOREST ZONE

Dracunculiasis is transmitted year-round in this zone found along the south of the Ivory Coast and is related to the significant and rather regular rainfalls. Maximum transmission intensity in some regions of the Ivory Coast (Daloa, Dimbokro, and Adzopé) occurs only in the dry season, particularly when the ponds have not dried up completely and they have a high concentration of *Cyclops*.

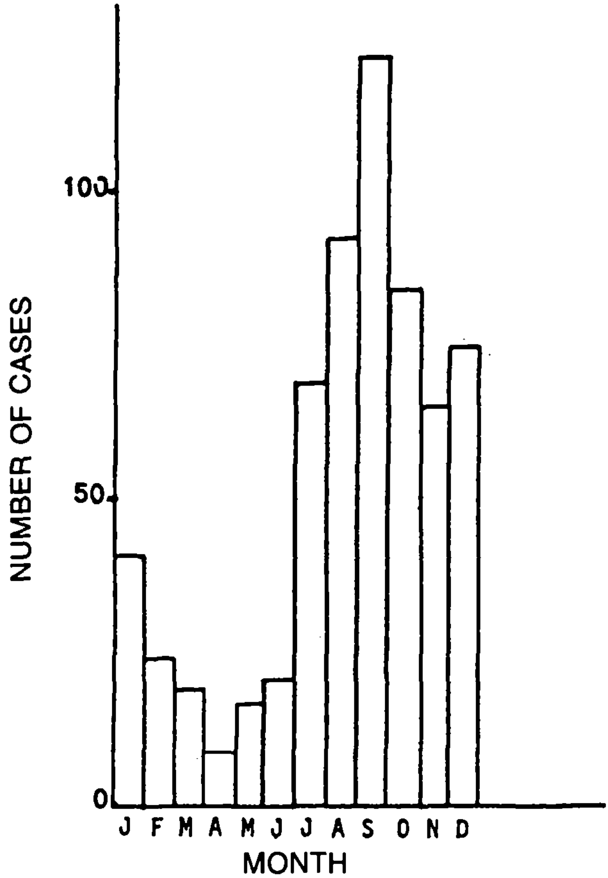

FIGURE 1 Average number of dracunculiasis cases reported monthly, Mali, 1972-1977.

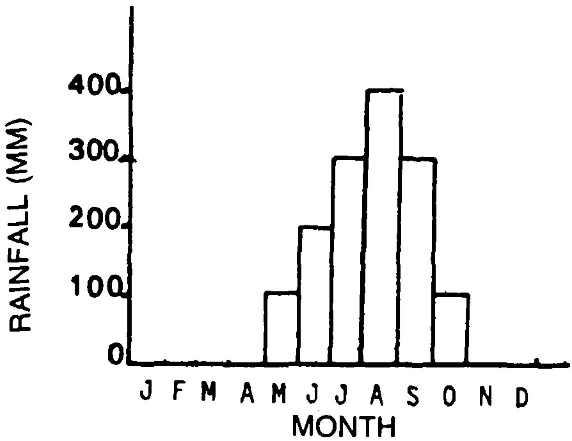

FIGURE 2 Average monthly rainfall (millimeters), Bamako, Mali, 1977.

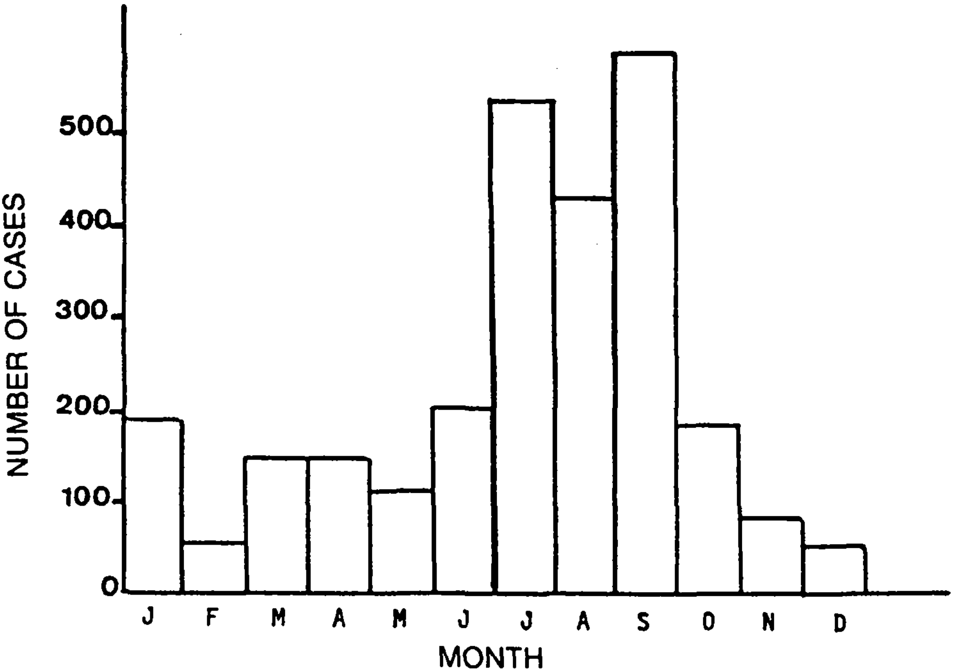

FIGURE 3 Average number of dracunculiasis cases reported monthly, Upper Volta, 1977.

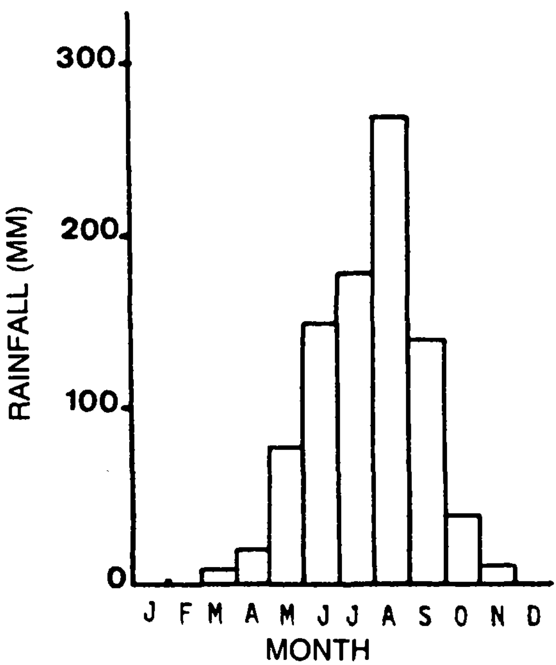

FIGURE 4 Average monthly rainfall (millimeters) over 25 years, Ouagadongou, Upper Volta

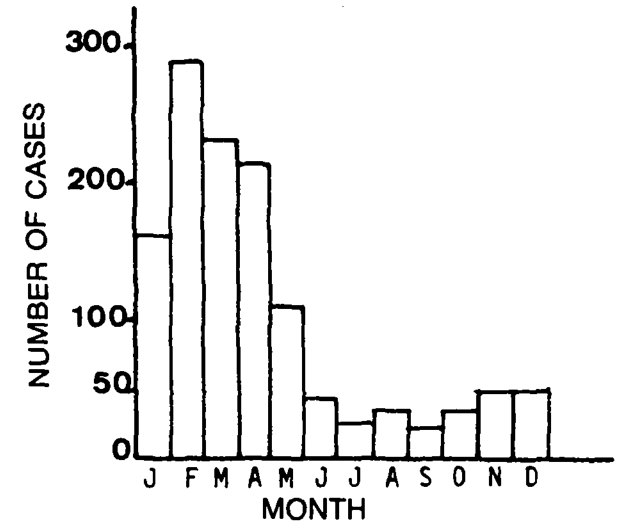

FIGURE 5 Average number of dracunculiasis cases reported monthly, Togo, 1975-1976.

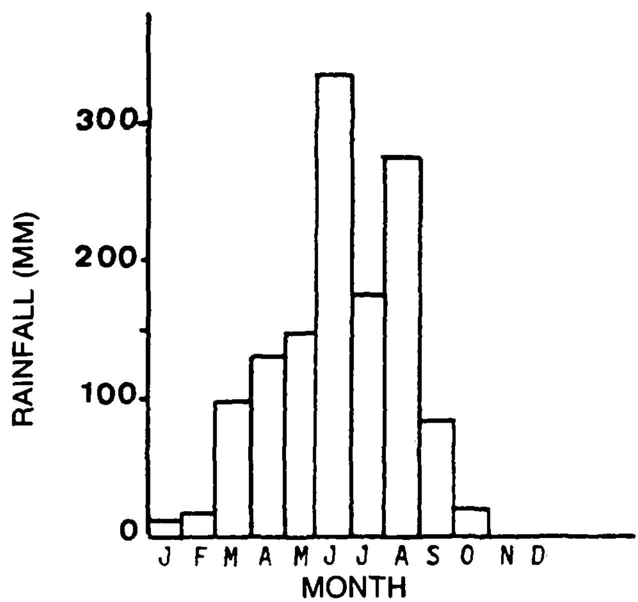

FIGURE 6 Average monthly rainfall (millimeters), region of Bassari, 1975, 1976.

The minimum number of reported cases generally appears in the rainy season.

REFERENCE

1. Amoussouga, P., 1976. Inquiry into Dracunculiasis Endemicity in the Administrative District of Bassari (Republic of Togo). Technical Document No. 6.679, Organisation Centrale contre les Grandes Endémies, Bouaké, Ivory Coast.

CONTROL METHODS

PROTECTION OF WATER SUPPLIES FOR THE CONTROL AND PREVENTION OF DRACUNCULIASIS

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Dracunculiasis (guinea worm disease) is transmitted entirely by drinking water, and thus its control and eventual elimination have been adopted as a major target of the United Nations International Drinking Water Supply and Sanitation Decade. The United Nations considers the protection of drinking water sources the best method for achieving guinea worm control. In May 1981, it specifically recommended: (1) filling stepwells, (2) providing piped water systems or other new water supplies, and (3) filtering drinking water through a double thickness cotton cloth. In addition, the U.N. System Steering Committee for the Decade has agreed that guinea worm prevention could serve as one indicator of the success of the Decade in affected areas.

PROVISION OF SAFE, ADEQUATE DRINKING WATER

Traditionally, safe, wholesome drinking water has been thought to be (1) uncontaminated (thus unable to infect the user with a water-related disease); (2) free from poisonous substances; and (3) free from excessive amounts of mineral and organic matter. Questionable water sources can be treated and protected to the degree necessary to render them safe for consumption, and this is the essence of the three U.N. recommendations just listed.

To prevent the transmission of guinea worm disease, the water source need only meet the first criteria given above. Nevertheless, using certain protection strategies, the transmission of guinea worm disease can be prevented without protecting the source against all water-related disease contamination.

Projects designed to provide safe drinking water include strategies to halt the three primary mechanisms of water-related disease transmission associated with water source quality:

- o Water-borne (the pathogen in the water is consumed resulting in infection)
- o Water-based (infection by parasitic worms that depend on aquatic host(s) to complete their life cycle)
- o Water-insect vectors (infection by insects that breed in water).

The preventive strategies for guinea worm disease, which is transmitted by the water-based mechanism, are:

- o Decrease or eliminate the need for water contact
- o Control aquatic host populations
- o Improve quality of drinking water.

It is clear that improvements based on the first two strategies would not prevent transmission of all water-based diseases. Thus, although the United Nations proposes to measure the effectiveness of the water decade by using statistical data on guinea worm infection, these data will only provide an inaccurate, partial indication of the degree to which the Decade goal of providing safe, adequate water has been met. The sensitivity of the guinea worm transmission mechanism to preventive measures may be used, however, to indicate for planning purposes those areas deserving priority for the provision of protected water supplies.

The epidemiological facts of guinea worm transmission supported by statistical data on guinea worm infection become persuasive arguments for pinpointing villages with priority needs for safe, adequate water systems. Where guinea worm disease infects 20-30 percent of the population, the water supply is certainly from unprotected sources such as surface ponds or other sources where contact with the water permits completion of the transmission cycle. In addition, statistical information on areas where guinea worm infection persists should be used to pinpoint areas and villages where existing programs are not successful. Used in conjunction with other epidemiological statistics, investigators may be able to determine whether physical protective mechanisms have failed or whether protected supplies have been bypassed because of sociological factors.

WATER SUPPLY SYSTEMS

Water supply systems can be divided into two broad categories: urban and rural. In the context used here, urban water supplies are defined as those distributed via pipes, and the raw water is treated prior to entering the distribution system. The distribution system delivers water, under constant positive pressure, to the consumer at standpipes or house connections. A properly designed urban water supply system generally provides treatment as required by clarification, filtration, or disinfection. In addition to eliminating infectious matter from water destined for public consumption, the piping of treated water assures that the general population does not have access to the raw water source.

Slums or fringe zones of urban developments present special water supply problems that are compounded by socioeconomic conditions. Public standpipes or water vendors generally serve lower income groups in urban areas. Most progressive governments extend, as a social service, the urban water system into these areas through such standpipes. Otherwise, dwellers may seek water from unprotected sources which, in some instances, may also be the raw water source for the public water supply system. Contamination of the raw water source results.

Criteria for design of such a distribution system must insure the provision of an adequate number of standpipes and suitable drainage to serve the population properly. In the lowest income neighborhoods, the use of water vendors should be avoided, as consumers may seek alternate water sources of questionable quality when they are unable to pay for vendor-sold water or to purchase the water in adequate quantities to maintain hygiene.

Rural water supplies may be classified as either piped water, with or without prior treatment, or unpiped water. The quality of treatment as well as the reliability of distribution reflect directly on how well the community or the responsible government agency is maintaining and operating the facility.

Most improved water supplies for rural villages consist of hand-dug or bored wells using traditional lifting systems or hand- (or foot-) operated pumps. Many villages are served with dug wells primarily designed to water livestock with little or no consideration being given to protection of the water source for human consumption. Where improved water supplies do not exist, the village uses its traditional water sources which may vary from unlined dug wells to ponds filled during the rainy seasons.

PROTECTION OF WATER SUPPLIES

The protection of any water source normally found in developing countries does not present any particular technical problems, especially with regard to preventing transmission of guinea worm infection. Major constraints to the designer are all too often socioeconomic in nature, and they may circumvent physical efforts to protect new or improved water supply systems. Researchers are now expending considerable effort to improve existing technology and to incorporate the use of economical local materials to improve and lower the costs of equipment. One major goal is to develop equipment that can be manufactured and repaired by local artisans.

The first consideration in ensuring an adequately protected water system is selecting the most appropriate water source. Surface or groundwater sources subject to a multitude of uses, such as bathing, laundry, irrigation, waste disposal, livestock watering, etc., should be avoided if at all possible. The rule is to utilize the purest or so-called most "innocent" source for drinking water. In following this rule, most planners rely on groundwater resources, since the collection, distribution, and treatment of surface waters are generally outside the technical possibilities and economic resources of most rural populations in developing countries. In this way, the movement of water through the soil and into the groundwater table provides adequate treatment. The removal of pollution as water travels through solids and water-bearing formations depends upon the mechanical removal of microorganisms and other suspended matter by filtration and sedimentation as well as the natural "die-away" of bacteria and intermediate hosts found in soils.

No improved water source can be considered fully protected, no matter how well it is constructed physically, unless steps are taken to ensure that the water supply is:

- o Technically viable, that is, the water produced by the well or source is safe and wholesome, meets the requirements of the community, and is readily available to the population it must serve.
- o Maintained and operated during its service life in a satisfactory manner.
- o The users are educated in the proper handling and use of the water.

Accordingly, protective measures for dug and bored wells include:

- o Protective linings to adequate depths
- o Protection from surface drainage using concrete aprons and covers
- o Adequate, well-designed water delivery systems
- o Proper operation and maintenance during its service life.

The economic implications of these protective measures may be considerable. For example, the addition of a reinforced concrete apron to a dug lined well designed primarily for livestock watering could increase construction material costs from 16 to 30 percent depending upon the depth of the well. Upgrading the water-lifting devices to provide adequate protection for human consumption will raise the cost even higher. The costs associated with health education and other social programs aimed at assuring the consumption of safe water are harder to pinpoint but, nevertheless, represent real drains on economic resources.

PLANNING FOR WATER SUPPLY PROTECTION

The protection of water supplies begins at the national or regional planning level. At this level, policies are established for the allocation of water resources, construction of water supplies, cooperation between resource-sharing agencies, distribution of manpower and economic resources, and determination of planning mechanisms that influence the character and nature of water supplies delivered to rural areas.

The inclusion of public health and sanitation officials in initial planning activities insures that epidemiological facts and statistical data are properly used in the decision process to determine priorities for water supply development. Planning at the national level must insure cooperation between interested agencies to realize maximum use of available resources.

Planning single-purpose water supplies in rural areas of most developing countries is not realistic given the limited resources available. For example, a well dug for livestock watering will also be used as a source of water for human consumption. For this type of well, provisions should be made to facilitate water collection for domestic purposes and eliminate problems associated with priorities of use. Otherwise, individuals seeking domestic water may become discouraged and abandon a potentially safe source to seek water from contaminated ponds or unprotected traditional sources.

Design and construction criteria should suit local conditions. For example, the adequacy of improved water supplies using hand (or foot) pumps to deliver sufficient flows to meet village needs during peak demand periods is usually not demonstrated before construction. Thus subsequently, protected wells are abandoned for traditional sources because flow is not adequate to meet demand where water collection activities are confined to specific periods of the day. Likewise, attempts to serve two adjacent villages with a single well located midway often lead to the continued use of traditional sources by inhabitants.

The final decision on any water supply should follow an extensive local survey. In addition to information and data normally sought to support technical design, preliminary field investigations at the village level should determine:

- The best water sources to meet present and projected multi-use demands of the village, that is, domestic, livestock, agriculture, local artisans
- Sanitation and water use practices of the local population, taking into consideration water-related diseases and health education requirements
- Local disease patterns, taking into consideration water-related diseases and health education requirements
- Local possibilities for construction, maintenance, and operation of water supplies
- The individual within the village who will be responsible for maintaining and operating the water supply to assure his early inclusion in regional and national training programs
- Inventory of activities, both ongoing and planned, to ascertain where combined efforts are feasible
- Experience of adjacent villages with improved supplies as well as feedback from other areas to learn from successes or avoid failures.

Although ideally one would conduct the local survey using a multidisciplinary team, this is seldom possible. Investigators should receive training and guidelines from all concerned agencies.

BIBLIOGRAPHY

Bourne, P. G., 1982. Global eradication of guinea worm. J. Roy. Soc. Med., 75:1-3.

Cairncross, S., Carruthers, I, Curtis, D., Feachem, R., Bradley, D., and Baldwin, G., 1980. Evaluation for Village Water Supply Planning. John Wiley & Sons, Chichester, England.

Gibson, U. P., and Singer, R. D., 1969. Small Wells Manual. U.S. Agency for International Development, Washington, D.C.

Lyons, G. R. L., 1973. The control of guineaworm with abate: A trial in a village of northwest Ghana. Bull. W.H.O., 49:215-216.

Sahba, G. H., Arfaa, F., Fardin, A., and Ardalan, A., 1973. Studies on dracontiasis in Iran. Am. J. Trop. Med. Hyg., 22(3):343-347.

Wagner, E. G., and Lanoix, J. N., 1959. Water Supply for Rural Areas and Small Communities. Monograph Series No. 42. World Health Organization, Geneva, Switzerland.

White, G. F., Bradley, D. J., and White, A. U., 1972. Drawers of Water, Domestic Water Use in East Africa. University of Chicago Press, Chicago, Illinois.

CYCLOPOID COPEPODS: THEIR ROLE IN THE TRANSMISSION AND CONTROL OF DRACUNCULIASIS

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INTRODUCTION

As long ago as 1906, Leiper stated that the "practical study of dracontiasis, one of the oldest known and, in some regions, the most prevalent of tropical diseases, has been singularly neglected."[1] Until very recently, Leiper's opinion has remained largely unchallenged in spite of the major socioeconomic advances and outstanding technological achievements of the last 50 years.

Few practical studies, with some notable exceptions, aimed at the prevention and control of dracunculiasis (guinea worm disease) have been undertaken during the present century. The main reasons for the long neglect of these studies include:

- Globally, the distribution and public health importance of the disease does not compare with such other parasitic infections as malaria, schistosomiasis, soil-transmitted helminths, etc. At the global level, therefore, its priority is relatively low.
- Nationally, the disease is seasonally restricted to small, often isolated communities located in impoverished areas without, to say the least, political influence, and with little chance of benefit from concerted public health activities.
- Neither effective drugs nor a vaccine to treat or prevent the disease exist. Infected villagers have, therefore, little incentive to seek treatment at dispensaries or hospitals and tend to rely much more on traditional methods. Consequently, the true gravity of the malady is often hidden.
- While the methods of preventing dracunculiasis are simple, their organization and effective implementation in remote rural areas are

surprisingly complex. However, recent advances in primary health care concepts give rise to more promising control prospects.

- Prevention and control of dracunculiasis demand a multidisciplinary approach.
- Biologists have, for obvious reasons, concentrated chiefly on medical entomology, occasionally on malacology, and hardly ever on the subclass Copepoda, probably because so few important human parasites are transmitted by the latter group.

This paper will summarize the role of cyclopoid copepods in the transmission and control of dracunculiasis. Attention will be drawn to some unresolved problems, with special regard to the intermediate hosts and their preferred habitats, particularly those deserving to be more fully studied with the aim of developing more cost-effective, integrated control strategies.

FRESHWATER CYCLOPOID COPEPODS

These minute, pinhead-sized crustaceans are biologically very successful, comprising many genera with diverse feeding habits. They are found worldwide and almost exclusively in standing or slowly-flowing marine, brackish, and freshwater water bodies. For example, the pelagic marine forms occur in enormous quantities and play a crucial role in the food chain of many fishes and whales. In addition, parasitic copepods are a favorite subject of study in many biology departments, as the parasitic way of life has been exploited by many different copepod families, and every stage of parasitism, between ordinary free-living forms and the most complex or degenerate parasites, is exhibited.

The free-living, freshwater cyclopoid copepods (also known as cyclops), are pear-shaped organisms, comprising a cephalothorax, an abdomen, and a telson with a tail of two caudal rami. The sexes are separate and the egg hatches into a typical nauplius larva, which is then succeeded by several metanauplius stages before molting into the first of five successive copepodid stages. Almost nothing is known of the susceptibility of the different instars to the infective larvae of *Dracunculus*. Moreover, few publications specify confirmation of the taxonomic status or the exact age or size class of infected cyclopoids.

Taxonomy and Biology of Cyclops Acting as Intermediate Hosts

Muller has listed 17 species of cyclops that can potentially act as intermediate hosts in different dracunculiasis endemic areas.[2] In addition, Cyclops vernalis americanus has proved an excellent experimental host,[3,4] although it has not been recorded in endemic regions. More recently, Steib, working in Upper Volta, added two more species (Thermocyclops incisus and Metacyclops exsulis) to the list of potential intermediate hosts.[5] Further species will no doubt be incriminated as more research at natural transmission sites is undertaken in the future.

Concerning the taxonomy and biology of cyclops, the following aspects are salient, but few have been studied exhaustively:

- Only large, predatory species can readily ingest D. medinensis larvae and can thus act as potential intermediate hosts. Of these carnivorous species, the older and larger copepodid stages are more predatory than the younger and smaller ones.[5] The smaller herbivorous species are excluded as natural intermediate hosts.
- In each endemic zone usually only one of the local predatory species is the dominant intermediate host by virtue of its preferred habitat, its seasonal population dynamics, or both.
- Even among carnivorous species some are more compatible with D. medinensis infection than others. While intermediate host specificity does not strictly occur, some species of predatory cyclops are more resistant to infection than others.
- The reproductive biology, bionomics, and behavior of the dominant intermediate host species in natural transmission sites in most endemic zones (seasonal ponds, stepwells, etc.), in relation to biotic and abiotic parameters and according to cyclops and D. medinensis infection patterns, have scarcely been studied even though valid techniques to do so are now available.[6] Obviously, data from such studies, together with information on human and water contact patterns, could help to identify and predict with reasonable certainty the most important site or sites of transmission according to geographic area.
- For unknown reasons, some species of carnivorous cyclops are more difficult to maintain in the laboratory than others, but good experimental hosts (e.g., C. vernalis americanus) do exist.

- Muller has already pointed out that nothing "is known of the number or density of infected cyclops necessary for continued transmission in a particular habitat."[2] Sound data on this subject are a prerequisite for a rational evaluation of control measures directed against the copepod hosts.

Preferred Habitats of the Cyclopoid Hosts and Season of Transmission

Transmission of D. medinensis is normally not associated with flowing water courses, drawwells, or impoundments such as lakes and dams which retain large volumes of water even at the climax of the dry season. Running water is, in general, incompatible with the maintenance of carnivorous copepod populations. They may occur in drawwells, but exposure to infection is minimal. While some species of potential intermediate hosts may occur in large impoundments, their population density is relatively low and thus the potential of these water bodies for transmission is low.

Both seasonally dense populations of cyclopoid hosts and high transmission potential are associated with two main types of water body:

1. Stepwells in the Indian subcontinent and cisterns ("birkehs") in Iran
2. Small, usually impermanent, man-made ponds, constructed to provide a seasonal domestic water supply and, therefore, much used during a particular time of the year.

Regarding the main seasons of transmission, it appears that:

- Transmission is not associated with the peak of the rainy season in the endemic areas.
- In the Sahel and dry savanna areas of West Africa, maximum transmission may take place at the onset of the rainy season, coinciding with the main planting period.
- In the wetter savanna zone closer to the West African coast and probably to the south of Sudan, peak transmission usually coincides with the advance of the dry season prior to the drying up of village ponds.
- In Pakistan and India, transmission is generally confined to areas of low rainfall and is maximal during the summer months.

- o In all endemic areas, peak densities of intermediate hosts and transmission of D. medinensis is confined to less than 3 months a year.
- o The incidence and prevalence rates of dracunculiasis are intimately related to local rainfall and evaporation patterns. Prediction of "good or poor dracunculiasis years" by analysis of local meteorological data has not yet been studied in depth.

Development of D. medinensis in the Cyclopoid Host

The Russian biologist Aleksej Pavlovic Fedchenko (1844-1873) was the first to describe this phenomenon just over 100 years ago. Muller has noted the historical significance of this discovery for tropical medicine.[2]

During the last 50 years, the salient features of the development of D. medinensis larvae in the cyclopoid host have been adequately described, although some minor and quantitative aspects have yet to be elucidated. Both epidemiologically and from the viewpoint of intervention, Muller's observation is pertinent: although the larvae may remain active in pond water for a week, the "percentage infection rate in cyclops fell sharply after three days of storage in pond water and was nil after six days."[2] Data on temperature were not given, but it can be predicted that the sensitivity to temperature, of the first-stage larvae within the cyclops host like that of later stages, is more pronounced than that of the cyclopoid copepods themselves to this parameter.

When the first-stage larvae are ingested by the intermediate host, they break through the gut wall to reach the hemocoel where, at temperatures above 25°C, they molt twice to reach the infective third stage in about 2 weeks. Thereafter, they may continue to develop for 1-3 more weeks.

There is little information in the literature on the average lifespan of infected and uninfected cyclops in relation to the range of abiotic factors normally recorded in natural transmission sites.

In nature, only a single larva is found in the copepod host, and multiple infection tends to be lethal. Muller, however, mentions that "experimentally infected adult cyclops [C. vernalis americanus] may have up to five larvae."[2] Steib has drawn attention to observations that infection not only retards development of the cyclops host, but also that infected immature cyclopoids do not mature.[5] According to him, little is known of the precise status of different cyclopoid species and their developmental stages in the transmission of dracunculiasis. Moreover, Steib[5] notes that the importance of the different instars of each cyclopoid species in acting as intermediate host of Dracunculus depends on the following conditions:

(a) the feeding habits of the cyclopoids: whether or not the different instars of each cyclopoid species ingest Dracunculus larvae;

(b) the potential for enduring infection with Guinea-worm larvae and the species-specific resistance of cyclopoids: whether or not the Dracunculus larvae may conclude their development in the different cyclopoid instars without being killed by the host or without lethally damaging the host;

(c) the survival time of infected cyclopoids after the Dracunculus larvae have reached their infective stages.

Regarding the behavior of infected cyclops, Onabamiro has noted that specimens harboring third-stage infective larvae tend to remain at the bottom of the pond in contrast to uninfected specimens (C. nigerianus, Kiefer) which exhibit marked vertical diurnal migration.[7] The role of the behavior of infected cyclops to transmission potential remains conjectural.

CYCLOPS CONTROL

Should global eradication of any pathogenic human entaparasite be anticipated, D. medinensis is probably the prime candidate despite the fact that control presently relies on preventive, rather than curative, measures.

Prevention at the community level can best be achieved by a combination of:

- Sustained health education aimed at ensuring maximum awareness of the problem and a commitment to overcome it by self-reliant means
- Provision of a safe and enduring domestic water supply using, if possible, appropriate technology
- Control of infected cyclops by chemical or biological methods or by, for example, simply ensuring that drinking water from potential transmission sites is sieved during the period that Dracunculus is patent. A research study on the latter topic, based on appropriate technology

and community participation concepts, is presently being carried out by K. Steib in Upper Volta, supported by the Director's Initiative Fund of the UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases.

Inevitably, dracunculiasis prevention must be multidisciplinary, and good coordination of the different elements involved is mandatory. Control of Dracunculus at the village level lends itself to primary health care principles. At the national level, marked reduction, if not elimination, of the infection is attainable where enthusiasm and support by all concerned are assured.

The possible need to control cyclops should not be omitted from the above preventive measures. Rural dwellers, in general, are conservative and prefer traditional water sources, or they may be forced to resort to them if the improved water supply fails to function adequately. In the upper region of Ghana, for example, more than half of over 2,000 water pumps had ceased to function within 2 years of installation.

Chemical Control of Cyclops

Compounds used for control of cyclops should be:

- Highly toxic to all developmental stages of cyclops
- Low in cost
- Of insignificant toxicity to mammals and fish
- Tasteless at effective concentrations
- Readily available
- Easily applied
- Effective residually for at least 4, but preferably 12, weeks
- Stable in storage.

Many chemicals have been tested,[8] though few under field conditions. The organophosphorous temephos (Abate, used primarily as an insecticide[9]) in sand granule formulation, is presently considered the compound of choice. This formulation is commercially available (1 percent active ingredients), and at the recommended dose of 1.0 mg/liter, cyclops should be eliminated from the water body within 5-7 weeks. Muller has observed that the sand granule formulation of temephos "provides a very convenient method of adding the compound to ponds as it has limited solubility and the quantities do not have to be dispensed with any great accuracy."[10] Since issuance of the WHO/FAO Data Sheets on temephos in 1975,[9] 2-year feeding studies of rats have been completed and no significant difference between the incidence of tumors in exposed rats (10 mg/kg, 100 mg/kg, and 300 mg/kg of temephos in the diet) and control animals was found. Moreover, during large-scale field trials and operational use of temephos in the drinking water at a target concentration of 1 mg/liter in Thailand and Indonesia, no complaints have been reported.

The timing and frequency of applications will vary according to the local epidemiological conditions. The timing of the first application will depend on local rainfall and evaporation patterns. It should also coincide as closely as possible with first evidence of patent infection in the community, bearing in mind that larvae in the intermediate host require about 2 weeks to develop to the infective third stage. Thereafter, applications may be repeated at monthly intervals until the end of the transmission season. Rarely more than four applications during the transmission period in any endemic area are likely to be necessary. An operational manual recently published in India[6] gives very clear, practical details for the use, properties, formulation, dosage, and frequency of application of temephos. This document should provide an excellent model for the preparation of other national manuals on dracunculiasis control.

The need cannot be stressed too strongly for both small-scale and large-scale field testing of the efficacy of temephos for D. medinensis control in different endemic areas representative of the range of epidemiological conditions. After the methodology for applying temephos has been clearly defined, the feasibility of its use under the supervision of community leaders should be emphasized. Similarly, studies to identify improved residual formulations, permitting reduction in the frequency of application, are desirable.

Biological Control of Cyclops

Two field investigations on the biological control of cyclops were recorded some 40 years ago in India,[11,12] but apparently in recent years no biocontrol studies have been carried out. Certain species of fish predators have been advocated on the basis that, apart from efficacy, they may be cheaper and more permanent than repeated chemical control. Gidgeon has recommended the use of Rasbora doniconius for permanent stepwells,[11] while Moorthy and Sweet reported encouraging results in 35 endemic villages using fish as biocontrol agents of cyclops.[12] Transmission of dracunculiasis was eliminated in six villages and significantly reduced in four others. The maintenance of fish in the transmission sites posed certain problems, but they were not insurmountable.

The first measure in routine control of D. medinensis transmission by small predatory fish should be the establishment of hatcheries for regular supply purposes. A successfully controlled stepwell could, of course, function as a hatchery. In India, the custom of keeping fish in the drinking water supply is widespread.

In spite of these encouraging results, the new manual on dracunculiasis eradication in India[6] makes no mention of biological control. In Africa, where many transmission sites dry up each year, the only fish that can be considered for biocontrol are the so-called annual species. The efficacy of certain invertebrate competitors or predators of cyclops should be explored.

REFERENCES

1. Leiper, R. T., 1906. The influence of acid on guinea worm larvae encysted in cyclops. Br. Med. J., 1:19-20.

2. Muller, R., 1971. Dracunculus and dracunculiasis. Adv. Parasitol., 9:73-151.

3. Mueller, J. F., 1959. The laboratory propagation of Spirometra mansonoides as an experimental tool. II. Culture and infection of the copepod host, and harvesting of the procercoid. Trans. Am. Microsc. Soc., 78:245-255.

4. Muller, R., 1968. Studies on Dracunculus medinensis (Linnaeus). I. The early migration route in experimentally infected dogs. J. Helminthol., 42:331-338.

5. Steib, K., 1982. Epidemiology and Vectorecology of Dracontiasis in Upper Volta as a Prerequisite for Control Measures. Preliminary Report, Institut für Tropenhygiene, Heidelberg, West Germany.

6. Government of India, 1982. Operational Manual. Guinea Worm Eradication Programme in India. Division of Helminthology, National Institute of Communicable Diseases, 22, Sham Nath Marg, Delhi-110054, India.

7. Onabamiro, S. D., 1954. The diurnal migration of cyclops infected with larvae of Dracunculus medinensis (Linnaeus), with some observations on the development of the larval worms. W. Afr. Med. J., 3:180-194.

8. Muller, R., 1970. Laboratory experiments on the control of cyclops transmitting guinea worm. Bull. W.H.O., 42:563-567.

9. WHO/FAO, 1975. Data Sheets on Pesticides, No. 8, Rev. 1, Temephos. Mimeographed document VBC/DS/75.8, World Health Organization, Geneva, Switzerland.

10. Muller, R., 1979. Guinea worm disease: Epidemiology, control, and treatment. Bull. W.H.O., 57:683-689.

11. Gideon, P. W., 1942. Experiments in the control of guineaworm infection in step-wells by means of larvivorous fish, Rasbora daniconius, and chlorogen. Proc. 28th Indian Sci. Congr., Part III: Abstracts, p. 225.

12. Moorthy, V. N., and Sweet, W. C., 1936. A biological method for the control of dracontiasis. Indian Med. Gaz., 71:565-568.

BIBLIOGRAPHY

Abolarin, M. O., 1981. Guinea worm infection in a Nigerian village. Trop. Geogr. Med., 33(61):83-88.

American Cyanamid Company, n.d. Abate Larvicide. Cyanamid, Agricultural Research Division, American Cyanamid Company, Princeton, New Jersey 08540.

Belcher, D. W., Wurapa, F. K., Ward, W. B., and Lourie, I. M., 1975. Guinea worm in southern Ghana: Its epidemiology and impact on agricultural productivity. Am. J. Trop. Med. Hyg., 24(2):243-249.

Edungbola, L. D., 1980. Water utilization and its health implications in Ilorin, Kwara State, Nigeria. Acta Trop., 37:73-81.

Fryer, G., 1957. The food of some freshwater cyclopoid copepods and its ecological significance. J. Anim. Ecol., 26:263-286.

Golvan, Y.-J., and Lancastre, F.-A., 1968. Developpement des larves de Dracunculus medinensis chez les Cyclops de l'Ile-de-France. Ann. Parasitol. Hum. Comp., 43:705-710.

Hsü, H. F., and Watt, J. Y. C., 1933. Dracunculus medinensis infection in two dogs in Peiping: Experimental infection of cyclops. Chin. Med. J., 47:1326-1330.

Issoufa, H., Monekosso, G., and Ripert, C., 1979. Etude épidémiologique de la dracunculose chez les podokwos des monts du Mandara (Nord Cameroun). Bull. Soc. Pathol. Exot., 72(2):135-144.

Laws, E. R., Jr., Sedlak, V. A., Miles, J. W., Joseph, C. R., Lacomba, J. R., and Rivera, D. R., 1968. Field study of the safety of Abate for treating potable water and observations on the effectiveness of a control programme involving both Abate and Malathion. Bull. W.H.O. 38:439-445.

Leiper, R. T., 1911. A method for dealing with town wells infected with Guinea-worm. J. Lond. School Trop. Med., 1:28-30.

Lyons, G. R. L., 1972. Guineaworm infection in the Wa district of north-western Ghana. Bull. W.H.O., 47:601-610.

Lyons, G. R. L., 1973. The control of guineaworm with Abate: A trial in a village of North-West Ghana. Bull. W.H.O., 49:215-216.

Macpherson, C. N. L., 1981. The existence of Dracunculus medinensis (Linnaeus, 1758) in Turkana, Kenya. Trans. R. Soc. Trop. Med. Hyg., 75(5):680-681.

Moorthy, V. N., 1938. Observations on the development of Dracunculus medinensis larvae in cyclops. Am. J. Hyg., 27:437-460.

Moorthy, V. N., and Sweet, W. C., 1936. Guinea worm infection of cyclops in nature. Indian Med. Gaz., 71:568-570.

Nugent, D. A. W., Scott, D., and Waddy, B. B., 1955. Effect of water-point treatment with DDT on the incidence of guinea worm infection. Trans. R. Soc. Trop. Med. Hyg., 49:476-477.

Nwosu, A. B. C., Ifezulike, E. O., and Anya, A. O., 1982. Endemic dracontiasis in Anambra State of Nigeria: Geographical distribution, clinical features, epidemiology and socio-economic impact of the disease. Ann. Trop. Med. Parasitol., 76:187-200.

Onabamiro, S. D., 1950. A technique for studying infection of Dracunculus in cyclops. Nature, 165:31.

Onabamiro, S. D., 1951. The transmission of Dracunculus medinensis by Thermocyclops nigerianus, as observed in a village in south-west Nigeria. Ann. Trop. Med. Parasitol., 45:1-10.

Ramakrishnan, N. R., and Rathnaswamy, G.K., 1953. Use of DDT for control of cyclops breeding and as an anti-dracontiasis measure. Indian Med. Gaz., 88:386-390.

Rao, C. K., Paul, R. C., Sharma, M. I. D., and Kumar, S., 1981. Guineaworm disease in India: Current status and strategy of its eradication. J. Commun. Dis., 13:1-7.

Rao, S. S., 1936. The effect of gastric juice and of bile on cyclops infected with guinea worm larvae. Indian J. Med. Res., 24:535-540.

Roubaud, E., 1913. Observations sur la biologie du ver de guinée infection intestinale des cyclops. Bull. Soc. Pathol. Exot., 6:281-288.

Sahba, G. H., Arfaa, F., Fardin, A., and Ardalan, A. 1973. Studies on dracontiasis in Iran. Am. J. Trop. Med. Hyg., 22:343-347.

Scott, D., 1960. An epidemiological note on guinea-worm infection in north-west Ashanti, Ghana. Ann. Trop. Med. Parasitol., 54:32-43.

Sharma, S. K., and Wattal, B. L., 1981. Faunistic studies on Indian cyclops with special reference to Delhi region. J. Commun. Dis., 13:8-16.

Sharma, S. K., and Wattal, B. L., 1981. Laboratory studies on the biology of Mesocyclops leuckarti (Claus). J. Commun. Dis., 13:115-120.

Stockman, C., Bollinger, E. H., and Naranch, R. N., Jr., 1970. Slow-release polymeric compositions for mosquito larviciding. Mosq. News, 30:584-589.

HEALTH EDUCATION STRATEGIES FOR THE CONTROL OF DRACUNCULIASIS

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INTRODUCTION

Behavioral factors contributing to the transmission of dracunculiasis (guinea worm disease) have been clearly documented.[1] Behaviorists generally agree that the transmission cycle involves two clearly distinguishable and preventable behaviors of man:[2]

1. An affected person, and thus that part of the body from which the adult female worm is emerging, comes in contact with water. This enables the anterior end of the worm to rupture, liberating thousands of larvae which are ingested by cyclops (the intermediate host).
2. A susceptible person fetches and drinks water containing infected cyclops. His gastric juices kill the cyclops, but the larvae develop into adult worms and the cycle continues.

Although these associated behaviors appear obvious and simple, it is paradoxical that their clear identification has not been used to advantage in planning control measures. Control of dracunculiasis presents two challenges to behavioral scientists, especially health educators, who have designed control strategies around human behaviors associated with the disease. The first challenge is the inability to find a solution to a situation in which humans pollute their own source of drinking water and then consume the water without taking any measures to protect themselves from the possible effects of their actions. The second challenge is that preventive measures against dracunculiasis are much cheaper, more effective, and more adaptable than curative measures which are costly, inconvenient, and relatively ineffective. Yet health educators have not succeeded in helping affected populations take sufficient advantage of the benefits of preventive measures.

OVERVIEW OF HEALTH EDUCATION ACTIVITIES FOR CONTROL OF DRACUNCULIASIS

A review of health education activities that have been carried out for control of dracunculiasis suggests that they have stemmed from three assumptions which are rationalistic in concept. First, if a man sees his contact with water as a source of pollution, he will not deliberately pollute his water. Second, if a man associates pollution as a causal factor in transmission of the disease and perceives himself at risk, he will not want to pollute his source of water. Third, if affected populations have faith in or are sufficiently convinced about the effectiveness of preventive measures, they will embark on them. Health educators have, therefore, directed their efforts toward three broad areas of educational intervention:

1. Community awareness and perception of the disease, in particular its causation and transmission
2. Provision of improved water supplies for affected populations
3. Acceptance of disease control measures through community participation and acquisition of skills needed for surveillance of introduced control measures.

With respect to the first area, research evidence continues to show a marked shift from the traditional, regionalized, and unscientific notions of causation and prevention to the more proven, scientific, and sophisticated ones. For example, studies carried out on some rural populations in Nigeria where dracunculiasis is endemic show that more and more people over time are associating the cause of the disease with polluted water.[3] Investigations during a 1980 epidemic of dracunculiasis in Idere in Oyo State of Nigeria revealed that the population was attributing the disease more to the god Sonponna (god of smallpox) than the scientific notion of causation (association with water pollution). This had also been recorded in a previous study in the same population.[4] These findings imply that a scientific explanation of causation is acceptable only when the infection rate is not out of proportion.

This type of behavior is not peculiar to just one culture. In any culture a new explanation to any abnormal situation is expected as people are always more satisfied with the invention or suggestion of a new reason for the unusual. Experience in areas with high endemicity in Nigeria also shows that a certain low rate of incidence every year is considered "normal" by the affected population. From this experience, it may be suggested that since dracunculiasis is to a large extent linked with people's environment and life-style, it should be expected that the affected population will develop a minimum level of tolerance for the disease, especially when an effective remedy is not available.

The danger of this attitude from an intervention point of view is that remedies sought for the disease may be geared more toward coping, which probably partly explains the lack of commitment to control programs on a long-term basis by affected populations. This phenomenon has a strategic implication for timing an intervention to coincide with abnormal situations in which people are likely to be more receptive to new information and willing to accept new measures hitherto considered extraordinary. The extent to which the interventionist can take advantage of the panic measure in the case of dracunculiasis, however, is limited in that an effect cannot be immediately demonstrated.

The second area of focus in the control of dracunculiasis is bridging the "application gap" in the acceptance of available control measures. It is well known that technology for the prevention of dracunculiasis has been more perfected than that for curative measures.

Improved water supplies that break the contact between the infected person and the vector in the form of protected wells and springs or pipe-borne water have been responsible for dramatic reductions in prevalence rates in many areas of the world. Although there have been instances of rejection of water-improved measures, these have been sporadic and largely attributable to lack of community participation and involvement in the planning and execution of the projects.[5]

With respect to curative measures for the disease, however, the available technology is far from perfected. For example, the criteria for early diagnosis are not yet well defined, and procedures for removal of the adult worm are not as dramatic as the infected person might want. At best, curative medicine has succeeded only in preventing such complications as tetanus and treatment of ulcers.

The educational implication is that the replacement of traditional approaches (considered to be ineffective) with modern ones (considered to be more effective) is bound to face major problems of acceptance unless the efficacy of modern technology is proven to be far superior to traditional measures. The level of perfection of preventive measures is hindered, of course, by a "delayed" demonstrated effect.

The third area of control measures relates to the importance of community participation with the ultimate goal of self-reliance in the surveillance of control measures once developed. The sign of success of most intervention programs has always been a marked short-term reduction in the prevalence and incidence of the disease. The most important evaluation criteria for successful intervention, however, should be the extent to which the affected population has accepted responsibility for carrying out established control measures on a permanent basis. This results from the fact that there has not been a major breakthrough in chemotherapy. Even when this is achieved, its usefulness is limited because reinfection is so easily possible. Furthermore, the maintenance of preventive control measures and their surveillance have not received adequate attention by the target population.

NEW METHODOLOGICAL OPTIONS

For analytical purposes, four behavioral change models could be used in designing health education strategies for the control of dracunculiasis:[3]

1. Behavioral control intervention matrix model
2. Replacement model
3. Application gap model
4. Primary health care model.

These models, although distinctive, are interrelated, and there may be an overlapping application of two or more of them.

Behavioral Control Intervention Matrix Model

Developed by William Brieger[6] in the course of his fieldwork on dracunculiasis control in the Ibarapa District of Oyo State, Nigeria, where dracunculiasis is endemic, this model provides a clearer understanding of the human behaviors that contribute to the disease. It includes four steps for identifying behavioral control action levels for guinea worm disease (see Table 1):

- <u>Step One</u>: Based on epidemiological information, identify the levels of prevention possibly applicable to dracunculiasis. Levels identified for dracunculiasis from an epidemiological point of view are: health promotion, specific protection, early detection, limitation of disability, and rehabilitation.[7]

TABLE 1 The Behavioral Control Intervention Matrix Model Applied to Dracunculiasis

Levels of Prevention	Levels of Prevention Applicable to Dracunculiasis (Behavioral Action Levels)	Behavioral Factors Operating at Each Behavioral Control Action Level	Health Education Strategies That May Be Used
1. Health promotion	Use of clean potable water	Unprotected sources; pollution and contamination of water sources during collection, inadequate water supply	Mass communication organization; Primary health care services
2. Specific protection	Not applicable (no immunization or chemoprophylaxis)	—	—
3. Early detection	Not applicable (long incubation period)	—	—
4. Limitation of disability	Treatment of blisters to prevent ulceration and tetanus infection, leading to reduction of physical handicap	Delay in seeking; unhygienic traditional methods of treatment	Training in self-care; primary health care services
5. Rehabilitation	Social rehabilitation for physical handicap; economic rehabilitation due to unemployment	Neglect; dependency	Social support resource linkages

- Step Two: Determine which of the five levels of prevention are specifically applicable to dracunculiasis. For example, the prevention level "health promotion" is applicable, since use of clean potable water can prevent transmission of dracunculiasis. The levels "specific protection" and "early detection" are not, however, very applicable to the control of dracunculiasis as immunization or chemoprophylactic measures for specific protection against the disease have yet to be developed, and early detection is difficult because the incubation period ranges from 6 to 12 months on the average. The level "limitation of disability" is resticted more or less to the prevention of secondary and tetanus infections. The "rehabilitation" level is also applicable and takes the form of social and economic adjustments necessitated by deformities as well as loss of income from lost working days and temporary unemployment. Each applicable level of control now constitutes an action level.

- Step Three: Determine the behavioral factors operating at each level of prevention applicable to the disease.

- Step Four: Tailor behavioral interventions to the characteristics of each level of prevention. For example, "health promotion" will require health information and community development strategies, whereas "limitation of disability" will revolve around strategies aimed at using modern health services for removal of worms, treatment of ulcers, and antitetanus immunization. Strategies applicable to "rehabilitation" might include health insurance, unemployment benefits, and social welfare services.

A level of behavioral control action may be defined, more simply, as any distinctive point or stage in the transmission of the disease at which an individual or community could engage in behaviors or actions capable of preventing the disease, reducing its severity and associated disabilities, and disallowing its transmission to healthy individuals. The control of dracunculiasis is made more difficult as no measures can be taken at the "specific protection" and "early detection" levels.

Replacement Model

The theoretical basis of this model developed by Adeniyi[8] for the control of dracunculiasis is that the choice of health service and the subsequent prescribed remedy for a disease are, to a large extent, predetermined by how the individual perceives the cause of the disease (Table 2).

	Traditional approach[a]	Modern (Western) Approach
Notion of causation	SUPERSTITION An enemy has used supernatural means to affect the sufferer by charming the worm to appear in his leg.	GERM THEORY A person is infected by drinking water containing infected cyclops.
Diagnosis	DIVINATION Use of oracles by traditional diviners to know the enemy in order to appease him	PHYSICAL EXAMINATION Physical examination; trace source of water supply for examination of cyclops
Remedy or treatment	TRADITIONAL MEDICINE Folk medicine (herbs), sacrifice to the god, charms and amulets	DRUGS Drugs (ambilhar) for worm removal; antibiotics in form of tablets and injection for accompanying ulcer and antitetanus immunization
Prevention	Charms and amulets, medicinal scarifications, taboos	Alternative source of water supply (protected wells), purification of water, health education

[a]Based on the Yoruba Belief System in Nigeria.

This model shows a marked but consistent and logical difference between the traditional and modern approaches to the control of dracunculiasis. When a change from traditional to modern is contemplated, it is helpful to have adequate information on the notion of causation, diagnostic criteria, type of remedy, and type of prevention practiced in both approaches. To ensure compliance with modern treatment regimens for the control of dracunculiasis, health educators must consider the following factors:

- The existing level of social, economic, and cultural development in the community as well as the degree of compatibility of the traditional and modern approaches being contemplated. The more compatible they are, the greater the chance of success.
- The relative strengths of the traditional over the modern methods being contemplated should be identified to determine whether there are any good aspects of the old that can be integrated into modern methods to help them gain acceptance in the affected population.

Application Gap Model

Also developed by Adeniyi,[8] the application gap model (Table 3) assumes that:

- The technologies available for various types of health problems are at different stages of development or levels of sophistication.
- There is wide variation in the level of acceptance of these technologies in different communities.

Indices for measuring level of sophistication of a health technology with respect to a given disease include potency of drugs, cost effectiveness of treatment or preventive measures, ease of administration of drugs, duration of treatment, presence or absence of side effects, and the extent to which the technology is designed to fit man.

The design of any technology should take into consideration the whole range of the consumers' characteristics. For example, a drug for children may be preferred in liquid form instead of tablets in a culture where traditional drugs for children are usually in liquid forms. Although a high level of technological sophistication should logically bring about a high level of

TABLE 3 The Application Gap Model Applied to Selected Tropical Diseases

	Level of Technological Sophistication	
Level of Acceptance	Perfected	Not Perfected
High	Smallpox	Cancer, diabetes
Low	Yaws Tetanus Tuberculosis	Malaria Schistosomiasis Onchocerciasis Dracunculiasis

acceptance, this is not always the case. For diseases like tuberculosis, tetanus, and yaws, the technology has been perfected but acceptance is low, probably because morbidity and mortality indices for these diseases are less severe and less dramatic.

As to treatment efforts using this analogy, control efforts for dracunculiasis are already severely limited in that technologies in use are not yet perfected. The available drugs are expensive, do not produce dramatic effects for worm removal, have serious side effects, and are difficult to use. There is also great room for improvement in the design of workable and acceptable alternatives in the form of improved water supply schemes. It is hoped that because of the physical, economic, and social costs of dracunculiasis to the victim a more perfected technology will have a high level of appeal.

The application gap model makes the health educator aware of the limitations of the technology for which he is trying to gain acceptance--the less perfected and accepted a technology, the greater the task of health education. This model also makes it possible to determine the relative progress that has been made in the control of other tropical diseases, as shown in Table 3.

Primary Health Care Model

According to a 1977 report of a UNICEF-WHO Joint Committee on Health Policy,[9] the characteristics of a primary health care input to a health program may be summarized as follows:

- A government policy to encourage community participation and the inclusion of primary health care at all levels of regional and decentralized planning
- Tapping of external resources to supplement limited local resources
- Establishment of an association or ties with other rural and urban development programs
- Mobilization of local resources--human, financial, and material--as well as training, supervision, and use of primary-level workers who are selected by the community and whose orientation is not necessarily restricted to health
- Use of existing traditional systems such as local government cooperatives, ceremonial events, and cultural practices and beliefs as one basis for expanding community participation efforts
- Determination and use of community-felt needs, degree of readiness for change, and capacity to undertake projects based on estimates of available infrastructure for the purpose of setting priorities and strategies for intervention
- Use as entry points of other programs in nonhealth sectors and programs in which children are beneficiaries
- Use of nongovernmental organizations as channels for community participation
- Engaging in activities that are acceptable and adaptable to local situations.

These characteristics of the primary health care model provide a sufficient framework for integrated team efforts for dracunculiasis control with sectors that are not medically oriented. The primary health care resources are found largely in the community itself. This allows participation of the target population in the planning and implementation of educational intervention strategies as dictated by the realities of their environment.

Self-reliance, which is fundamental to long-term control measures, will also be promoted by application of the primary health care model. Primary health care has already been introduced by Akpovi[10] in Idere, in the Ibarapa District of Oyo State, Nigeria, to bring health services within the reach of the people for control of dracunculiasis.

Akpovi's research and its culmination at the intervention phase show that the change was focused on three factors:

1. The existing behaviors that are associated with the diseases

2. The situational realities under which these behaviors occur, and particularly the barriers to desired behaviors needed for control of the disease, of which economic and geographic factors are the most important. The main occupation in Idere is subsistence farming, and water is scarce because of rocky topography and low rainfall.

3. The organized systems and institutions to which people belong (social, cultural, religious, technological, political, etc.), which impose rules and codes of conduct that sometimes conflict with desired actions and behaviors required for the control of dracunculiasis. Because most of the people in Idere had enjoyed pipe-borne water which is no longer available, they have become overly dependent on the government to come to their aid. The self-help spirit which died down must be rekindled as a first step toward community participation in new control measures.

ACKNOWLEDGMENT

Research on the social and behavioral aspects of the control of four tropical diseases--malaria, schistosomiasis, onchocerciasis, and dracunculiasis--in the context of primary health care is under way at the African Regional Health Education Centre, University of Ibadan, Nigeria. An interdisciplinary team of 21 researchers from 10 specialties are collaborating in this research which is supported by grants from the Social and Economic Research Scientific Working Group of the UNDP/World Bank/ WHO Special Programme for Research and Training in Tropical Diseases Project 800432. The development of this paper is largely based on personal experiences as the principal investigator in this research project.

REFERENCES

1. Kale, O. O., 1977. The clinico-epidemiological profile of guineaworm in the Ibadan District of Nigeria. J. Trop. Med. Hyg., 26(2):208-214

2. Oluwande, P. A., 1971. Environmental survey of Ibarapa Division 1964-1971. Ibarapa Project Bulletin, University of Ibadan, Ibadan, Nigeria, 6:14-24.

3. WHO/UNDP/World Bank, 1981. Research on Social and Behavioral Aspects of Malaria, Schistosomiasis, Onchocerciasis and Dracontiasis in the Context of the Primary Care Approach. Preliminary Findings. Project 800432, African Regional Health Education Centre, University of Ibadan, Nigeria.

4. Adeniyi, J. D., 1972. Cholera control: Problems of beliefs and attitudes. Int. J. Hlth. Educ., Supp. 14(4):238-245.

5. Feachem, R. G., et al., 1981. Water, Health and Development: An Interdisciplinary Evaluation. Tri-Med Books Ltd., London, England.

6. Akpovi, S. U., Johnson, D. C., and Brieger, W. R., 1981. Guinea worm control: Testing the efficacy of health education approach in primary care. Int. J. Hlth. Educ., 24(4):229-237.

7. Lucas, A. O., and Gilles, H. M., 1976. A Short Textbook of Preventive Medicine for the Tropics. University Medical Texts, Hodder and Stoughton, London, England.

8. Adeniyi, J. D., 1980. Health Education in Primary Health Services. An Approach to the Teaching of Health Education in Primary Care to Medical Students. Report of the Workshop on Primary/Secondary Health Care Curriculum for Undergraduate Medical Students, College of Medicine, University of Lagos, Lagos, Nigeria.

9. UNICEF/WHO Joint Committee on Health Policy, 1977. A Report on Primary Health Care Approach. World Health Organization, Geneva, Switzerland.

10. Akpovi, S. U., 1982. Putting paid to guinea worm infection. African Health, 4(4):23-25.

CONTROL PROGRAMS

DRACUNCULIASIS ERADICATION IN INDIA

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INTRODUCTION

Eradication of smallpox from all countries, as declared by the World Health Organization in December 1979, has been an unprecedented achievement.

The achievement of smallpox-free status in India in the brief period of about 2 years beginning July 1973, clearly demonstrated the sound basis of the intensified campaign against the disease. Besides bestowing invaluable benefits on humanity at large, this miraculous achievement has generated confidence in the leadership of the country, technical and nontechnical administrators, health organizations, the community and its leaders, and health workers, and has spread the belief that such successes against other diseases are possible and well within their reach with all the consequent benefits.

It is well known that operations against smallpox mainly consisted of searching for cases and implementing containment measures to liquidate the foci that were found. It was thought that for a country like India the same approach could be used successfully to eradicate dracunculiasis (guinea worm disease). Experienced epidemiologists elsewhere have also been thinking along the same lines and are confident that with the implementation of a well-planned, fool-proof strategy--keeping eradication of the disease as the firm ultimate objective--success can be achieved within a few years.[1,2,3] (D. R. Hopkins, 1974, personal communication; G. Weisfeld, 1979, personal communication).

Dracunculiasis, one of the oldest tropical diseases, has existed in India from very early times.[4] In 1947, it was estimated that out of 48 million persons residing in endemic areas worldwide, 25 million were in India.[5]

The latest information on dracunculiasis has been obtained through visits by paramedical personnel to all villages in the known affected or suspected districts who inquired about the occurrence of cases from the year 1977 onward. It was found that seven states--Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, and Tamil Nadu--have endemic areas of the disease. A total of 10,582 villages in 80 districts with a population of 12.2 million are affected by the disease[6] (C. K. Rao, 1982, personal communication).

DRACUNCULIASIS AS A HEALTH PROBLEM

A program to eradicate dracunculiasis, beyond eliminating suffering from the disease, may also have demonstrable secondary effects on agricultural output (in some areas, up to 30 percent of the work force is incapacitated during the period of maximum agricultural activities). Furthermore, it is very likely to have tertiary effects on the nutrition of young children in affected villages. Although infection by itself does not cause mortality, it does result in prolonged suffering and disability of its sufferers for about 3 months. A number of patients suffer from complications as a result of the disease, and at least 0.5 percent of them may be permanently disabled[3] (D. R. Hopkins, 1974, personal communication). The preventable economic loss is, therefore, enormous.[7,8]

It is sometimes argued that the population under risk is so small that the disease as such is not a major health problem. This is a fallacious assertion from the point of view of the affected community, however, and of health planners who always stress that programs should cater to the felt needs of the people. Moreover, a program to eradicate dracunculiasis is more than justified on economic considerations alone.

The epidemiological features of dracunculiasis are such that it cannot spread to nonendemic areas. It is transmitted only from a specific water source. In fact, there is little chance of a known water source's infecting other water sources. It is also a disease of remote and under-developed areas where the movement of persons remains extremely limited. These are, indeed, the reasons that the disease is easily eradicable in practice.

PLAN OF OPERATIONS FOR DISEASE ERADICATION

The Government of India, based on the recommendations of the task force on "Eradication of Guinea-worm Disease in India," agreed to undertake eradication of this disease. The National Institute of Communicable Diseases is the focal point for planning, guiding, and monitoring operational activities and their impact on disease incidence in the endemic states. In this connection, an operational manual on guinea worm eradication has been prepared, and it details the strategy, calendar of activities, job descriptions of the staff, and methods of assessing of activities and results.[9]

DISEASE ERADICATION PROGRAM

Identification of Endemic Areas and Infective Water Sources

The first essential step in this program is to identify those villages in which dracunculiasis cases have occurred since 1977. This is being achieved by means of case search operations carried out by paramedical personnel. In endemic areas, the disease is well recognized and thus information can be easily elicited from a few prominent persons. Similarly, infective water sources are identified with the help of the cases and community leaders. Three case search operations have already been carried out, and two similar operations are planned for the coming years. Areas in which no cases are detected for 2 consecutive years will be declared free of the disease.[9]

The lists of the endemic villages have been given to the concerned public health environmental engineering organizations so that they can arrange to supply safe water in these places on a priority basis. The current International Drinking Water Supply and Sanitation Decade has provided additional stimulus and impetus to such an activity.[10] The infective water sources will be closed when an alternative safe water supply is available. In places where this is not possible, these sources may be made safe by, for example, converting them to drawwells.

Use of Temephos as a Cyclopscidal Agent

The provision of a safe water supply in all the disease endemic areas will take time, and, when available, the supply may be intermittent or it may break down at times. For these reasons, people may continue to use water from infective sources, which must, therefore, be treated periodically with a cyclopscidal agent.

Temephos is considered the most suitable because of its effectiveness and very low mammalian toxicity (G. Weisfeld, 1979, personal communication; G. C. Joshi, 1980, personal communication). Sand granules containing

2 percent temephos have been found to be a suitable formulation, and this is applied at the rate of 1 g/20 liters of water (50 g/m^3) resulting in a dosage of one part temephos per million parts of water. A premeasured quantity of granules in a sprinkler should be applied uniformly. Usually temephos is applied every 6 weeks or so as indicated by the density of cyclops during the transmission season. The first application should be made immediately before the transmission season. The effectiveness of temephos for different types of water collections may vary. A new device for determining densities of cyclops--the recently designed "funnel net"--could be adopted.[11]

Personal Prophylaxis

For individual protection the simple measure of sieving water through a double-folded muslin cloth to filter out the cyclops is advocated.[4] Boiling infected water, although effective, is neither practical nor economical.

Treatment

Treatment of cases is undertaken as a medical relief measure. Patients are encouraged to visit the nearest primary health center or dispensary where they can receive the necessary health education. The age-old treatment of laboriously rolling out each emerging worm a few centimeters each day is no longer necessary, since drugs such as niridazole, thiabendazole, and metronidazole can be given to the patient for more rapid expulsion of the worm. Other measures can also be taken for the prevention or treatment of complications.[2,12]

Health Education

Health education is a vital component of the disease eradication program, and all staff and the available media will be used for this purpose. They will tell how this disease is transmitted, what methods of personal prophylaxis exist, and what kinds of activities are being undertaken toward eradication of the disease. The affected communities, and particularly the active cases with blisters, are instructed about the imperative necessity of their not coming into contact with sources of drinking water.

Evaluation of the Program

Officers responsible for the implementation of the program at the central, state, and peripheral levels will undertake a concurrent evaluation. This evaluation will cover achievements related to the main operational activities (e.g., quality and thoroughness of case search operations), progress in the provision of safe water supplies in disease endemic areas, and chemical treatment of infective water sources. The evaluation exercise will also include the impact of operational activities, which is measured in terms of reductions in the number of affected areas and incidence of cases until no affected village or new case is recorded in any of the endemic states for 2 consecutive years.

If a new endemic area is found during any of the case search operations, proper epidemiological investigations will be carried out as to how and from where the person(s) acquired the infection. The necessary remedial action will then be instituted accordingly.

REFERENCES

1. Sharma, M. I. D., 1980. Lessons learnt from the intensified campaign against smallpox in India and their possible applicability to other health programmes, with particular reference to eradication of dracunculiasis. J. Commun. Dis., 12(2):59-64.

2. Muller, R., 1979. Guinea worm disease: Epidemiology, control, and treatment. Bull. W.H.O., 57:683-689.

3. Hopkins, D. R., and Foege, W. H., 1981. Guinea-worm disease. Science, 212:495.

4. Maplestone, P. A., Rao, S. S., Ramakrishnan, S. P., and Raghavan, N. G. S., 1966. Dracontiasis or guinea-worm disease. Health Bulletin, No. 7, Manager of Publications, Delhi, India.

5. Stoll, N. R., 1947. This wormy world. J. Parasitol., 33(1):1.

6. Rao, C. K., Paul, R. C., Sharma, M. I. D., and Kumar, S., 1981. Guinea worm disease in India: Current status and strategy of its eradication. J. Commun. Dis., 13:1-7.

7. Singh, J., and Raghavan, N. G. S., 1957. Dracontiasis in India: Its public health importance and control. Bull. Nat. Soc. Indian Malar. Mosq. Dis., 5:141-161.

8. Rao, C. K. and Reddy, G. V. M., 1965. Dracontiasis in West Godavari and Kurnool districts, Andhra Pradesh. Bull. Indian Soc. Malar. Commun. Dis., 2:275-295.

9. Government of India, 1982. Operational Manual Guinea Worm Eradication Programme in India. Division of Helminthology, National Institute of Communicable Diseases, 22, Sham Nath Marg, Delhi-110054, India.

10. Bourne, P. G., 1982. Global eradication of guinea worm. J. Roy. Soc. Med., 75:1-3.

11. Sharma, M. I. D., and Rao, C. K., 1982. A newly designed device for sampling cyclops densities. J. Commun. Dis., 14. (In press)

12. Kale, O. O., 1974. A controlled field trial of the treatment of dracontiasis with metronidazole and niridazole. Ann. Trop. Med. Parasitol., 68:91-95.

DRACUNCULIASIS: ITS HISTORY AND ERADICATION IN THE USSR

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HISTORY OF DRACUNCULIASIS RESEARCH

Dracunculiasis is one of the oldest parasitic diseases of man. The parasite itself and the symptoms of the disease were known quite long ago.

The first information on dracunculiasis was found in the writings of Egyptian, Roman, and Greek physicians, and much attention was paid to this helminthosis by such Eastern doctors as Abu Ali al-Husain ibn Abdallah ibn Sina (Avicenna), Bagadur, and Hodzendi. Avicenna (980-1037) was the first to give a detailed clinical picture of the disease. He noted the animal origin of the pathogen and recommended various treatment procedures and drugs.

Interest in the structure of the parasite dates from the seventeenth and eighteenth centuries. In 1674, Velschius described the parasite and discussed various theories concerning its existence. In 1758, Linnaeus published his Systema Naturae, in which names were given to all the then-known helminths, including the dracunculiasis pathogen, which thereafter bore the name Dracunculus medinensis (L. 1758). Until the nineteenth century, scholars knew nothing about the biology of the parasite, nor about the epidemiology and prophylaxis of dracunculiasis.

In 1868, Russian researcher Aleksej Pavlovic Fedchenko (1844-1873) organized an expedition to the area that is now Soviet Central Asia. During his travels, he noted the great harm caused by dracunculiasis to the health of the populations of Samarkhand, Bukhara, Dzhizak, and Karshi, and in 1869, he began to study the disease.

Until the middle of the last century there were four points of view as to how humans contracted dracunculiasis. The parasite larvae either: (1) were carried by insects; (2) were dispersed in the air and entered the human body when infected air was breathed; (3) entered the human body with food and drinking water; or (4) were present in ponds and the soil and entered the human body through uncovered parts. Fedchenko's discovery of the intermediate host provided information on the life cycle of the helminth and explained how dracunculiasis was contracted.

In 1869, Fedchenko discovered D. medinensis larvae in the body cavity of copepods (Cyclops), successfully infected Cyclops with the larval parasites in a number of experiments, and traced their development in Cyclops. On the basis of his knowledge of the biology of the parasite, Fedchenko put forward the epidemiological formula of dracunculiasis: man is the definitive host of the parasite; Cyclops is the intermediate host; Cyclops are infected with larval parasites that enter water from a person with the disease; and man becomes infected when he drinks unboiled water that contains Cyclops with mature larvae in their bodies.[1]

Fedchenko established the epidemiological features of dracunculiasis in the areas of Central Asia that he visited. He noted the importance of the small storage ponds ("hauzy"), which literally teemed with Cyclops, as well as the way in which they were used as sources of water for washing clothes, bathing, etc. Furthermore, he compared foci in Bukhara, Dzhizak, and Karshi, where the storage ponds were never cleaned, where their water was hardly ever changed, and where dracunculiasis morbidity was extremely high, with those in Tashkent,* where the water in the storage ponds was frequently changed and invasion was not noticed. Fedchenko also outlined prophylactic measures: "What needs to be done to avoid becoming infected is to drink boiled or filtered water, or, at the very least, running water from irrigation channels. . . ."[1] Fedchenko published his experimental results and observations in five papers that appeared from 1870 to 1875.

The years 1923-1932 were mainly a period in which the epidemiology of dracunculiasis was studied and systems of measures were devised for eradication of the disease in the city of Bukhara and in eight adjacent permanent settlements--the only remaining foci of invasion in the USSR by that time. (Other known foci--Samarkhand, Dzhizak, Karshi, Khiva, Gergana, Katta-Kurgan, and Merv--had, for various reasons, become extinct by this time.) This task was carried out by the Tropical Institute, founded in Bukhara in 1924 and headed by Leonid Mihajlovic Isaev. Isaev demonstrated that D. medinensis

*A number of authors have mistakenly reported the existence of dracunculiasis in Tashkent, (e.g., R. Muller[2] and others).

embryos did not find their way into the body of *Cyclops* by boring through the integument but through ingestion, and he made a detailed study of larval development in *Cyclops* to the invasive stage. He also succeeded in reproducing dracunculiasis experimentally in dogs.

ERADICATION OF DRACUNCULIASIS

All this work made it possible to define approaches to control of the disease: the timely detection and recording of sufferers from dracunculiasis, measures to render them harmless as sources of invasion, the destruction of *Cyclops* in storage ponds, and health education. Control was based on the principle of breaking the epidemic link between the definitive and intermediate hosts.

To prevent larvae from entering storage ponds, corrosive sublimate (in a dilution of 1:1,000) was administered to worms already in human tissues, resulting in death of the larvae, and mechanical stimulation of the helminth leading to expulsion of embryos from the uterus was sometimes carried out. Well covers were also fitted. Action taken against the definitive host also included a campaign in Bukhara against dogs with dracunculiasis, which played an important role in the epidemiology of the invasion in Bukhara. Finally, health education was widely carried out using a film produced for the purpose.

In the campaign against the intermediate host, stagnant storage ponds were periodically drained and cleaned, keeping in mind the development periods of *Cyclops* and the larvae. In addition, water levels in storage ponds were lowered at certain times to make conditions less favorable for resident *Cyclops*, and cracks in lined storage ponds inhabited by *Cyclops* were cemented. Finally, the clay-lined storage facilities ("humby") in which people stored water were cleaned periodically.

All foci had been rendered healthy by 1932. Before initiation of this effort, dracunculiasis infestation had reached 20 percent (some 10,000 sufferers).* New cases recorded in the years 1926-1932 were 148, 207, 95, 59, 39, 1, and 0, respectively. Defeat of the helminth was assisted by the construction of a water supply system in Bukhara in 1929.

The period from 1932 to the present has been mainly one of epidemiological monitoring and carrying out prophylactic measures to prevent reestablishment of the disease in settlements. During this period, the dracunculiasis pathogen has been found in various districts in

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*In 1947, N. R. Stoll inaccurately estimated the number of dracunculiasis sufferers in the USSR, namely, 3.3 million instead of 10,000.

the republics of Soviet Central Asia and Transcaucasia in a number of carnivorous animals (badger, jackal, common fox, cat, dog). No human cases have, however, been found during this period. Consequently, dracunculiasis has not occurred as a human disease in the USSR for half a century* despite the presence of the pathogen under natural conditions.

REFERENCES

1. Fedchenko, A. P., 1870. Concerning the structure and reproduction of the guinea worm (*Filiaria medinensis* L.). *Proceedings of the Imperial Society of the Friends of Natural Sciences, Anthropology, and Ethnography*. Vol. 8. (In Russian) Reprinted in: *Am. J. Trop. Med. Hyg.*, *20*:511-523.

2. Muller, R., 1971. *Dracunculus* and dracunculiasis. *Adv. Parisitol.*, *9*:73-151.

3. Stoll, N. R., 1947. This wormy world. *J. Parasitol.*, *33*(1):1.

*The 1940s are mistakenly given in the literature as the time when dracunculiasis was eradicated in the USSR.

PROPOSED WHO/AFRO PROGRAM FOR CONTROL OF DRACUNCULIASIS IN THE AFRICAN REGION

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As improvements are made to water supply systems, the incidence of dracunculiasis (guinea worm disease) will no doubt continue to decline in areas where it still persists, but additional control measures will probably be required. For example, India has recently embarked on a national effort that combines intensified surveillance, provision of safe drinking water, provisional chemical treatment of unsafe water sources, and health organization. This effort is intended to eradicate dracunculiasis from India by December 1985. Although the control and eventual elimination of dracunculiasis are feasible, this disease has not received enough attention in national health programs in the African Region.

PROPOSED PROGRAM

Objectives

The specific objectives proposed by the World Health Organization (WHO) for the control of dracunculiasis in the African Region include:

- o Creating awareness of this disease and its socio-economic impact, and the benefits of eliminating it
- o Strengthening international recognition of the problem and attracting bilateral and multilateral resources
- o Demonstrating the role of safe drinking water in eliminating dracunculiasis.

The proposed program would, during the International Drinking Water Supply and Sanitation Decade (IDWSSD), give priority to the provision of safe drinking water for all identified villages and areas affected by dracunculiasis and currently having cases of the disease.

Areas with a past history of cases should have second priority.

International awareness and recognition of dracunculiasis have been essentially accomplished by the May 1981 resolution of the World Health Assembly, the advent of the IDWSSD whose steering committee endorsed the idea of using dracunculiasis control as an indicator of the Decade's impact on health, and the initiation of a national program for the eradication of dracunculiasis in India.

Planned Activities

Although the planned activities deal with dracunculiasis in the whole African Region, immediate efforts will focus on West Africa. AFRO, the WHO regional office located in Brazzaville, Congo Republic, is cooperating with affected member states in this subregion to initiate and implement their national programs for dracunculiasis eradication in conjunction with their primary health care services and water and sanitation projects.

The plan of operation includes three principal phrases. In Phase I, current knowledge of dracunculiasis will be reviewed and accurate baseline data established. During Phase II, suitable control measures will be developed, while Phase III will include evaluation and monitoring.

Phase I

During this phase, heavily infected villages and areas at risk will be identified. As a first step, AFRO has asked all concerned member states in West Africa to intensify their epidemiological surveillance of dracunculiasis, to identify areas of high prevalence, to select sample villages or areas for frequency observation, to measure the extent of infection in selected communities, and to measure the economic impact. All these activities will pave the way for follow-up studies to monitor progress in the reduction of this disease and its final elimination.

The current distribution of dracunculiasis in the African Region includes much of the savanna belt of West Africa and some parts of eastern Africa. The disease apparently exists in Benin, Cameroon, Chad, Ethiopia, Ghana, Guinea, Ivory Coast, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sudan, Togo, Uganda, and Upper Volta. The number of cases given in Table 1 were obtained from official data and from published reports related to the areas of operation.

TABLE 1 Reported Cases of Dracunculiasis, Africa

Country	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Benin	1,480	-	820	-	-	-	-	-	-	-
Atakora	90	-	90	-	-	-	-	-	-	-
Atlantic	100	-	90	-	-	-	-	-	-	-
Borgou	130	-	50	-	-	-	-	-	-	-
Mono	70	-	30	-	-	-	-	-	-	-
Queme	90	-	50	-	-	-	-	-	-	-
Zou	1,000	-	510	-	-	-	-	-	-	-
Cameroon	-	-	-	251	-	-	-	-	-	-
Chad	-	-	-	-	-	-	172	-	-	-
Ghana	693	1,606	1,226	4,052	1,421	1,617	1,676	-	-	-
Accra	6	30	15	49	3	65	22	-	-	-
Ashanti	35	-	-	1,536	229	19	88	-	-	-
Brong. Ahafo.	290	453	90	194	225	362	619	-	-	-
Central	18	95	-	267	62	143	146	-	-	-
Eastern	624	48	261	600	335	319	89	-	-	-
Northern	127	910	748	1,031	454	231	432	-	-	-
Upper	348	9	56	185	86	347	75	-	-	-
Volta	45	27	39	127	62	71	148	-	-	-
Western	200	34	15	63	15	60	57	-	-	-
IvoryCoast	4,891	4,654	6,283	4,971	4,656	5,207	6,993	-	-	-
Mali	668	786	737	542	760	1,084	-	-	-	-
Mauritania	-	-	-	-	-	127	-	-	-	-
Niger	-	-	-	-	2,600	3,000	5,560	-	-	-
Nigeria	98	-	-	1,007	-	-	-	-	-	1,693
Senegal	-	334	208	65	137	-	-	-	-	-
Togo	-	-	-	3,261	1,648	-	2,617	2,673	-	-
Upper Volta	5,822	4,404	4,008	6,227	1,557	-	2,885	2,694	2,565	-

The surveillance data obtained are useful only as a broad indication of the general geographic areas known or reported recently to be affected. They reflect only superficially the numerical extent of the problem, since this disease occurs in areas where reporting and surveillance systems tend to be rudimentary or nonexistent. The disease has, in general, been neglected, and affected communities realize that hospital visits can do little, apart from controlling secondary infection, to modify the course of the disease. Thus patients tend to accept this health problem with resignation.

In one study in Togo in 1977, less than 4 percent of observed dracunculiasis cases had been reported to public health authorities. A recent study in Benin, in 1981, showed dracunculiasis to be present in almost all regions of the country. Out of 513 villages surveyed, the infection exists in 192 villages, and it is estimated that 600,000 persons are affected. Another survey to study the socioeconomic impact on these affected areas is under way, and the final results are expected to be available by May 1983.

When public health workers conducted a special village-by-village search for dracunculiasis in India in January-February 1981, they found an estimated 5.9 million persons to be at risk in 7,533 affected villages of seven states, whereas in response to a written inquiry 15 months earlier, the same areas had reported 1.8 million persons in 728 villages to be at risk of this disease. That is, therefore, a need to investigate further the present incidence and prevalence of dracunculiasis, particularly since it is established that only a third of the cases are seen in health centers and hospitals in West Africa. It is hoped that as more attention is paid to this disease, surveillance will improve.

In West Africa, a survey of dracunculiasis in Upper Volta is now being carried out by the Organisation Centrale Contre les Grandes Endémies (OCCGE), which has its headquarters in Bobo Dioulasso, with the participation of a U.S. Centers for Disease Control (CDC) staff member. Discussions are now under way on the initiation of similar studies in other countries, namely, Mali, Benin, Togo, and Ivory Coast. There is an understanding that the CDC staff member on EPI projects carried out under the auspices of the U.S. Agency for International Development (AID) will be available if additional studies are carried out.

As a further step toward accelerating the dracunculiasis survey, the project, Strengthening Health Delivery Systems (SHDS), based in West Africa under AID auspices, has agreed to provide a consulting epidemiologist for 3 years to cooperate with interested governments in carrying out surveys to clarify the extent of the disease and its impact on affected areas. During his mission, the consultant will study further the most suitable methods of case-finding to determine the prevalence of infection in selected areas and the peak season.

Phase II

In Phase II, a feasibility study will be carried out to determine the most suitable methods and strategies for controlling dracunculiasis, with an emphasis on cost-effectiveness in the African environment. This study is intended to support AFRO's initiation and encouragement of national efforts in West Africa to intensify surveillance, provision of safe drinking water, provisional chemical treatment of unsafe water resources, and health education with the intention of eradicating dracunculiasis.

The use of all available media and various approaches to health education to convey the necessary knowledge about the disease is the backbone of the eradication program. Special training and hygiene instruction will be particularly directed to paramedicals, primary health care workers, village elders, religious leaders, teachers, and all voluntary agencies. In the absence of a safe drinking water source, the salient methods of prevention are: boiling water before drinking, sieving it through a double-folded cloth, or treating it with chemicals. Wide publicity will encourage communities to only use safe drinking water and, more important, will discourage infected persons from coming into contact with water in ponds, wells, tanks, etc. Full participation by members of the community in planning and operating the campaign will encourage proprietary pride and ensure the success of the eradication program through their own efforts.

Phase III

Indices of economic and social activities must be identified and developed to measure the impact of dracunculiasis control. These parameters must be based on the local social and economic situation, e.g., industrial or agricultural enterprises, school attendance and absenteeism, etc.

Guidelines for evaluating control achievements and to act as a suitable basis for assuring that elimination has been achieved will be established. The prevalence of dracunculiasis before and after intervention to interrupt transmission will be measured. A 2-year follow-up after safe water is provided and used will be needed.

WHO/AFRO INVOLVEMENT

Resolutions by the May 1981 World Health Assembly and by the IDWSSD Steering Committee emphasized the importance of the Decade to health worldwide, efforts expected from member states, and the support to be given by WHO, the U.N. Development Program (UNDP), and other organizations and donor agencies. Following resolution WHA 34.25 of the thirty-fourth World Health Assembly, AFRO strengthened its communication and technical cooperation with member states in order to start and consolidate their national campaigns for eradication of dracunculiasis based on a primary health care system.

The activities of the program have thus far consisted chiefly of joint multidisciplinary consulting missions involving health engineers, epidemiologists, health educators, financial analysts, etc. Interested international, intergovernmental, nongovernmental, and bilateral agencies have also been contacted for technical and financial cooperation. As part of its regional program for the Decade, WHO is collaborating with member states in formulating national drinking water supply and sanitation programs, including dracunculiasis eradication, and in identifying external funds. In this connection, operational linkages are being developed with CDC, SHDS, and OCCGE.

EHE/HQ has proposed that a WHO sanitary engineer be attached to the mission that is presently carrying out a dracunculiasis survey in Upper Volta with a view toward relating the mission more effectively to actual government programs for the improvement of water supply and sanitation. Funds had been earmarked for this offer.

A variety of international, bilateral, and multilateral agencies are currently cooperating with WHO in providing technical or financial support for the African Region:

- The interregional WHO/SIDA (Swedish International Development Agency) cooperative project is providing two permanent professional staff members--a health engineer and a financial analyst.
- The interregional WHO/GTZ (Agency for Technical Cooperation of the Federal Republic of Germany) cooperative project is providing a health engineer to be based permanently at Ouagadougou, Upper Volta. A decision has also been made to

assign a second full-time health engineer to be based at Lome, Togo. The project has been particularly active in organizing and running national workshops which have provided excellent media for gaining national support for ongoing activities.

- The joint WHO/World Bank program is under way in many countries in the region.
- At the country level and frequently on a bilateral basis, several multilateral, bilateral, and nongovernmental agencies are currently cooperating or are willing to do so, including the European Development Fund, West African Economic Community, Fonds d'Aide et de Coopération, Norwegian Agency for International Development, Danish International Development Agency, Saudi Fund, CARE, etc. For all these activities, coordination and follow-up are provided at the WHO/AFRO Regional Office in Brazzaville, Congo.

WHO intends to coordinate its program with the planned or yet unplanned water sanitation programs carried out in dracunculiasis-infected areas and supported by UNICEF; the International Labor Organization's Special Public Works Program; the World Bank's Technical Advisory Group and Population, Nutrition, and Health Project, and the European Development; GTZ, and WHO's own programs carried out in connection with the water and sanitation decade.

A comprehensive operations manual on the eradication of dracunculiasis in Africa will also be developed. Persons working in the field will find such guidelines and methods of national surveillance useful in carrying out their day-to-day work.

Training of nationals at all levels will have top priority in order to improve managerial skills, provide manpower training, establish information systems, and allow the operation and maintenance of existing facilities. Such task forces are needed to carry out a well-planned strategy for the eradication of dracunculiasis in West Africa.

IMPLEMENTATION OF CONTROL ACTIVITIES IN GHANA

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Dracunculiasis (guinea worm disease) is posing a serious health problem in Africa, Asia, and the Middle East. In Ghana, the records indicate that it occurs in almost all the poor rural areas of the country.

Information on water-borne diseases is needed to plan water supplies and health measures for their control. In this regard, attempts have been made to compile information for Ghana on the occurrence of dracunculiasis and on how the disease relates to sources of water supply. The resulting report provides an organized presentation of existing records of observed incidence of water-borne diseases and where those diseases occur in Ghana.

To make the report as useful as possible for planning purposes, information was provided by district, that is, each of Ghana's nine regions was divided into survey areas. Medical statistics, hospital records, and other information on the number of recorded cases of water-borne diseases in each survey area depict how these diseases relate to sources of water supply. Where no figures were provided for given disease, it only meant that no cases had been recorded and not that the survey area was necessarily free of disease.

An analysis of the compiled information supported the initiation of a government policy on water supplies and sanitation programs. From the data, it was observed that where treated pipe-borne water was provided, as in towns and urban communities, dracunculiasis was virtually eliminated. Furthermore, the district surveys indicated that dracunculiasis was prevalent in almost all rural communities where there were no safe water supplies.

In southern Ghana, guinea worm disease was found in villages that depend on pond water during the dry season. The recent occurrence of the disease in the survey area indicates that the disease is spreading. This is attributable to the fact that almost half of the 159 villages surveyed use pond water, and residents frequently travel to endemic areas.

These observations led to the conclusion that dracunculiasis can be completely eliminated by the provision of safe water supplies. Ghana must now develop the information available about the incidence of infection--geographically and numerically--and institute continuous surveillance and documentation of the benefits of disease control.

Guinea worm disease incapacitates farmers, school children, and other villagers, thus affecting a community's agricultural productivity. In southern Ghana, the survey established that male farmers are at the greatest risk of infection.

The disease has had particular effect on cocoa production in Ghana. Cocoa farms are normally located in remote areas where water sources are grossly polluted and farmers have no alternative but to use the sources for drinking purposes. Because these areas do not have access to health posts, clinics, or hospitals, cases of the disease are not reported. Thus health agencies must attempt to study the prevalence of guinea worm disease particularly in remote farming areas. In the meantime, public health educators must inform Ghanaians about the preventive measures of boiling and filtering water.

CONTROL OF DRACUNCULIASIS

The most effective preventive measure for control of dracunculiasis is the provision of safe water supplies, and attempts are being made to provide low-cost systems to the affected communities. The type of water supply system selected will vary from one community to the next. Those under consideration are:

- Wells and springs, protected to avoid contamination
- Rain harvesting
- Wells fitted with hand pumps
- Deep mechanized bore holes (i.e., fitted with submersible pumps)
- Conventional treatment (i.e., surface water, preferably selecting water treatment systems that incorporate slow sand filtration).

Water Source Selection

The process of choosing the most suitable water source for a public water supply largely depends on local conditions. Where springs are not available, the best option is exploring groundwater--digging wells and drilling a tube well. If groundwater is not available, it will be necessary to consider surface water from sources such as rivers, streams, or lakes, which will almost always require treatment to make it safe for human consumption. Where the rainfall pattern permits, rainwater harvesting and storage for dry periods can be provided. This may be sufficient only for household and small community supplies, however.

All control measures should be directed toward freeing domestic water supplies from Cyclops and preventing infected people from contaminating water supplies. Boiling unsafe drinking water is a good control measure since cyclops are killed when water is heated to 65°C. Simple filtration will remove cyclops and excess lime will kill them, but they are resistant even to comparatively large doses of chlorine. Public education is also a vital control ingredient.

Control in the Context of the IDWSSD

Since guinea worm disease prevention is an official target of the International Drinking Water Supply and Sanitation Decade (IDWSSD), provision of safe drinking water in rural communities continues to receive the support of the Ghanaian government so that the disease can be eliminated in the early part of the Decade.

According to the present sector status and policy for a water supply, the Ghana Water and Sewerage Corporation (GWSC) is responsible for supplying water in both urban and rural communities. Urban communities are always provided with pipe-borne water. House-to-house connections are encouraged, and public standpipes are provided wherever necessary. In rural areas, pipe-borne water through standpipes is provided for communities of between 2,000 and 5,000 people. For those with less than 2,000 population, water is provided from drilled wells fitted with hand pumps. In 1975, 92.49 percent of the urban population had access to a potable water supply, while only 16.6 percent of the rural population enjoyed this benefit. Consequently, the emphasis has now greatly shifted to the rural areas.

The Ghanaian government's concern with protecting public health is reflected in the increasing resources it has been devoting to this area over the past years. For example, from 1975 to 1980, the percent of total population enjoying a potable water supply increased from 38.2 to 48.3. The percentage of urban and rural populations served with potable water in 1980 was 94.1 and 29.9, respectively. This represents, over the 5-year period, increases of 1.61 percent for the urban population and 13.3 percent for the rural population.

National Sector Plan for the Decade

The Decade target is to:

- Provide pipe-borne water to 71 communities with over 2,000 inhabitants and 250 communities with between 500 and 1,999 inhabitants which are en route or close to pipelines.
- Provide water from drilled wells fitted with hand pumps for 790 communities in the 500-1,999 population range.
- Upgrade and extend existing water supply systems to the urban fringes.

It is expected that this target will make it possible for 72 percent of the total population to enjoy potable water supplies by the end of the Decade in 1990, including 61 percent of the rural population. Although the target for providing everyone in the country with access to a safe supply of drinking water will not have been achieved, the occurrence of guinea worm disease in the rural areas will be reduced considerably.

The largest rural water supply scheme, which is located in the upper region of Ghana, presently has a public education component aimed at creating an awareness of the value of hand pump-fitted systems. This program will encourage the population to ignore their polluted water sources and appreciate the value of good drinking water. A similar program will be incorporated in a rural water supply program currently under way in central and southern Ghana.

Two major ongoing projects in Ghana that will have a tremendous impact on the health of rural dwellers by eliminating dracunculiasis are concerned with drilling wells and fitting them with hand pumps. With the help of bilateral assistance from the Federal Republic of Germany and the Canadian International Development Agency, these projects will cover 3,000 wells in central and southern Ghana (2,000 have already been completed under Phase 1 of the program), and 1,500 wells in upper Ghana, all of which are in operation. These projects are scheduled for completion by early 1983.

Close cooperation between the Ghana Water and Sewerage Corporation and the Ministry of Health will be required so that high priority is given to the construction of safe water supply schemes in areas where guinea worm disease occurs. It is expected that this disease will be reduced drastically in most areas of Ghana during IDWSSD, although some difficulties remain in implementing Decade programs:

- o There is a shortage of GWSC professional staff to carry out efficiently the planning, design, and supervision of development projects and the operation and maintenance of the system.
- o Government financing and foreign exchange for the importation of plant and equipment are inadequate.
- o The supply of contruction materials (i.e., reinforced steel, cement, etc.) is inadequate.
- o Local pipe manufacturers are unable to supply pipes on schedule due to a shortage of imported raw materials.

DRACUNCULIASIS IN TOGO

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INTRODUCTION

The population of Togo is estimated at 3 million, 85 percent of whom live in rural areas, grouped in 2,579 population centers. More than 49 percent of the total rural population is clustered in villages of between 100 and 500 inhabitants.

The climate of Togo is one of moderate rainfall with intense evaporation and fixed dry seasons every 3-5 months, especially in the northern part of the country. The geologic conditions in Togo make it difficult to excavate wells by hand. The shallow bedrock composing much of the country is made up of crystalline rocks.

Because of these conditions, most of the population must use the traditional polluted sources of water supply: small rivers or lakes, ponds, catchments, poorly constructed and badly protected wells, etc. Sanitation statistics show that diseases directly or indirectly connected to water are prevalent in Togolese pathology, and that dracunculiasis (guinea worm disease) is one of these water-borne diseases.

SOME EPIDEMIOLOGIC CONSIDERATIONS

Table 1 shows the reported cases of dracunculiasis in Togo in 1979. Transmission of the disease is linked to the environment and poor hygiene. A long dry season promotes the population's use of scarce water sites heavily infested with infected Cyclops, particularly in the regions of Tsévié, Notse, Bassari, Niamtougou, and Dapaong.

Both the intake of nonfiltered or unboiled water and exposure of the diseased part of the human body to water, allowing the female worm to discharge embryos that are ingested by Cyclops, assure perpetuation of the disease.

TABLE 1 Number of Reported Cases of Dracunculiasis, Togo, 1979

Location	Number of Cases
Lomé	27
Anécho	3
Vo	--
Tsévié	204
Tabligbo	12
Kloto	62
Notse	87
Atakpamé	18
Amlame	--
Badou	--
Sotouboua	--
Tchaoudjo	19
Bafilo	4
Tchamba	--
Bassari	98
Lama-Kara	25
Niamtougou	412*
Kandé	--

*Dracunculiasis and onchocerciasis.

CONTROL STRATEGIES

General control strategies include managing wells and other water sources, furnishing safe potable water, and impeding the users' direct contact with sources of water. Some preventive measures include treating the water before consumption by boiling it or at least filtering it through finely meshed material. Ponds that provide drinking water could be disinfected using lime or chlorine. Some fish that eat Cyclops, such as Gambusia affinis and the Poecilia "guppy" which is being tested in Togo, could be introduced into pools.

In the strategy for Togo's 3-year plan, the provision of safe water to Togo's population is number one priority, and all other government programs are more or less dedicated to achieving this goal. Justification of this policy does not reside solely in the aims of providing proper sanitation and improved water supplies; economic factors are also important. This policy is being accomplished by supplying potable water to all urban population centers and establishing village waterworks, including a certain number of projects of which the principal objective is to manage a water site for 500 inhabitants.

The success of this policy should result in a better quality of life for the Togolese in general, and better health. The success of the village waterworks program will unquestionably result in the reduction, and perhaps even the elimination, of dracunculiasis, which has long been a cause of absenteeism from work by many of Togolese who live in heavily infested areas.

The principal bottleneck of such a village waterworks program is insufficient financial resources. Outside bilateral or multinational sources of funding are needed to bring about the desired effect and to complement the effort being made by the Togolese government. To measure the level of reduction or elimination of guinea worm disease resulting from the village waterworks program, a number of population centers in heavily infected areas should serve as the subject of epidemiological studies to be carried out, during, and after the program.

SOCIAL AND ECONOMIC ASPECTS

THE IMPACT OF DRACUNCULIASIS ON THE HOUSEHOLD: THE CHALLENGE OF MEASUREMENT

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The annual worldwide incidence of dracunculiasis (guinea worm disease) is a matter of widely varying speculation, and estimates range from 10 to 48 million cases.[1,2] One scholar, however, has indicated that nearly 20 years have elapsed since these estimates were made. The doubling of the world's population without a reduction in mitigating factors could have resulted in an increase over these figures.[3] Other studies suggest these figures may be overestimates.[4]

A review of the literature on dracunculiasis provides only limited estimates of the number of households or percentage of productive members (defined here as ages 15-44) represented among the affected. A considerable number of studies fail to provide simple community demographic information organized according to the same age and sex breakdowns used in counting cases. Others only cite experience with clinical cases.[5-7] For other disease entities, however, the pattern of reporting may include:

- Actual community maps showing geographic incidence and prevalence by household[8,9]
- Information on the percentage of a given age group afflicted[9-12]
- Household attack rates.[13]

In the epidemiologic literature on guinea worm disease, therefore, the incomplete data on the individual, household, and community severely hamper attempts to estimate the extent of the problem.[14] Needed are (1) an understanding of the variability in attack rates by community and household, (2) a unified scaling system for estimating individual case severity, and (3) a consensus on which of the many existing systems is adopted for estimating the physical, economic, and social impacts of the disease.

Until that consensus is reached, however, it is necessary to examine what is currently provided about variations in levels of infection, the extent of possible disability, and the possible range of duration of such disability. Dean et al.[15] have posed the following formula for calculating the impact of morbidity:

$$\text{Impact of Morbidity} = \frac{\text{duration of illness} \times \text{degree of disability}}{\text{population (in 100,000's)}}$$

This formula will provide a measure of disability per 100,000 people per year. To estimate lost working potential, it is necessary to have an idea of the average lifespan of the worker in each geographic area under investigation.

Existing studies provide a wide range of qualitative and quantitative measures of degree and duration of disability.[2,12,16,17] Based on the availability of this information, rough attempts can be made to estimate annual days of work lost.

FACTORS IN TRANSMISSION

Transmission of guinea worm disease is limited to specific and identifiable times of the year[12,18] (usually the driest season), when water use needs are greatest because of higher temperatures[19] and heavy labor is required to prepare the fields for planting or harvesting.[10]

The agent, the adult Dracunculus medinensis whose life cycle has been described elsewhere,[17] has a propitious (for the worm) sense of timing. The larva reaches the water source at the time of year when ponds have begun to dry up. At this time, the intermediate host Cyclops is in greatest concentration and is most likely to ingest the larva. Furthermore, the probability of humans completing the infection cycle is greatest.[18]

Differential infection rates may occur among those communities that rely on a variety of water sources. Similarly, the extent to which there is selective access to a water site can influence infection and contamination. Migration of individuals to endemic areas and their periodic return can lead to recurring contamination of a local water source after a period of abatement.[20]

Most water sources are used for a wide variety of purposes in addition to water fetching, the most prominent being, swimming, bathing, and drinking[19]—activities that increase the potential for direct transmission of infection. Although efforts to provide barriers to direct access to the water site, most notably for step-wells, have led to rapid reductions in Dracunculus infection, many sites do not lend themselves to such barriers. Furthermore, even if feasible, the use of pumps or pulleys generally requires a greater expenditure of energy and may reduce the social aspects of drawing water. In establishing such a system, all communities with standing water drinking sources must be identified. Moreover, migration patterns to and from such communities should be noted.

Table 1 summarizes the relationship between the agricultural season in a given area and the season of highest disease impact. Although these data provide only a rough sketch, there is apparently a considerable overlap between major agricultural activity and time of high incidence and prevalence of disease onset. This suggests that the potential impact of guinea worm disease on the economy is greater than that of diseases that lack such a highly defined seasonal relationship to peak productivity periods.

India's effort to develop a continual surveillance system[23] is a major step forward in the eventual elimination of this dread disease. Identifying those villages without existing cases but with the necessary environmental characteristics must be a part of this effort.

IMPACT OF GUINEA WORM DISEASE ON THE INDIVIDUAL, HOUSEHOLD, AND COMMUNITY

Any attempt to eradicate dracunculiasis must include consideration of: (1) the environmental factors affecting transmission, (2) aspects of the intensity of disease impact, (3) high-risk factors that lead to variation in susceptibility, and (4) social and health implications.

The chief impact of guinea worm disease, outside of physical pain and anguish, is socioeconomic. This fact and the immediate problem of severe morbidity suggest that eradication programs must emphasize not only prevention but also have an aggressive primary care component. This suggestion springs from growing evidence in the literature that the period of disability can be reduced considerably through timely medical intervention.[16,24] Further, emergency programs must be developed to assist those communities where attack rates deplete the ability of households to come to each other's aid during planting and harvesting activities.

TABLE 1 Summary of Studies Documenting the Relationship Between Peak Transmission Periods of Guinea Worm Disease and the Rainy Season

Study	Relation of Peak Transmission Period to the Rainy Seasons			
	During Rains	Beginning of Rains	1-3 Months Before	4 or More Months Before
Muller[17]	3	2	9	2
Sahba et al.[20] (South Iran)				1
Saxena[21] (Madhya Pradesh)			1	
Belcher et al.[10] (South Ghana)			1	
Kale[12] (West Nigeria)			1	
Johri and Saxena[22] (Madhya Pradesh)			1	
Edungbola[19] (Kwara State, Nigeria)			1	
Carme[5] (Mali)	1			

The Individual

Two factors appear to be highly related to the impact of dracunculiasis on the individual and, as a result, on his or her productivity: (1) duration of the disability, and (2) its severity. Table 2 lists a number of categorizations used to estimate severity. Definitions of severity revolve around the extent to which the individual is unable to farm or participate in other economic and important household activities. Although only limited evidence exists, according to the definition above, it appears that the estimate that approximately 40 percent of those afflicted are completely disabled is reasonable.[25]

TABLE 2 Categorization of Severity

Kothari et al.[16]

(i) Severe: acute edema, erythema, ulcer, and swelling accompanied by severe pain and marked disability

(ii) Moderate: local swelling and ulcer with some pain and disability

(iii) Mild: local swelling, ulcer, or both but no disability

Pardanani et al.[2]

Grade I: visible and palpable subcutaneous worm but no acute inflammation, preemergent stage

Grade II: ulceration with or without a protruding worm; inflam- mation, but not so severe as to cause disability

Grade III: abscess, ulcer, edema, and cellulitis, with or without malaise; secondary bacterial infection resulting in disability

Grade IV: more severe manifestations with acute deformities and marked disability

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Kale[12]

Grade I (mild): with minimal or no discomfort

Grade II (moderate): with severe discomfort but mobile--usually with a limp (31 percent)

Grade III (severe): with severe discomfort and immobile

Packer[26]

1--Minor disability
2--Restricted activity
3--Limited activity
4--Limited mobility
5--Confined
6--Death

There is obviously no correlation between village attack rate and average individual duration of disability, but a high correlation does exist between (1) degree and disability and location of the worm in the foot and (2) length of disability and greater number of worms.

The Household

Although there is limited information on attack rates by household, where information does exist the household attack rate averaged 5.4 times that of the village. In cases where the household attack rate was lower than 5.4 times that of the village, it could be assumed that a number of households in the village were sharing unequally in the burden of affliction.*

The extent to which a household has a high household dependency ratio, little opportunity for alternate cash income, greater consumption demands than potential for productivity, and multiple members afflicted with dracunculiasis, identifies those households at high risk of further eroding their socioeconomic and health base. In short, a high rate of guinea worm suggests a possible vicious cycle of problems with a potential for actual economic destruction. Fortunately, this sequence is a worst-case scenario. While it is drawn from studies of the impact of other diseases on rural productivity as well as the general literature of rural development, the important point is that the existing literature on the impact of guinea worm disease provides a very limited basis for actually estimating disease impact.

The household dependency ratio is an heuristic statistic that attempts to estimate the extent to which household consumption demand is balanced with productivity.[27,28] Most household productivity results from the efforts of members aged 15-44. Since this age group also consumes a higher level of household productivity than those who are younger, the value in having a high percentage of productive workers in the household is marginal rather than absolute.[29]

Other factors such as availablity of land and the potential for obtaining high cash wages are important considerations,[30] and the specific mix of cash and farming income is significant in estimating socioeconomic status. For example, to increase yields, a household may need to purchase advanced technology (machinery, pesticides, etc.).[31] Families that have both adequate

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*A more reliable figure is needed than that presented here. It was obtained from data on only six villages or village clusters (the standard deviation was ±2.25).

material resources and local wage labor are likely to be the most successful, but at the same time, outside work in a cash cropping economy, unless only seasonal, reduces the pool of farm workers, and it can accelerate village and household member outmigration.[27,32] The hypothesis that there is considerable labor flexibility in rural areas as a result of constantly available underemployment has not been well demonstrated.[33] Furthermore, during times of peak activity such as planting or harvesting, any flexibility that might have existed in rural areas disappears as the marginal farm workers are conscripted to help.[29,32]

There is growing evidence that increasing demographic pressure on the household is important since the result is the "financing" of increased total food through reduced savings and nonfood consumption.[34] The additional demand for productivity also reduces leisure time and the expenditures of resources on equally critical activities such as child care.[28]

The following formula is one means of estimating demographic pressure on a household, or region, but actual quantification of the variables would be difficult:

$$\text{Demographic pressure} = \frac{\text{productive adults} + \text{nonproductive adults} + \text{seniors} + \text{children}}{\text{productive adults (cash + farming income)}}$$

In this formula, demograhic pressure is defined as the total of all household members divided by the number who are productive. Thus loss of a single productive member can seriously increase the demographic pressure on a household. The member point made by this formulation is that it is much more a function of social units for coping with the surrounding environment than a measure of people per square mile.[28]

The states of the life cycle through which a household passes may also determine its ability to cope with disability. Additional children have an initial impact on household socioeconomic status because of child care demands, but make only modest demands on consumption.[35] As they grow, consumption demand also grows until the age they become productive.[29]

Socioeconomic status can be represented in several ways. Household income has been found to be significantly related to "a child surviving to age 3."[36] Other socioeconomic factors found related to child mortality are: (1) the mother's educational level, (2) her health, (3) household use of toilet facilities, and

(4) type and availability of medical facilities.[36] In addition, an obvious and recurring theme in the literature is the relationship between health and the extent of disease prevalence in the area.[36]

Community

Studies of an Asian influenza epidemic among developing country farm workers and of malarial attacks in Thailand and Sri Lanka have shown that a mere week of disability, on the average, can have a major effect on productivity.[37-39] Assuming that 40 percent of those afflicted are completely disabled for an average of 43.4 days, an examination of village attack rates, primarily those of men and women in the most productive periods of their lives (ages 15-44), will give a rough estimate of days of productivity lost annually by the village:[26,31]

$$\text{Total days lost} = \frac{\text{\% ages 15-44 affected x 40\% complete disability}}{\text{annually x average affliction of 43.4 days}}$$

Thus for every 6 percent of the population ages 15-44 affected, it may be assumed that approximately one day of productivity per worker is lost annually. An attack rate of around 35 percent would represent a week's work lost for each member of the productive population. Among the studies reviewed, this attack rate was not uncommon. In general, there appears to be high correlation between village and household attack rates.

In summary, factors that seem to identify villages at highest risk of serious economic loss from dracunculiasis through lost productivity are:

- Attack occurs during peak agricultural effort.
- A high attack rate occurs in the 15-44 age group.
- A high average worm count per individual.
- A long average period of disability.

CONCLUSION

Dracunculiasis has a major impact on community and household productivity because of its frequent occurrence at times of peak farming activities and its ability to disable severely those afflicted. Attempts made here to estimate its impact are based on sketchy information. The existing literature, however, permits an assessment of its impact which may justify establishing a comprehensive surveillance system and a balanced approach that includes preventive and curative services. There is also a need to establish more complete data bases, comparing those attacked to the remainder of the village population in order to identify high-risk communities and households.

To build a case for a comprehensive intervention program, it must be determined to what extent the disease is responsible for the following sequence of events:

- Increased disability
- Reduced manpower
- Increase in the effective dependency ratio (due to disabled adults)
- Reduced leisure time
- Reduced productivity
- Increased market dependency
- Reduced savings
- Reduced consumption
- Reduced nutrition
- Decline in general health parameters.

Development of studies to assess this impact should have a high priority, but should not divert resources away from efforts to eliminate guinea worm disease as a health threat. Rather, studies that provide field workers with clear guidelines in deciding where to focus scarce resources should be assigned the highest priority, and they should include:

- Refined comprehensive surveillance schemes
- Systems for identifying communities and households at high risk of serious socioeconomic and health repercussions from infection
- Careful estimates of variables influencing loss of productivity as a result of disease
- Studies that provide criteria for allocating limited resources in a balanced fashion to preventive primary disease care and social welfare efforts for those most affected.

Programs to deal with dracunculiasis should not, however, wait until this information is available. Its impact has already been demonstrated in numerous studies worldwide.

REFERENCES

1. Biswas, A. K., 1981. Water for the Third World. Foreign Affairs, 60(1):148-166.

2. Pardanani, D. S., Trivedi, V. D., Joshi, L. G., Daulatram, J., and Nandi, J. S., 1977. Metronidazole ("Flagyl") in dracunculiasis: A double blind study. Ann. Trop. Med. Parasitol., 71(1):45-52.

3. Dunn, F. L. (n.d.) Parasitic enteric disease. Communicable Disease Control Planning. International Health Planning Methods Series, 1:111-118.

4. Rao, C. K., Paul, R. C., Sharma, M. I. D., and Kumar, S., 1981. Guinea worm disease in India: Current status and strategy of its eradication. J. Commun. Dis., 13:1-7.

5. Carme, B., Duda, M., Datry, A., and Gentilini, M., 1981. La filariose de Medine (dracunculose) au decours de vacances en Afrique de l'Ouest. Nouv. Presse Med., 10(33):2711-2713.

6. Shafei, A. Z., 1976. Preliminary report on the therapeutic effect of mebendazole in guinea worm infection. J. Trop. Med. Hyg., 79(9):197-200.

7. Sharma, V. P., Rathore, H. S., and Sharma, M. M., 1979. Efficacy of metronidazole in dracunculiasis--A clinical trial. Am. J. Trop. Med. Hyg., 28(4):658-660.

8. Hiatt, R. A., Cline, B. L., Ruiz-Tiben, E., Knight, W. B., and Berrios-Duran, L. A., 1980. The Boqueron Project after 5 years: A prospective community-based study of infection with Schistosoma mansoni in Puerto Rico. Am. J. Trop. Med. Hyg., 29(6):1228-1240.

9. Smith, D. H., Warren, K. S., and Mahmoud, A. A. F., 1979. Morbidity in Schistosomiasis mansoni in relation to intensity of infection: Study of a community in Kisumu, Kenya. Am. J. Trop. Med. Hyg., 28(2):220-229.

10. Belcher, D. W., Wurapa, F. K., Ward, W. B., and Lourie, I. M., 1975. Guinea worm in southern Ghana: Its epidemiology and impact on agricultural productivity. Am. J. Trop. Med. Hyg., 24(2):243-249.

11. Bidinger, P. D., Crompton, D. W. T., and Arnold, S., 1981. Aspects of intestional parasitism in villagers from rural peninsular India. Parasitology, 83:373-380.

12. Kale, O. O., 1977. The clinico-epidemiological profile of guinea worm in the Ibadan District of Nigeria. Am. J. Trop. Med. Hyg., 26:208-214.

13. Johnson, S., and Joshi, V., 1982. Dracontiasis in Rajasthan, VI: Epidemiology of dracontiasis in Barmer District, Western Rajasthan, India. Int. J. Epidemiol., 11(1):26-30.

14. Buck, A., 1979. Infection and illness in the community: The diagnostic challenge of tropical diseases as seen by an epidemiologist. Am. J. Trop. Med. Hyg., 28(2):171-179.

15. Dean, A. G., West, D. J., and Weir, W. M., 1982. Measuring loss of life, health, and income due to disease and injury: A method for combining morbidity, mortality and direct medical cost into a single measure of disease impact. Public Health Rep., 97(1):38-47.

16. Kothari, M. L., Pardanani, D. S., Mehta, L., Kothari, D. L., and Anand, M. P., 1969. Niridazole in dracontiasis: A controlled study. Trans. R. Soc. Trop. Med. Hyg., 63(5):608-612.

17. Muller, R., 1971. Dracunculus and dracunculiasis. Adv. Parasitol., 9:73-151.

18. Muller, R., 1979. Guinea worm disease: Epidemiology, control, and treatment. Bull. W.H.O., 57:683-689.

19. Edungbola, L. D., 1980. Water utilization and its health implications in Ilorin, Kwara State, Nigeria. Acta Trop., 37:73-81.

20. Sahba, G. H., Arfaa, F., Fardin, A., and Ardalan, A., 1973. Studies on draconctiasis in Iran. Am. J. Trop. Med. Hyg., 22(3):343-347.

21. Saxena, A. K., 1971. An epidemiological note on guinea-worm infection in Madhya Pradesh-I. Indian J. Med. Res., 59(6):940-944.

22. Johri, G. N., and Saxena, A. K., 1974. An epidemiological note on guinea worm infection in Madhya Pradesh. 3. Incidence and infestation rate of infection in the village of Nipania. J. Hyg. Epidemiol. Microbiol. Immunol., 18(2):154-159.

23. Centers for Disease Control, 1981. Program to eradicate dracunculiasis--India. MMWR, 30(44):555-556.

24. Kale, O. O., 1975. A controlled field trial of the treatment of dracontiasis with metronidazole and niridazole. Ann. Trop. Med. Parasitol., 68:91-95.

25. Centers for Disease Control, 1981. Guinea worm (dracunculiasis) and the International Drinking Water Supply and Sanitation Decade. MMWR, 30(16):194-195.

26. Packer, A. H., 1968. Applying cost-effectiveness concepts to the community health systems. Operations Research, 16(2):227-253.

27. Eckholm, E., 1979. The Dispossesed of the Earth: Reform and Sustainable Development. Worldwatch Paper 30, Worldwatch Institute, Washington, D.C.

28. Levi, J. F. S., 1976. Population pressure and agricultural change in the land-intensive economy. J. Dev. Stud., 13(1):61-78.

29. Musgrove, P., 1978. Determinants of urban household consumption in Latin America: A summary of evidence from the ECIEL surveys. Econ. Dev. Cult. Change, 26:441-465.

30. Odum, H. T., 1971. Power basis for man. Pp. 104-138 in: Environment, Power, and Society. Wiley-Interscience, New York.

31. Poffenberger, M., and Zurbuchen, M. S., 1980. The economics of village Bali: Three perspectives. Econ. Dev. Cult. Change, 29(1):91-133.

32. Morrison, B. M., Rural household livelihood strategies in a Sri Lankan village. J. Dev. Stud., pp. 443-462.

33. Parikh, A., 1972. Market responsiveness of peasant cultivois: Some evidence from prewar India. J. Dev. Stud., 8(2):291-306.

34. Bilsborrow, R. E., 1979. Age distribution and savings rates in less developed countries. Econ. Dev. Cult. Change, 28(1):23-45.

35. Musgrove, P., 1980. Household size and composition, employment, and poverty in urban Latin America. Econ. Dev. Cult. Change, 28(2):249-266.

36. Anker, R., and Knowles, J. C., 1980. An empirical analysis of mortality differentials in Kenya at the macro and micro levels. Econ. Dev. Cult. Change, 29(1):165-185.

37. Griffith, D. H. S., Ramana, D. V., and Mashaal, H., 1971. Contribution of health to development. Int. J. Health Serv., 1(3):253-270.

38. Kuhner, A., 1971. The impact of public health programs on economic development: Report of a study of malaria in Thailand. Int. J. Health Serv., 1(3):285-292.

39. Laurell, A. C., 1981. Mortality and working conditions in agriculture in underdeveloped countries. Int. J. Health Serv., 11(1):3-20.

ON CORRELATIONS BETWEEN DRACUNCULIASIS AND MALNUTRITION IN WEST AFRICA

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Unlike previous regional health efforts in Africa to control diseases with high mortality rates (such as smallpox), the prospect of curtailing dracunculiasis (guinea worm disease) promises increased agricultural production, and thus a better nourished population, without placing additional burdens on the environment due to direct increases in population. Reduced incidence of dracunculiasis will not only relieve severe and recurring suffering, but--as important--would remove a significant constraint (shortage of labor) at the most critical points during the short monsoon-linked agricultural cycle in affected areas. Availability of this manpower resource should produce sizable increases in crop yields, even without the addition of scarce capital inputs such as agro-chemicals or mechanization.

REVIEW OF PREVIOUS STUDIES ON THE SOCIOECONOMIC AND NUTRITIONAL EFFECTS

There has been little research on the measurable economic effects of dracunculiasis and no research on potential nutritional effects on afflicted populations. Most research has been limited to clinical, epidemiological, and therapeutic investigations.

Prior to the 1978 Conference on Seasonal Dimensions of Rural Poverty, conducted by the Institute for Development Studies (IDS), University of Sussex, economic considerations of dracunculiasis were limited to remarks by Bildhaiya et al.,[1] Raffier,[2] and Lamontellerie[3] and to the epidemiological perspective of Belcher, et al.[4] of the infection's impact on agricultural productivity.

The investigation by Bildhaiya et al.[1] in India demonstrated an average labor loss of 60-90 days per victim. Although they made no further calculations of their own, Bildhaiya et al. reported that the director of health services estimated in 1956 that the nominal value of lost labor per farmer was Rs. 2 per day. They note that "the effects are so incapacitating that the (Division's) agricultural operations may be interfered with owing to the scarcity of labor."[1]

Raffier's 1969 report on the "Activity of Niridazole" estimated anecdotally that the Ivory Coast alone had up to 50,000 victims annually, with agricultural operations in 35-50 percent of the villages "immobilized."[2] Lamontellerie's 1972 analysis of filarial infections near Banfora, Upper Volta, concluded that of the human filariases, dracunculiasis plays a more important role economically, as it can render an important fraction of the population temporarily inactive.[3]

The most significant work, however, is the 1975 study by Belcher et al., which quantitatively confirms the pattern suggested by Bildhaiya, Raffier, and Lamontellerie. After explaining how afflicted farmers coped with illness to minimize its impact, Belcher et al. conclude that, despite efforts to substitute family or hired labor

> because guinea worm is seasonal, coinciding with peak agricultural activities, and few alternative (uninfected) labor sources are available for the incapacitated farmers, marked reduction in agricultural output occurs.[4]

Although crop losses were not reported in cash or harvest yield equivalents, and no comparison was made between yield or nutritional status in infected versus non-infected villages, the correlational links between the seasonality of dracunculiasis, labor constraints, and agricultural production were unequivocally established. Some dracunculiasis studies since then have looked more closely at a demographic analysis of incidence rates and labor incapacitation, but to date no systematic analysis has done more than point out these correlations.

By the 1978 IDS conference, the linkages made by Belcher et al.,[4] in terms of the seasonality of dracunculiasis and its effect through incapacitation on crop production, had been broadened considerably. Data from a variety of disciplines suggested a wide range of correlations between disease, cultural practices, the agricultural crop cycle, nutrition, and the onset of the seasonal rains.

Chambers[5] provides a holistic view of the linkages between health, agriculture, and rural poverty and the onset of the rainy season, arguing that

> for agriculturalists in the tropics, the worst times of the year are the wet seasons,

> typically marked by a concurrence of food shortages, high demands for agricultural work, high exposure to infection . . ., loss of body weight, low birth weights, high neo-natal mortality, poor child care, malnutrition, sickness and indebtedness. In this season, poor and weak people, especially women, are vulnerable to deprivation and to becoming poorer and weaker. . . .

Although much of Chamber's work extends beyond the scope of immediate concern, the salient point is the relationship between the nutritional shortfall during the pre-harvest season and the occurrence of dracunculiasis (particularly acute among rural farmers), which coincides annually with the onset of the monsoonal rains at the most critical labor input points of the crop cycle. B. B. Waddy[6] has also emphasized the synergistic, negative impact of several infections, including dracunculiasis, and shortages of food during the same important period of the agricultural year in Ghana.

EVIDENCE OF INTERACTION AMONG DRACUNCULIASIS, NUTRITIONAL STATUS, AND AGRICULTURE

The absence of any paradigm by which to measure the impact of guinea worm disease on Sahelian pastoral populations restricts one to looking mainly at sedentary farmers. However, the marked need of pastoralists for grain (usually millet) in their traditional diets makes them, despite their transhumance, also nutritionally dependent on how successfully sedentary farmers produce surplus stocks. Swift[7] has demonstrated that pastoralists represent a significant reservoir of demand for grain.

Millet production studies conducted by Nigeria's National Accelerated Food Production Project (NAFPP) in 1975-1976, and analyzed by Knipscheer, Menz, and Khadr[8] of the International Institute of Tropical Agriculture (IITA), estimated a gross per capita yield of 202.9 kg--an indication of the nutritional marginality in the savanna zone studied. According to U.N. Food and Agriculture Organization (FAO) figures quoted by the government of Upper Volta, this yield would assure 2,150 calories per day. As 94 percent of the millet farmers studied by NAFPP also grew some sorghum, groundnuts, and or cowpeas, and 78 percent engaged in at least some other part-time employment during the year, their basic nutritional needs were met. However, the gross per capita yield ignores postharvest storage losses caused by pests or bacteria, the traditional barter of grain for services with pastoral populations, and payments-in-kind of grain to cover credit and other expenses.

Ideally, one would like to be able to compare longitudinal agricultural and general nutritional data on similar ethnic groupings within the same ecological/agronomic zone--the only variable being the presence or absence of dracunculiasis. If such data existed one might be able to postulate nutritional relationships with some confidence. In the absence of such direct data from the sub-Sahelian zone, however, indirect indicators must be used. The NAFPP/IITA survey of millet farming in northern Nigeria provides as accurate a description of the time allocated to the various production tasks of the crop cycle as currently exists. Fortunately, additional data on monthly weaning distribution, live birth distribution, and hospitalizations for pediatric malnutrition are also available from other sources for the same region. Unfortunately, however, although dracunculiasis is endemic in this area, a literature search revealed no epidemiological studies of the disease in the same area. A 1972 study* by Lyons[9] in northwestern Ghana near the Upper Volta frontier correlates monthly data on guinea worm disease incidence and prevalence to rainfall distribution. A long-term comparison of monthly rainfall figures in northern Nigeria and northwestern Ghana suggests, if not environmental similarity, at least parallel patterns of rainfall and distribution of agricultural tasks. Upon examining the relationship between rainfall, the millet crop cycle, and selected statistics, it is apparent that increased requirements occur at the onset of the rainy season to support the activities of males, although northern Nigeria is a Moslem society where women are frequently confined to household compounds. This

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*Lyons reports that average annual precipitation in the Wa district of northwestern Ghana is 1,105 mm, based on observations from 1917-1957. He provided no monthly rainfall distribution figures, however. The nearest location for which longitudinal monthly precipitation figures were available was the Bobo Dioulasso reporting station, approximately 100 air miles northwest of WA. Average annual precipitation, based on 10 years' observation during the pre-drought period of the late 1950s to 1960s, was 1,179 mm (converted from English measurement at 1" = 25.4 mm). As the ecological zone, ethnic composition, and crop mixture on both sides of the Voltaic-Ghanaian frontier are similar, the Bobo Dioulasso monthly precipitation table is considered regionally accurate.

sudden reallocation of labor is associated with a 400 percent increase in the weaning rate. In fact, 40 percent of the preceding year's live births are weaned within 2 months of the onset of monsoonal rains. By the time the heaviest rains arrive 6-8 weeks later, local hospital admissions for pediatric malnutrition have jumped by almost 75 percent. It is believed that this is due to the combination of (1) premature weaning of infants and women's increased labor requirements, both of which preclude time to prepare adequate meals for toddlers; and (2) changes in food allocation practices during times of high adult energy demands when children eat last and least.

Figure 1 shows the relationship of the monthly totals of self-reported guinea worm from Lyons'[9] most heavily infected villages in northwestern Ghana over 3 years (1968-1971) and the area's average monthly rainfall, calculated on a 10-year base. As mentioned earlier, the monthly distribution of precipitation between northern Nigeria and northwestern Ghana is quite similar, especially at the onset of the rainy season. This figure also indicates when specific tasks related to millet production are conducted in northern Nigeria. Although there are undoubtedly some differences in the crop mix and agricultural labor cycles between northern Nigeria and northwestern Ghana, the need for field preparation in the 2 months prior to the rains, planting at the onset of the rains, and initial weeding shortly thereafter is the same. Crippling of affected populations by dracunculiasis thus reaches its peak in this geographic zone just at the time of highest demand for agricultural labor.

The reported interaction of dracunculiasis, seasonal precipitation, and food production in the savannah areas of West Africa may then be summarized as follows:

1. Agricultural cycle. The period of highest labor input demand in the study area runs from April (when field preparation and early planting begin in earnest) to July (when the second weeding and fertilization have been completed), at which point crops should be adequately established.

2. Dracunculiasis cycle. The period of highest self-reporting of the onset of the patent stage of dracunculiasis runs from April to July. This period accounted for 75 percent of the cases annually reported in the study area.

3. Precipitation cycle. Almost 85 percent of the annual rainfall in the study area occurred

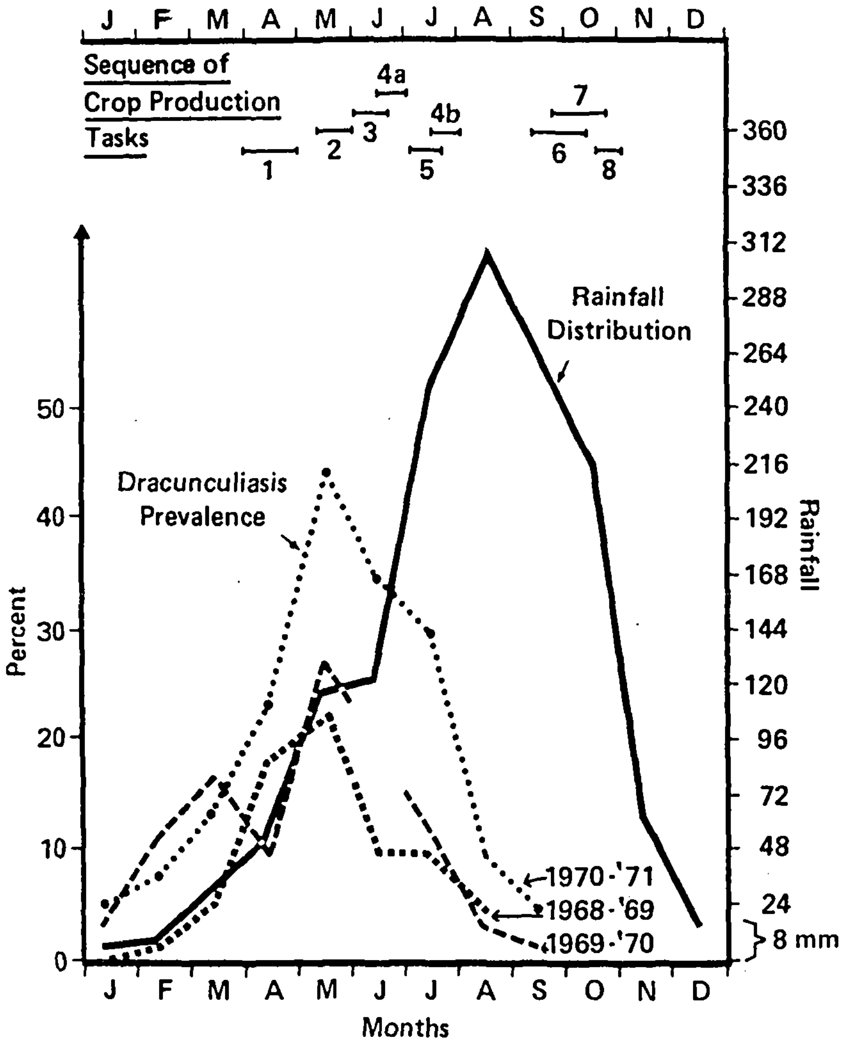

FIGURE 1 Interaction of dracunculiasis prevalence, seasonal rainfall, and crop production tasks. The indicated crop (millet) production tasks are: (1) land clearing/preparation, (2) planting, (3) thinning/transplanting, (4) weeding, (5) fertilizing, (6) harvesting, (7) threshing, (8) storage. (Dracunculiasis and rainfall data on Ghana from Lyons; data on millet production tasks in similar Nigerian zone from Knipscheer et al.; rainfall distribution from U.S. Department of Commerce.[10]

between May and September. Not only does the onset of monsoon rains govern the crop cycle, but a positive correlation may exist between any year-to-year fluctuations in precipitation distribution and the onset of dracunculiasis. Although the reported average length of physical incapacitation suffered by guinea worm victims is variable--according to whether one uses lower (about 30 days) or higher (about 90 days) estimates--the impact of such labor losses on crop production and, therefore, on carry-over grain stores is staggering.

DISCUSSION

Although no direct causal link between dracunculiasis and chronic seasonal malnutrition has been documented, the preceding data suggests a causal relationship between labor losses resulting from dracunculiasis-related physical incapacitation, production of inadequate staple food supplies, and seasonal chronic malnutrition. The evidence cited above includes seasonal fluctuations in weaning rates, seasonal variations in food consumption patterns affecting the adequacy of child nutrition, and seasonal variations in hospitalizations for pediatric malnutrition.

This is not to suggest that the eradication or significant abatement of dracunculiasis will result in the elimination of chronic seasonal malnutrition among afflicted populations. (Note that if improvement of water supply sources is the intervention chosen, this would also be expected to reduce the prevalence of gastroenteritis, another condition that may be associated with malnutrition.)

It may be expected, however, that increased availability of labor in the agricultural sector due to suppression of dracunculiasis will result in improved crop yields which will be reflected, over time, in improved nutritional status. Thus any dracunculiasis abatement program should include indicators of community nutrition status among its evaluation criteria. Considering the complex interaction of physical, social, economic, and health variables affecting a population's crop yields, and subsequent nutrition status, of the populations concerned, studies of the impact of anti-dracunculiasis efforts should include the following indicators:

1. Epidemiologic indicators--using standard pre- and post-intervention epidemiological survey data.

2. Socioeconomic indicators--including not only longitudinal shifts in crop yields, but also pre- and post-intervention patterns of male and female labor allocation and incapacitation.

3. Quality of life indicators--general health levels, family food consumption, nutritional status, education, shelter, life expectancy.

As chronic malnutrition is most easily recognized in, and has its greatest impact on, young children, it may be more productive to avoid the problems associated with collecting data about adult nutritional status by focusing on measurement of age, weight, and height of children under 5 years.

Dracunculiasis programs may seek to "capture" existing data collected by other agencies conducting ongoing maternal and child health programs in target areas, or they may assess nutritional status as part of their own annual household and village-level monitoring and evaluation samples. An effective place to begin, therefore, is to determine what nutritional data are already being collected and whether such data are amenable to reexamination for the purposes desired. Potential problems with this approach include variability in different agencies' data collection methodologies; variability in the accuracy and reliability of anthropometric measurements, as well as recording, transcribing, and maintenance of data among agencies; and variability in clinic outreach effectiveness.

Changes in the nutritional status of children from weaning to age 5 appear to be the best proxy indicator not only of the nutritional status of the population at large, but also the clearest indicator of changes in the overall quality of life of the target population. As existing data suggest that children in the Sahelian zone are at greatest nutritional risk during the 3-month period following the onset of the rainy season, annual age-based, cross-sectional analyses of their nutritional status should be collected during this period based on age, height, and weight. Regardless of the area to be served or the technical intervention(s) selected to combat dracunculiasis, longitudinal cross-sectional examination of children's nutritional status may be expected to reflect success in the elimination of or significant reduction in dracunculiasis transmission.

ACKNOWLEDGMENT

The author wishes to express his appreciation to Dr. Juan Aguilar, Dr. R. L. Bruce, Dr. J. Lin Compton, Dr. Richard Jacobson, and Dr. John Mason for their criticisms of this paper. Such errors as remain are exclusively the author's.

REFERENCES

1. Bildhaiya, G. S., Marwaha, S. M., and Patidar, S. R., 1969. An epidemiological assessment of dracunculiasis. J. Indian Med. Assoc., 52:67-71.

2. Raffier, G. 1969. Activity of niridazole in dracuntiasis. Ann. N.Y. Acad. Sci. 160:720-728.

3. Lamontellerie, M., 1972. Resultats d'enquêtes sur les filarioses dans l'Ouest de la Haute Volta (Cercle de Banfora). Ann. Parasitol. (Paris), 47:783-838.

4. Belcher, D. W., Wurapa, F. K., Ward, W. B., and Lourie, I. M., 1975. Guinea worm in southern Ghana: Its epidemiology and impact on agricultural productivity. Am. J. Trop. Med. Hyg., 24:243-249.

5. Chambers, R., 1979. Health, Agriculture and Rural Poverty: Why Seasons Matter. Discussion Paper 148. Institute of Development Studies, Sussex, England.

6. Waddy, B. B., 1956. Organization and work of the Gold Coast Medical Field Units. Trans. R. Soc. Trop. Med. Hyg., 50:333-334.

7. Swift, J. J., 1978. An Overview of Sahelian Pastoral Production Systems. Center for Research on Economic Development, University of Michigan, Ann Arbor, Michigan.

8. Knipscheer, H., Menz, K., and Khadr, eds., 1980. Benchmark Surveys of Three Crops in Nigeria. International Institute of Tropical Agriculture, Ibadan, Nigeria.

9. Lyons, G. R. L., 1972. Guineaworm infection in the Wa district of north-western Ghana. Bull. W.H.O., 47:601-610.

10. U.S. Department of Commerce, 1979. Climates of the World. Environmental Service Administration, Washington, D.C.

SOCIAL AND CULTURAL ASPECTS OF GUINEA WORM ERADICATION

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INTRODUCTION

Most attention to guinea worm disease (dracunculosis, dracontiasis, dracunculiasis, Medina worm, la filariose de Médina) has focused on the biology of the worm and hosts, supplies of safe water, chemical treatment of water, and medical treatment of infected individuals. All too neglected are the cultural beliefs and practices surrounding guinea worm disease; patterns of social structure that determine water use, contact, and consumption; and the often considerable variation in these dimensions among even neighboring ethnic groups. While it is theoretically simple to eradicate this disease--to interrupt its cycle at any of several points--it has proven more complex to actually do so. Lack of attention to practical social or cultural factors has resulted repeatedly in the reappearance of the disease where it was once eradicated, or resurgence where it was once under control.

Several researchers involved in the study and reduction of dracunculiasis have noted that the difficulties in controlling and eventually eradicating this disease require an interdisciplinary, integrated campaign, which includes attention to local beliefs, attitudes, social structure, and patterns of water use and migration. Akpovi's comments on Idere, Nigeria, also apply to much of West Africa, the Middle East, and India:[1]

> Since engineering and medical approaches have not produced lasting benefit to the people of Idere, the challenge became obvious to try a health education approach. Hopefully better results would come from emphasizing citizen participation, self-help and careful attention to the social and behavioral aspects of the problem.

As the operational manual from the Indian Division of Helminthology states, "the social customs of the inhabitants and unsanitary conditions of the area determine the extent of disease transmission."[2] An example from francophone West Africa makes the point dramatically:[3]

> It's clear that the dracunculosis is a real sociological disease. The curative action (in our present knowledge), the chemical fight against the vector, the piped-water buildings are certainly indispensable, but they can only be considered as a substitute meant to palliate the total lack of health education. In fact, the villages often prefer the Cyclops-infested pond-water to the protected and safer well-water because of its taste. We even discovered, to our amazement, that in a village in the North of Mali, the villagers filled up a well with whatever they could find, simply because they would not give up drinking the pond-water.

Understanding the social and cultural context of guinea worm disease does not require accumulating anthropological esoterica for its own sake, but the use of facts directly and indirectly helpful in hastening eradication of the disease. This paper describes a member of the social and cultural aspects of dracunculiasis, culled from articles on Dracunculus medinensis listed in Index Medicus over the last 15 years and from papers presented at this workshop, to emphasize the variety of factors that must be considered in a comprehensive war against this disease. These examples are, however, by no means exhaustive.

BELIEFS, ATTITUDES, AND VALUES

In locations of high endemicity, inhabitants tend to be fatalistic about the disease, accepting incapacitation as an unavoidable part of life. Where the incidence of disease is moderate, infection is considered normal and acceptable provided it does not "go out of proportions."[4] As Adeniyi hypothesizes, "since dracunculiasis is to a large extent linked with people's environment and lifestyle, it should be expected that the affected population will develop a minimum level of tolerance for the disease, especially when an effective remedy is not available."[4] Although a sense of hope could arise when the level of infection is reduced, any modern scientific understanding of the disease may yield to supernaturalistic explanations in the face of an epidemic of guinea worm disease.[4] In Ghana, Ward and colleagues found that 67-90 percent of the respondents in two ethnic groups believed that dracunculiasis could not be prevented.[5] They also discovered in the same culture that while the disease had major economic and health impacts, it was not a topic of conversation, for "to discuss the disease might increase a person's chance of getting it."[5]

The source of the disease may be understood in terms of modern materialistic germ theory or in terms of traditional animistic concepts. For example, some Ghanaian villagers believed that inherited characteristics caused the disease.[5] In Nigeria, beliefs emphasize its generational links.[6] Illustrating the ways in which traditional beliefs can be combined with modern approaches, Akpovi and colleagues,[1] also working in Nigeria, described how

> in one village the chief related that while the caretaker said guinea worm was spread through water, he personally believed the god of smallpox was at fault. By neither challenging traditional belief and alienating the chief nor undercutting the role of the caretaker, the lecturer suggested that possibly the god of smallpox might trick people into contaminating and drinking the water, thereby spreading guinea worm. This explanation was acceptable to all.

Traditional beliefs have consequences, of course, for the use of modern curative opportunities. In Ghana, for example, it was found that although all the villages were within 32 km of a hospital, patients did not seek, nor were they taken for, medical treatment. This attitude is not surprising, particularly when modern medicines are not especially helpful, except against secondary infections. In Wawa village of Kwara State, Nigeria, attitudes were similar. "Few patients went to the hospital . . . or to the Dispensary in the village . . . because they believed that traditional treatment is more effective than modern medicine."[8] Some may have been reluctant to go for help because the worms emerged in their genital areas.[8]

To what extent villagers associate guinea worm disease with contaminated water is an important question for health educators working in rural areas. In general, a considerable proportion of people link the disease with unclean water, and have done so, in some areas at least, for centuries. Ward and colleagues found that one-third of both ethnic groups studied in Ghana made this connection.[5]

Writing in 1768 and referring to practices in West Africa, James Lind reported how containers of pond water were sealed until the cyclops were dead:[9]

> And thus supposing the guinea-worm to be generated from animalcula or their ova, contained in the waters of the country, their production in the human body may probably be afterwards prevented by drinking those waters only that have been rendered perfectly sweet by undergoing a previous putrefaction.

Describing dracunculiasis at Ormus in 1584, the Dutch navigator Linschoten wrote: "There is in Ormus a sicknesse or common plague of wormes, which growe in their legges, it is thought that they proceede of the water that they drink."[10] According to British Secretary Sir James Tennent who worked there from 1845 to 1850, "in Ceylon, as elsewhere, the natives attribute its occurrence to drinking the waters of particular wells."[10]

Preventive and Treatment Measures

Even when people engage in the most desirable public health practices, they may not understand the reasons for doing so. If this is the case, they may still run a risk of infection. In the Kurnool District of India, "even those who boil or filter the water in their own houses may contract the infection by drinking untreated water in neighboring houses."[11] In Banaskantha District, Gujarat, India, "practically all the affected families did filter water with a piece of cloth merely as a cultural habit as only 23.50 percent of families thought it as a measure of avoiding infection."[12]

The application of herbs and oils, and the eventual extraction of the worm by incision or winding it around a stick are widespread. In one area of Ghana, Ward's group reports the use of local herbs to stimulate swelling at the pre-blister stage, followed by palm oil to soften the skin. Then the ulcer may be incised or, following eruption of the worm, other herbs will be placed on the wound and the limb soaked to hasten the exit of the worm, as it is wound around a stick. A string may be tied around the infected limb to keep the worm from migrating should it break.[5] Similarly, in Idere, Nigeria, "traditional treatment includes application of palm oil (of no obvious therapeutic value) or certain leaves (called "ewe imin" in the local language) on the ulcer."[1] Describing the situation in West Nemar District, Holkar State, India, Bildhaiya and colleagues found neither modern nor traditional methods effective for guinea worms:[13]

> The villagers applied locally indigenous preparations and leaves like neem, ipomoea, nirgud, tameshwar, hing (asafoetida), lime, camphor, and akao. The local quacks practised extraction of the worm in a single piece by suction with an animal horn. This procedure worked well especially if the worm was superficial and the ulcer was large. Marking nuts were also administered orally by some of the villagers.

And Linschoten's 1584 description[10] was unsurpassed:

> These wormes are like unto lute strings, and about two or three fathomes longe, which they must plucke out and winde them aboute a straw or a feather, everie day some part thereof, so longe as they feele them creepe; and when they hold still, letting it rest in that sort till the next daye, they bind it fast and amongst the hole, and the swelling from whence it commeth forth, with fresh butter, and so in ten or twelve dayes, they winde them without any let, in the meanetime they must sit still with their legges, for if it should break, they should not without great paine get it out of their legges, as I have seen some men doe.

Social Structure and Water-Use Patterns

Social structure and water-use patterns are often intimately related. Which groups are involved in water collection and where and when they collect it, can influence rates of infection or reinfection. If water-use patterns must be changed, it can be essential to identify and work through the influential decision makers in a village or community.

The intimate and varied association of humans with water has been detailed for studies of schistosomiasis and other water-borne diseases,[14] and these should not be neglected in the efforts to extinguish guinea worm disease. Edungbola lists 14 ways in which humans use water in Ilorin, Nigeria, any of which might be significant for perpetuating dracunculiasis: swimming, drinking, clothes washing, car washing, animal washing, food washing, bathing, farming, refuse disposal, defecation, fishing, recreation, building, and religion.[15] Contaminated water consumed spontaneously while filling water vessels, or drunk by farmers on the way to their fields, are primary occasions for infection.[8,16]

Sources of Water

When piped, treated water is not available, several sources of contaminated water may pose problems. Stepwells, but not drawwells or rapidly flowing water, are notorious sources of infection, as are water holes excavated in dry river beds. In northern Nigeria, "cattle dams" constructed for use by Fulani pastoralists were sites of transmission.[8] Where most villagers depended on cement-lined cisterns (berkehs) in Iran, a high density of cyclops in the dry season resulted in high rates of guinea worm infection.[17] Even when modern wells are installed, they may remain unused and weed-covered if inappropriate locations are used. "The residents [of Idere, Nigeria] did not particpate in the design and location of the well. The engineers' inadvertent choice of a politically unpopular site doomed that effort to failure."[1]

Caste is a factor in southern India. In one case where the lower caste people were not allowed to use the well, they used the river water and were free of infection. Most of the others used the stepwell and acquired guinea worms.[11]

Good wells may be available and there may be no social structural constraints, yet people will persist in using contaminated sources for making palm wine or drinking for the simple reason that it tastes better. Pond water is preferred in Benin because well water "does not quench their thirst."[3] Water from tubewells and drawwells may not compare to pond water in "palatability and satiety."[12] All of these factors must be considered by health educators and somehow resolved before guinea worm disease can be totally eliminated.

Migration Patterns

Migration of workers, pastoralists, and refugees can have a bearing on patterns of infection and reinfection. Kale found that workers in the city who returned to their homes in rural areas on weekends to help with their gardens had much less chance of infection because of less exposure to contaminated water.[18] Examples of reinfection in areas once free of guinea worm disease--Pakistan,[7] Iran,[17] and Sri Lanka[10]--emphasize the need to reinspect remote villages from time to time until the disease has been eradicated. In Paris, 50 cases of dracunculiasis were found recently among workers who had come from West Africa.[19] The first report of guinea worm disease in Kenya is associated with nomadic Turkana pastoralists who may have acquired it while trading and raiding cattle in affected areas of the Sudan.[20] The problems of the Fulani pastoralists in Nigeria have already been mentioned.[8]

Although this list of social and cultural aspects of guinea worm disease could be longer, and despite the potential value these factors might have in the work against dracunculiasis, relatively little attention has been paid to these aspects of the problem. It is extremely important that the value of the social and cultural dimensions of this disease not be lost in the rush to carry out biomedical research and water sanitation engineering.

REFERENCES

1. Akpovi, S. U., Johnson, D. C., and Brieger, W. R., 1981. Guinea worm control: Testing the efficacy of health education in primary care. Int. J. of Hlth. Educ., 24(4):229-237.

2. Government of India, 1982. Operational Manual. Guineaworm Eradication Programme in India. Division of Helminthology, National Institute of Communicable Diseases, 22, Sham Nath Marg, Delhi-110054, India

3. Desfontaine, M., and Prod'hon, J., 1982. Epidemio-Geographic Data on the Dracunculosis in French-Speaking West Africa. Paper presented at the Workshop on Opportunities for Control of Dracunculiasis, National Academy of Sciences, Washington, D.C., June 16-19.

4. Adeniyi, J. D., 1982. Health Education Strategies for the Control of Dracunculiasis. A paper presented at the Workshop on Opportunities for Control of Dracunculiasis, National Academy of Sciences, Washington, D.C., June 16-19.

5. Ward W. B., Belcher, D. W., Wurapa, F. K., and Pappoe, M. E., 1979. Perception and management of Guinea worm disease among Ghanaian villagers. A framework for differential health education planning. Trop. Geogr. Med., 31(1):155-163.

6. Kale, O. O., 1982. Epidemiology of Dracunculiasis in Nigeria. Paper presented at the Workshop on Opportunities for Control of Dracunculiasis, National Academy of Sciences, Washington, D.C., June 16-19.

7. Muller, R. L., 1979. Guinea worm disease: Epidemiology, control, and treatment. Bull. W.H.O., 57:683-689.

8. Abolarin, M. O., 1981. Guinea worm infection in a Nigerian village. Trop. Geogr. Med., 33(1):83-88.

9. Muller, R. L., 1967. A historical note on the transmission of Dracunculus. Trans. R. Soc. Trop. Med. Hyg., 61:747-750.

10. Gooneratne, B. W. M., 1969. An additional historical note on the transmission of Dracunculus medinensis. Trans. R. Soc. Trop. Med. Hyg., 63:546.

11. Reddy, C. R. R. M., Narasaiah, I. L., and Parvathi, G., 1969. Epidemiological studies on Guinea-worm infection. Bull. W.H.O., 40:521-529.

12. Bhatt, A. N., and Palan, K. H., 1978. Guinea-worm infection in Banaskantha District of Gujarat: Some important epidemiology aspects. Indian J. Med. Sci., 32(1-2):1-4.

13. Bildhaiya, G. S., Marwaha, S. M., and Patidar, S. R., 1969. An epidemiological assessment of dracontiasis. J. Indian Med. Assoc., 52:67-71.

14. White, G. F., Bradley, D. J., and White, A. U., 1972. Drawers of Water: Domestic Water Use in East Africa. University of Chicago Press, Chicago, Illinois.

15. Edungbola, L. D., 1980. Water utilization and its health implications in Ilorin, Kwara State, Nigeria. Acta Trop., 37:73-81.

16. Ray, G. C., and Saha, A. L., 1972. Persistent Guineaworm infection in a village in West Bengal. Indian J. Public Health, 16(1):7-9.

17. Sahba, G. H., Arfaa, F., Fardin, A., and Ardalan, A., 1973. Studies on dracontiasis in Iran. Am. J. Trop. Med. Hyg., 22(3):343-347.

18. Kale, O. O., 1977. The clinico-epidemiological profile of guinea worm in the Ibadan District of Nigeria. Am. J. Trop. Med. Hyg., 26:208-214.

19. Carme, B., Duda, M., Datry, A., and Gentilini, M., 1981. La filariose de Medine (dracunculose) au decours de vacances en Afrique de l'Ouest. Nouv. Presse Med., 10(33):2711-2713.

20. Macpherson, C. N. L., 1981. The existence of *Dracunculus medinensis* (Linnaeus, 1758) in Turkana, Kenya. *Trans. R. Soc. Trop. Med. Hyg.*, *75*(5):680-681.

Bibliography of *Dracunculus*

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This bibliography was conceived as a pilot project for a much larger computerised bibliography of filariasis and the financial assistance of the Sasakawa Foundation through the UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases in its production is gratefully acknowledged.

All titles have been translated into English but the first three letters of the original language are given at the end of all non-English citations.

Historical references were obtained principally from Bartet (1909), Bremser (1819), Davaine (1860), Hirsch (1885), Hoeppli (1959), Huber (1894), Inglis & Leiper (1912) and, most important of all, the Index Catalogue of Medical and Veterinary Zoology by C.W. Stiles and A. Hassall (1920-1952).

The writings of Classical and 'Arabian' authors are given in editions or translations available in libraries today and no attempt has been made to indicate their probable original date of publication; e.g. a 1735 edition of the work by Areteus of Cappodocia (who lived ca 200 AD) is cited and reference is also made to an English translation of 1856.

More doubtful allusions in ancient literature are not included directly: these include the oft-quoted passage in the Old Testament (Numbers XXI, 6) - see Bartholinus (1672), Bloch (1899), Kuechenmeister (1857) and Velschius (1674); the Ebers Papyrus - see Ebbel (1937); the Rg Veda (p360 of the 5th edition of the 1889 translation by R. Griffith) - see Kevan (1977); the connection with the Caduceus Motif - see Kintzen (1968), Markell (1968), Menk (1974) and Velschius (1674).

Literature published this century has been obtained principally from the following sources:

Annals and Magazine of Natural History
Archiv fur Schiffs- und Tropenhygiene
Abstracts of World Medicine
Biological Abstracts
Bulletin Institut Pasteur
Bulletin Signaletique (now Analytique) d'entomologie medicale et Veterinaire
Excerpta Medica
Helminthological Abstracts
Index Catalogue of Medical and Veterinary Zoology
Index Catalogue of the Surgeon General's Office
Index Veterinarius
Referativnyi Zhurnal
Tropical Diseases Bulletin
Zentralblatt fur Bakteriologie etc.
Zoological Record

and a search of the BIOSIS, CAB, EMBASE and MEDLINE data bases from 1970.

Abblart
1883
Phlegmonous dermatitis of the leg and foot (left side) of parasitic origin.
Jrnl Arch Med Nav, 40, 454-6 FRE

Abbot P H
1951
X-ray showing calcified guinea-worms round the hip joint and in the pelvis (demonstration).
Trans Roy Soc Trop Med Hyg, 45, 14

Abbott A C
1899
The hygiene of transmissable diseases etc.
Philadelphia, p226

Abolarin M O
1981
Guinea worm infection in a Nigerian village.
Trop Geog Med, 33, 83-88

Abukhalil J M
1971
Radiography of the Dracunculus medinensis, the Medina worm.
Radiography, 37, 173-7

Abulcasim (= Alsaharavius)
1519
Vena exiens.
Aug Vindel, Tract. 28, cap 12, fol118 LAT

Acharyma G V, Palekar V S, Dastur D K
1967
An unusual presentation of guinea-worm, a case report.
J Postgrad Med, 13, 135-6

Acton H W
1910
The treatment of Filaria medinensis by subcutaneous injection of Chinosol.
Ind Med Gaz, 45, 258-9

Adam
1824
(No title ?).
Trans Med & Surg Soc Calcutta,

Adekolu-John E O
1979
A communication on health and development in the Kainji Lake area of Nigeria.
Acta Tropica, 36, 91-102

Adekolu-John E O
1980
The probable impact of the proposed Jebba Dam on the health aspects of the River Niger Basin of Nigeria.
Publ Health, 94, 235-242

Adekolu-John E O
1983
The impact of lake creation on guinea-worm transmission in Nigeria on the eastern side of Kainji Lake.
Int J Parasit, 13, 427-32

Adeloye A
1983
Extradural compression by guinea worm.
Surg Neurol, 19, 482

Adeniyi J D, Brieger W R
1983
Guineaworm control in Idere.
World Health, April/May, 8-11

Advier, Dejou L
1938
Acute athritis of the knee: microfilaria volvulus in the articular fluid.
Bull Soc Path Exot, 31, 727-30 FRE

Aetius of Amida
1549
Dracunculus of the arms and legs.
Med graec contractae ex vet med IV sermo II cap 85, pp800-1 LAT

Agnew D H
1883
Guineaworm.
In The principles and practice of surgery. Philadelphia: vol 3, p480

Aguilar F J
1940
Study of Cyclops coronatus, intermediate host of guineaworm, encountered in the vicinity of the capital.
Guatemala Med, 5, 20 SPA

Aitken W
1863
The Entozoa.
In The science and practice of medicine, vol 2, chap 12

Aitken W
1866
Parasitic diseases.
In Science and practice of medicine. Philadelphia; p847 and 863-880

Akpovi S U, Johnson D C, Brieger W R
1981
Guinea worm control: testing the efficacy of health education in primary care.
Int J Health Educ, 24, 229-37

Albucasis
1541
On the extraction of Vena cruris.
Methodus mebendi Basiloe, lib II cap 91, 162 LAT

Alcock A
1912
Miscellaneous notes from the Entomological Department. 3 A suggestion for destroying cyclops in small collections of water.
J London Sch Trop Med, 1, 206

Aldrovandus
1640
The history of serpents and dragons.
Bononiae fol lib III, pp328-9 LAT

Allenstein
1870
Extraction of a guineaworm from the foot of a sailor.
Cor-Bl Natur-Ver Riga, 18, 117 GER

Alvarez A
1903
A case of filariasis in the Argentine Republic.
Semana Med, 10, 1288-9 SPA

Amado S
1872-3
On filariasis.
Correio Med de Lisboa, 2, 151-153 POR

Ambroise-Thomas P
1969
Serological and immunological study of ten parasitic diseases using immuno-fluorescence techniques.
Faculte de Medecine: Lyon (mimeo) FRE

Ampofo O
1977
Plants that heal.
World Health, Nov, 26-30

Anand S V, Evans K T
1964
Pyomyositis.
Brit J Surg, 51, 917

Anantaraman M
1966
Dracontiasis in animals.
Proc 1st Inter Congr Parasit; Rome (1964), 2, 798-9

Anantaraman M
1968
Epidemiological viewpoints in parasitic zoonoses in India.
Bull Indian Soc Mal, 5, 270-4

Anderson J, Dubois
1806
History of the guineaworm and of the method of cure employed by the Hindoos.
Edin Med Surg J, 2, 300-7

Anderson R G
1908
Medical practices and superstitions among the people of Kordofan.
3rd Rec Wellcome Res Lab, pp281-322

Andonin J V
1824
Guineaworm (draggonneau).
In Dict Class d'Hist Nat Paris, v5, pp563-564 FRE

Andry N
1700
On the generation of worms in the body of man.
Paris (plates sep in 1718 and 3rd ed 1741 vol1 p131) FRE

Annandale T
1862
Guinea-worm in the skin of the leg.
Edinburgh Med J, 8, 434-5

Annesley J
1841
Researches into .... diseases of India.
London, p67

Anon
1833
(No title?).
Zeitschr fur Ophth; Leipzig, 3, 40 GER

Anon
1836
Review of the writings and opinions of Duncan, Johnson, Bird, Myline, Kennedy, Chisholm, H. Scott, A.J. Robertson, Smytton, MacGregor, Thomas, Mosely, Morehead,Twining and others on the Dracunculus or guinea-worm.
Corbyn's India J Med Phys Sci, 2, 118

Anon
1843
The guinea-worm, very prevalent at Bokhara.
Boston Med Surg J, 28, 387

Anon
1867
The Abyssinian expedition and the guinea-worm disease.
Standard, 3rd Sept

Anon
1868
Case of guinea-worm or Narve successfully treated with carbolic acid.
Indian Med Gaz, 3, 7-8

Anon
1880
The guinea-worm.
Brit. Med J, i, 488-9

Anon
1880
Guinea-worm - novel mode of extraction.
Indian Med Gaz, 5, 170

Anon
1886
A case of guinea-worm (at Le Hor).
Lancet, ii, 658

Anon
1894
A new treatment of guinea-worm.
Brit Med J, ii, 23

Anon
1915
Annual medical report for 1914.
East African Protectorate, p20-1

Anon
1915
Annual medical report for 1914 (with 10 cases of guineaworm).
Nyasaland Protectorate, p20

Anon
1916
Medical and sanitary report for 1915.
Gold Coast Government, no 8, p524

Anon
1916
Fifty second annual report of the sanitary commissioner with the Government of Bombay for 1915.
Govt Central Press: Bombay

Anon
1924
Report of the Bombay bacteriological laboratory for the year 1923.
Govt Central Press: Bombay, pp49

Anon
1936
Dracunculus medinensis.
Indian Med Gaz, 71, 469

Anon
1936
Dracunculus infection in an Arab.
Meded Dienst Volksgezondh Ned-Ind, 25, 356 DUT

Anon
1951
Colonial research 1950-51.
London: HMSO, pp243

Anon
1954
Colonial research 1953-54.
9th Annual Rep Col Med Res Comm. London: HMSO, pp278

Anon
1973
Aquatic animal health.
Washington DC: National Academy of Sciences, pp46

Anon
1981
War on guinea worm.
Africa, Nov, 99-101

Anon
1981
Guinea worm (dracunculiasis): an economically important water borne disease that could be eliminated in extensive areas during the "Water Decade".
Dept Hlth Human Services, Public Health Service, CDC: Atlanta, pp22

Anon
1981
Metronidazole - unanswered questions.
Lancet, i, 818-9

Anon
1981
Guineaworm (dracunculiasis) and the International Water Supply and Sanitation Decade.
Morbidity and Mortality Weekly Rep, 30, 194-5

Anon
1982
Operation manual. Guineaworm eradication programme in India.
NICD, Division of Helminthology. Delhi, 35pp

Anon
1982
Dracunculiasis surveillance.
Weekly Epidemiological Record, 57, 65-7

Anon
1983
After smallpox, guineaworm?
Lancet (editorial), i, 161-2

Anon
1983
Dracunculiasis surveillance - India.
MMWR, 32, 208-10

Anon
1983
Guineaworm eradication programme in India: operational manual.
NICD: Delhi, rev. ed, 52pp

Anon
1983
Opportunities for control of dracunculiasis.
Rep of Workshop (16-19 June 1982). Washington DC: Nat Acad Press, 65pp

Anon
1983
Dracunculiasis surveillance.
Weekly Epidemiological Record, 58, 166-8

Anon
1983
Dracunculiasis surveillance.
Weekly Epidemiological Record, 58, 21-3

Anon
1983
Workshop on opportunities for control of dracunculiasis.
Weekly Epidemiological Record, 58, 249-50

Anon
1984
Dracunculiasis surveillance.
Weekly Epid Record, 59, 69-71

Anraedt J L
1955
A case of Dracunculus infection of the scrotum.
Bull Soc Path Exot, 48, 57-8 FRE

Ansari A R, Nasir A S
1963
A survey of guinea worm disease in the Sind desert (Tharparkar District of West Pakistan).
Pak J Hlth, 13, 52-67

Antani J A, Srinivas H V, Krishnamurthy K R, Borgaonkar A N
1972
Metronidazole in dracunculiasis: report of further trials.
Amer J Trop Med Hyg, 21, 178-81

Antani J, Srivinas H V, Krishnamurthy K R, Jahagirdar B R
1970
Metronidazole in dracunculiasis: a preliminary report.
Amer J Trop Med Hyg, 19, 821-2

Antonovic S, Cepic N, Mudrinski M, Pejovic D, Milosavljevic B, Lazarevic B, Arsenijevic V
1981
The first case of dracontiasis in Yugoslavia.
SRP Arkh Tselok Lek, 109, 1399-404

Antony
1904
Presentation of a patient suffering from guineaworm and treated unsuccessfully with chloroform.
Bull Mem Soc Med Hop Paris 3rd ser, 21, 1027-30 FRE

Areteus of Cappadocia
1735
(On Dracunculus).
In De causis et signis acutorum et diuturnorum morborum libri quator. Lugduni fol Lib II C I, p51 (also Adams F 1856 The Sydenham Soc: London) LAT

Arthus G D
1604
On worms etc.
In Indiae orientalis pars VI Guinea and Africa, Frankfurt fol C48, p101 LAT

Avenzoar Abhumeron
1497
Comments on Vena medinensis.
Theizir Venetiis lib II tract vii cap 19(or 20), fol 32b LAT

Avicenna (= Ibn Sina)
1564
Comments on Vena medinensis.
Can lib IV sect iii tract ii cap 21 Venetiis ii, p128 LAT

Avouac B
1979
Articular manifestations of parasites.
Gaz Med de France, 86, 4923-8 FRE

Ayensu E S
1978
Medicinal plants of West Africa.
Algonac Mich: Ref Publ Inc, 330pp

Azim
1939
Helminths of dogs and cats in Egypt.
Ann Parasit Hum Comp, 17, 32-6 FRE

Bafna P L, Das Gupta H K, Baid J C
1977
A guinea-worm with cyst formation in the scrotum simulating extra testis with its vas deferens.
Indian J Surg, 39, 421-2

Baines E J
1977
Metronidazole: 16 years of developments.
Proc Int Conf on Metronidazole (Netherlands), no438, 61-71

Baines E J
1978
Metronidazole: its past, present and future.
J Antimicrobial Chemotherapy, 4 Suppl C, 97-111

Bajon
1777
Memoir on the history of Cayenne and of French Guyana.
Paris, vol 1, mem 10 FRE

Balasubraman V, Ramamurthi B
1965
An unusual location of guineaworm infestation; report of a case.
J Neurosurg, 23, 537-8

Balfour A
1903
Eosinophilia in bilharzia disease and dracontiasis.
Lancet, ii, 1649 (also Rep Wellcome Res Lab, 1, 58-61)

Balfour A
1920
Treatment of guinea-worm.
Lancet (corr), i, 885

Balfour J
1858
Note on the incubation of guinea-worm (Filaria medinensis).
Edin Med J, 6, 442-3

Balfour J
1859
A few remarks on guinea-worm.
Indian Ann Med Sci, 6, 175-6

Bamagunda D
1934
An unusual case of dracontiasis.
East Afr Med J, 11, 242-3

Bandyopadhyay A K
1964
Dracontiasis.
Bull Calcutta Schl Trop Med, 12, 140

Bandyopadhyay A K
1969
Dracontiasis.
Bull Calcutta Schl Trop Med, 17, 133-4

Banks A, Muller R
1981
Guinea worm.
London, Foundation for Teaching Aids at Low Cost, Inst. of Child Hlth, 11pp + slides 24.

Barbot
1759
General history of travels.
Vol 10, 262 FRE

Barere P
1775
Writings in Guiana.
In der Berlin Samml Bejorder der Arz, Naturwiss etc, Berlin, 7, 3, p242 GER

Barkan A
1876
A case of Filaria medinensis in the anterior chamber.
Arch Ophth Otol, 5, 151-2

Bartels M
1898
Photographs taken by Dr. Opper and Dr. Grampner of a case of dracunculiasis.
Sitzungsb Gesselsch Naturf Berlin, 9, 155-6

Bartels Y
1898
Photographs taken by Dr. Opper and Dr. Grampner of a case of dracunculiasis.
Med News, July 23, p121 GER

Bartet A
1908
On urticaria of filarial origin (F. medinensis).
Arch Med Nav, 88, 353-8 FRE

Bartet A
1908
Urticaria in dracunculiasis.
Bull Soc Path Exot, 1, 309-12 FRE

Bartet A
1908
Notes on the pathogenicity of urticaria in dracunculiasis.
Bull Soc Path Exot, 1, 330-3 FRE

Bartet A
1908
Urticaria in dracunculiasis.
Presse Med, 16, 309-12 FRE

Bartet A
1908
Urticaria in dracunculiasis.
Presse Med, 16 (40), 316 FRE

Bartet A
1909
Guinea-worm, Dracunculus or Filaria medinensis.
A Maloine: Paris FRE

Bartet A J A L
1898
The expeditionary column in Upper-Dahomey.
Arch Med Nav, 70, 162 FRE

Barth H
1857
Travels and discoveries in Northern and Central Africa.
London, Vol II, Chapt 37, p546

Bartholinus T
1672
(Guinea worm in the Old Testament. Numbers XXI, 6).
In de Morbis biblicis miscellanea medica: Francofurti, p32 LAT

Bartley R
1858
On the _Filaria medinensis_ or guineaworm.
Chemist Lond, n s 3, 47-8

Bartley T H
1868
On the _Filaria medinensis_ or guineaworm.
J Cutan Med London, 1, 4, Jan, 381-7 (pp387-9, note by editor Erasmus Wilson)

Bartsch R C, Ward B C
1976
Visceral lesions in raccoons naturally infected with _Heterobilharzia americana_.
Vet Pathol, 13, 241-249

Barus V, Moravec F
1969
Three interesting nematodes from _Aonyx cinerea_ (Carnivora) from Malaya.
Folia Parasit; Praha, 16, 235-6

Basset A
1982
Filariasis.
Rev Med Suisse Romande, 102, 53-54 FRE

Bassini E
1891
A case of _Filaria medinensis_.
Boll Clin; Milano, 8, 193-6 ITA

Bastian H C
1863
On the structure and nature of the Dracunculus or guinea-worm.
Trans Linn Soc; Lond, 24, 101-34

Batliwala J C
1983
Guinea-worm in the horse.
Vet J Ann; Lond, 36, 412-3

Bauvallet H
1933
Dracunculiasis in African natives.
Bull Soc Path Exot, 26, 444-6 FRE

Beal A M
1938
Calcified guinea-worm (Dracunculus medinensis), a report of five cases.
Am J Roentgenol, 39, 210-5

Beaver P C
1963
Tour of Iran for information on intestinal helminths and Dracunculus.
WHO/PA/11.63 (mimeo unpub), p30

Beclere A
1903
Note on a case of guinea-worm and on a new method for the extraction of this parasite (brief note).
Brit Med J, ii, 345

Beclere A
1903
Note on a case of guinea-worm and on a new method for the extraction of this parasite.
Bull Mem Soc Med Hop Paris, 20, 763-7 FRE

Belcher D W
1981
Dracunculiasis.
In International Textbook of Medicine (A I Braude ed). Saunders: Philadelphia, pp1623-7

Belcher D W, Wurapa F K, Ward W B
1975
Failure of thiabendazole and metronidazole in the treatment and suppression of guinea worm disease.
Am J Trop Med Hyg, 24, 444-6

Belcher D W, Wurapa F K, Ward W B, Lourie I M
1975
Guinea worm in southern Ghana: its epidemiology and impact on agricultural productivity.
Am J Trop Med Hyg, 24, 243-9

Beliaev A E
1968
Ambilhar. A new drug for the treatment of schistosomiasis, dracunculosis and amoebiasis.
Med Parazit; Moskva, 37, 473-81 RUS

Bellet E
1908
The removal of guinea-worm after cocainisation.
Bull Soc Path Exot, 1, 560-3 FRE

Beltzoff A S
1932
Case of Filaria medinensis (Linnaeus 1758) appears in the United States as a parasite of the fox.
J Am Vet Med Ass, 81, 821-4

Benbrook E A
1940
The occurrence of the guinea-worm, Dracunculus medinensis, in a dog and in a mink, with a review of this parasitism.
J Am Vet Med Ass, 96, 260-3

Benenson A S (Ed)
1970
Control of communicable diseases in man.
Washington, DC; Amer Publ Health Assoc, Ed. 11, 316pp

Bennett A L
1897
(Letter to the Editor)
Cal Med J, Dec.

Bennett A L
1898
Guinea-worm disease (Filaria medinensis) (Abstract of letter of 1897).
Med Rec N Y, 53, 216

Benoit J
1859
On Dracunculus or guinea-worm, following a new observation of this worm in man.
Bull Soc Med Gand, 26, 310-5 FRE

Benoit J
1859
On Dracunculus or guinea-worm, following a new observation of this worm in man.
Monit Hosp, 7, 692-6 FRE

Benoit J
1859
On Dracunculus or guinea-worm, following a new observation of this worm in man.
Thesis: Montepellier, 24pp FRE

Benoit J
1862
A case of Filaria medinensis.
Allg Wien Med Zig, 7, 161-91 GER

Benoit J, Thibaud
1859
On Dracunculus or guinea-worm.
Montpellier Med, 2, 518 FRE

Berenger-Feraud
1875
Diseases of Europeans in Senegal.
Paris, p336

Bergeret
1889
Notes on Mellacorea.
Thesis: Lille FRE

Berman L M
1977
Control of guinea worm disease by eutrophication and changes in cultural practices by village health educators.
Bull N J Acad Sci, 22, 53

Berncastle J
1851
On the Dracunculus or guinea-worm of India.
Lancet, i, 457-8

Berner L
1950
Entomological report on development of the River Volta Basin.
Univ of Florida: Gainesville 84p

Bernier F
1723
Voyages.
Amsterdam TII, 12, p212 FRE

Bernstein J
1948
The fiery serpent (Dracunculus medinensis).
Natural History, N Y, 57, 368-370

Bertapalia Leonardis
1498
On Vena civilis vel medena.
The canons of Avicenna. Venetiis fol, Tract I, Cap 27, 242 LAT

Bertherand
1855
Medicine and hygiene of the Arabs.
Paris, p426 FRE

Berville
1858
On nervous colic and various other common maladies.
Gaz d'Hopit, 37, 147 FRE

Besse S, Macario C
1965
Treatment of dracunculiasis with a single injection of 9955RP (Trimelarsan). Second and last preliminary note.
Bull Soc Path Exot, 58, 1086-9 FRE

Besson
1886
Topography of Rio Numes.
Thesis: Montpellier FRE

Beverley-Burton M, Crichton V F
1973
Identification of guinea-worm species.
Trans R Soc Trop Med Hyg, 67, 152

Beverley-Burton M, Crichton V F
1976
Attempted experimental cross infections with mammalian guinea-worms, Dracunculus spp. (Nematoda: Dracunculoidea).
Am J Trop Med Hyg, 25, 704-8

Bhachech P M
1927
Guinea-worm infection: a personal experience.
Indian Med Gaz, 62, 450

Bhajekar M V
1951
A note on the treatment of guinea-worm infection.
Indian Med Gaz, 86, 193-6

Bhandari R M
1949
Penicillin in guinea-worm infection.
Indian Med Gaz, 84, 548-50

Bhargava R K, Shak P K D, Ujwal J S, Maheswari K L
1975
Thiabendazole in the treatment of dracunculosis.
Jnl Assoc Physicians of India, 23, 763-767

Bhatnagar B L
1952
Guinea-worm disease.
Antiseptic, Madras, 49, 327-8

Bhatnagar B L
1953
Guinea-worm and its treatment.
Indian Med J, 47, 274-6

Bhatt A N, Palan K H
1978
Guinea-worm infection in Banaskantha district of Gujarat - some important epidemiological aspects.
Indian J Med Sci, 32, 1-4

Bhattacharya N C
1961
Dracontiasis.
Bull Calcutta Schl Trop Med, 9, 163-4

Biainville M H D de
1825
Worms.
In Dict usci Nat Paris, v51, pp365-625 FRE

Bieltsou A S
1885
Guinea worm (Filaria medinensis).
Vrach St. Petersburg Acad, 6, 539-41 RUS?

Bikhovskaya-Pavlovskaya I E
1972
The centenary year of the discovery by A P Fedchenko of the guinea-wrm life-cycle.
Parazitologiya, 6, 403-7 RUS

Bildhaia G S, Marhawa S M, Datidar S R
1969
An epidemiological assessment of dracontiasis.
J Indian Med Ass, 52, 67-71

Bilharz T
1858
(No title?).
In Zeitschrift d. Wiener Aerzie, p448

Billet A
1896
Eosinophilia in a case of subcutaneous dracunculiasis.
C R Seanc Soc Biol, 9, 18 FRE

Billet A
1906
Eosinophilia in a subcutaneous case of guinea-worm.
C R Seanc Soc Biol, Paris, 58, 891-2 FRE

Billet A
1906
Eosinophilia in a subcutaneous case of guinea-worm.
Presse Med, 14, 379-80 FRE

Binet-Sangle
1907
A case of guinea-worm in France.
Caducee, 7, 39 FRE

Bird J
1825
Observations on Dracunculus.
Trans Phys Soc Calcutta, 1, 151-64

Birkmeyer J M
1838
Review of F. medinensis illustrated with appropriate observations.
Onoldi: 8vo LAT

Biroleau J
1887
Memoirs of a campaign in the Senegal on the Salamandre.
Thesis, Bordeaux FRE

Blacklock B, O'Farrell W R
1919
Note on a case of multiple infection by Dracunculus medinensis.
Ann Trop Med Parasit, 13, 189-94

Blair M C
1919
Annual Medical and Sanitary report of the Northern provinces for 1918.
Govt Printer; Lagos, 56pp

Blanchard M
1911
Note on guinea-worm in the region of Upper-Sassandra (Ivory Coast).
Bull Soc Path Exot, 4, 206-9 FRE

Blin
1895
Treatment of guinea-worm by injections of a solution of bichloride of mercury at 1:1000.
Arch Med Nav, 64, 368 FRE

Bloch I
1899
A new document about the history and spread of guinea-worm (Filaria medinensis) in antiquity.
Allg Med Centr-Zig, Berlin, 68, 729-30 GER

Bloss J F E
1941
Notes on the health of the Sudan prior to the present government.
Sudan Notes and Records, 24, 131-43

Blummenbach J F
1825
A manual of the elements of natural history.
London pp240 (transl from 10 Ger ed)

Bodet
1918
Note on a few cases of rampant pseudomyasis or pseudodracunculiasis seen in Tamatare (Madagascar).
Bull Soc Path Exot, 9, 716-22 FRE

Bodet
1920
Note on a few cases of rampant pseudomyasis or pseudodracunculiasis seen in Tamatare (Madagascar).
Ann Med Pharm Colon, Extra No, 50-6 GER

Boettcher A
?
On Filaria medinensis.
Sitzungsb Natur Gesellsch Dorpat, 3, 275-7
GER

Bohm P
1972
Dracunculiasis or guineaworm disease.
Dtsch Arzteblatt, 69, 1873-4 GER

Bollag U, Schmidt H, Fryers T, Lawani J
1982
Medical education in action: community-based experience and service in Nigeria.
Med Educ, 16, 282-9

Bolschwing
1842
A further word on Gordius aquaticus in foot abscesses.
Med Argos Leipzig, 4, 339-41 GER

Bondin
1857
Treatise of medical geography and statistics.
Paris; Vol. 1, p 345 FRE

Bonis de
1876
Parasites.
Napoli, p128 ITA

Boondalah
1848
Filaria medinensis.
India Reg Med Sci; Calcutta, 1, 418

Borius
1864
Diseases of Senegal. Some considerations on the post of Dagana.
Thesis: Montpellier FRE

Borius
1882
A case of guinea-worm in Senegambia.
Arch Med Nav, p373 FRE

Bosman G
1705
Voyage to Guinea.
Utrecht 12, 8me lettre, p116

Boston
1843
Occurrence at Cape Coast Castle.
Med Surg J, June

Botreau-Roussel J P
1928
Radiography of guinea-worm after intasomatic injection of Lipioidol.
Bull Soc Path Exot, 23, 1010-5 FRE

Botreau-Roussel J P
1930
Aseptic puriform arthritis in dracunculiasis in the negro.
Bull Soc Path Exot, 23, 1020-5 FRE

Botreau-Roussel J P
1932
Dracunculiasis
Gaz Med France, 37, 542-5 FRE

Boucher H
1916
Rapid treatment of the phagedenic ulcer of tropical countries.
Bull Soc Path Exot, 9, 419-25 FRE

Bouckaert J I, Dr Castro J
1973
Anthelmintics.
Ars Medici (Brussel), 2, 1515-26 FRE

Boudin C M
1857
Guinea-worm.
In traite de Geographie et de Statistique Medicales, Bailliere et Fils, Paris, 1, 343-7 FRE

Bougenault
1927
Tartar emetic per rectum in schistosomiasis and dracunculiasis.
Bull Soc Path Exot, 20, 285-6 FRE

Bouilliez M
1912
Orchitis due to the presence of a guinea-worm in the testicle.
Ann Hyg Med Colon, 15, 872-5 FRE

Bouilliez M
1916
Contribution to the study on the distribution of some parasitic diseases in Mid-Chari (Central Africa).
Bull Soc Path Exot, 9, 143-67 FRE

Boulenger C L
1928
Report on a collection of parasitic nematodes, mainly from Egypt. Part V. Filarioidea.
Parasitology, 20, 32-55

Bouree P
1977
Treatment of urogenital parasitic infections.
Rev. de Medecine, Paris, 18, 496-504 FRE

Bourgeade A, Pene P, Bouvry M
1968
Etiological, clinical, and therapeutic notes on tetanus in Abidjan.
Bull Soc Path Exot, 20, 285-6 FRE

Bourne P G
1982
Global eradication of guinea worm.
J R Soc Med (editorial), 75, 1-3

Bourrel P
1960
Gangrene of the scrotum from massive discharge of guinea-worms.
Med Trop; Marseille, 20, 382-3 FRE

Bourrel P
1974
Has the need for surgery in tropical diseases been reduced by drug therapy and antibiotics?
Med Armees, 2, 567-69 FRE

Bourrel P, Cerutti J, Damas R
1975
Dracontiasis. (Guineaworm infection).
Med Trop, 35, 55-66 FRE

Bourrel P, Delatte P
1972
Articular and para-articular localisations of calcified guinea-worms. Note on four cases.
Med Trop; Marseille, 32, 291-4 FRE

Bourrell P
1968
Compression of the nerves due to calcified guinea-worm.
Med. Trop; Marseille, 28, 803-4 FRE

Bourrell P, Courbil T, Auphan D, Bourges M, Delatte P
1972
Intrascrotal localisation of guinea-worm.
Med Trop; Marseille, 32, 169-74 FRE

Bourrell P, Palinacci J C, Gourul J C, Nosny Y
1975
Coxopathy in a drepanocytic patient (a case for diagnosis).
Med Trop, 35, 503-5 FRE

Boye
1880
Essay on the post of Medina.
Thesis: Monpellier FRE

Boyle
1831
Medical account of the western coast of Africa.
London, p394

Braband H
1964
Parasites shown by x-ray.
Fortschr Roentgenstr, 100, 400-6

Braband H
1964
The radiological manifestations of parasitic diseases.
Zblatt Bakt; Abt I (Orig), 195, 116-130 GER

Brackett S
1938
Description of the life history of the nematode Dracunculus ophidensis n.sp. with redescription of the genus.
J Parasit, 24, 353-361

Bradley D J
1977
Improvements of rural domestic water supplies.
Proc R Soc Lond (B Biol Sci), 199, 37-47

Bradley D J, Diesfeld H J, Barnley G R
1975
Uganda atlas of disease distribution.
In Hall S A, Langlands B W (ed) Nairobi: East African Publishing House, 165pp

Branellel D L M
1887
Contribution to the study of guinea-worm.
Thesis: Bordeaux FRE

Bras De Sa
1919
Note on the occurrence of Cyclops coronatus in Diu (Nova Goa), containing a few indications for the extinction of dracunculiasis in this province.
Bol Ger Med Farmacia, 5, 10 FRE

Bremser J G
1819
Filaria dracunculus.
In On living worms in living people. C. Schaunburg: Vienna, pp194-221 GER

Bremser J G
1824
Treatise on worms.
pp214 FRE

Brera V L
1811
Filaria medinensis.
In Medical-practical memoire of worms causing disease in man etc, Crema, Vol. 4, p289 ITA

Brett F H
1840
On Dracunculus (Filaria medinensis).
India J Med Phys Sci, 5, 491-494

Brett F H
1840
On Dracunculus (Filaria medinensis).
Trans Med Phy Soc Bengal, 2, 131-137

Briscoe J
1978
The role of water supply in improving health in poor countries with special reference to Bangladesh.
Am J Clin Nutr, 31, 2100-2113

Brocklebank J A
1944
Calcification in the guinea-worm.
Brit J Radiol, 17, 163-164

Brook-Fox E
1913
Chinkara suffering from guinea-worm.
J Bombay Nat Hist Soc, 22, 390

Brooks M
1970
A bibliography of hydrobiological work in Ghana including references to onchocerciasis, bilharziasis and dracontiasis excluding yellow fever, malaria and trypanosomiasis.
Ghana J Sci, 10, 49-67

Brousse G, Brucker G, Danis M
1977
Geographical distribution of the principal parasitic or tropical diseases.
Gaz Med Fr, 84, 2685-2708 FRE

Bruce I
1865
Travels to discover the source of the Nile in the years 1768-1773.
London: 2nd ed, Vol 4, p34

Bruce N
1791
Voyage to Nubia.
Paris, Vol 3, p43

Bruce N
1806
Remarks on the Dracunculus, or guinea-worm, as it appears in the peninsula of India.
Edinburgh Med Sur J, 2, 145-150

Brug S L
1930
Dracunculus medinensis in the Dutch East Indies.
Mededeel Dienst Volksgezondheid Nerdl-Indie, 19, 162-167

Brung G
1928
Embryos of Dracunculus medinensis in an abscess.
Ann Parasit Hum Comp, 6, 447-450 FRE

Bryson
1847
Report on the climates and diseases of the African station.
London, p259

Bueding E
1949
Metabolism of parasitic helminths.
Physiol Rev, 29, 195-218

Bueding E, Oliver-Gonzalez J
1950
Aerobic and anaerobic production of lactic acid by the filarial worm, Dracunculus insignis.
Br J Pharmac, 5, 62-64

Bugri S Z
1981
Guinea worm: an indicator of the quality and quantity of rural water aupply in northern Ghana.
Dissertation, LSHTM: London University

Bulgatoff
1886
A case of Filaria medinensis in the Techuguer Military Hospital.
Russk Med, St Petersburg, 32, 543-545 RUS

Burguieres
1861
Essay on dracunculus or guinea-worm.
Gaz Hop; Paris, 34, 452 FRE

Burnes A
1836
Dracunculus (in Bokhara).
Trans Med Phys Soc Calcutta, 8, 459

Burnett G T
1830
Case of Dracunculus, or Filaria medinensis.
Med Phys J, 9, 285-291

Burot F
1896
Diseases of sailors and nautical epidemics.
Paris FRE

Burot F, Legrand A
1897
Colonial troops. Hygiene of soldiers in the topics. Diseases of the soldier in hot countries. Mortality statistics.
Paris FRE

Burstin S
1966
History of 'tendinitis'.
Arch Mal Prof, 27, 597-598 FRE

Busk G
1846
Structure and nature of the Filaria medinensis, or guinea-worm (abstract of paper presented before London Microsc. Soc.).
Med Times; London, 14, 130

Busk G
1849
Observations on the structure and nature of the Filaria medinensis or guinea-worm.
Micr Soc Tr, 2, 65-76

Butterworth A E
1977
The eosinophil and its role in immunity to helminth infection.
In (Arber W et al. eds). Current Topics in Microbiology and Immunology, Vol 77. Springer-Verlag: New York, Berlin, pp 127-168

Buxton P A
1948
Slides made by Sir Patrick Manson (one of them dated July 1894) showing development of guinea-worm larvae in cyclops. Also one slide of Wuchereria (Filaria) bancrofti in a mosquito.
Trans R Soc Trop Med Hyg, 41, 431-432

Caelius Aurelianus
1950
Soranus of Ephesus on Dracunculus.
In Acute diseases and chronic diseases, Book 3, 3 (Ed I E Drabkin, Chicago Univ Press)

Caillon Geneste
1949
A case of calcified dracunculiasis.
J Med Bordeaux, 126, 136 FRE

Cairncross A M
1978
Village water supplies.
Overseas Building Notes, No 178, 13 pp.

Cammeleran
1907
The 'merreu' of Tidjikja (Mauritania) an urticaria of filarial origin.
Ann Hyg Med Colon, 10, 379 FRE

Cammermeyer J
1914
A case of dracunculiasis medinensis.
Norsk Mag Laegevidensk, 75, 1169-70 NOR

Canizares O
1975
Clinical tropical dermatology.
Oxford: Blackwell Scientific Pubns, 464pp

Cantafora N
1902
Filaria medinensis - new method of cure.
Gior Med R Esercito, 50, 1050-8 ITA

Cantafora N
1902
Guinea-worm, a new method of cure.
Med Rec New York, 62, 910

Capron A, Gentilini M, Vernes A
1968
Immunological diagnosis of filarial infections. New possibilities offered by immunoelectrophoresis.
Pathologie-Biologie, 16, 1039-45 FRE

Capus G
1884
Doctors and medicine in Central Asia.
Revue Scientif, p168 FRE

Carayon A, Bezes H, Camain R
1961
Surgical aspects of helminthiasis in West Africa (Ascaris, Dracunculus, Filaria and Bilharzia).
Med Trop Marseilles, 21, 369-7 FRE

Carayon A, Camain R, Guirard R, Havret P
1961
Pathology of usual, aberrant, or unsuccessful migrations of Filaria medinensis.
Med Trop Marseilles, 21, 538-49 FRE

Carayon A, Camain R, Guirard R, Havret P
1961
Usual, aberrant, or unsuccessful migrations of guineaworm (about 25 cases).
Press Med, 69, 1599-600 FRE

Carbonnel
1873
On the current mortality in Senegal, particularly in St. Louis.
Paris: Thesis FRE

Carme B, Duda M, Datry A, Gentilini M
1981
Dracunculus medinensis infection following vacations in West Africa. Epidemiological implications.
Nouvelle Presse Med, 10, 2711-3 FRE

Carme B, Sainte-Laudy J, Ben-Ismail R, Benveniste J, Gentilini M
1980
The in vitro basophil degranulation test in human filariases.
Ann Soc Belge Med Trop, 60, 271-6 FRE

Carpot C
1886
Notes on parasites which penetrate the skin in hot countries, especially in Senegal.
Bordeaux: Thesis, p55 FRE

Carrade L R E
1886
The post of Podor (Senegal).
Paris: Thesis FRE

Carro J de
1805
On guineaworm and the sting of the scorpion in India.
Bibl Britt Genee, 30, 166-85 FRE

Carro J de
1806
Letter to the editor of the Bibliotheque Brittanique on the guineaworm and on the sting of the scorpions of India.
Phil Mag, 25, 97-104

Carro J de
1813
Letter of Dr de Carro in Vienna to the editor on the skin-worm (guineaworm, Gordius medinensis) and on the sting of the Indian scorpion.
J Pract Arztnk Wundarznk Berlin, 37, 112-36 GER

Carstein-Niebuhr
1772
Description of Arabia.
Copenhagen GER

Carter H J
1855
Note on Dracunculus in the island of Bombay.
Trans Med Phys Soc Bombay, 2, 45-56

Carter H J
1858
Observations on Dracunculus in the island of Bombay.
Ann Mag Nat Hist London, 1, 410-4

Carter H J
1859
On Dracunculus and microscopic Filaridae in the island of Bombay.
Ann Mag Nat Hist London, 4, 28-116

Carter H J
1859
Further observations on Dracunculus in the island of Bombay.
Trans Med Phys Soc Bombay, 4, 215-20

Carter H J
1862
Notes on the possibility of the embryos of the guinea-worm and so-called 'fungous disease' of India, respectively, entering the human body through the sudorific ducts.
Tans Med Phys Soc Bombay, 7, 3-7

Casile M, Saccharin H
1953
Intradermal reaction in bancroftian filariasis in French Guyana.
Bull Soc Path Exot, 46, 137-44 FRE

Castay A
1937
A case of macrofilaria or guineaworm revealed by radiography.
J Radiol Electrol, 21, 455 FRE

Cauliaco Guido de
1559
Vena famosa or meden.
In Chirurgia. Lugduni, 8 tract II, cap VIII, p129 LAT

Cayley H
1882
A case of suppurated cyst in the back containing a guinea-worm.
Indian Med Gaz, 17, 305

Cayley H
1882
Case of suppurated cyst in the back containing a guinea-worm.
Trans Calcutta Med Soc, 3, 155-6

Cazanove F
1927
Notes on dracunculiasis and filariasis.
Bull Soc Path Exot, 20, 445-7 FRE

Cazin A
1976
The filariases.
Rev Infirm Afrique Noire, (49), 5-11 FRE

Cezilly A H
1858
Observations on Dracunculus or guineaworm.
Paris: Thesis FRE

Chabaud A G
1960
Two nematode parasites of Madagascar snakes (D. doi n.sp.).
Mem Inst Scient Madagascar (ser A), 14, 95-103 FRE

Chaddock T T
1940
Diseases of mink.
Am Fur Breeder, 2, 8

Chaigneau Y
1927
Treatment of dracunculiasis by Tournier's method.
Bull Soc Path Exot, 20, 395-7 FRE

Chaigneau Y
1930
Leucocyte formula and treatment by 'Kermes' (witch doctors) of dracunculiasis in infantry men.
Ann Med Pharm Colon, 28, 81-5 FRE

Chalmers A J, Archibald R G
1914
Two early 18th century treatises on tropical medicine.
Proc Roy Soc Med, 7, 98-106

Chambolle F
1827
Observations on guineaworm.
Rec Mem Med Milit, 23, 57-62 FRE

Chambolle F
1828
Observation on guineaworm.
J Univ Sci Med Paris, 49, 87-9 FRE

Chandler A C
1927
The prevalence and epidemiology of hookworm and other helminthic infections in India. VII. Bihar and Orissa.
Indian J Med Res, 14, 745-60

Chandler A C
1942
The Dracunculus insignis (Leidy, 1858), a common parasite of raccoons in East Texas.
Am J Trop Med, 22, 153-7

Chandler A C
1942
The helminths of raccoons in East Texas.
J Parasit, 28, 255-66

Chang J, Wescott R B, Strube W J
1967
Canine dracunculiasis in a Missouri dog.
Missouri Vet J, 16, 5-6

Chapard C, Roux F X, George B et al.
1982
Intraspinal dracunculiasis. On a case of epidural compression of the spinal cord.
Neuro-Chir, 28, 339-42 FRE

Chapotin
1810 (or 1816?)
(Occurrence of guineaworm in Ile-de-France).
Bull Sci Med, May FRE

Chardin C
1711
Journey in Persia and other places in the East.
Amsterdam, vol3, p151 FRE

Charles R H
1892
A contribution on the life-history of the male Filaria medinensis founded on the examination of specimens removed from abdominal cavity of man.
Sci Mem Med Officers Army India; Calcutta, 7, 51-6

Charvet
1834
Observations on two species of the genus Dracunculus which live in some running waters in the region of Grenoble.
Ann Mus Hist Nat Paris, 3, 37-46 FRE

Charvet
1834
Observations on guineaworm.
Ann Sci Paris; Zool, 2, 123-5 FRE

Charvet
1834
Observations on guineaworm.
Institut, 2, 272 FRE

Charvet
1835
Observations on guineaworm.
Arch f Naturg; Berlin, 1, 341 GER

Chatterjee A
1962
Dracontiasis, a case report.
Bull Calcutta Schl Trop Med, 10, 137

Chatton E
1918
The military bacteriological laboratory of South Tunisia at Gabes. Report on the period 1 Aug 1916 to 1 Aug 1918.
Arch Inst Pasteur Tunis, 10, 199-242 FRE

Chatton E
1918
Observations in Gabes of guineaworm. Experimental proof that cyclops are infected through their digestive tract.
Arch Inst Pasteur Tunis, 10, 158-69 FRE

Chatton E
1918
Observations on guineaworm. Experimental proof that cyclops are infected through their digestive tract.
Bull Soc Path Exot, 11, 338-48 FRE

Cheatum E L, Cook A H
1948
On the occurrence of the North American guinea-worm in mink, otter, raccoon and skunk in New York State.
Cornell Vet, 38, 421

Chikmath N C
1934
A case of Filaria medinensis in a dog.
Indian Vet J, 9, 120

Chisholm M C
1801
On the malignant pestilence, fever, etc.
London, vol 1, p57

Chisholm M C
1815
On the Malis dracunculus or guinea worm (in Grenada).
Edinburgh Med Surg J, 11, 145-64

Chisholm M C
1836
On the Malis dracunculus or guinea worm (in Grenada).
Veterinarian, 9, 505

Chitale P K
1912
Observations on three hundred cases of guineaworm.
Indian Med Gaz, 47, 318-20

Chitwood B G
1933
Does the guinea-worm occur in North America?
J Am Med Ass, 100, 802-4

Chitwood B G
1950
The male of Dracunculus insignis (Leidy 1858) Chandler 1942.
Proc Helm Soc Washington, 17, 14-5

Chopra B L, Thirumalachar M J, Rajagopalan Nayar P
1977
Control of guinea worm infestation by chemotherapeutic agents.
Ga J Sci, 35, 20-3

Chowdhury A B
1955
A case of dracunculosis.
Bull Calcutta Schl Trop Med, 3, 190

Chukerbuti J C
1931
Eosinophilia in dracontiasis.
Indian Med Gaz, 66, 21-2

Chun-Sun F
1958
Dracunculus infection in dogs in Kazachstan.
Medskaya Parazit, 27, 219 RUS

Chun-Sun F
1966
A case of Dracunculus infection in a domestic cat in the Kazakh SSR.
Medskaya Parazit, 35, 374-5 RUS

Chupin A, Gandar
199
Guineaworm suppurating arthritis of the knee. Septicaemia and cure.
Arch Med Pharm Mil Paris, 35, 53-62 FRE

Cinotti F
1906
A case of Dracunculus medinensis in a dog.
Nuovi Ercolani Pisa, 11, 466-70 ITA

Clark R
1840
A case of Dracunculus or guineaworm.
Med-Chir Rev London, 13, 585-6

Clarke
1841
Fatal outcome of a case of guineaworm.
Arch Gener Med, 2, FRE

Clarke
1844
Journey to Sierra Leone etc.
London

Clarke
1860
Diseases of the Gold Coast.
Trans Epidem Soc, 1, 118-20

Clarke G H V
1978
Diseases of the skin.
In Diseases of children in the subtropics and tropics (eds D B Jelliffe, J P Stanfield). London: Edward Arnold, pp655-87

Clarkson N F
1845
Case of Filaria medinensis in the horse.
Vet Record London, 1, 73-4

Clericus Daniel
1715
Dracunculus or Vena medinensis following various authors.
In Historia Lator Lumbric l c, cap XIII, pp253-67 LAT

Clot-Bey
1830
Observations on guineaworm.
Gaz Hop paris, 4, 51-6 FRE

Clot-Bey
1830
On guineaworm.
Lancette Francaise, Nov FRE

Clot-Bey
1831
Note on Dracunculus observed in Egypt.
Ann Med Physiol, 2, 126-50 FRE

Clot-Bey
1832
Guineaworm.
Arch Gen Med, 30, 573 FRE

Clot-Bey
1849
General survey of Egypt. Vol 2. Summary of Egyptian medical education.
Paris, p319 FRE

Clymer
1859
(Occurrence in Elmina).
Amer J Med Sci, Oct, 375

Cobbold T S
1864
Filaria medinensis.
In Entozoa. An introduction to helminthology with reference more particularly to the internal parasites of man. London, pp260-73

Cockburn A, Barrago R A, Reyman T A, Peck W H
1975
Autopsy of an Egyptian mummy.
Science, 187, 1155-1160

Cockshott P, Middlemiss H
1979
Clinical radiology in the tropics.
Edinburgh: Churchill Livingstone, 232 pp

Cohen A J
1929
Filaria medinensis (in Java).
Geneesk Tijdschr N Nederl-Indie, 69, 55-8 and 204-5 DUT

Cohen G
1959
The radiological demonstration of Dracunculus medinensis.
South Afr Med J, 33, 1094-5

Colbourne M J, Edington G M, Hughes M H
1950
A medical survey in a Gold Coast village.
Trans R Soc Trop Med Hyg, 44, 271-290

Collier C
1836
On Dracunculus.
London Med Gaz, 19, 217-21

Collin
1887
Contribution to the geography of Upper-Senegal.
Thesis: Paris FRE

Connel W K, Buchanan J C R
1932
Guinea worm disease in Tanganyika (corr.).
Trans R Soc Trop Med Hyg, 26, 99

Connor F P
1922
Some surgical aspects of filarial disease.
Brit Med J, 10, 253-258

Connor F P
1918
Notes on cases of surgical interest. I. Inflammatory conditions due to calcified remains of guinea-worms.
Indian Med Gaz, 53, 297-299

Cooper C
1871
The origin of the guinea-worm.
Med Times Gaz: London (letter), 1, 617

Coppola N
1906
On F. medinensis in the Eritrean colony, its penetration into the human organism and its cure.
Giorn Med R Esercito, 54, 92-96 ITA

Cornish
1861
(No title?).
Madras Quart J Med. Sci, Oct, 314

Costa O R
1956
Contribution to the knowledge of filariasis in Amazonia.
Riv Serv Especial Saude Publ, 8, 329-422 POR

Coudert J, Ambroise-Thomas P, Kien Truong T, Terreno S
1968
Serological diagnosis of filariasis by immunofluorescence on sections of Dirofilaria immitis and Dipetalonema viteae. Preliminary results involving 200 examinations.
Bull Soc Path Exot, 61, 434-441 FRE

Coulaud J P, Duchatelle C, Rouvillois A, Deluol A M
1982
Zentel in the treatment of intestinal helminthiases in Niger, Gabon and Paris.
Med d'Afr Noire, 29, Numero Spec, 41-42 FRE

Coulaud J P, Larouze B
1974
Other imported parasites.
Progr Med, 102, 153-158 FRE

Coulaud J P, Mechali D
1979
Metronidazole and its derivatives.
Revue de Practicien, 29, 2919-2923 FRE

Courbon
1861
Topographical and medical observations in the isthmus of Suez.
Paris, p69 FRE

Cowper S G
1966
A review of helminthiasis in the Western region of Nigeria with special reference to the Ibadan area.
W Afr Med J, 15, 3-11

Crambes C M L
1887
The gold-bearing region between the Upper-Senegal and the Upper-Niger.
Thesis: Bordeaux FRE

Craun G F
1974
Water pollution. Microbiology: waterborne outbreaks.
J Water Pollut Contr Fed, 46, 1384-1395

Craun G F
1975
Microbiology. Waterborne outbreak.
J Water Pollut Contr Fed, 47, 1566-1581

Craun G F
1976
Microbiology. Waterborne outbreaks.
J Water Pollut Control Fed, 48, 1378

Craun G F
1978
Disease outbreaks caused by drinking water.
J Water Pollut Contr Fed, 50, 1362-1374

Crawford D G
1909
Case of Dracunculus or guinea-worm.
Indian Med Gaz, 44, 379

Crespigny
1859
(No title?).
Bombay Med Trans, 4, 94

Crespin J
1902
Dracontaisis at Bandar-Bushehr, a port on the Persian Gulf.
Arch Parasit, 5, 198-199

Crichton V F, Beverley-Burton M
1973
Dracunculus lutrae n.sp. (Nematoda: Dracunculoidea) from the otter, Lutra canadensis, in Ontario, Canada.
Can J Zool, 51, 521-529

Crichton V F, Beverley-Burton M
1975
Migration, growth and morphogensis of Dracunculus insignis (Nematoda: Dracunculoidea).
Can J Zool, 53, 105-113

Crichton V F J
1973
The biology of Dracunculus spp. (Dracunculoidea: Dracunculidae) in wildlife from Ontario.
Diss Abstr Int, 338, 5573-5574

Crichton V F J, Beverley-Burton M
1974
Distribution and prevalence of Dracunculus spp (Nematoda: Dracunculoidea) in mammals in Ontario, Canada.
Can J Zool, 52, 163-168

Crichton V F J, Beverley-Burton M
1977
Observations on the seasonal prevalence, pathology and transmission od Dracunculus insignis (Nematoda: Dracunculoidea) in the raccoon (Procyon lotor (L.) in Ontario.
J Wildl Dis, 13, 273-280

Crichton V J
1970
Dracunculiasis in otter, mink and raccoon from Ontario.
J Parasit, 57, 13

Crites J L
1963
Dracontiasis in Ohio carnivores and reptiles with a discussion of the dracunculid taxonomic problem.
J Sci, 63, 1-6

Cruchet F
1866
Three Dracunculus, or guinea-worms, observed on Mr Sylva on the 27th July, 6th August, and 10th October 1865.
Union Med Gir; Bordeaux, 11, 633-642 FRE

Cummins S L
1911
Notes on the guinea-worm in the Sudan.
J R Army Med Corps, 16, 64-70

Cunelius M G
1689
A medical argument about guinea-worm.
Basle, 33pp LAT

Currie
1868
(No title).
British Army Reports for 1867, 9, 296

Cuvier
1817
The medina or guineaworm.
In The Animal Kingdom. Paris, Vol 4, p30 FRE

Cuynat C S
1842
Observations on guinea-worm or Dracunculus medinensis.
Mem Acad Sci Dijon, pp102-109 FRE

Da Silva Lima J F
1877
Note on Filaria medinensis (Bicho da Costa). Endemicity of this parasite in the province of Bahia and its entry in the human body through drinking water.
Gaz Med Bahia, 2, 301-316 POR

Da Silva Lima J F
1879
Remarks on the Filaria medinensis, or guinea-worm; on the occurrence of this parasite endemically in the province of Bahia; on its entrance into the human body by drinking water.
Veterinarian, 52, 67-238

Da Silva Lima J F
1881
On guinea-worm endemic in the province of Bahia, and its mode of penetration in the human body through drinking water.
Arch Med Nav; Paris, 35, 395-406 FRE

Dampier G
1715
Supplement to the voyage round the world.
Rouen, 3, 340 FRE

Daniell
1849
Medical topography of the Gulf of Guinea.
London, pp44-45

Daniels C W
1906
Preliminary note on the results of infection of monkeys with embryos of the guinea worm.
Typescript (unpubl) in reprint collection of Commonwealth Institute of Parasitology, St Albans, 2pp.

Datta S P, Stanislas L, Veeraraghavan M
1964
Dracontiasis in Pondicherry Settlement.
Bull Indian Soc Mal Com Dis, 1, 11-18

Davaine
1860
Treatise on entozoa and verminous diseases of man and animals.
Paris, pp 782-818 FRE

Davenport C B, Love A G
1920
Defects found in drafted men.
Scient Monthl, N Y, 10, 125

Davis G, Hilton J J
1915
Guinea-worm disease.
J Amer Med Ass, 65, 1275-1176

Davis L J
1931
A note on some experiments with agents lethal to cyclops.
Trans R Soc trop Med Hyg, 24, 631-633

Davoren V
1894
A new treatment of guinea-worm.
Brit Med J, ii, 298

Davril J E
1885
Medical notes on the post of Sedhiou (Senegal).
Thesis: Bordeaux FRE

Day
1862
(No title?).
Madras Quart J Med Sci, Jan, p36

De Bourges M
1666
Avoidance of guineaworms by drinking only wine or filtered water at Lar, Iran.
In The voyage of the Bishop of Beirut to Cochinchina, Turkey, Persia, the Indies, Siam and other places. Paris FRE

De Campos M
1915
Some cutaneous affections of the Brazilian hinterland.
Arch Brasil Med, 5, 358-363 POR

De Veiga T
1561
(Comments on guineaworm).
In Comment. in Galeni Opera. Antwerp comment and libr de lok affect Lib 6, p 298, no. 3 LAT

Decorse
1905
Chari and Lake Tchad.
Ann Hyg Med Colon, 8, 173 FRE

Defaut
1877
Clinical history of the Maritime Hospital of Gorea.
Paris, p134 FRE

Defaye
1860
Observation of two occurrences of guinea-worm (*Filaria medinensis*) in the same individual.
J Med Bruxelles, 12, 268-270 FRE

Defaye
1860
Observations of two occurrences of guinea-worm (*Filaria medinensis*) in the same individual.
Press Med Belge, Bruxelles, 12, 221-222 FRE

Defaye
1863
Observation of two occurrences of guinea-worm (*Filaria medinensis*) in the same individual.
Schmidts Jahrbuch, 119, 52-53 GER

Defaye, Testalin
1860
Note on a case of guinea-worm (*Filaria medinensis*).
Bull Acad Roy Med Belg, Bruxelles, 3, 568-572 FRE

Degos R, Lortat-Jacob E, Sigal S, Reyrole L
1965
Successive abscesses due to guinea-worm in the left upper limb.
Bull Soc Fr Derm Syph, 72, 233-234 FRE

Dejou L
1947
Suppurating cysts and chronic abscess caused by guinea-worm.
Bull Med Afr Occ Franc, 4, 121-123 FRE

Dejou L
1947
Suppurating cysts and chronic abscesses due to guinea-worm.
L'Algerie Med, 50, 453 FRE

Dejou L
1947
Surgical locations of African filariasis - *Dracunculus* and *Onchocerca*.
Med Trop, Marseilles, 1, 15-25 FRE

Dejou L
1948
Suppurating cysts and chronic abscesses caused by guinea-worm.
Bull Soc Path Exot, 41, 200-202 FRE

Dejou L
1951
Deep localisations of Dracunculus (particularly peritoneal and juxta-peritoneal).
Med Trop Marseille, 11, 645-652 FRE

Dejou L
1954
Lesions pf the spermatic cord in filariasis (Filaria bancrofti, F. loa, F. medinensis).
Proc Int Congr Trop Med Malar (5th), 2, 610-613 FRE

Dejou L, Camain R
1951
Peritoneal localization of a guinea-worm with symptoms of gastric ulcer.
Bull Soc Path Exot, 44, 438-440 FRE

Del Favero E
1928
Abnormal localisation of a guineaworm in an inguinal gland.
Arch Ital Sci Med Colon, 9, 277-280 ITA

Delahaye R P, Combes A
1973
Filariases.
In Delahaye R P (ed) Radiologie tropicale et parasitaire.
Neuchatel: Delachaux & Niestle S A, pp 253-280 FRE

Delamare G, Achitou
1924
Calcified guinea-worm; giant cells from foreign bodies, embryonic infiltration and sclerosis.
Bull Soc Path Exot, 17, 788-790 FRE

Delamare G, Mouchet
1925
Marginate dischromic dermatitis of filarial origin.
Bull Soc Path Exot, 18. 316-318 FRE

Delamare G, Djemil S
1923
Calcified guinea-worm.
Etude et Notes; Chaire de Med. Trop. Fac. Constantinople, p106
FRE

Delamare G, Mouchet
1925
Calcification of guinea-worm (radiological note).
Bull Soc Path Exot, 18, 318-319 FRE

Dellamonica P, Le Fichoux Y, Coussement A, Serres J J
1977
Diagnosis of parasitic califications: (excluding fungal and protozoal calcifications).
J Radiol d'Electrol Med Nucl, 58, 125-133 FRE

Delmas M, Longy M, Dupont A, Fontan-Ferriere I, Le Bras M, Moretti G
1980
When and how to treat or not to treat filariasis.
Bordeaux Med, 13, 1375-1378 FRE

Delorme
1818
On guinea-worm, Filaria medinensis (Letter to Girard).
J Phys Chim Hist Nat; Paris, 87, 155-156 FRE

Delort
1919
On the opacity of guinea-worm to x-rays.
J Radiol; Paris, 3, 320 FRE

Denecke K
1941
Frequency and course of infection of diseases of natives of the Gulf of Guinea.
Arch Hyg Bakt, 126, 331-348 GER

Denecke K
1954
The drinking water situation in Mesopotamia.
Arch Hyg, 138, 628-638 GER

Denecke K
1954
Helminthic infections in Iraq.
Arch Hyg Bakt, 138, 149-156 GER

Denuce J L P
1866
Dracunculus or guinea-worm.
Mem Bull Soc Med-Chir Hop Bordeaux, 1, 99-102 FRE

DeRoth L, Frechette J L
1975
Dracunculus insignis (Leidy, 1858) in a German shepherd.
Can Vet J, 16, 176-178 FRE

Desfontaine M, Prod'hon J
1980
Prophylaxis of dracunculiasis.
Bull OCCGE Inf No 69, Sep/Oct, 58-66 FRE

Deshmukh P G
1969
New species of the genus _Dracunculus_ Reichard, 1759 from snakes (_D. alii_ and _D. coluberensis_).
Folia Parasit, Praha, 16, 105-110

Deshmukh P G
1970
Dracunculus ricci sp.n. from a snake _Natrix natrix_.
Riv Parassitol, 31, 143-146

Deshmukh P L
1940
Note on village method of guinea-worm extraction.
Antiseptic; Madras, 37, 348-349

Desiderius P
1605
On earth worm, _Dracunculus_ and hairworm.
In Narenius: Nosologia. Leipzig, pp 215-228 LAT

Desportes C
1938
Filaria oesophagea, Polonio 1859, parasite of the grass-snake is a _Dracunculus_, closely related to the guineaworm.
Ann Parasit Hum Comp, 16, 305-326 FRE

Dettmar J J
1779
Observation on hair-worms
Copenhagen, 12vo GER

Devi C S, Morthy D P, Devi S L, Reddy C R
1971
Fibrinolytic activity of infective larvae of _Dracunculus medinensis_.
Am J Trop Med Hyg, 20, 101-103

Dick F
1880
The treatment of guinea-worm.
Brit Med J, ii, 207-208

Dickson
1851
(No title?).
Trans Path Soc Lond,

Dietz K
1975
A pairing process.
Theor Popul Biol, 8, 81-86

Dikmans G
1948
Another case of guinea-worm, Dracunculus so., infestation in a dog in the United States.
Proc Helminth Soc Wash, 15, 39-40

Dimier, Bergonie J
1918
Search for guinea-worm by radiography.
Arch Electr Med Physio, 26, 337-341 FRE

Dinakar I, Seetharam W, Leelanaidu P S, Rao P S, Khan M J, Sivanagamani K
1977
Spinal compression due to an extradural guinea worm abscess: a case report.
Neurol India, 25, 191-192

Diters R W, Ryan M J
1980
Vegetative endocarditis with generalized bacterial embolism in association with phlegmon induced by Dracunculus insignis in a raccoon.
Cornell Vet, 70, 213-217

Dobie S L
1881
A note on the incubation period of guinea-worm (letter).
Indian Med Gaz, 16, 7

Doenges J
1966
Parasitic abdominal cysts in Nigerians.
Z Tropenmed Parasit, 17, 252-256 GER

Dogba K, Setodji A
1982
Dracontiasis in a rural Togo environment situation in the prefecture of Haho.
Proc 5th Internat Congr Parasit, Toronto, Mol Biochem Parasit (Suppl), 302-303

Donaldson J R, Angelo T A
1961
Quadriplegia due to guinea-worm abscess.
J Bone Joint Surg, 43A, 197-198

Doorenbos W B
1926
Medina worm.
Geneesk T Ned-Ind, 66, LXXIX DUT

De Brun
?
Illnesses of hot countries.
Paris FRE

Drobis D
1963
Dracunculiasis as an unusual cause of an abscess of the Bartholiny gland.
Cesk Gynek, 28, 348 CZE

Drummond J
1793
Observations respecting guinea-worm.
Med Comm, 8, 294-300

DSL
1881
A note on the incubation period of guinea-worm.
Indian Med Gaz, 16, 7

Du Castel J
1919
Mercury in the treatment of dracunculiasis.
Bull Soc Franc Derm Syph, 72-74

Dubois
1806
History of the guinea-worm and the method of cure employed by the Hindoos.
Edin Med Surg J, 2, 300

Dubreuilh W, Beille L
1897
Guinea-worm.
Arch Clin Bordeaux, 6, 425-442 FRE

Ducasse
1843
Observations on guinea-worm.
Hist Mem Acad Sci Toulouse, 30, 165-176 FRE

Duclot
1887
French Sudan, Upper Senegal and Upper-Niger.
Thesis: Bordeaux FRE

Dudgeon L S, Child F J
1903
Eosinophilia associated with dracontiasis.
J Trop Med, 6, 253-254

Duff D
1921
Short note on the use of antimony orally in the treatment of guinea-worm.
Gold Coast Reg. of the Med Dep, 1921, append. B, p53

Dufrenoy J, Dufrenoy M L
1949
Francoise Bernier and parasitology.
Ann Parasit Hum Comp, 25, 111-112 FRE

Dujardin
1845
Natural history of helminths.
pp 44-45 FRE

Duke B O L
1984
Filtering out the guinea worm.
WHO, March, p. 29.

Duke J
1893
On a symptom specially diagnostic of guinea-worm in central India.
Indian Med Gaz, 28, 403-407

Duke, J
1895
Note on the symptoms of Filaria medinensis or guinea-worm.
Indian Med Gaz, 30, 64-65

Dumas M, Girard P L
1978
Filariasis of the nervous system. In (Vinken P J, Bruyn G W, Eds). Handbook of clinical neurology. Vol 35 Infections of the nervous system. Part III.
North-Holland Publish Co.: Amsterdam, pp161-173

Dumeril A M C
1807
Note on some behaviour habits observed in species of a genus of worm named Dracunculus (Gordius Lin).
N Bull Sci Soc Philom; Paris, 1, 25-26 FRE

Duncan
1850
Travels in the Sahara.
London

Duncan A
1864
A case of guinea-worm in the scrotum.
Brit Med J, ii, 715

Duncan A
1884
A case of guinea-worm in the scrotum.
Trans Med Phys Soc Calcutta, 7, 273-281

Duncan J
1821
Inaugural medical lecture on Filaria or Gordius medinensis.
Edinburgh LAT

Duncan J
1879
Case of guinea-worm.
Edinb Med Surg J, 14, 713-715

Dupont R
1934
A case of guinea-worm observed in France.
Rev Med Hyg Trop, 26, 96-99 FRE

Durand J B P
1887
The fort of Bafoulabe.
Thesis; Bordeaux FRE

Durante
1897
Guinea-worm and the lepers of Turkestan.
Bull Soc Anat Paris, 72, 808-809 FRE

Durkee S
1856
Demonstration of Dracunculus medinensis.
Proc Boston Soc Nat Hist, 5, 277-278

Dutrouleau
1868
Treatise on the diseases of Europeans in hot countries.
Paris FRE

Dutt Chunder
1880
The guinea-worm.
Brit med J, Mar 27

Eay S K
1920
Guinea-worm in the inguinal canal.
Indian Med Gaz, 55, 100

Ebbel B
1937
(Possible passage on guinea worm).
Papyrus Ebers, the greatest Egyptian medical document.
Copenhagen

Edungbola L D
1980
Water utilization and its health implications in Ilorin, Kwara State, Nigeria.
Acta Trop, 37, 73-81

Edungbola L D
1983
Babana Parasitic Diseases Project. II. Prevalence and impact of dracontiasis in Babana District, Kwara StaTe, Nigeria.
Trans R Soc Trop Med Hyg, 77, 310-315

Egido M di
1955
Radiological aspects of calcified Dracunculus medinensis.
Arch Ital Sci Med Trop, 36, 5-23 ITA

Egido M di
1959
Arthritis due to Dracunculus medinensis.
Nunt Radiol, 25, 52-62 ITA

Eichler W
1970
Outline of Egyptian medical parasitology.
Bull Inst Marine Med Gdansk, 21, 83-88

Ejezie G C
1983
The Nigerian environment and parasitic infections.
Folia Parasit, 30, 89-95

El Khoury G, Artinian B
1970
Dracunculus medinensis, guinea-worm, (an x-ray survey).
J Med Liban, 23, 475-477

El Sewefy A Z, Abdel Wahab M, Wahab M A
1976
Calcified medina worm among Yemeni immigrants in Mecca.
Ain Shams Med J, 27, 219-220

El Zawahry H
1963
Notes concerning dermatoses in our countries.
J Egypt Med Ass, 46, 1155-1162

Elder C
1954
Dracunculiasis in a Missouri dog.
J Am vet Med Ass, 124, 390-391

Elliott M
1942
A new treatment for dracontiasis.
Trans R Soc Trop Med Hyg, 35, 291-301

Elst Van der
1873
A case of Dracunculus infection in an African soldier.
Geneesk T Ned-Ind, 15, 142-144 and 192-193 DUT

Emily
1894
A new cure for guinea-worm.
Arch Med Nav, 61, 460-467 FRE

Emily
1894
Treatment of guinea-wowm by injections of mercuric chloride at 1/1000.
Arch Med Nav, 61, 406 FRE

Emily
1900
Medical report on the Marchand expedition from Loango to Djibouti through Fachoda.
Arch Med Nav, 74, 81 FRE

Emily
1910
Note on a small tumour caused by an encysted guinea-worm.
Bull Soc Path Exot, 3, 740 FRE

Ennet D
1971
Anti helminthics Part 56.
Pharm Prax, 12, 216-222

Erasmus J F P
1942
Tropical surgery in the East African campaign.
S Afr Med J, 16, 379-382

Erhardt A, Wellensiek U
1956
Filariasis in Africa.
In World Atlas of Epidemic Diseases (Rodenwaldt E E, Jusatz H E eds). Hamburg GER

Erickson A B
1946
Incidence of worm parasites in Minnesota Mustelidae and hosts lists and keys to North American species.
Am Midl Nat, 36, 494-509

Eschricht
1838
(No title?).
In i Act Nat Cur xix, Suppl 2, 148

Esprit
1898
Tumour of the scrotum caused by guinea-worm embryo.
Arch Med Pharm Mil, 31, 364-371 FRE

Essed W F R, Marjitno M
1935
Dracontiasis.
Geneesk T Ned-Ind, 75 (15), 1250 DUT

Everard C O, Muller R, Duckett V
1971
Experimental infections with guinea worm from a snake.
Trans R Soc Trop Med Hyg, 65, 433

Ewald
1882
On the history of Filaria medinensis.
Berlin Klin Wochen, 19, 547 GER

Ewart J
1860
Questions relating to Dracunculus.
Madras Quart J, 1, 449-461

Ewing S H, Hibbs C M
1966
Dracunculus insignis (Leidy 1858) in dogs and wild carnivores in the great plains.
Amer Midl Nat, 76, 515-519.

Eyrie
1861
(No title?).
Madras Quart J Med Sci, April, 308

Fabry H
1907
A case of dracunculiasis.
Arch Schiffs Tropenhyg, 1, 298-299 GER

Fahmy A
885
Contribution to the study of guinea-worm. Observations in Nubians of the negro regiments of Cairo.
Thesis: Paris, 47pp FRE

Fain A
1981
Why must filariasis be controlled?
Ann Soc Belg Med Trop, 61, 145-154 FRE

Fairley N H
1924
Studies in dracontiasis. V. Observations and reflections on intravenous medicine with special reference to tartar emetic.
India J Med Res, 12, 369-374

Fairley N H
1924
Studies in dracontiasis. IV: The clinical picure, an analysis of 140 cases.
Indian J Med Res, 12, 351-367

Fairley N H
1924
Studies in dracontiasis. VI. Mechanical and surgical extraction.
Indian J Med Res, 59, 429-38

Fairley N H, Liston W G
1923
Report of the Bombay bacteriological Laboratory for the year 1922.
Govt Central press; Bombay, 15 pp

Fairley N H, Liston W G
1924
Studies in Dracontiasis. III. A note on various local Indian remedies.
Indian J Med Res, 2, 374-379

Fairley N H, Liston W G
1924
Studies in the pathology of dracontiasis. part 1.
Indian J Med Res, 11, 915-932

Fairley N H, Liston W G
1924
Studies in the transmission of Dracunculus medinensis. Part II. A negative experiment.
Indian J Med Res, 12, 93-104

Fairley N H, Liston W G
1924
Researches in the treatment of guinea-worm disease.
Proc 10th Indian Sci Congr (Lucknow 1923), p219

Fairley N H, Liston W G
1925
Studies on guinea-worm disease. Collected papers from the Indian J Med Res and Indian Med Gaz.
Calcutta: Govt Printer

Falkenstein
?
(Occurrence in an antelope in Loango)
Virchow's Archiv, 71, 56-69 RUS

Fargher R G
1920
The role of antimony in tropical medicine.
J Soc Chem Ind, 39, 333R-334R

Farmer W H, Witter W F
1952
Canine guinea-worm (Dracunculus insignis) infestation: a clinical report.
J Small Anim Med, 1, 174

Faulker
1883
Electrolysis in the treatment of dracontiasis.
Brit Med J, ii, 1280-1281

Faure
1920
On three cases of guinea-worm.
Ann Med Pharm Colon; Paris, Num Except, 79-86 FRE

Faust E C
1937
The use of anthelmintics.
J Am Med Ass, 108, 386-392

Faust E C
1944
Diseases in the tropical war zones. III. The diseases of the Mediterranean Basin and of tropical Africa.
Gastroenterol, 2, 13-31

Feachem R G
1977
Infectious diseases related to water supply and excreta disposal facilities.
Ambio, 6, 55-58

Fedchenko A P
1870
On the development and reproduction of Filaria medinensis L.
Izvest Imp Obsh Liub Estestroza, Moskva, 8, 71-82 RUS

Fedchenko A P
1874
On the anatomy of roundworms.
Isvest Imp Obsh Liub Estestroza Moskva, 10, 56-59 RUS

Fedchenko A P
1879
Structure and development Of Filaria.
Berdk Gesd Frd d Nat Anthrop Ethnograph, 8 (1), 71 RUS

Fedchenko A P
1890
Filaria medinensis.
Izvest Obsh Liub Estestvoza Antrop: Moskva, 59, 132-140 RUS

Fedchenko A P
1971
Concerning the structure and reproduction of the guinea-worm (Filaria medinensis L.). (Transl of Fedchenko, 1870.)
Am J Trop Med Hyg, 20, 511-523

Fekete E
1978
The pattern of diseases of the skin in the Nigerian Guinea savanna.
Internat J Derm, 17, 331-338

Felkin R W
1889
Geographical distribution of some tropical diseases.
Edinburgh, 50pp

Ferg
1813
Observation of a filarial epidemic in Surinam.
Jahrb Deutsch Med, 1, 151 GER

Ferg
1814
Notes on the insects of Surinam with a harmful sting.
Bibl Med, 43, 100 FRE

Feris
1878
The slave-coast.
Arch Med Nav, 31 FRE

Feris
1879
(Occurrence of guineaworm in West Africa.)
Arch Med Nav, FRE

Fermin P
1769
On worms.
In General, historical and geographical distribution of the colony of Surinam. Amsterdam, 8, chap 24 FRE

Ferreira F S da C
1948
Report of the head of the mission for the study and campaign against sleeping sickness in Portuguese Guinea in 1947.
An Inst Med Trop; Lisbon, 5, 407-444 POR

Ferreira F S da C, Lopes M R
1948
Clinical and epidemiological aspects of an epidemic focus of dracunculiasis in Portuguese Guinea.
An Inst Med Trop; Lisbon, 5, 71-86 POR

Ferrini
1860
Essay on the climate and the principal diseases of Tunisia.
Milan ITA

Fieliz G H
?
Notes on various verminous skin or flesh worms in the human body, especially on Dracunculus or Vena medinensis.
N Mag Aerzt; Leipzig, 10, 492-507 GER

Fischer S
1838
Note on Filaria medinensis or so-called skin-worm.
Muenchen Med Jahb, 4, 4 GER

Fitzgerald R D
1929
A case of dracontiasis.
Mayalan Med J, 4, 78

Fleming
1897
(Dracunculus in horse.)
Vet J, p 412

Floch H
1954
Intradermal reaction in filarial patients: comparative study of two antigens; D. medinensis and D. immitis.
Arch Inst Pasteur; Guyane Franc, 15, 1-6

Fontoynont
1902
Guineaworm and jiggers in the early 18th century.
Arch Parasit, 6, 509 FRE

Foot A W
1861
Filaria medinensis in both legs.
Dublin Med Press, 46, 339

Forbes C
1894
Observations on Dracunculus.
Bombay Med Phys Soc Trans, 1, 215-225

Forbes C
1894
A chapter on filarial disease. The guinea-worm Filaria medinensis, or Dracunculus, with a method of prevention and radical cure.
Indian Med Rec, 6, 301-304

Forbes J G
1920
Intravenous injection of tartar emetic in guinea-worm infections.
Lancet (corr.), i, 837-838

Foster W D
1965
Dracunculus medinensis.
In A history of parasitology. Edinburgh: Livingstone, pp105-111

Foulkes T H
1898
Injection of alcohol in the treatment of guinea-worm.
Brit Med J, ii, 236

Fourn L, Monteiro B, Sadeler B C
1978
Dracontiasis: an unusual parasitosis.
Rev Med Tours, 12, 35-39 FRE

Fox W T
1879
Case of guinea-worm.
Lancet, i, 330-331

Franca C
1925
The Portuguese of the Renaissance and their contribution to tropical medicine and parasitology.
Asoc Espanola p el Progr. d.7. Ciencias TII/ Conferencias: Madrid, pp187-218

Francis E
1901
Report of a case of Filaria medinensis, guinea-worm disease.
Am Med; Philadel, 2, 651-652

Frank L
1812
Practical medicine with a memoir on the commerce of the Negroes of Cairo.
Paris, 8, p235

Fryer G
1957
The food of some freshwater cyclopoid copepods and its ecological significance.
J Anim Ecol, 26, 263-286

Fuchs G F C
1781
Historical-medical commentary on the Dracunculus of the Persian or Vena medinensis of the Arabs.
Jena; Quarto LAT

Fulleborn F
1924
Report on the present state of the therapy (especially chemotherapy) of exotic helminthic disease.s
Arch Schiffs Tropenhyg, 5, 526-535 GER

Gaiger S H
1910
Filaria medinensis in the dog.
J Trop Vet Sci, 5, 481

Gaiger S J
1910
A preliminary check list of the parasites of Indian domesticated animals.
J Trop Vet Sci, 5, 65

Gaitonde B B, Renapurkar D M, Apte V H
1979
Comparative efficacy of three anthelmintic drugs in treatment of guineaworm infection.
Bull Haffkine Inst, 7, 20-27

Gaitonde B B, Renapurkar D M, Ramchandani G S, Sant M V
1974
Metronidazole in Dracunculus infection: report of field trials.
Bull Haffkine Inst, 2, 90-93

Galenus C Claudius
1833
On Dracunculus.
In Medicorum graecorum opera guare exsant. Works (ed K G Kuhn) liv vi, cap iii. GRE + LAT

Gallandat D H
1760
Letter to the editor of the Journal de Medecine on Dracunculus or guinea-worm, and on the use of mercuric chloride in the disease.
J Med Chir Pharm; Paris, 12, 24-28 FRE

Gallandat D H
1773
Dissertation on Dracunculus sive Vena medinensis.
Nova Acta Phys Med Acad Nat Curios; Nuremburg, 45, 103-116 LAT

Gallandat D H
1775
The 'Nestelwurms'.
Nenes Hamburg Mag; Leipzig (96), Vol 16, pp526-549 GER

Galliard R, Sice A
1936
Purulent arthritis due to D. medinensis. Sequelae of a case.
Marseille Med, 73, 724-730 FRE

Gandhi N J
1962
Unusual manifestation of dracunculiasis.
Brit Med J, i, 1206

Ganpule M, et al.
1967
Dracontiasis in Greenock.
Brit J Dermat, 79, 566-568

Garin J P
1979
Filariasis.
Lyon Med, 241, 337-338 FRE

Garin Y, Vazquez M P, Lariviere M, Rene L
1978
Calcified aseptic abscess due to Dracunculus medinensis.
Nouv Presse Med, 7, 272-272 FRE

Garnham P C C
1970
Robert Thomson Leiper (1881-1969).
Biographical Memoirs of Fellows of the Royal Society, 16, 385-404

Garnier L J
1888
Contribution to the medical geography of the post of Sedhiou (Senegal).
Thesis; Bordeaux FRE

Garnuszewski Z
1973
Filariasis of the lungs and chest wall.
Gruzlica; Poland, 41, 1075-1082 POL

Gash S L, Hanna W L
1972
Occurrence of some helminth parasites in the muskrat _Ondatra zibethicus_ from Crawford County, Kansas, USA.
Trans Kans Acad Sci, 75, 251-254

Gatschet T P, Schmidt G D
1974
A redescription of _Dracunculus globocephalus_ Mackin 1927 (Nematoda: Dracunculidae), a parasite of turtles.
Helminthologia, 15, 835-8

Gauthier
1865
On the endemic diseases of Senegal.
Paris, p43 FRE

Gedevanoff D A
1889-90
Case of _Filaria medinensis_ causing phlegmon of the left leg.
Protck Zasaid Kavkazsk Med Obsh Tiflis, 26, 601-608 RUS

Gentilini M
1963
Dracunculiasis.
Bull Soc Path Exot, 56. 469-474 FRE

Gentilini M
1964
Aspects of dracunculiasis in France.
Rev Sci Med, 162, 55-58 FRE

Gentilini M, Carme B
1981
Hospital treatment of filariasis: complications and results.
Ann Soc Belg Med Trop, 61, 319-326 FRE

Gentilini M, Carme B, Smith M, Brucker G, Nosny Y
1978
A case of eosinophilic pleurisy due to _Dracunculus medinensis_ infection.
Trans R Soc Trop Med Hyg, 72, 540-541

Gentilini M et al.
1965
Calcified dracunculiasis.
Presse Med, 73, 2231-2232 FRE

Gentilini M, Pinon G C D, Raffier G, Niel G, Ravet D
1972
Results of a serological study of 356 patients suffering from dracunculiasis carried out by means of indirect immunofluorescence.
Bull Soc Path Exot, 65, 103-111 FRE

Gentilini M, Pinon J M, Niel G, Danis M
1972
Comparative study of precipitation and indirect immuno-fluorescencw reactions in the diagnosis of filariasis.
Bull Soc Path Exot, 65, 849-858 FRE

Ghenis D E
1972
New cases of Dracunculus medinensis L., 1758 detected in domestic cats and dogs in Kazakhstan.
Medskaya Parazit i Parazit Bolezni; Moskva, 41, 365 RUSS

Ghigi M, Magrini M
1959
X-ray pictures of calcified guinea-worm.
Radiol ed. Rot. 45, 953-963 ITA

Ghooi A, Sikdar A K
1963
Guinea-worm infestation at abnormal sites.
Curr Med Prac, 7, 549-554

Ghosal M L
1932
Dracunculus medinensis (guinea-worm) in veterinary practice.
Indian Vet J, 8, 264-265

Ghose D C
1952
Guinea-worm disease: case notes.
Indian Med Gaz, 87, 525-526

Ghosh J M
1939
Dracontiasis or guinea-worm infestations.
Antiseptic; Madras, 36, 410-411

Gibson A
1839
Dracunculus.
Trans Med Phys Soc Bombay, 2, 209-210

Gibson G G, McKiel D A
1972
Dracunculus insignis (Leidy 1858) and larval Eustrongylides sp. in a muskrat from Ontario, Canada.
Can J Zool, 50, 897-901

Gideon P W
1942
Experiments in the control of guinea-worm infection in step-wells by means of larvivorous fish, Rasbora doniconios, and chlorogen.
Proc 28th Ind Sci Congr, p225

Gideon P W
1943
The biological control of guinewaorm in some villages of the Dharwar district.
Proc 29th Ind Sci Congr: part 3

Gilles H M
1964
Akufo: an environmental study of a Nigerian village commur ity.
Ibadan Univ Press

Gilles H M
1968
Current therapeutics - 243 niridazole.
Practitioner, 200, 451-453

Gilles H M, Ball P A J
1964
Guinea-worm infection and gastric function.
Ann Trop Med Parasit, 58, 78-82

Gillet P E
1887
Contribution to the study of the region of Porto-Novo.
Thesis: Bordeaux FRE

Giordano C, Kanga K, Doucet J, Nozais J P, Vidal H, Piquemal P
1976
Spinal compression due to filariae of Dracunculus medinensis.
Report of 3 cases.
Med Afr Noire, 23, 83-87 FRE

Giordano M
1936
Review of health conditions in Eritrea.
Rev Parasit Clin Lab; Habana, 2, 355-366 ITA

Giraud
1891
The region of Benin.
Arch Med Nav, 450 FRE

Gmelin O F
1790
Filaria medinensis.
In C Linne's Systema naturae Vol I, p vi, Lips p 8 LAT

Goble F C
1942
The guinea-worm in a Boneparte weasel.
J Mammal, 23, 221

Goldsmid J M
1977
Leech infestation of man in Rhodesia.
Trans R Soc Trop Med Hyg (corr), 71, 86

Golvan Y-J, Lancastre F A
1968
Development of the larvae of D. medinensis in cyclops of
Ile-de-France.
Ann Parasit Hum Comp, 43, 705-710 FRE

Gooneratne B W M
1969
An additional historical note on the transmission of Dracunculus
medinensis (correspondece).
Trans R Soc Trop Med Hyg, 63, 546

Gordon C A
1856
Some observations on medicine and surgery as practised by the
natives of West Africa.
Edin Med J, Dec, 535-537

Gore K B
1932
Cases of _Dracunculus medinensis._
J R Army Med Corps, 58, 288-289

Gore R N
1938
Ichthyol as a treatment for guinea-worm.
Indian Med Gaz, 73, 139

Gorraeus J
1568
(Comments on guineaworm.)
In Defin medic libri 23 Paris, p 87 LAT

Gospos C
1980
Dracunculus medinensis: a rare cause of calcification.
Radiologe, 20, 38-39 GER

Graham W M
1905
Guinea-worm and its hosts.
Brit Med J, ii, 1263-1266

Graham W M
1905
Guinea-worm and its hosts.
J Trop Med, 8, 248-249

Graham W M
1905
The guinea-worm and its hosts.
Lancet, ii, 386

Graham W M
1905
Guinea-worm and its hosts.
Med Rec, N Y, 68, 399-401

Graham W M
1908
A description of some Gold Coast Entomostraca.
Ann Trop Med Parasit, 1, 415-432

Graham W M
1908
Report on guinea-worm.
J Trop Med Hyg, 9, 353-355

Graham W M
1912
Report upon experiments made at Lagos to ascertain the possibility of killing cyclops in the public wells by heating the well-water with steam from a portable steam boiler.
Report to the Secretary of State for Colonies: HMSO

Gramberg H S G
1862
Short communication about guinea-worm.
Geneesk T Ned-Ind, 9, 632-640 DUT

Grant R E
1831
(Letter concerning guineaworm.)
Edin Med Surg J, 35, Jan 1, 116-118

Gravellat
1927
Recruitment of native troops in French West Africa.
Ann Med Pharm Colon, 25, 225-248 FRE

Greenhow H M
1856
On Dracunculus in Mairwara.
Indian Ann Med Sci, 3, 556-557

Greenhow H M
1861
Note on the treatment of guinea-worm.
Indian Ann Med Sci, 7, 31-32

Greenwood B M
1968
Guinea-worm arthritis of knee-joint (correspondence).
Brit Med J, i, 314

Gregor
1804
Medical sketches of the expedition to Egypt from India.
London

Gretillat S
1965
Prophylaxis pf Dracunculus by the destruction of cyclops by means of an organic derivative of synthesis, zinc dimethyldithiocarbamate or zirame.
Biol Med, 54, 529-539 FRE

Gretillat S
1965
Zinc dimethyldithiocarbamate in the prophylaxis of dracunculiasis.
Med Afr Noire, 12, 93-96 FRE

Grey C G
1920
Novarsenobillon in the treatment of guinea-worm (corr.).
Lancet, ii, 100.

Grierson D
1841
Observations on the Dracunculus, as it prevailed in the 22nd Regiment N.I. from April til Sept., 1841.
Bombay Med Phys Soc Trans, 4, 90-93

Griffith G de
1864
Remarks on the Dracunculus.
Med Circ; London, 24, 19-21

Griffith G R
1888
Dracunculus medinensis in the dog.
Vet J, 27, 317-318

Grigorov G
1971
Surgical manifestations of Filaria medinensis.
Khirugiya; Sofia, 24, 79-73 BUL

Grove D I
1979
Tissue nematodes. In (Mandell G L, Douglas R G Jr, Bennet J E Eds): Principles and practice of infectious diseases.
Sussex: John Wiley, pp2165-2173

Gruner C G
1774
Vena medinensis.
In Morborum antiquitates Vratislav, pp216-226 LAT

Gruner C G
1777
On the Vena medinensis of the Arabs or Dracunculus of the Greeks.
Acta Acad Elect Moguntinae Scient Util, pp257-264 LAT

Guerra F
1968
Aleixo de Abrev (1568-1630) author of the earliest book on tropical medicine describing amoebiasis, malaria, typhoid fever, scurvy, yellow fever, dracontiasis, trichuriasis and tungiosis, in 1623.
J Trop Med Hyg, 71, 55-69

Guiguemde T R, Sokal C S, Roux J
1983
Dracunculiasis: a public health problem?
Med Afr Noire, 30, 419-426 FRE

Guillet P
1980
Chemical treatment of copepods.
Bull OCCGE inf no 69, Sep/Oct, 67-70 FRE

Guillet P E
1887
Contribution to the study of the region of Porto-Novo.
Thesis; Bordeaux, No. 63

Gupta J J R
1917
Guinea-worm and iodine (corr).
Ind Med Gaz, 52, 419

Gupta N L, Gupta R, Gupta R, Gupta S
1982
Guinea-worm is a tropical disease with intense and prolonged suffering.
Geogr Med, 12, 154

Guyton
1865
On Dracunculus or guinea-worm.
C R Seanc Acad Sci Paris, 61, 475-477 FRE

Haaf E
1967
A medical-entomological study in north Ghana.
Giess Beitr Entwickl, Pt 2, vol 1, pp260-262 GER

Haim Ben Hamran
1959
A history of dracunculiasis and bilharziasis and their economic and social consequences.
These de Lettres; Rennes FRE

Halyfilius Abbas (= Ali Abbas)
1553
Vena saniosa.
Lib totius med necessaria continens etc 4 Lib IV pract, Cap 16, p 201 LAT

Hamilton W J, Cook A H
1955
The biology and management of the fishes in New York.
New York Fish & Game J, 2, 13-35

Harbans S T
1937
Guinea-worm.
Indian Med Gaz, 72, 606-609

Harington V
1899
A note on Dracunculus medinensis.
Brit Med J, i, 146-147

Harington V
1899
A note on Dracunculus medinensis.
Indian Med Rec, 16, 418

Harington V
1900
A note on Dracunculus medinensis.
Archs Schiffs Tropen-Hyg, 4, 57-58 GER

Harkema R, Miller G C
1964
Helminth parasites of the raccoon, Procyon lotor, in the southeastern United States.
J Parasit, 50, 606-66

Harkness J
1955
Dracontiasis in Tanganyika.
Trans R Soc Trop Med Hyg, 49, 197

Harley G
1863
A guinea-worm.
Trans Path Soc Lond, 14, 260-262

Harley G
1863
On the young of the guinea-worm.
Trans Path Soc Lond, 14, 263-264

Harrington V
1899
A note on Dracunculus medinensis.
Indian Med Rec, 16, 418-419

Harris
1844
The Highlands of Aethiopia.
London, Vol 3, p389

Hartmann
1865
Medical sketches of the Nile region.
Berlin GER

Hartwich H
1972
Type nematode material in the Berlin Zoological Museum. VII. Dracunculoidea etc.
Mitt Zool Mus Berlin, 48, 183-196 GER

Hashikura T
1926
A case of Filaria medinensis in Chosen (Korea).
Chosen Igakka Zasshe, 68 JAP

Hashikura T
1927
On a case of Filaria medinensis in Korea.
Jap Med World, 7, 145-146 JAP

Hawking F
1943
The distribution of filarioid infections in East Africa.
J Trop Med Hyg, 45, 159-165

Hawking F
1973
Chemotherapy of tissue nematodes. In Cavier R, Hawking F (Eds). Chemotherapy of helminthiasis. Vol. 1.
Oxford: Pergamon Press, pp 437-500

Hawking F
1981
Chemotherapy of filariasis. In Schoenfeld H (Ed). Antibiotics and chemotherapy. Vol 30. Antiparasitic chemotherapy.
Karges: Basel, pp135-162

Heath T
1816
Observation on the generation of guinea-worm and its mode of access into the human body.
Med Surg J, 22, 120

Hebbar A C K
1918
Filaria medinensis (Dracunculus medinensis), guinea-worm.
Antiseptic: Madras, 15, 163-166

Hebert
1880
A medical year in Dagana (Senegal).
Paris, p41 FRE

Hemboldt C F, Jungherr E L
1955
Distemper complex in wild carnivores simulating rabies.
Am J Vet Res, 16, 463-469

Hemmersam M
1669
Account of journeys to Guinea and the West Indies in the years 1639-45.
Nuremberg: 8 cap 13 GER

Hempelmann F A
1912
Guineaworm.
In Handworterb Naturwiss, vol 7, p111 GER

Henderson J
1841
Four cases of Dracunculus occurring in the 48th Regiment.
Madras Quart J, 3, 353

Hendley T H
1872
Filaria or Dracunculus medinesis at Kherwarrah.
Indian Med Gaz, 7, 59-60

Henric
1905
The road to Zinder.
Ann Hyg Med Colon, 8, 24 FRE

Hentsz van
1926
One indigenous and two imported cases of Dracunculus infection in Java.
Geneesk T Ned-Ind, 66, xxxv DUT

Herbst J F W
1787
Short treatise on worms for the beginner.
Berlin, vol 1, p22 GER

Heront V, Kanan M W
1969
Review of histopathological material in the Department of General pathology during the year (1968) in Kuwait.
J Kuwait Med Ass, 3, 237-253

Heymann
1855
Presentation of the diseases of tropical countries.
Wuerzb, p 220 GER

Hillary
1776
Observations on epidemic diseases in Barbadoes.
London and Leipzig; 2nd edit GER

Hille
1845
(Guineaworm).
In Casper's Wuchenschr fur die ges, Heilkde, p556 GER

Hiller E
1891
A guinea-worm in the tongue.
Indian Med Rec, 3, 79

Hinz E
1965
The current status of information on the infection of mammals with Dracunculus medinensis as a basis for a model experiment for testing chemotherapeutic substances.
Z Tropenmed Parasit, 16, 90-105 GER

Hirsch A
1885
(Bibliography of guineaworm).
In Handbook of geographical and historical pathology (Trans C Creighton). New Sydenham Society: London, vol 2, pp357-359

Hodgson C, Barrett D F
1964
Chronic dracunculosis.
Brit J Dermatol, 76, 211-217

Hoeppli R
1959
Parasites and parasitic infections in early medicine and science.
Singapore: Univ Malaya Press, pp5, 8, 19, 95, 101, 256

Hoeppli R
1969
Parasitic diseases in Africa and the western hemisphere - early documentation and transmission by the slave trade.
Acta Trop, Suppl 10, 244pp

Hoffman G L
1970
Incidental aquatic zoonoses.
J Wildl Dis, 6, 272

Hopkins D R
1982
Guinea worm disease - a chance of eradication?
World Health Forum, 3, 434-435

Hopkins D R
1983
Dracunculiasis: an eradicable scourge.
Epidemiol Rev, 5, 208-219

Hopkins D R, Foege W H
1981
Guinea worm disease (corr).
Science, 212, 495

Horton J A B
1868
Guinea-worm or Dracunculus: its symptoms and progress, causes, pathological anatomy, results and radical cure.
London: 8 vo, 51 pp

Horton J A B
1870
Guinea-worm amongst a detachment of 2nd West Indian Regiment on the west coast of Africa.
Med Dep Rept; London, 10, 335-336

Houin R, Deniau M, Barbier D, Bonnet M
1975
A deceptive form of onchocerciasis: abscess of the anal border.
Bull Soc Path Exot, 68, 205-207 FRE

Hsu H F
1933
On _Dracunculus houdermeri_ n.sp., _Dracunculus globocephalus_ and _Dracunculus medinensis_.
Z ParasitKde, 6, 101-118

Hsu H F, Wyatt J Y C
1933
Dracunculus medinensis infection in two dogs in Peiping - experimental infection of cyclops.
Chinese Med J, 47, 1326-1330

Hsu P K, Li D N
1981
Dracunculus medinensis Linnaeus, 1758 from a cat in Guangdong.
Ann Bull Soc Parasit, Guandong Province, 3, 92

Huard P
1938
Guinea-worm arthritis.
Bull Soc Path Exot, 31, 722-725 FRE

Huard P, Grmek M I
1960
The first Turkish surgical manuscript, compiled by Charaf-Ed-Din (1465) and illustrated with 140 miniatures.
Roger da Costa: Paris FRE

Huard P, Tran-Anh
1950
Intradermo-reaction in filariasis patients in Hanoi. (_D. immitis_ used as antigen.)
Med Trop; Marseilles, 10, 858-864 FRE

Huber
1927
A case of _Dracunculus_ infection.
Geneesk T Ned-Ind, 67, xciv-xcv

Huber J C
1894
Dracunculus persarum Kaempfer.
In Bibliographie der Klinischen Helminthologie, Vols 7-8, 245-267, Munich, 381 p GER

Hudellet C
1919
Treatment of guinea-worm by complete removal.
Arch Electr Med Physiother, 27, 105-106 FRE

Hudellet G
1919
Complete removal of a guinea-worm after diagnosis of its position by x-rays.
Bull Soc Med Chirurg Franc Ouest Afri, 1, 17-19 FRE

Hudellet G
1920
Complete removal of a guinea-worm after diagnosis of its position by x-rays.
Presse Med, 28, 29 FRE

Hugghins E
1958
Guinea worm in a raccoon from South Dakota and in mink from Minnesota.
J Parasit, 44, 41-42

Hugghins E J
1958
Guinea-worms from carnivores in South Dakota and Minnesota, with a review of the distribution and taxonomy of dracunculid worms in North America.
Proc S Dakota Acad Sci, 37, 40-46

Hughes M H
1967
A historical note on the transmission of dracontiasis (corr.).
Trans R Soc Trop Med Hyg, 61, 442-443

Huillet
1868
(Guineaworm).
Arch Med Nav, Feb, p87 FRE

Hulshoff A A
1941
A case of dracunculiasis medinensis.
Alta Med Scholae Med trop, 15-16, pp205-209

Huntley W
1894
The medical and surgical treatment of guinea-worm.
Indian Med Rec, 6, 363-364

Huriez C, Agache P, Bombart-Thoreaux M, Lelievre G
1961
Multiple sub-cutaneous abscesses due to guinea-worm.
Lille Med, 6, 326-328 FRE

Hussem B
1771
Observations concerning Dracunculus.
Verh Genootsch Vlissingen, 2, 443-464 GER

Hutcheson R, Forbes G
1744
Ulcers from dracunculi.
Med Essays Obs Soc; Scotland, 5, 784-787.

Hutchinson F H G
1916
History of chief diseases.
Ann rep San Comm Govt Bombay, pp7-20

Ijima I
1889
Guineaworm.
In The animal parasites of man: Tokyo, p367 JAP

Imperato P J
1974
Treatment and control of infectious diseases in man.
Springfield, Illinois: Charles C Thomas, 744pp

Inglis V A, Leiper R T
1912
Bibliography of dracontiasis.
J London Sch Trop Med, 2, Suppl 1, 24 pp

Ingrassin P
1552
(Comments on guineaworm.)
De tumoribus practer naturum, Naples + 1 cap 1 lib 26 LAT

Innes H
1900
A case of guinea-worm causing suppuration of the knee-joint.
Brit Med J, i, 255-256

Isert P E
1788
Journey to Guinea, the Caribbean Islands and to Colombia.
Copenhagen, GER

Isert P E
1789
The Guinea fathom-worm.
Phys Oekonom Biblioth Goettingen, 16, 46 GER

Issajev L M
1930
Epidemiology of guinea-worm infection in Middle Asia.
In Proc 3rd Sci Med Congr Middle Asia: Tashkent (20-28 Dec 1928), 315pp. Med Mysl Uzbekistana, Suppl, p 51 RUS

Issajev L M
1934
A simple method of demonstrating nematode larvae in Crustacea.
Med Parazit Moskva, 3, 238-240 RUS

Issajev L M
1934
Experimental dracunculiasis in dogs.
Med Parazit, 3, 231-238 RUS

Issajev L M
1934
On the penetration of Dracunculus medinensis larvae into cyclops.
Med Parazit, 3, 212-230 RUS

Issoufa H, Monekosso G, Ripert C
1979
Epidemiologic study of dracunculosis in the Podokwos of the Mandara mountains (northern Cameroon).
Bull Soc Path Exot, 72, 135-144 FRE

Iura V
1941
Dracunculiasis in Italy, a case.
Policlinico, 48, 473-480 ITA

Ivanov U P, Markov G S, Nikulin V P, Chernobai V F
1960
Helminth fauna of reptiles on the northern shores of the Caspian Sea.
Tezisi Dokl Nauchnoi Vses Obshch gelm, Dec 5-20, pp. 46-48 RUS

Jackson H F
1951
Calcified worm in soft tissues of the thorax.
Proc AluMNI King Edward Coll Med; Singapore, 4, 66

Jackson J
1838
Curious case of Dracunculus.
Trans Phys Med Soc Calcutta, 2, 115-116

Jackson J
1842
Curious case of Dracunculus.
Trans Phys Med Soc Calcutta, 8, 314-316

Jacobson L L
1834
On the Filaria medinensis.
Ann Mus Nat Hist Nat Paris, 3, 80-83 FRE

Jacobson L L
1834
Extract of a letter addressed to M. de Blainville on guinea-worm.
Ann Sci Nat Paris: Zool, 1, 320 FRE

Jacobson L L
1834
Remarks on the guinea-worm (Gordius medinensis).
Med Surg J, 5, 432

Jacobson L L
1834
On Gordius.
Notiz Gen Nat-u Heilk, 40, 57-58 GER

Jacobson L L
1834
Observation on the guinea-worm.
Overs od K Danske Widensk-Selsk Forh Khoebenh, pp1-9 DAN

Jacobson L L
1837
Observations on the guinea-worm (Filaria medinensis, Dracunculus etc.).
K Danske Vidensk Selsk Skr Kjoebenh Naturv-Math Afd, 6, 48-49 DAN

Jacobson L L
1848
Observations of guinea-worm.
Isis-Oken, 2, 132-133 GER

Jain R C, Gupta O P
1966
Electrophoretic pattern of serum proteins in dracunculosis.
Indian J Med Sci, 20, 713-715

Janssens P G, Benoit P L
1979
Parasites in the skin: scabies - cutaneous myiases - cutaneous nematodes.
Berh K Acad Geneeskd Belg, 41, 388-508 DUT

Jarvis N S
1857
A case of Filaria medinensis, Dracunculus or guinea-worm.
Virginia Med J, 8, 399-401

Jeanselme E A
1919
Note on a case of recovery from guinea-worm.
Boll Acad Nac Med, Rio de Jan, 90, 58-60 POR

Jeanselme E A
1919
On a case of guinea-worm cured by novarsenobenzol.
Brazil-Med, 33, 172 POR

Jeanselme E A
1919
A note on a case of guinea-worm completely cured by novarsenobenzol in intravenous injections.
Bull Acad Med, 81, 156-158 FRE

Jelliffe D B
1950
Calcification of a guinea-worm.
J Trop Med Hyg, 53, 210-211

Jenkinson A
1558
The voyage of Master A Jenkinson made from the citie of Mosco in Russia to the citie of Boghar in Bactria in the yeere 1558.
Hakluyt's Voyages, Vol 1, p 444 (Everyman edition)

Jilla A D
1914
Notes on guinea-worm in Ceylon.
J Ceylon Brit Med Ass, 1, 76

Job J T
1941
Food and feeding habits of the glassfishes (Ambassis, Cuv. & Val.) and their bearing on the biological control of guinea-worm and malaria.
Indian J Med Res, 29, 851-862

Job T J
1944
Public health fish-farming.
Indian Farming, 5, 10-13

Joerdens j H
1801
The skin worm, Filaria medinensis.
In Entomology and helminthology of man. C A Gran: Hof, vol 1, 94-103 GER

Johnson G C
1974
Dracunculus insignis in a dog.
J Am Vet Med Ass, 165, 533

Johnson J
1821
The influence of tropical climates on European constitution.
London, p 226

Johnson M F
1968
Guinea-worm arthritis of knee joint.
Brit Med J (corr.), i, 314

Johnson S, Joshi V
1980
Dracontiasis in Rajasthan. V. The incidence of Dracunculus medinensis in some villages of Barmer district.
Indian J Parasit (abst), 3, 77

Johnson S, Joshi V
1980
Epidemiological studies in guinea-worm infection in some villages of western Rajasthan.
Proc 3rd European Multicolloq Parasitol; Cambridge, p 114

Johnson S, Joshi V
1982
Dracontiasis in Rajasthan. VI. Epidemiology of dracontiasis in Bermer district, western Rajasthan, India.
Internat J Epidemiol, 11, 26-30

Johnson S, Joshi V
1982
Dracontiasis in western Rajasthan, India.
Trans R Soc Trop Med Hyg, 76, 36-40

Johnson S, Singhvi A
1977
Dracontiasis in Rajasthan. 1. The incidence of Dracunculus medinensis in the village of Hapan (Jodhpur, India).
Abs 1st Nat Congr Parasitol, Baroda: Indian Soc Parasitl, pp48-49

Johnson S, Singhvi A
1978
Dracontiasis in Rajasthan. II. The incidence of Dracunculus medinensis in some villages of Shergarh Tehsil.
Abs Asian Congr Parasitol, Bombay: p. 145

Johnston C A
1900
Treatment of guinea-worm.
Indian Med Gaz, 35, 197

Johri G N, Saxena A K
1974
An epidemiological note on guinea worm infection in Madhya Pradesh III. Incidence and infestation rate of infection in the village of Nipania.
J Hyg, Epidemiol, Microbiol and Immunol, 18, 154-159

Johri J N
1978
The report on the occurrence of Dracunculus medinensis (Linn., 1758) from Delhi State.
Indian J Zool, 6, 63-64

Jojot C
1916
Medical review on the Camerron campaign of 1914-16.
Bull Soc Path Exot, 9, 584-591 FRE

Jollet A A
1887
Medical history of the post of Koundou.
Thesis; Bordeaux FRE

Joseph S A, Kandasamy S
1980
On the occurrence of the guinea-worm, Dracunculus medinensis (Linneus, 1758) Gallandant 1773 in an Alsatian dog.
Cheiron, 9, 363-365

Joshi M J
1982
Surgical diseases in the tropics.
Macmillan India: New Delhi, pp137-150

Joshi V
1981
A survey of the incidence of dracontiasis in the villages of western Rajasthan.
Thesis; Jodhpur Univ.

Jospin Y
1937
Unusually located cystic swellings due to guineaworm.
Bull Soc Path Exot, 30, 146 FRE

Joubert L E
1864
Remarks on Dracunculus or guinea-worm.
Thesis: Montpellier, 42pp FRE

Journe H
1934
Puriform arthritis in dracunculiasis.
Bull Soc Path Exot, 27, 588-590 FRE

Kadyrov A A
1954
A contribution to the history of the extinction of dracunculiasis (rishta) in the Uzbek SSR.
In Akad Medits Nauk SSSR; Scient Sessn Prob region Path; Summaries of papers Tashkent, pp72-73 RUS

Kaempfer E
1712
Dracunculus persarum on the coast of the Persian Gulf.
Amoenitatum exotico-politico-physico-medicorum. Fasc V, Lemgoviae 4. Fasc iii, Observ. 4, p534 LAT

Kagan I G
1963
A review of immunologic methods for the diagnosis of filariasis.
J Parasit, 49, 773-798

Kairov I Kh
1973
Helminthiasis with a natural focal occurrence in the Karakalpak area.
Voprosy Prirodnoi Ochagovosti Boleznei, No 6, pp131-138 RUS

Kale O O
1974
A controlled field trial of the treatment of dracontiasis with metronidazole and niridazole.
Ann Trop Med Parasit, 68, 91-95

Kale O O
1975
Mebendazole in the treatment of dracontiasis.
Amer J Trop Med Hyg, 24, 600-605

Kale O O
1977
The clinico-epidemiological profile of guinea worm in the Ibadan district of Nigeria.
Am J Trop Med Hyg, 26, 208-214

Kale O O
1977
Clinical evaluation of drugs for dracontiasis.
Trop Doctor, 7, 15-16

Kale O O
1982
Fall in incidence of guinea-worm infection in western Nigeria after periodic treatment of infected persons.
Bull WHO, 60, 951-957

Kale O O
1982
Dracontiasis.
In CRC Handbook series in zoonoses. Section C: Parasitic zoonoses, Vol. II, [Ed.: Schulz, M.G.]. Boca Raton, Florida: CRC Press, pp 111-122

Kale O O, Elemile T, Enahoro F
1983
Controlled comparative trals of thiabendazole and metronidazole in the treatment of dracontiasis.
Ann Trop Med Parasit, 77, 151-7

Katzenellenbogen I
1950
Dracontiasis among immigrants from Yemen.
Harefuah, 39, 77-80 HEB

Katzenellenbogen I
1954
Dracontiasis among Yemenite immigrants to Israel.
Dermatologica; Basle, 198, 129-136

Katzenellenbogen I, Feuerman-Pogorzelski E J, Boss J
1961
The Groenblad-Strar iberg syndrome with residual dracontiasis in a Yemenite woman.
Dermatologica; Basle, 122, 440-448

Kearney
1859
(Guineaworm.)
Bombay Med Trans, ns, iv, 173

Kemp D C
1904
Some clinical features associated with guinea-worm.
Brit Med J (corr.), i, 189

Kendrick J L, Phalan G S, Hartman J T
1966
Calcification in soft tissues.
Postgrad Med, 39, 165-173

Kennedy A
1821
Notes on remarks on the Drcunculus or guinea-worm, as communicated in a letter addressed to the Medical Board, Madras by W Scot.
Edinb Med Surg J, 17, 103-105

Kennedy R H
1825
On Dracunculus.
Calcutta Med Phys Soc Trans, 1, 165-178

Kevan D K McE
1977
Mid-eighteenth century entomology and helminthology in the West Indies: Dr James Grainger.
J Soc Bibliog Nat Hist, 8, 193-222

Khajavi A
1968
Guinea worm calcification - a report of 83 cases.
Clin Radiol, 19, 433-435

Khan M A, Lathan F, Samarik S, Edeson J F B
1982
X-ray identification of parasitic infections in the western region of Saudi Arabia.
Ann Trop Med Parasit 76, 499-505

Khwaja M S, Dossetor J F, Lawrie J H
1975
Extradural guinea-worm abscess. Report of two cases.
J Neurosurg, 43, 627-630

Kinare S G, Parulkar G B, Sen P K
1962
Constrictive pericarditis in the tropics: report on Nyasaland.
Trop Dis Bull, 4, 418

King W G
1913
Applied hygiene in the tropics: report on southern Nigeria
Trop Dis Bull, 3, 333-339

King W G
1914
Applied hygiene in the tropics: report on northern Nigeria
Trop Dis Bull, 4, 173

Kintzen W
1968
The caduceus motif and the guinea-worm (letter).
J Amer Med Ass, 203, 234

Klein J T
1755(?)
Studies on worms in the human body.
Hamburgischen Magazin, 18 (1), 19-58 GER

Klein S R
1911
Dracontiasis.
Med Times, New York, 39, 237

Klopotovskii T
1876
Guineaworm or Rishta (Filaria medinensis).
Zdorovjem St Petersb, v. 2 (32), 31 Janv, pp 39-41, 15 mar, pp 121-124 RUS

Koischwitz D, Distelmaier W
1984
Radiological demonstration of Medina worm (_Dracunculus medinensis_).
Fortschr Roentgenstr, 140, 325-329 GER

Koischwitz, D, Distelmaier W
1984
Radiological detection of the Medina worm (_Dracunculus medinensis_).
ROFO, 140, 325-328 GER

Kothari M L, Pardanani D S, Anand M P, Mehta L, Kothari D L
1970
Management of dracontiasis.
Indian J Surg, 32, 479-484

Kothari M L, Pardanani D S, Anand M P, Mehta L, Kothari D L
1970
Dracontiasis in man: biology of the worm and pathology of the lesions.
Indian J Surg, 32, 462-470

Kothari M L, Pardanani D S, Anand M P, Mehta L, Kothari D L
1971
Dracontiasis in man: epidemiology and clinical features.
Indian J Surg, 33, 1-9

Kothari M L, Pardanani D S, Anand M P, Mehta L, Kothari D L, Dastur P
1971
Dracontiasis and secondary bacterial infection.
Indian J Surg, 33, 119-122

Kothari M L, Pardanani D S, Mehta L, Arnand M P
1968
Guinea-worm arthritis of knee joint.
Brit Med J (corr), iii, 435-436

Kothari M L, Pardanani D S, Mehta L, Kothari D L
1969
Niridazole in dracontiasis: a controlled study.
Trans R Soc Trop Med Hyg, 63, 608-612

Kothari M L, Pardanani D S, Anand M P
1968
Niridazole in dracunculiasis.
Am J Trop med Hyg, 17, 864-866

Kothari M L, Pardanani D S, Anand M P, Mehta L, Kothari D L, Dastur P
1969
Role of secondary bacterial infection in dracontiasis.
Trans R Soc Trop med Hyg (corr), 63, 687-688

Krishna Rao C, Kumar S, Jain M L, Jairaj D, Narasimhan M V V L, Mathur A R L, Apparao M C, Rao C K
1982
Control of cyclops with temephos in guineaworm endemic villages of Andhra Pradesh and Rajasthan.
J Commun Dis, 14, 36-40

Kuechenmeister F
1857
Filaria medinensis.
In Animal and vegetable parasites of the human body (Engl transl by E Lankester), Sydenham Society: London, pp389-409

Kuechenmeister F, Zuern F A
1878-81
Parasites of man: 2nd edit
Leipzig, pp 419-425 GER

Kulkarni D R, Nagalotimath S J
1973
(Guineaworm).
J Mysore Med Ass, 38, 279

Kulkarni D R, Nagalotimath S J
1975
Guinea-worms and metronidazole.
Trans R Soc Trop Med Hyg (corr.), 69, 169-170

Kulkarni D R, Nagalotimath S J
1976
Metronidazole in guineaworm.
Bombay: Asian Congr of Parasit, Abstracts, pp33-34

Kumar S
1982
Guineaworm eradication programme and primary health care.
J Commun Dis, 14, 12-15

Kunsemueller
1797
Of the disease called yaws and of guinea-worm.
Halle, 24pp LAT

Labegorre J, Pelloux H, Piacentini M, Grimaldi A
1989
Adult tetanus in Cotonou - on 353 cases.
Med Trop, 29, 702-10 FRE

Lachmund F
1688
Remarkable worms of the feet, back and scrotum in America.
Ephem Acad Nat Cur, Dec1, Ann 4, u5, 1673-74 LAT

Lacombe M, Gentilini M
1963
On intrascrotal localisation of guineaworm.
Press Med, 71, 1862-4 FRE

Lafage G
1886
Five guineaworms in the same subject; abscess; haematuria.
Gaz Med Paris, 3, 173-4 FRE

Lafaye
1756
(Comments on guineaworm).
In Principles of surgery. Paris, 81 PV, sect 1, chap 1, p220
FRE

Laffond
1889
Medical report of the campaign of 1887-8 in French Sudan.
Arch de Med Nav, vols li and lii FRE

Lafont
1901
The isle of Anjouan (Comores).
Ann d'Hyg Med Colon, 4, 184 FRE

LaHerminier F J
1826
On guineaworm and the five worms to be found most frequently in the human intestine.
Thesis: Paris FRE

Laigner-Terrasse P
1932
Nematodes and platyhelminthes of the human eye.
Maloine: Paris, pp73-7 FRE

Lalarriere A A
1887
Medical memories from the military post of Kayes.
Thesis: Bordeaux FRE

Lalitha C M, Anandan R
1980
Guinea worm infection in dogs.
Cheiron; Tamil Nadu J Vet Sci and Anim Husb, 9, 198-9

Lamb G
1898
Treatment of guinea-worm by injection of perchloride of mercury.
Brit Med J, i, 686

Lambie J
1917
Brief notes on the clinical features of diseases prevalent in the Upper Nile and Sobat Pibor district.
J Trop Med Hyg, 20, 61-2

Lamontellerie M
1966
Investigation of filariasis in the Banfora (Upper Volta). 2. Results concerning dracunculiasis in six districts.
Proc 8th Conf Techn OCCGE (Bamako), vol 1, pp201-4 FRE

Lamontellerie M
1972
Results of surveys on human filariasis in West Upper Volta (Banfora circle).
Ann Parasit Hum Comp, 47, 783-838 FRE

Lane C
1912
The prevention of guinea-worm disease.
Indian Med Gaz (corr), 47, 294

Lang G
1864
A case of <u>Filaria medinensis</u>.
Orvosi Hetilap, 8, 485-505 HUN

Lang G
1864
A case of <u>Filaria medinensis</u>.
Wien Med Wochenschr, 14, 772-808 GER

Lange C E
1980
Tropical parasitoses.
Aktuel Dermatol, 6, 61-8 GER

Lapage G
1950
Parasites and war.
Endeavour, 9, 134-7

Laporte
1792
Guineaworm: Dracunculus persarum, Nervus medinensis.
Encycl Methodique Paris Med, vol 5, p531 FRE

Larrey C
1804
Note on the so-called guineaworm.
Bull Sci Soc Phil Paris, 3(or 83), 178-9 FRE

Lasnet
1898
The Mission of Baoule.
Ann d'Hyg Med Colon, Ti FRE

Lauckner T R, Rankin A M, Adi F C
1961
Analysis of medical admissions to University College Hospital, Ibadan.
West Afr Med J, 10, 3

Laurens R
1908
Note on a case of guineaworm observed in the hospital of Val-de-Grace (Paris).
Caducee, 8, 135-6 FRE

Laurie W
1954
Dracontiasis in Tanganyika, British East Africa.
Trans Roy Soc Trop Med Hyg (corr), 48, 538-9

Layet A
1907(?)
Hygiene and colonisation. The health of Europeans in the tropics.
Paris, 364pp FRE

Layne J N, Birkenholz D E, Griffo J V
1960
Records of Dracunculus insignis (Leidy 1858) from raccoons in Florida.
J Parasitol, 46, 685

Le Beau J, Corcos A
1980
Parasitoses of the central nervous system observed during neurosurgery.
Semaine des Hopitaux, 56, 613-8 FRE

Le Bras J, Duchatelle C, Andrieu B, Coulaud J P
1980
Dracontiasis. Specific antibody pattern and diagnostic implications.
Ann Soc Belge Med Trop, 60, 163-71 FRE

Le Bras J, Duchatelle C, Payet M, Savel J
1977
Comparison of results obtained with homologous and heterologous antigens in the immunological diagnosis of onchocerciasis and dracontiasis.
Bull Soc Path Exot, 70, 515-24 FRE

Le Dentu R
1923
Treatment of guineaworm by intravenous injections of tartar emetic.
Bull Soc Path exot, 16, 566-7 FRE

Le Dentu R
1924
Malaria and guineaworm in Upper Volta. Common prophylaxis.
Bull Soc Path exot, 17, 104-7 FRE

Le Fort L
1886
On a case of guineaworm.
Bull Acad Med Paris, 16, 22-6 FRE

Le Guyader A, Boucher J, Delteil
1965
Consideration of calcified worms, particularly those of the mesenteries.
Ann Univ Abidjan Med, 1, 283-92 FRE

LeBlanc
1879
(No title?).
Arch de Med Nav, Oct, 250 FRE

LeBlond
1836
Some material for the history of Filaria and Strongylus.
Paris FRE

Lecigne D
1971
Contribution to the study of genital localisations of human dracunculiasis.
Thesis: Bordeaux FRE

Lee C
1982
Helminthiases.
Practitioner, 226, 1535-41

Lefevre
1908
Extraction of a guineaworm by cocainisation of the parasite.
Press Med, 16, 688 FRE

Lefevre
1931
Giant urticaria during dracunculiasis.
Ann Med Pharm Colon, 29, 329-32 FRE

Leger L
1903
Guineaworm in Sudan.
Caducee, 3, 175 FRE

Leger L
1903
Note on dracunculiasis in Sudan.
Gaz Hebd Sci Med Bordeaux, 24, 246-7 FRE

Legmann P, Chiras J, Launay M, Philippon J, Bories J
1980
Epidural dracunculiasis: a rare cause of spinal cord compression.
Neuroradiology, 20, 43-5

Legrand
?
Hygiene of troops in the tropics and in colonial expeditions.
Paris FRE

Leidy J
1858
Contributions to helminthology.
Proc Acad Sci Philadelphia (1850-1851), 10. 110-2

Leiper R T
1906
The influence of acid on guineaworm larvae encysted in cyclops.
Brit Med J, 1, 19-20

Leiper R T
1906
Some results of the infection of monkeys with guinea-worm.
Rep Brit Ass Adv Sci, 76, 600

Leiper R T
1907
Etiology and prophylaxis of dracontiasis.
Brit Med J, (1), 129-32

Leiper R T
1907
Report of the helminthologist at the London School of tropical Medicine.
Trop Dis Res Fund; Rep of the Adv Comm for 1906. HMSO: London, pp34-8 and 42-3 and 45-51

Leiper R T
1910
Guinea-worm in domesticated animals with a note on its discovery, by Mr. Charles Grey, in a leopard.
J Trop Med Hyg, 13, 65-6

Leiper R T
1910
Guinea-worm in domesticated animals with a note of its discovery by Mr. C. Grey in a leopard.
J Vet Sci, 5, 414-9

Leiper R T
1910
Guinea-worm (Dracunculus medinensis) in a leopard at Broken-Hill, northwest Rhodesia.
Vet News, 7, 113

Leiper R T
1911
A method for dealing with town wells infected with guinea-worm.
J London Sch Trop Med, 1, 28-30

Leiper R T
1911
Note on the native tradition that the guinea-worm can attain maturity outside the body.
J Trop Med Hyg, 14, 77

Leiper R T
1911
Note on the seasonal incidence of dracontiasis on the Gold Coast.
J Trop Med Hyg, 14, 211

Leiper R T
1913
Seven helminthological notes. (a) The occurrence of guinea-worm in Nyasaland.
J London Sch Trop Med, 2, 175-8

Leiper R T
1913
Report of the helminthologist, London School of Tropical Medicine, for the half-year ending April 30th, 1913.
Rep Adv Comm of Trop Dis Res Fund Colonial Office. HMSO: London

Leiper R T
1921
Egg-laying habit of the guinea-worm - not hydrotropic.
J Parasitol, 8, 92

Leiper R T
1926
Discussion of the validity of certain generic names at present in use in medical helminthology.
Arch Schiffs u Tropenhyg, 30, 484-91

Leiper R T
1929
Landmarks in medical helminthology.
J Helminth, 7, 101-18

Leiper R T
1936
Crustacea as helminth intermediates.
Proc Roy Soc Med, 29, 1074-4

Leonard
1869
Recent medical observations at the post of Sedhiou (Senegal).
Paris FRE

Leonard, Garnier
1888
Medical memories from the post of Sedhiou (Senegal).
Casamance FRE

Leonides of Alexandria
1583
On worms.
In Ars mebendi, Bonoiae, fol sect iii, lib IV, c9, p575 LAT

Leuckart K G F R
1872
On Filaria medinensis and Echinorhynchus gongustatus.
Ges Naturw Berlin, 40, 315 GER

Leuckart K G F R
1872
On Filaria medinensis.
Versamml Deutsch Naturf Aerzte Leipzig, 7, 137-8 GER

Leurer J
1954
High eosinophilia in dracontiasis. Report of a case.
J Trop Med Hyg, 57, 155-7

Liance M, Houin R
1979
Skin manifestations of parasitoses.
Concours Med, 101, 5691-707 FRE

Licetus F
1618
(On Dracunculus).
In De spontaneo viventium ortn Vicetiae, fol lib III, cap51,
p242 LAT

Limsuwan C, Dunn M C
1978
A survey of helminth parasites from turtles in Rutherford
County, Tennessee.
J Tennessee Acad Sci, 53, 111-4

Lind J
1768
A proposal to prevent guineaworm.
In Essay on diseases incidental to Europeans in hot climates.
London, pp57-68

Lindberg K
1935
A guineaworm in the soft palate.
Bull Soc Path Exot, 28, 438-41 FRE

Lindberg K
1935
Notes on the epidemiology of dracunculiasis in British India.
Bull Soc Path Exot, 28, 866-75 FRE

Lindberg K
1935
Note on Indian freshwater Cyclopidea, with descriptions of a new species and of two new varieties.
Rec Indian Mus, 37, 405-19 FRE

Lindberg K
1935
Knee joint arthritic suppuration associated with dracunculiasis and cryptogenic suppurating arthritis.
Rev Med Hyg Trop, 27, 215-30 FRE

Lindberg K
1936
Dracunculiasis in Iran.
Arch Schiffs u TropenHyg, 40, 330-42 FRE

Lindberg K
1936
A new freshwater cyclops from Iran, Mesocyclops iranicus n.sp., probable intermediate host of guineaworm in Lar.
Bull Soc Zool France, 6, 253-9 FRE

Lindberg K
1936
Note on some Cyclopidea from Iran.
Bull Mus Roy Hist Belgique, 12, 1-26 FRE

Lindberg K
1938
Study of the morphological variations of Mesocyclops leuckarti Claus in India.
Ztschr Wissensch Zool abt A, 151, 75-100 FRE

Lindberg K
1939
Natural infection of Mesocyclops vermifer Lindberg by guineaworm embryos in Deccan water well (India).
Bull Soc Path Exot, 32, 816-21 FRE

Lindberg K
1939
Cyclops-eating fish in the water tanks of the Deccan.
Bull Soc Path Exot, 32, 880-2 FRE

Lindberg K
1940
Seasonal variations of Cyclopidea in wells in the Deccan (India).
Rec Indian Mus Calcutta, 42, 178 FRE

Lindberg K
1942
Crustacea of the state of Djodhpur (Rajputana).
Rec Indian Mus, 44, 341-5 FRE

Lindberg K
1946
Dracunculiasis in the state of Djodhpur (Rajputana), India.
Bull Soc Path Exot, 39, 318-28 FRE

Lindberg K
1946
Epidemiological study on dracunculiasis in a village of the Deccan (India).
Bull Soc Path Exot, 39, 303-18 FRE

Lindberg K
1948
Second epidemiological enquiry on dracunculiasis in India.
Bull Soc Path Exot, 41, 282-93 FRE

Lindberg K
1950
Dracunculiasis in the Middle East with list of the Cyclopidea found in endemic areas.
Rev Palud Med Trop, 8, 87-111 FRE

Lindquist W D
1967
The presence of Dracunculus insignis in a Michigan dog.
M S U Vet, 28, 16-8

Linnaeus C
1758
Gordius medinensis.
In System Natur, vol 10 p647 and vol 12 p1075 LAT

Linschoten J H van
1610
Story of the sea voyage of J H L.
Amsterdam, 2nd ed (with plate of extraction). 1st ed 1599 FRE

Lister M
1697
Part of a leter from Fort St. George in the East Indies, giving an account of the long worm which is troublesome to the inhabitants of those parts.
Phil Trans, 19, 417-8

Lister M
1731
The long worm in the flesh in the East Indies.
Phil Trans Roy Soc, 3, 138

Liston W G
1912
Report of the Bombay Bacteriological laboratory for the year 1911.
Govt Central Press: Bombay, sect6, p32-6

Liston W G
1914
Guinea-worm disease.
Indian Med Gaz, 49, 34

Liston W G
1916
Report of the Bombay Bact Lab for the year 1914.
Govt Central Press: Bombay, p11

Liston W G
1920
A lecture on dracontiasis or guinea-worm disease.
Indian Med Dept: Simla Cent Press, pp44

Liston W G, Turkhud D A
1914
Report of the Bombay Bact Lab for the year 1913.
Govt Central Press: Bombay, p12-6

Liston W G, Turkhud D A
1914
Guinea-worm disease in an Indian village.
Proc 3rd All-Indian Sanit conf; Indian J Med Res (supp), 4, 1203

Littlewood W
1893
Guinea-worm in Egypt.
Veterinarian, 39, 209-11

Litvinov S K
1968
On the clinical picture and treatment of dracunculiasis.
Med Parazit, 37, 401-6 RUS

Litvinov S K
1968
Epidemiology of dracontiasis in Ghana.
Medsk parazit, 37, 347-50 RUS

Litvinov S K
1970
The 100h anniversary of the discovery of the intermediate host of Dracunculus medinensis by A. P. Fedchenko.
Med Parazit, 39, 728-9 RUS

Litvinov V F, Litvinov V P
1981
Helminths of predatory mammals from eastern Azerbaijan SSR, USSR.
Parazitologiya, 15, 219-23 RUS

Lodha S C
1974
Dracontiasis survey in Rikhabdeo village.
Rajasthan Med J, 13, 233-6

Lodha S C, et al
1972
Paraplegia produced by guinea worm abscess.
Ind J Surg, 34, 367-9

Loeffler A F
1788
Dracunculus or Vena medinensis.
In Contribution to surgery. Altona and Leipzig, 1st part, pp59-65 GER

Loeffler A F
1791
Dracunculus or Vena medinensis.
Richter's Chir Bibl, vol 7, p785 and vol 12, p334 GER

Loney W
1844
Extirpation of dracunculi from the eye.
Lancet, 1, 309

Looss A
1905
Worms and arthropods causing disease.
In Handb Tropenkrankh (C Mense ed), vol 1, pp180-7 GER

Lop M
1913
A case of guineaworm. Surgical treatment.
Gaz Hop Civ Milit, 86, 1254 FRE

Lorimer A
1839
Further observations on Dracunculus.
Madras Quart Med J, 1, 365-70

Lorimer A
1839
Observations on epidemic cholera and Dracunculus etc.
Madras Quart Med J, 1, 46-54

Lorry A C
1777
On Dracunculus of the Greeks or Vena medinensis of the Arabs.
In Tract on skin diseases. Paris, vol 4, pp586-92 LAT

Lota
1887
Two years in Senegal and Niger.
Thesis: Paris, p58 FRE

Lovetsky A
1824
Filaria medinensis.
In Human hleminthology. Moscow: Reschentnikow, p151 LAT

Lowthrop J
1722
(No title?).
The Phil Trans and Collections: London, vol3, p121

Lucas A O, Oduntan S O, Gilles H M
1969
Niridazole in guinea-worm infection.
Ann New York Acad Sci, 160, 729-39

Lusitanus Amatus (=Rodriguez de Castell-Branco J)
1570
(Comments on guineaworm).
In Curationum med centuria VII; Lugduni, cur 64, p199 LAT

Lyons G R
1972
Guineaworm infection in the Wa district of north-western Ghana.
Bull Wld Hlth Org, 47, 601-10

Lyons G R
1973
The control of guineaworm with abate: a trial in a village of North-west Ghana.
Bull Wld Hlth Org, 49, 215-6

Lysenko A Y
1976
The most important directions in the study of parasitic tropical diseases.
Med Parazit, 45, 387-93 RUS

Macario C
1965
Treatment of dracunculiasis by 9955 or Mel W in single injection - preliminary to mass treatment (first clinical results).
Bull Soc path Exot, 58, 1089-103 FRE

MacConnell R E
1914
Dracontiasis or dracunculosis: a review.
J Trop Med Hyg, 17, 337-40

Macfie J W S
1920
Tartar emetic in guinea-worm infections.
Ann Trop Med Parasit, 14, 127-47

Macfie J W S
1920
Intravenous injection of tartar emetic in guinea-worm infections.
Lancet, 1, 654-5

Macgillivray P H
1860
On a case of guinea-worm.
Aust Med J; Melbourne, 5, 172-4

Mackay G
1870
Note on Dracunculus.
Madras Monthly J Micr Sci, 1, 292-4

Mackenzie
1859
(No title?).
Bombay Med Trans, 4, 138

Mackenzie E
1898
Treatment of Filaria medinensis in the human system by the hypodermic injection into the parasite when possible, or into the part where it is situated, of a solution of hydrargyrum perchloride.
Indian Med Rec, 15, 326

Mackin J G
1927
Dracunculus globocephalus n.sp. from Chelydra serpentina.
J Parasit, 14, 91-4

Macpherson C N
1981
The existence of Dracunculus medinensis (Linneaus, 1758) in Turkana, Kenya.
Trans Roy Soc Trop Med Hyg, 75, 680-1

Magno L
1959
Radiological aspects of infection with Dracunculus medinensis.
Minerva Med, 50, 3192-5 ITA

Mahmoud A A F, Warren K S
1974
Anti-inflammatory effects of tartar emetic and niridazole. Suppression of schistosome egg granuloma.
J Immunol, 112, 222-8

Mahomed el Tounsy
1845
Journey in Darfour.
Paris, p286 FRE

Mai H
1971
Pediatrics in Lambarene.
Ther G G W, 110. 906-16

Maisonneuve J G
1844
Note on a guineaworm seen in in Paris and shown to the Societe de Chirurgie.
Arch Gen Med Paris, 6, 472-80 FRE

Maisonneuve J G
1845
Guineaworm extracted from the foot of an old soldier at Paris.
Edin Med Surg J, 64, 527-8 FRE

Maitra H
1945
Guinea-worm infection.
J Indian Med Ass, 14, 169

Makel H D, De Vault V T
1930
Dracontiasis, a case report.
Milit Surgeon, 67, 600-4

Malgaigne, Vautrin
1854
(No title?).
Bull Soc Anat Paris, p311 FRE

Malgaine
1855
(Guineaworm in Bombay).
Gaz Med Paris, 9 June, no. 23 FRE

Malgat
1893
Guineaworm in the vitreous chamber.
Recueil Ophth, 2, 280 FRE

Mallik K L B
1935
A case of guinea-worm infection.
Indian Med Gaz, 60, 264

Mallows H R
1951
Two cases of dracontiasis.
J Roy Nav Med Serv, 37, 211-3

Manson P
1893
Guinea-worm.
In Davidson's Hygiene and diseases of warm climates: London, p947

Manson P
1895
On the guinea-worm.
Brit Med J, 2, 1350-1

Manson P
1895
Some little-understood points in the life history of the guinea-worm.
Brit J Dermat, 7, 302-4

Manson P
1896
On the guinea-worm.
Indian Med Rec, 10, 41

Manson P
1899
(Filaria medinensis).
J Trop Med (corr), 1, 316

Manson P
1903
The life-span of Filaria medinensis.
Brit Med J, 2, 10 Manson P

Manson P
1905
Lectures on tropical diseases.
A Constable: London, pp28-43

Manson P
1908
Diseases of tropical countries.
Paris FRE

Manson P, Boyd S
1896
A case of guinea-worm (Filaria v Dracunculus medinensis) treated by injection of corrosive sublimate.
Brit J Dermat, 8, 37-40

Manson-Bahr P
1955
Guinea-worm.
The Medical Annual Bristol, 73, 161-2

Maplestone P A, Rao S S
1939
Dracontiasis or guinea-worm disease.
Health Bull Indian Med Serv no 7: New Delhi, 21pp

Marchoux E
1900
On the mode of transmission of guinea-worm.
C R 13th Congr Internat Med Paris, pp95-6 FRE

Margairaz A, Rosier M, Schneider J, Vachon F
1963
Unrecorded neurological complications of dracunculiasis. Acute compression of the medulla by epidyra by contact of a guineaworm.
Rev Neurol, 108, 59-61 FRE

Mariantschik L P
1931
Facts on guineaworm. A case of calcified guineaworm in the stomach wall and in the lumbar region.
Zent Chirurgie, 58, 270-4 GER

Marie R
1898
Inguino-crural adenolymphocoele of filarial origin. Histological examination.
Bull et Mem Soc Chir paris, 24, 807-9 FRE

Marin G A
1969
Calcified guineaworm simulating various orthopaedic conditions.
Int Surgery, 51, 117-9

Marion M H, Rivierez M, Chiraz J, Porta M
1983
Spinal cord compression due to guineaworm. A new case.
Rev Med, 24, 901-4 FRE

Marjitno M, Essed W F R
1938
Development of Dracunculus medinensis in cyclops of Java.
Meded Dienst Volksgesondheid Nederl-Indie, 27, 141-6 DUT

Markell E K
1968
The caduceus motif and the guinea-worm.
J Amer Med Ass (letter), 203, 233-4

Markov G S, Ivanov V P, Nikulin V P, Chernobal V F
1962
Helminth parasites of reptiles from the Volga delta and Caspian steppe.
Trudy Astrakhan Zapovednika, (6), 145-72 RUS

Marque
1933
Transmissable diseases seen in the French colonies and mandated territories in 1931.
Ann Med Pharm Colon, 31, 123 FRE

Marsden P D
1983
Cutaneous filariases.
In Infectious diseases (ed P D Hoeprich). Harper and Row: Hagerstown, 3rd ed, pp1004-6 (also 2nd ed 1977, pp855-60)

Marshall
1905
(No title?).
Edinburgh Med J, 60, 342-5

Martin E
1852
Observation of a guinea worm.
Union Med Louisiane; New Orleans, 1, 257-61 FRE

Martinaud G
1924
Observations on various methods of treatment of guineaworm.
Bull Soc Path Exot, 17, 146-9 FRE

Martiny G
1978
Scrotal and intra-scrotal manifestations of parasitoses, with the exclusion of ectoparasites and superficial mycoses.
Diss Abs Internat, 39C 1, 99 FRE

Mathe G
1958
A Dracunculus medinensis in Antwerp port.
Belg Tijdschrift Geneeskunde, 14, 395-7 DUT

Mathur P P, Dharker S R, Hiran S, Sardana V
1982
Lumbar extradural compression by guinea worm infestation.
Surg Neurol, 17, 127-9

Mattey A
1820
Observation of a guineaworm in a green grasshopper.
Bibl Univ Sci Arts Geneva, 15, 288-94 (abs in J Phys, 91, 476-7) FRE

Matthey A
1821
On the revival of a dead worm.
Ann Gen Sci Phys, 8, 18-9 FRE

McClelland J
1840
Remarks on Dracunculus.
Calcutta J Nat Hist, 1, 359-71

McClelland J
1842
On guinea-worm.
Arch Naturg Berlin, 2, 341-2 GER

McKenzie
1853
A case of tetanus proceeding from the irritation of a guinea-worm.
Proc Hyderabad Med Phys Soc, 1, 126

McNally C J
1975
Some observations on guinea-worm.
Indian Ann Med Sci Calcutta, 17, 108-14

Medway W, Soulsby E J L
1966
A probable case of Dracunculus medinensis (Linn. 1758) Gallandant 1773, in a dog in Pennslyvania.
J Am Vet Med Ass, 149, 176-7

Meer-Ushruf U
1868
Remarks on the treatment of guinea-worm.
Indian Med Gaz Calcutta, 3, 6-7

Megaw J W D, Gupta J C
1927
The geographical distribution of some diseases of India.
Indian Med Gaz, 62, 299-313

Mehta S, Srivastava R C, Gupta A N
1982
Relative toxicity of non-insecticidal chemicals to the freeliving larvae of guinea-worm (Dracunculus medinensis).
Acta Hydrochimica et Hydrobiologica, 10, 397-400

Meier K
1937
On the real Mummy.
Arch fur Gesch Med, 30, 62-9 GER

Meissner G
1856
On _Filaria medinensis_.
Verhandl Naturf Ges Basel, 1, 376 GER

Meissner H
1863
Helminthological studies and notes.
Schmidt's Jahrb, 119, 41-55 GER

Meissner K
1937
A short note on _Filaria medinensis_.
Diss: Berlin, 25pp GER

Menk H
1974
Symbol for healthy occupations. Aesculapius' snake or medinaworm.
Med Welt, 25, 240-1 GER

Menschell A
1860
Filaria medinensis.
Berlin Med Zeitg, p44 GER

Menzel A
1878
Filaria medinensis.
Resoc Sanit Osp Civ Trieste, 4, 400 ITA

Mercurialis H
1587
(Comments on guineaworm).
In Variet lectonis Libris 6: Venetiis, lib 2, cap 20, p46 LAT

Meyer F A A
1788
Some doubts about Fieliz's observations etc.
Baldinger's Magazin, 10, 71 GER

M'Gregor J
1805
On the guinea-worm (account of the diseases of the 88th Regiment, Bombay).
Edinburgh Med Surg J, 1, 284

Michie
1831
Extract from a correspondence on the Filaria medinensis among some of the medical officers in the Honourable East India Company's service at Bombay, with a letter from Dr. Robert Grant.
Edinburgh Med Surg J, 35, 117-8

Mignacca P
1914
Guineaworm.
Studi Med Trop Coll Pubbl Sci sull'Eritrea, 1, 149-53 ITA

Miller M J
1976
Proozoan and helminth parasites - review of current treatment.
In Progress in drug research (E Jucker ed). Birkhauser: Basel, vol 20, 433-64

Millet-Horsain
1925
Extraction of guineaworm by zinc ionisation.
Rev Prat Mal Pays Chaud, 5, 415 FRE

Milne J
1831
Summary of remarks on Dracunculus, also termed lymphangitis.
Edinburgh Med Surg J, 35, 112-6

Minas P A
1856
Notes on Dracunculus, with the plan of treatment adopted by the natives.
Indian Ann Med Sci Calcutta, 3, 568-72

Minning W
1952
Filariasis and dracunculiasis.
In Handb Inneren Med, 4, aufl1, vol 2, Tl s Berlin etc GER

Mirza M B
1929
Contribution to the structure of Dracunculus medinensis Velsch.
Z Parasitenk, 2, 129-56 GER

Mirza M B
1932
Dracontiasis (naru) in Shorapur (H E H The Nizam's State).
Proc Muslim Ass Adv Sci, pp43-7

Mirza M B
1938
Treatment of guinea-worm in India.
Zool Anz supp (Verhandl Deutsch Zool Ge), 11, 170-2 Ger

Mirza M B
1957
On Dracunculus Reichard 1759, and its species.
Z ParasitKde, 18, 44-7

Mirza M B, Basir M A
1937
A report of the guinea-worm found in Varanus sp. with a short note on Dracunculus medinensis.
Proc Indian Acad Sci (sect B), 5, 26-32

Mirza M B, Roberts L S
1957
A redescription of Dracunculus from a snake, Natrix sipedon Linn.
Z ParasitenKde, 18, 40-3

Misra S C
1983
Beware of guinea worm.
Indian Farming, 33, 34-5

Mitchell H
1859
Report of a case of guinea worm in the eye.
Dublin Med Press, 42, 358-9

Mitchell H
1859
Report of a case of guinea-worm in the eye.
Lancet, 2, 533-4

Mitchell S W
1870
Remarks on Dracunculus.
Proc Acad Nat Sci Philadelphia, 22, 11

Mitra A K, Haddock D R W
1970
Paraplegia due to guinea-worm infection.
Trans Roy Soc Trop Med Hyg, 64, 102-6

Mitter S N
1910
Cutaneous filariasis in a dog.
J Trop Vet Sci Calcutta, 5, 411-4

Miz-Izzet-Ullah
?
(No title?).
J Roy Asiatic Soc, 8, 335

Modeer
1795
Furia medinensis.
Mem de l'Acad Stockhol, FRE

Mohiuddin A
1973
Parasitic infections in Pakistan.
CENTO Scientific Secretariat; Teheran, rep 11, pp20-6

Mohr W
1939
Calcified guineaworms in the spinal musculature.
Roentgenpraxis, 1, 361-3 GER

Molin R
1858
Attempt at a monograph of the Filariae.
Sitz K Akad wissensch Wien Math-Natur Cl, vol 8, 365 GER

Mongin
1770
Observations on a worm found under the conjunctiva, in Maribou, on San Domingo Island.
J Med Chir Pharm Paris, 32, 338-9 FRE

Moniez R L
1896
Guineaworm.
In Textbook of medical parasitology, p317 FRE

Montani J B
1556
On Vena endimini.
Libri de excremintiis; Venetiis 8, de morb gallic, p121 LAT

Monteiro B, Hountondji A
1982
A case of paraplegia and one of tetanus as serious complications of dracunculiasis (in republic of Benin).
Med Afr Noire, 29, 43-6 FRE

Montpelier J, Ardoin E
1919
Arsenobenzol in the cure of dracunculiasis.
Bull Soc Path Exot, 12, 730-2 FRE

Moore C H
1865
A case in which the same person was twice infested with guineaworm.
Lancet, 1, 365-6

Moore F
1738
Travels in the inland parts of Africa.
London, p130

Moore P
1856
(No title?).
Assoc Med Jour, Nov, 996

Moore P
1861
(No title?).
Bombay Med Trans, 6, 313

Moore R
1874
(No title?).
Lancet, 2, 750

Moorthy V N
1931
Investigations regarding the infection of a new species of Cyclops, Daphnia and Dioptumus (sic), with guinea-worm larvae.
Proc 18th Ind Sci Congr (Nagpur), p358

Moorthy V N
1932
An epidemiological and experimental study of dracontiasis in Chitaldrug district.
Ind Med Gaz, 67, 498-504

Moorthy V N
1932
Treatment and prophylaxis of dracontiasis.
Ind Med Gaz, 67, 617-9

Moorthy V N
1935
The influence of fresh bile on guinea-worm larvae encysted in cyclops; a preliminary report.
Ind Med Gaz, 70, 21-3

Moorthy V N
1937
A simple method of staining and mounting nematode larvae.
J Parasit, 23, 100-2

Moorthy V N
1937
A redescription of *Dracunculus medinensis*.
J Parasit, 23, 220-4

Moorthy V N
1938
Observations on the development of *Dracunculus medinensis* larvae in cyclops.
Am J Hyg, 27, 437-60

Moorthy V N
1942
Guinea-worm cyst, a case report.
Ind J Surg, 3, 4

Moorthy V N
1942
Life history of *Dracunculus medinensis*.
Ind J Surg, 3, 8

Moorthy V N
1942
Recent advances in guinea-worm studies.
Madras Med Coll Mag, 21, 12

Moorthy V N, Sweet W C
1936
A peculiar type of guinea-worm embryo.
Ind J Med Res, 24, 531-4

Moorthy V N, Sweet W C
1936
A note on the experimental infection of dogs with dracontiasis.
Ind Med Gaz, 71, 437-42

Moorthy V N, Sweet W C
1936
Guinea-worm infection of cyclops in nature.
Ind Med Gaz, 71, 568-70

Moorthy V N, Sweet W C
1936
A biological method for the control of dracontiasis.
Ind Med Gaz, 71, 565-8

Moorthy V N, Sweet W C
1938
Further notes on the experimental infection of dogs with dracontiasis.
Am J Hyg, 27, 301-10

Moquin-Tandon C H B A
1859
Young filariae discovered in the abdominal cavity of an adult.
Compt Rend Acad Sci paris, 49, 175 FRE

Morard
1933
Dracunculiasis at Bilina, Niger.
Bull Soc Path Exot, 26, 535-6 FRE

Moravec F
1966
The first record of dracunculosis in the anaconda, Eunectes murinus L.
Folia Parasit Praha, 13, 281-3

Morehead C
1833
Observations on Dracunculus.
Trans Med Phys Soc Calcutta, 6, 418-34

Morehead C
1835
Observations on Dracunculus.
Edinburgh Med Surg J, 44, 460-2

Morehead C
1836
Observations on Dracunculus.
Trans Med Phys Soc Calcuttta, 8, 49-84 Morehead C

Morehead C
1856
Clinical researches on disease in India.
London, vol 2, p709

Morel
1903
The Chari.
Ann Hyg Med Colon, 5, 261 FRE

Morenas H, Gardere, Augay
1942
Radiological diagnosis of guineaworm infection; histological studies on the calcification of the worm.
Lyon Medical, 167, 384-7 FRE

Morgan J, Comroe B I
1946
A brief review of arthritis and allied conditions in tropical diseases.
Ann Intern Med, 24, 233-40

Moriarty
1866
(Occurrence in Cape Coast Castle).
Med Times and Gaz, Dec, 663

Morsy T A, Sebai Z A
1975
Dracunculiasis in Saudi Arabia.
J P M A, 25, 306-8

Morsy T A, Soliman M S
1975
Treatment of Dracunculus medinensis with niridazole (Ambilhar, Ciba).
J Kuwait Med Ass, 9, 165-6

Morton T G
1877
Account of a worm (Dracunculus or Filaria Loa) removed by a native woman from beneath the conjunctiva of a negress at Gaboon, West Africa, with a brief history of the parasite and Prof. Leidy's description of the specimen.
Am J Med Sci, 74, 113-6

Mosler F
1883
On the medical significance of guineaworm.
Wien Med Presse, 24, 1405-568 GER

Motais F, Jamot E, Robert M J F
1914
Notes on the medical geography of Onadai (Chad basin).
Bull Soc Path Exot, 7, 522-8 FRE

Moule L
1911
Parasitology in ancient literature. Part 3: parasites of the skin and underlying tissues.
Arch Parasit Paris, 15, 543-95 FRE

Mudalta V S B
1896
Treatment of guinea-worms by hakeems.
Indian Med Rec, 10, 183

Mueller R
1926
The Sagalla and Kabartu diseases of the cuneiform scripts and Filaria medinensis and Mycetoma pedis.
Arch Geschichte Med, 18, 189-92 GER

Muller R
1966
First steps in the laboratory maintenance of Dracunculus medinensis.
Trans Roy soc Trop Med Hyg (dem), 60, 431-2

Muller R
1967
The development of Dracunculus medinensis in the intermediate host after deep freezing.
Trans Roy soc Trop Med Hyg (dem), 61, 451-2

Muller R
1967
A historical note on the transmission of Dracunculus.
Trans Roy soc Trop Med Hyg, 61, 747-50

Muller R
1968
Studies on the serological diagnosis of dracontiasis.
Abs VIII Internat cong Trop Med Mal; Teheran, 940-1

Muller R
1968
Studies on Dracunculus medinensis (Linneaus). I. the early migration route in experimentally infected dogs.
J Helminth, 42, 331-8

Muller R
1968
Experimental dracontiasis in animals.
Parasitology, 58, 7p-8p

Muller R
1969
The fluorescent antibody test in the diagnosis of Dracunculus infection.
Trans Roy Soc Trop Med Hyg (dem), 63, 18

Muller R
1970
Laboratory experiments on the control of cyclops transmitting Dracunculus.
Bull Wld Hlth Org, 42, 563-7

Muller R
1970
Dracunculus medinensis: diagnosis by indirect fluoresent antibody technique.
Expl Parasit, 27, 357-61

Muller R
1970
Dracontiasis.
IN Diseases of children in the subtropics and tropics, 2nd ed, Edward Arnold: London, pp893-8

Muller R
1970
Development of Dracunculus medinensis after deep freezing.
Nature London, 226, 662

Muller R
1970
Egg division in Dracunculus medinensis.
Trans Roy soc Trop Med Hyg (dem), 64, 473

Muller R
1971
Dracunculus and dracunculiasis.
Advances in Parasitology, 9, 73-151

Muller R
1971
Studies on Dracunculus medinensis (Linneaus). II. Effect of acidity on the infective larva.
J Helminth, 45, 285-8

Muller R
1971
The possible mode of action of some chemotherapeutic agents in guinea worm disease.
Trans Roy soc Trop Med Hyg, 65, 483-4

Muller R
1972
Maintenance of Dracunculus medinensis (L.) in the laboratory and observations on experimental infections.
Parasitology, 64, 107-16

Muller R
1976
The pathology of experimental Dracunculus infection and its relevance to chemotherapy.
IN Pathophysiology of parasitic infection (E J L Soulsby ed). Academic Press: New York, pp133-47

Muller R
1978
Dracontiasis.
IN Diseases of children in the subtropics and tropics (D B Jelliffe and J P Stanfield eds). 2nd ed. Edward Arnold: London, pp928-33

Muller R
1979
Guinea worm disease: epidemiology, control and treatment.
Bull Wld Hlth Org, 57, 683-9

Muller R
1979
Dracunculiasis: epidemiology, control and treatment.
Bull Wld Hlth Org, 57, 903-10 FRE

Muller R
1980
Treatment of dracunculiasis.
Bull OCCGE, inf 69 (special issue), Sep-Oct, 53-7 FRE

Muller R
1980
Dracunculiasis.
IN Current ocular therapy (F T Frauenfelder and F H Roy eds). W B Saunders: Philadelphia, pp87-8

Muller R
1980
Filariasis.
IN International slidebank on tropical diseases (W Peters, H R Folmer eds). Meddia 7. Royal Trop Inst: Amsterdam, 24pp

Muller R
1981
Guineaworm infection.
IN Seasonal dimensions to rural poverty (R Chambers, R Longhurst, A Pacey eds). Francis Pinter: London, pp125-7

Muller R
1981
Control and treatment of guinea worm disease.
Postgraduate Doctor - Africa, 3, 292-5 (also Postgrad Doc - Asia, 1, 184-8)

Muller R
1982
Guinea-worm eradication and the water decade.
Mol Biochem Parasit (suppl), p208

Muller R
1983
Dracontiasis.
IN Hunter's Tropical Medicine (G T Strickland ed), 6th ed. Saunders: Philadelphia,

Muller R
1984
Dracunculiasis.
IN Tropical and geographical medicine (K S Warren, A A F Mahmoud eds). McGraw Hill: New York etc, pp423-6

Muller R, Ellis D S
1973
Studies on Dracunculus medinensis (Linnaeus). III. Structure of the phasmids in the first-stage larva.
J Helminth, 47, 27-33

Muller R, Ellis D S, Bird R G
1970
Electron microscope studies of the phasmids in Dracunculus medinensis larvae.
Trans Roy Soc Trop Med Hyg (dem), 64, 24

Muller R, Furse H, Duckett V
1970
Pathology and chemotherapy of Dracunculus infection in rhesus monkeys.
Trans Roy Soc Trop Med Hyg (dem), 64, 24

Murgatroyd F, Lawrence D
1952
Guinea-worm disease.
Trans Roy Soc Trop Med Hyg, 46, 9

Murray J
1847
Guinea-worm, a very common disease at Sattara.
Trans Med Phys Soc Bombay, 9, 198

Murtazev A
1965
Presence of Dracunculus medinensis in dogs in Nukus (Uzbec SSR).
Vestnik Karakalpiiskogo filiala Akad Nauk UzSSR, pp1-19 and 99-101 RUS

Nachtigal G
1881
High infection rates with Medina worm (Nyuddi).
IN Sahara and Sudan, vol 2, p473 GER

Nadim A
1973
Parasitic infections prevalent in Iran.
CENTO Scientific Secretariat: Teheran, rep 11, 28-41

Nagalotimath S J, Andrade A T
1974
(Guineaworm).
J Sci Soc, 1, 49

Nagalotimath S J, Hafiz Z F, Arshad C, Janthly B V
1973
(Guineaworm).
J Mysore Med Ass, 38, 285

Nagalotimath S J, Kulkarni D R
1978
A study of guinea worm infestation.
Abs Asian Congr Parasitology; Bombay,

Napier L E
1971
Teaching tropical medicine.
39, 273

Nathan
1868
Filaria medinensis.
Med Times and Gaz London (corr), 2, 542

Nauck E G
1975
Dracunculiasis.
IN Lehrbuch der Tropenkrankheiten (W Mohr, H H Scumacher, F weyer eds). George Thieme: Stuttgart, GER

Naust E
1971
Concerning the structure and reproduction of the guinea worm (Filaria medinensis L.) by Aleksej Pavlovich Fedchenko, 1890.
Am J Trop Med Hyg, 20, 511-23

Neafie R C
1972
Morphology of Onchocerca volvulus.
Am J Clin Path, 57, 574-86

Neafie R C, Connor D H, Meyers W M
1976
Dracunculiasis.
IN Pathology of tropical and extraordinary diseases. AFIP: Washington, vol 2, 397-401

Neshat H A, Eslami A H
1976
The importance and incidence of food borne helminth infections in man in Iran.
Iranian J Pub Hlth,

Neumann G
1895
On a filaria (Filaria dahomensis n.sp.) of the Natal python, related to guineaworm.
Bull Soc Zool Fra, 20, 123-7 FRE

Neveux
1908
Blind guineaworm.
Rev Med Hyg Trop, 5, 147-50 FRE

Nguyen-Van-Ai
1963
Studies on the helminthological fauna of South Vietnam (Dracunculus sp. in Python molurus).
Ann Fonction Techn Inst Pasteur Vietnam, pp3-10 FRE

Nicolas, Lacaze, Signol
1885
Hygiene and medical guide for the traveller in Central Africa.
Paris, FRE

Niel G, Gentilini M, Couture J, Pinon J M, Danis M
1972
Use of Ascaris suum antigenic extracts for the diagnosis of filariasis by means of double diffusion. comparison with the use of Onchocerca volvulus and Dipetalonema wite antigens.
Bull Soc path Exot, 65, 569-79 FRE

Nieremberg J E
1635
Harmful worms.
IN Hist nat Maxime Peregrinae Lib XVI dist: Antwerp, fol lib XII, cap 24 LAT

Nimier, Laval E
1904
A case of guineaworm.
Caducee, 4, 320-2 FRE

Nimier, Laval E
1905
A case of guineaworm.
Arch Schiffs Tropenhyg, 9, 419 GER

Ninian
1806
Remarks on the Dracunculus or guinea-worm.
Edinburgh Med Surg J, 2,

Nnochiri E
1966
Urinary schistosomiasis: a review of 179 cases seen in a Lagos clinic.
W Afr Med J, 15, 17-21

Nnochiri E
1979
Textbook of imported diseases.
OUP: Oxford, 350pp

Nugent D A W, Scott D, Waddy B B
1955
Effect of water-point treatment wih DDT on the incidence of guinea-worm infection.
Trans Roy Soc Trop Med Hyg, 49, 476-7

Nwokolo C
1981
The filariases.
Postgraduate Doctor - Africa, 3, 15-19

Nwosu A B C
1982
Human factors in the ecology and epidemiology of dracontiasis in Anambra State of Nigeria.
Parasitology, 84, lxxiii-lxxiv

Nwosu A B C
1983
The human environment and helminth infections: a biomedical study of four Nigerian villages.
IN Human ecology and infectious diseases (N A Croll, J H Cross eds). Academic Press: New York, pp225-52

Nwosu A B C, Ifezulke E O, Anya A O
1982
Endemic dracontiasis in Anambra State of Nigeria: geographical distribution, clinical features, epidemiology and socio-economic impact of the disease.
Ann Trop Med Parasit, 76, 187-200

Nyberlin D
1931
On the history of the development of _Filaria sanguinea_ Rudolphi with remarks on related species, especially on guineaworm.
Zent Bakt Abt 1 orig, 121, 58-64 GER

O'Donoghue D J F
1912
A case of guinea-worm.
J London Schl Trop Med, 2, 146

Oduntan S O, Lucas A O, Gilles H M
1967
Treatment of dracontiasis with niridazole.
Lancet, 2, 73-5

Ogilvie B M, Worms M J
1976
Immunity to nematode parasites of man with special reference to _Ascaris_, hookworms and filariae.
IN Immunology of parasitic infections (S Cohen, E H Sadun eds). Blackwell: Oxford, p402

Ojha A K, Johri G N
1978
Certain statisical conclusions on incidence of dracontiasis in village Phulpura of Madhya Pradesh.
Abs Asian Cong Parasit; Bombay, 145-6

Ojha A K, Johri G N
1978
Statistical analysis on certain observations regarding the incidence of dracontiasis in the village of Phulpura, Madhya Pradesh, India.
Bioresearch (Ujjain), 2, 61-6

Ojha A K, Johri G N
1980
Dracontiasis in Madhya Pradesh. IV Statistical observations on incidence of dracontiasis in five villages of Manasa Tehsil.
Indian J Parasit (abs), 3(supp), 84

Ojha A K, Johri G N
1980
Dracontiasis in Madhya Pradesh. II Statistical analyis on incidence in Arnnhaydhani, a highly endemic village.
J Hyg Epidemiol Microbiol Immunol, 24, 454-9

Oke W S
1843
Case of Filaria medinensis or guinea-worm (at Cape Coast Castle).
Provinc Med J London, 6, 446-7

Okujie X G
1954
Symptoms of dracunculiasis.
Brit Med J, 1, 397

Oldfield
1835
Case of Dracunculus.
London Med Surg J, p403

Oldfield
1838
Case of Dracunculus.
Dublin Journal, 12,

Oliveira J A de, Paulino J
1843
The Dracunculus, Medina- or guinea-worm; observations preceded by a description of this worm and followed by some reflections.
J Soc Sci Med Lisbon, 18, 132-41 POR

Onabamiro S D
1950
A technique for studying infection of Dracunculus in cyclops.
Nature London, 165, 31

Onabamiro S D
1951
The transmission of Dracunculus medinensis by Thermocyclops nigerianus as observed in a village in south-west Nigeria.
Ann Trop Med parasit, 45, 1-10

Onabamiro S D
1952
On the diurnal migration and seasonal fluctuation in the numbers of Thermocyclops nigerianus Kiefer in a Nigerian pond.
Ann Trop Med Parasit, 46, 38-47

Onabamiro S D
1952
the geographical distribution and clinical features of Dracunculus medinensis in south-west Nigeria.
W Afr Med J, 1, 159-65

Onabamiro S D
1954
The diurnal migration of cyclops infected with the larvae of Dracunculus medinensis (Linnaeus), with some observations on the development of the larval worms.
W Afr Med J, 3, 180-94

Onabamiro S D
1956
The early stages of the development of Dracunculus medinensis (Linnaeus) in the mammalian host.
Ann Trop Med Parasit, 50, 157-66

Onabamiro S D
1956
The effects of Hetrazan (Banocide), diethylcarbamazine, on the larval form of Dracunculus medinensis.
W Afr Med J, 5, 64-70

Onabamiro S D
1958
Dracontiasis.
IN Diseases of children in the subtropics and tropics (H C Trowell, D B Jelliffe eds). Edward Arnold: London, pp815-21

Osmanov S O, Arystanov E, Ametov M
1976
Occurrence of Dracunculus medinensis (L., 1758) in a fox near Lake Dautkul (Uzbek SSR).
Vestnik Karakalpakskogo Filiala Akad Nauk UzSSR, 1, 90-1 RUS

Osoba A O, Oyediran A B
1977
Guinea worm inguinal adenopathy.
Brit J Ven Dis, 53, 63-4

Ostroglasow
1888
Case of Filaria medinensis in man.
Nachricht dK Gesellsch d Feunde der Naturwissen Moscow, vol50, pt 1, RUS

Oudard, Ploye, Jean G
1923
Diseases of joints caused by the presence of Dracunculus.
Presse Med, 31, 174-5 FRE

Oxamendi
1864
Guineaworm (lombriz di Guinea) in the white race.
An Roy Acad Cienc Med Fis Habana, 1, 118-20 SPA

Padonou K D
1975
Metronidazole against dracontiasis in Nigeria.
Angew Parasit, 16, 94-97

Padonu K O
1972
A controlled trial of metronidazole in the treatment of dracontiasis in Nigeria.
Canad J Publ Hlth, 63, 89-90

Padonu K O
1973
A controlled trial of metronidazole in the treatment of dracontiasis in Nigeria.
Am J Trop Med Hyg, 22, 42-44

Pallas P S
1760
Gordius L., Vena medinensis, Vitulus aquaticus, Seta aquatica, Dracunculus veterum.
In Sandifort Thes diss. Rotterdam, Vol I, 4, p247 (1768?) Lat

Pardananai D S, Trivedi V D, Joshi L G, Daulatram J, Nandi J S
1977
Metronidazole ("Flagyl") in dracunculiasis: a double blind study.
Ann Trop Med Parasit, 71, 45-52

Pardanani D S, Kothar M L
1971
Studies of guinea-worm (Dracunculus medinensis). Intra-uterine development of the larvae.
J Postgrad Med, 17, 97-102

Pardanani D S, Kothari M L
1970
Metronidazole in dracunculosis: a preliminary report of a therapeutic trial.
J Indian Med Ass, 54, 359-360

Parekh G, Kulkarni D R
1958
A clinical and therapeutic study in dracontiasis (guinea-worm) infection.
J Hosp Grant Med Coll, 3, 22

Pareus A
1582
On Dracunculis.
Opera Paris de tumoribus contra natur partic, Lib VII, cap 31, pp253-256 LAT

Parish L C, Millikan L E, Witkowski J A
1983
Thoughts on tropical dermatology.
Int J Dermatol, 22, 18

Park Mungo
1799
(Occurrence among the Mandingoes.)
In Travels in the interior districts of Africa in 1795, 1796 and 1797. London

Passauer O
1860
A case of Filaria medinensis.
Arch Path Anat etc; Berlin, 9, 432-435 GER

Passauer O
1861
A case of guinea-worm.
Gaz Med; Paris, 16, 749 FRE

Patel C V, Ananad
1960
A rare case of multiple guinea-worm calcification.
Hautarz, 11, 325-327 GER

Patnaik K C, Kapoor P N
1967
Incidence and endemicity of guinea-worm in India.
Indian J Med Res, 55, 1231-1242

Paton
1806
Cases of guinea-worm, with observations.
Edinb Med Surg J, 2, 151-169

Patterson J
1899
The Dracunculus medinensis.
Med Rec: New York, 56, 518-519

Patterson K D
1979
Infectious diseases in twentieth-century Africa: a bibliography of their distribution and consequences.
Massachusetts: African Studies Assoc, 251pp

Patton W S, Cragg F W
1913
Guineaworm
In A textbook of medical entomology: London, Madras and Calcutta, p700

Paul R C, Mathur A B, Pal S P, Rao C K
1981
Guineaworm disease in selected rural areas of Dungarpur district, Rajasthan.
J Commun Dis, 13, 207-210

Paulus Aeginata
1538
On Dracunculus.
Dere Medica. Libri septem Basilae, Liv IV, Cap 59, p321 (also Engl transl by F Adams 1846 London) LAT

Peacocke J C H
1896
On the guinea-worm.
Brit Med J (corr.), i, 311

Pedemontanus Franciscus
?
Vena egredians (from Arabic sources).
De apostem sanguinis, Sect II, p11

Peixoto A
1908
Climate and diseases of Brazil.
Ann Hyg Med Colon, May FRE

Peltier M, Dominique H
1924
Note on the action of the emetic-organ extract compound in the treatment of dracunculiasis.
Bull Soc Path Exot, 17, 846-850 FRE

Pendse A K, Soni B M, Omprakash R, Gupta S P
1982
Testicular dracunculosis - a distinct clinical entity.
Brit J Urol, 54, 56-58

Pere
1774
Note on guinea-worm.
J Med Chir Pharm, 42, 121-132 FRE

Pereira V
1876
Most frequent parasitic diseases in intertropical climates.
Diss Bahia FRE

Pereira V
1877
Guinea-worm brought to America by the African Negroes. Proof of its endemicity in the province of Bahia, and of its introduction into the human body through the stomach.
Arch Med Nav, 28, 293-302 FRE

Pereira V
1877
The guinea-worm brought to America by the African Negroes. proof of its endemicity in the province of Bahia and its introduction into the human body through the stomach.
Gaz Med Bahia, 2, 151-166 POR

Perrin L
1896
Medina or guinea-worm.
Ann Dermat Syph, 8, 1315-1318 FRE

Perrin L
1896
Medina or guinea-worm.
Bull Soc Franc Dermat Syph, 7, 549-552 FRE

Perron C
1838
Memoir on guinea-worm (dragonneau).
Observation recueillie a l'hopital militaire de Kassoal-Ayniyy, en 1838 FRE

Perrudet-Badoux A, Boiteau A, Gentilini M
1984
Differential diagnosis of Dracunculus medinensis infection by the ELISA.
Path Biol, 32, 182-184 FRE

Perry W L M
1948
Case of dracontiasis. (Memoranda-in hernial sac.)
Brit Med J, ii, 1107

Pestonji C
1886
Treatment of guineaworm.
Lancet, ii, 956

Petherik
1861
Egypt, The Soudan.
Edinburgh, p332

Petrov A M, Chubabriya I T
1955
Occurrence of Dracunculus medinensis L., 1758 in the subcutaneous tissue of a cat in the Georgian SSR.
Trud Gruzin Nauchno-Issled Vet Inst, 11, 231 RUS

Peyron J F, Pascal Suisse P, Charlot J et al.
1977
Radiological appearances in standard examinations seen in a number of tropical parasitic manifestations.
Med Armees, 5, 626-629 FRE

Peyrot J
1905
Customs and medicine of the Bombaras.
Ann Hyg Med Colon, 8, 456 FRE

Peyrot J
1905
Oniric delirium and guinea-worm.
J Med; Bordeaux, 95, 940-941 FRE

Peyrot J
1919
On a case of antenephrotic abscess caused by dracunculiasis.
J Med; Bordeaux, 49, 308-310 FRE

Picipid M
1858
Guinea-worms, numbering seven, growing in the lower limbs - sudden appearance of symptoms after eight months of incubation - consequent phenomena, recovery, discussion.
Gaz Med Orient; Constantinople, 2, 85-89 FRE

Pieron R, Lesobre B, Mafart Y, Lemeunier J M
1980
Pathology among African immigrants in France.
Concours Med, 102, 547-569 FRE

Pieron R, Puel M, Lesobre B et al.
1983
Therapeutic and economical aspects of dracunculosis in a Parisian hospital.
Sem Hop, 59, 2457-2464 FRE

Pigafetta A
1598
True description of the African kingdoms, with an account of the inhabitants of the Lusitanian Congo.
Francofurti LAT

PigaFetta A
1800
(Plate of extraction of guineaworm.)
First journey around the seas of the world and information on the navigation of the East Indies (1519-22). Amoretti: Milan, quarto (Gotha: Perthes 180 GER) ITA

Pillay D M K
1907
Guinea-worm.
Antiseptic: Madras, 4, 39-41

Pinard E, Boye
1904
French Guiana, medical geography (p. 516).
Ann Hyg Med Colon, 475-520 FRE

Piot J B
1906
Tropical diseases of domestic animals observed in Egypt.
Rep 8th Internat Vet Congr; Budapest, v2, p 589 FRE

Pirame Y
1963
Aspects of tetanus in the Upper-Volta concerning 211 cases observed over 2 years.
Presse Med, 71, 1043-1047 FRE

Pirame Y, Becquet R
1963
Dracunculiasis and tetanus - concerning 15 observations.
Bull Soc Path Exot, 56, 469-474 FRE

Pirame Y, Becquet R
1964
A Study on the connection between dracunculiasis and tetanus in Upper-Volta.
J Sci Med Lille, 82, 333-340 FRE

Pisani
1891
The treatment of guinea-worm disease by weight extension.
Brit Med J, i, 223

Plehn F
1898
The Cameroon Coast. Studies in climatology, physiology and pathology in the tropics.
Hirshenwald: Berlin, p 294 GER

Pliny C
1723
(Comments on Dracunculus).
In Hist naturalis Lib XXXVII c not Hardnini. Paris fol Lib XI cap 33, p611

Plotnikov N N
1951
Priority of Russian scientists in investigations on dracunculiasis.
Byul Moskov Obshch Ispyt Prirodi, 52, 92-96 RUS

Plouzaine
1887
Practical hygiene of European troops in intertropical countries - Upper Senegal and Upper Niger.
Thesis; Bordeaux FRE

Plutarch
1599
(Comments by Agatharchides of Cnidus on Dracunculus.)
In Opera quae ext omnia. Frankfurt: H Cruzerii fol, Tom II Symp Lib VIII quaest 9, p 733 LAT

Poggio E di
1937
Filariasis (and dracunculiasis).
Gaz Osp Cliniche, 58, 169-175 ITA

Pollux Julius
1706
(Comments on Dracunculus.)
In Onomasticum graece et latinae. Amsterdam fol. Lib IV cap 25 Segm 205, p 472

Polonio A F
1859
Review of helminths found in reptiles and amphibia in italy.
Biachi, Padua, p 10 LAT

Polverini G
1903
About a case of Filaria medinensis.
Clin Mod Pisa, 9, 100-102 ITA

Ponthieu A, Cezilly P, Lombard J
1971
A filarial tumour of the scrotum.
J Urol Nephrol, 77, 159-160 FRE

Porter A
1870
The treatment of guinea-worm by carbolic acid.
Madras Mnthly J Med Sci, 1, 108-110

Pouppe-Desportes
1770
History of diseases of San Domingo.
Paris, Vol 2, 271 FRE

Powell A
1903
The life-span of the guinea-worm.
Indian Med Gaz, 38, 414

Powell A
1903
Examination of the blood in 3400 cases of fever.
Trans Bombay Med Phys Soc, Sept

Powell A
1904
The life-span of the guinea-worm.
Brit Med J, i, 73

Powell A
1904
The life-span of the guinea-worm.
Deutsche Med Wchnschr, 30, 148 GER

Powell A
1904
The life-span of the guinea-worm.
Lancet, i, 76-77

Powell A
1904
The life-span of the guinea-worm.
Med Rec, N Y, 65, 151

Pradhan Y M
1930
Observations on experiments designed to combat dracontiasis in an endemic area by Col Morrison's method of liming wells.
Indian J Med Res, 18, 443-465

Preston J I C
1886
Treatment of guinea-worm.
Lancet, ii, 956

Price R L, Harman D M
1983
Helminths from the raccoon, Procyon lotor lito eus Nelson and Goldamn 1930, on St. Catherines Island, Georgia.
Proc Helminth Soc Wash, 50, 343-344

Prod'hon J
1980
Dracunculiasis.
Bull OCCGE inf no 69, Sep/Oct, 31-36 FRE

Prod'hon J, Desfontaine M
1980
Methods for investigating dracunculiasis.
Bull OCCGE inf no 69, Sep/Oct, 45-52 FRE

Pruner-Bey
1847
The diseases of the orient seen from the standpoint of comparative nosology.
p 25n GER

Quintin
1868
Extracts from a voyage in Sudan.
Paris FRE

Rachon R G, Deane L M
1952
First steps in combatting filariasis due to Wuchereria bancrofti in Brazil.
Rev Bras Malariol; Rio de Janeiro, 4, 187-191

Raddock
1877
A case of guinea-worm.
Indian Med Gaz; Calcutta, 12, 265

Raffi P, Dutz W
1967
Urogenital dracunculosis: review of the literature and report of 3 cases.
J Urol, 97, 542-543

Raffier G
1965
Preliminary note on the activity of CIBA 32644-BA in dracunculiasis.
Acta Trop, 22, 350-353 FRE

Raffier G
1966
Preliminary note on the activity of a new anti-helmintic agent in dracunculiasis.
Med Trop; Marseille, 26, 39-46 FRE

Raffier G
1967
Thiabendazole in dracunculiasis.
Med Trop; Marseille, 27, 673-678 FRE

Raffier G
1968
Preliminary note on the action of thiabendazole in dracunculiasis. (Conclusions)
Conf Techn OCCGE: Proc 8th Bamako. Vol 1, p68 FRE

Raffier G
1968
Campaign for the eradication of dracunculiasis.
Conf Techn OCCGE: Proc 8th Bamako, Vol 1, pp379-383 FRE

Raffier G
1968
Dracunculiasis. Recent developments in epidemiology, treatment and control.
XIIIth Internat Congr Trop Med Mal: Teheran, Abstracts pp937-937 FRE

Raffier G
1969
Activity of niridazole in dracontiasis.
Ann N Y Acad Sci, 160, 720-728 FRE

Raffier G
1969
Effects of thiabendazole in dracunculiasis.
Bull Soc Path Exot, 62, 581-593 FRE

Raffier G
1969
Efficacy of thiabendazole in the treatment of dracunculiasis.
Texas Rpts Biol Med, 27, Suppl 2, pp 601-609 FRE

Raghavan N G S
1958
Diagnosis of early dracontiasis.
Bull Natn Soc India Mal, 6, 155-162

Rahim-Ud-Din M
1941
Guinea-worm in a dog.
Indian Vet J, 17, 300

Raillet A
1915
The use of drugs in the treatment of diseases caused by nematodes.
Ind Vet Congr, 3, 747 FRE

Railliet A
1889
Occurrence of guinea-worm in animals.
Bull Soc Zool Fr, 14, 73-76 FRE

Railliet A
1889
Filaria medinensis in animals. (abstract)
J Roy Micr Soc Lond, 7, 756

Ramakrishnan N R, Rathnaswamy G K
1953
Use of DDT for control of cyclops breeding and as an anti-dracontiasis measure.
Indian Med Gaz, 88, 386-390

Ramdas A
1953
Chronic encysted guinea-worm lesion.
Indian med Gaz, 88, 391

Ramsay G W St C
1935
Observations on an intradermal test for dracontiasis.
Trans R Soc Trop Med Hyg, 28, 399-404

Randle J
1894
The treatment of guinea-worm.
Lancet, i, 143

Range
1899
Medical report on the health service of Benin.
Arch Med Nav Colon, 61

Ranque P, Degoga I S, Tounkara A, Balique H, Quilici M
1979
Distribution of dracunculiasis in Mali. A survey of the cyclops habitat.
Med Trop, 39, 545-548 FRE

Rao C K
1981
Program to eradicate dracunculiasis - India.
Morbid Mortal Wkly Rept, 30, 549

Rao C K, Kumar S, Jain M L, Jairaj D, Narasimham M V, mathur A B, Appa Rao M C, Rao C K
1982
Control of cyclops with temephos in guineaworm endemic villages in Andhra Pradesh and Rajasthan.
J Commun Dis, 14, 36-40

Rao C K, Paul R C, Sharma M I, Kumar S
1981
Guinea worm disease in India - current status and strategy of its eradication.
J Commun Dis, 13, 1-7

Rao C K, Reddy G V M
1965
Dracontiasis in West Godavari and Kurnool districts, Andhra pradesh.
Bull Indian Soc Mal Com Dis, 2, 275-293

Rao C K, Russel S, Sharma S K et al.
1979
Dracontiasis in West Godavari District - Andhra Pradesh.
J Commun Dis, 11, 37-40

Rao M G R
1931
Guinea-worm in boy aged 2.
Indian Med Gaz, 66, 505-505

Rao N M, Duraiswan P K
1939
Hypernephroma with calcified guinea-worm surrounding it. Case.
Indian J Surg, 1, 6-7

Rao S R
1942
Some epidemiological factors of guinea-worm disease as noticed in a recent survey of the Osmanabad District.
J Indian Med Ass, 11, 329-337

Rao S S
1936
The effect of gastric juice and of bile on cyclops infected with guinea-worm larvae.
Indian J Med Res, 24, 535-540

Ray S K
1920
Guinea-worm in the inguinal canal.
J Trop Med Hyg, 23, 186

Rayer P
1836
Guinea-worm, Dracunculus.
In Maladies de la peau (appendix); Bruxelles, pp454-455 FRE

Reddy C R
1968
Guinea worm infestation.
Christ Nurse (India), 219, 16-18

Reddy C R R M
1971
The problem of dracontiasis and its treatment.
Indian J Med Surg, 36, 25-29

Reddy C R R M, Murthy D P, Devi S L, Sivaramappa M
1975
Pathology of acute guinea-worm synovitis.
J Trop Med Hyg, 73, 28-32

Reddy C R R M, Narasai H I L, Parvathi G
1969
Epidemiological studies on guinea-worm infection.
Bull WHO, 40, 521-529

Reddy C R R M, Parvathi G, Sivaramappa M
1969
Adhesion of white blood cells to guinea-worm larvae.
Am J Trop Med Hyg, 18, 379-381

Reddy C R R M, Prasantha Murthy D, Sita Devi C, Lakshmi Devi S, Sivaramappa M
1970
Pathology of acute guinea-worm synovitis.
J Trop Med Hyg, 73, 28-32

Reddy C R R M, Reddy M M, Sivaprasad M D
1969
Niridazole (Ambilhar) in the treatment of dracunculiasis.
Am J Trop med Hyg, 18, 516-519

Reddy C R R M, Reddy N V, Reddy M, Sulochana G
1969
Scrotal dracunculiasis.
J Urol, 101, 876-880

Reddy C R R M, Reddy S V R, Suvarnakumari G
1970
Clinical picture of dracontiasis.
Indian J Surg, 32, 471-478

Reddy C R R M, Sita Devi C, Reddy N V
1969
Dracontiasis: review of surgical problems and treatment.
Internat Surg, 52, 481-488

Reddy C R R M, Sivaprasad M D, Parvathi G, Chari P S
1968
Calcified guinea-worm: clinical radiological and pathological study.
Ann Trop Med Hyg, 62. 399-406

Reddy C R R M, Sivaramappa M
1968
Guinea-worm arthritis of knee joint.
Brit Med J, i, 155-156

Reddy C R R M, Valli V V
1967
Extradural guinea-worm abscess: report of two cases.
Am J Trop Med Hyg, 16, 23-25

Reddy D B, Raju G C
1975
Dracunculosis.
J Indian Med Ass, 65, 289-290

Reddy D B, Raju G C, Suvarnakumari G, Prasantha D
1974
Observations on viability of guinea worm larvae encysted in cyclops with gastric juices of various animals.
Clinician, 38, 262-263

Reeder M M
1973
Tropical diseases of the soft tissues.
Seminars Roentgenol, 8, 47-71

Reeder M M, Palmer P E S
1981
The radiology of topical diseases with epidemiological, pathological and clinical correlation.
Baltimore: Williams & Wilkins, 1030 pp

Regnault J
1903
Contribution to the study of dracunculiasis.
Caducee, 3, 320-321 FRE

Reichard C W E
1759
On fleas, insects and worms affecting man.
Dissert: Erfurti, 51pp LAT

Reinhard M C, Jr.
1961
Calcified guinea-worm simulating intrapulmonary calcification.
J Am Med Ass, 175, 53-55

Remlinger P
1904
Guinea-worm and eosinophilia.
C R Seanc Soc Biol, 57, 76-77 FRE

Remlinger P
1904
Guinea-worm and eosinophilia.
Caducee, 4, 203 FRE

Remlinger P
1905
Guinea-worm and eosinophilia.
Arch Schiff-Tropenhyg, 9, 44 GER

Rendall P
1892
Guinea-worm in scrotal cyst.
Lancet, i, 121

Renou
1903
Guinea-worm.
Arch Med Angers, 7, 29-35 FRE

Reynaud G, Bonnaud J
1906
A serious case of medinaworm in Marseilles.
Caducee, 6, 302-302 FRE

Reynaud G, Bonnaud J
1907
A serious case of medinaworm in Marseilles.
Arch Schiffs Tropenhyg, 11, 468 GER

Reynhout M J
1824
Note on guinea-worm ("huitdraadworm").
Hippocrates; Rotterdam, 6, 13-25 DUT

Reynolds J W
1884
Electrolysis in the treatment of Dracunculus.
Brit Med J (corr.), i, 138

Reza R
1976
General survey of the present distribution of helminths in Iran and comparison with those of past years.
Acta Trop, 33, 177-184 FRE

Rhazes (= Abu El Razi)
1544
On Vena medeme sive civit.
Opera exquisiteria; Basileae, fol de re medica, Lib VII, Cap 24, p179 LAT

Ribeiro A L
1953
A case of dracunculiasis (guinea-worm) in Nairobi (patient had drunk unboiled water in India).
Brit Med J, ii, 1310

Ribeiro A L
1954
Symptoms of dracunculiasis.
Brit Med J, i, 819

Ricci M
1940
Human helminthology of East Africa (Dracunculus medinensis in Ethiopia and Eritrea).
Riv Biol Colon: Roma, 3, 241-295 ITA

Rice D T
1959
Guinea-worm in Semra (M.P.).
Indian J Publ Hlth, 3, 289-293

Richard A
1830
On Dracunculus or guinea-worm observed in France.
J Chim Med; Paris, 6, 624-629 FRE

Richard-Lenoble D, Carme B, Yebakina A, Kombila M Y
1980
Use and limitations of ELISA in the diagnosis of Loa loa infection.
Med Mal Infect, 10, 217-221 FRE

Richards W G
1904
Note on guinea-worm (India).
St Barth Hosp J; London, 1, 58

Richards W G
1922
Note on Dracunculus medinensis.
Parasitology, 14, 307-308

Richardson
1848
Travels in the Sahara.
London; Vol 1, p196.

Riou M
1934
Unusual location of a guineaworm, with presence of many larvae in pus.
Bull Soc Path Exot, 27, 86-87 FRE

Ripert C, Ekobo S, Palmer D
1978
Evaluation of the repercussions of the construction of 57 dams in the Mandaras mountains, North Cameroon, on endemic parasitic diseases - malaria, bilharziases, onchocerciasis, dracunculiasis.
Rapp Final Conf Tech Oceac (1), 206-221

Ripert C, Same-Okobo A, Enyong P, Palmer D
1979
Repercussions on parasitic diseases (malaria, schistosomiasis, onchocerciasis, dracontiasis) of the construction of 57 dams in the Mount Mandara area (North Cameroon).
Bull Soc Path Exot, 72, 324-339 FRE

Riveros C E, Moriena R A, Bulman G M, Lombardero O J
1981
Dracunculosis in dogs in Formosa (Argentina).
Gaceta Vet, 43, 255-258 SPA

Rives
1965
New perspectives in therapy and prophylaxy for an effective control of dracunculiasis.
Proc 1st Conf Techn OCGEAC; Yaounde FRE

Riy G C, Saha A L
1972
Persistent guineaworm infection in a village in West Bengal.
Indian J Publ Hlth, 16, 7-10

Robertson A
1908
A short account of the diseases of the Gilbert and Ellice Islands.
J Trop Med Hyg, 1, 17-21

Robin C P
1855
Guinea-worm (Filaria medinensis, Gmelin) extracted by Mr. Malgaigne from the leg of a man, the 13th July 1854.
C R Seanc Soc Biol Paris, 2, 35-37 FRE

Robineau M, Sereni D
1978
Acute arthritis of knee with intra-articular presence of D. medinensis. Comparative clinical and immunologic evolution. 1 case.
Bull Soc Path Exot, 71, 85-89 FRE

Robinson F
1865
Case of Filaria medinensis, Dracunculus, or guinea-worm.
Canad Med J; Montreal, 55-57

Robinson W
1846
Observations on guinea-worm at Cape Coast Castle for the quarter ending 30th June 1845.
London Med Gaz, 2, 70-72

Roche L C
1837
Dracunculus.
Universal-Lexicon Pract Med Chir, 4, 807-811 FRE

Rodiguez L, Neveux
1908
Guinea-worm prophylaxis.
Rev Med Hyg Trop, 5, 258-260 FRE

Rodrigues S L
1922
A simple and rapidly effective treatment of guinea-worm.
Antiseptic; Madras, 19, 597

Rodschied
1796
Medical and surgical remarks on the Rio Essequebo.
Frankfurt, p 301 GER

Rolleston H D
1892
Guinea-worm embedded for 21 years under the skin of the calf of the leg.
Trans Path Soc; London, 43, 152-153

Rollinson D
1980
Snail-eating mummy?
Brit Med J (corr.), 280, 183-184

Roquemaure
1903
A quick new method for removing guinea-worm.
Ann Hyg Med Colon Paris, 6, 497-500 (abs in Centralb Backt, 1904, 35, 22-37). FRE

Rosa V
1794
Zoological letter concerning various animals.
Gior Fis-Med Pavia, 4, 258-269 ITA

Rosanov V V
1929
Cases of Filaria medinensis.
Russ Klin, 12, 587-589 RUS

Rose G, Biguet J, Rose F, D'Haussy R
1966
The application of a haemagglutination reaction to the diagnosis of onchocerciasis.
Rev Hyg Med Soc; Paris, 14, 383-392 FRE

Ross
1868
Sketch of the medical history of the native army of Bengal.
Calcutta

Rosster A, Brunel C M, Bulman G M
1981
A first description of dracontiasis in a puma (Puma concolor concolor).
Gaceta Vet, 43, 164-166 SPA

Roth F
1894
Guinea-worm and its treatment.
Lancet, i, 801

Roubaud E
1913
Notes on guinea-worm biology. Intestinal infection of cyclops.
Bull Soc Path Exot, 6, 281-288 FRE

Roubaud E
1918
Discussion of Chatton (1918) on infection of cyclops through digestive tract.
Bull Soc Path Exot, 11, 347-348 FRE

Roubaud E
1920
A new contribution to the history of guinea-worm. An attempt at infection of cyclops of the Paris region with absence of evolution but conservation of the embryo in C. viridis - aetiological considerations.
Bull Soc Path exot, 13, 254-261 FRE

Roubaud R
1906
Contribution to the study of guinea-worm.
Thesis: Paris, 72 pp FRE

Rougier-Grangeneuve E
1880
On the history of various points in the pathology of parasites.
In Helminth and infectious diseases. Thesis: Bordeaux, 77 pp FRE

Rouppe
1764
On the diseases of sailors.
Leyden; p. 282 (also p216 DUT) LAT

Rousset P
1952
Attempt at prophylaxis and treatment of dracunculiasis by Notezin.
Bull Soc Med Afr Occ Franc, 9, 351 FRE

Rudolphi C A
1809
Treatise on intestinal worms.
Amsterdam, vol 2, p55 LAT

Ruysch Fr
1703
(Guineaworm in the head of a child).
In Thesaur anatum, 3, No 14 LAT?

Sabokar R
1968
Dracunculiasis in Iran (infects 40,000 people).
VIIIth Internat Congr Trop Med Mal; Teheran, p938-939 FRE

Sachs
1878
On some surgical conditions caused by Entozoa.
Versamml Deutsch Naturf Aertze, 4, 95-96 GER

Sachse C T
1846
The armyworm (heerworm) or dragonworm.
Allg Deutsche Naturh Ztg, 1, 26-32 GER

Saha K, Sarkar N, Paul D N, Ray D
1979
Serum immunoglobulin and complement profile in parasitic diseases.
Indian J Med Res, 70, 22-32

Sahba G H, Arfaa F, Fardin A, Ardalan A
1975
Studies on dracontiasis in iran.
Iran J Publ Hlth (abs), 4, 61

Sahba G H, Srfaa F, Fardin A, Ardalan A
1973
Studies on dracontiasis in iran.
Am J Trop Med Hyg, 22, 343-347

Saint George J
1975
Bleeding in pregnancy due to retroplacental situation of guinea worms.
Ann Trop Med Parasit, 69, 383-386

Sallam M A, Abdel Gawad M A, Maklad M N, Shaker A
1974
Calcified Dracunculus medinensis (guinea worm): clinical presentation and radiological study.
Ain Shams Med J, 25, 483-587

Sambon L W
1908
The part played by metazoan parasites in tropical pathology.
J Trop Med Hyg (abs), 1, 29-36

Sankale M, Esterni J P
1981
Filariases in France.
Medit Med, 9, 33-34, 36 FRE

Sankaranarayanan M V, Ramamirthan S, Lashminarayanan K S
1965
Record of the guinea-worm, Dracunculus medinensis, in an Alsatian bitch.
Indian Vet J, 42, 972-973

Santelli
1867
Medical considerations on Dakar.
Thesis: Paris FRE

Sastry S C, Jayakumar K
1977
Thiabendazole in guinea worm disease.
Clinician, 41, 333-337

Sastry S C, Jayakumar K, Lakshminarayana V, Rao V N S
1978
Abate - its value as cyclopscide.
J Trop Med Hyg, 81, 156-158

Sastry S C, Kumar J K, Lakshminarayana V
1978
The treatment of dracontiasis with thiabendazole.
J Trop Med Hyg, 81, 32-35

Sastry S C, Kumar K J
1978
Dracunculus of pancreas. A case report.
Indian J Path Microbiol, 21, 81-83

Sastry S C, Ramakrishnan Rao Y, Chandrasekhar M, Ranga Reddy S V
1975
Involvement of penis in dracunculosis: report of 3 cases with a review of literature on other unusual sites.
Indian J Surg, 37, 214-216

Sastry S C, Rao Y R K, Narayana D L
1974
Metronidazole in the treatment of dracunculosis.
J Indian Med Ass, 62, 412-414

Saulnier de Pierrelevee D P
1845
Observations on guineaworm in America.
Gaz Hop Paris, 7, 37-38 FRE

Saunders R J, Warford J J
1976
Village water supply. Economics and policy in the developing world.
Baltimore: Johns Hopkins University Press, 279pp

Sauvages
1760
Malis Dracunculus.
Nosologia Methodica; Leiden LAT

Sauveplane
1909
On a case of guinea-worm.
Toulouse Med, 11, 257-258 FRE

Savarese
1805
Notes on Egypt (Filaria medinensis).
Naples; ITA

Saxena A K
1971
An epidemiological note on guinea-worm infection in Madhya Pradesh. I.
Indian J Med Res, 59, 940-944

Saxena K N, Singh M M, Hazra D K, Sharma S K
1970
Dracontiasis. (A case report). Multiple infections.
Indian J Dermat Venereol, 36, 169-171

Sayal N N
1971
Dermofilariidioses.
J Remount Vet Corps, 10, 19-28

Schaffer G D et al.
1981
Helminth parasites of translocated raccoons (Procyon lotor) in the southeastern United States.
J Wildl Dis, 17, 217-227

Schneider A
1868
On the structure and evolution of Polygordius.
Area Anat Physiol Wissensch Med, 51-60 GER

Schneider J
1964
Diagnostic and therapeutic problems of tropical medicine in everyday medical practice in france.
Bull Soc Path exot, 57, 669-715 FRE

Schneidermuehl G
1896
Guineaworm.
In Textbook of comparative pathology and therapy of man and domestic animals etc. Leipzig, vol 2, p306 GER

Schoeler L
1781
Observations on diseases of Surinam.
Dissert; Goettingen LAT

Scholten R G
1975
Filarial infections - with a note on dracunculiasis.
In (Hubbert W T, McCulloch W F, Schnurrenberger P R (eds), Diseases transmitted from animals to man. Springfield: Charles C Thomas, pp 572-583

Schroetter H von
1915
Prophylaxis on Nile journeys with notes on tropical hygiene in Sudan.
In Tagebuch Blaetter einer Jagdreise Weiland des Prinzen Georg Wilhelm etc.: Braumueller: Wien, pp362-380 GER

Schwartz E
1898
Inguinal adeno-lymphocele of filarial origin with presence of the worm in the ganglion.
Bull Soc Anat Paris, 73, 705 FRE

Schwarz E
1858
On guinea-worm (Filaria medinensis).
Zeit K K Ges Aerzte Wien, 1, 481-503 GER

Scott
1823
(no title?)
Med Chir Rev, June

Scott D
1960
An epidemiological note on guinea-worm infection in north-west Ashanti, Ghana.
Ann trop Med Parasit, 54, 32-43

Sehr A
1972
X-ray manifestations of dracunculiasis.
Ceskoslov radiol, 26, 271-274 CZE

Seifert O
1908
Clinical-therapeutic section.
In Tribute to Max Braun: Wuerzburg, p547 GER

Seize P
1874
Study of guineaworm.
Paris, quarto, 49pp FRE

Sellei J
1896
Some cases of Filaria medinensis.
Orvosi Hetilap; Budapest, 40, 536-537 HUN

Sellei J
1896
Some cases of Filaria medinensis.
Pester Med-Chir Presse, 32, 1143-1145 GER

Senator Jr
1898
Demonstration of Filaria medinensis in a Togo negress.
Deutsche Med Wschr, 24, 130-131 GER

Senator Jr
1898
Guineaworm (Demonstr. before Ver. Inner Med. Berlin).
Klin Ther Wchnschr, 5, 1005 GER

Sennert D
1641
Serpents and dragons (dracunculi) of desert regions.
Opera: Paris, v3, lib 3m pt 2, sect 1, cap 5 de Lumbricis (also vi, cap 8, p233 and v3, lib 3, pt 7, sect 1, cap 7, p359 LAT

Severance C E
1860
History of a case of the dracunculus or guinea-worm (Filaria medinensis).
Am Med Times, 1, 165-166

Severance C E
1861
History of a case of guinea-worm.
Glasgow Med J, 9, 377

Shafei A Z
1976
Preliminary report on the therapeutic effect of mebendazole in guinea worm infection.
J Trop Med Hyg, 79, 197-200

Shaker Y H
1960
Calcified medina-worm in the abdominal wall - a case report.
Alexandria Med J, 6, 582-585

Sharma G K, Hussain A
1946
A note on guinea-worm disease in dogs (in Lahore).
Indian J Vet Sci Anim Husb, 16, 31-32

Sharma M I D
1980
Lessons learnt from the intensified campaign against smallpox in India and their possible applicability to other health programmes, with particular reference to eradication of dracunculiasis.
J Commun Dis, 12, 59-64

Sharma M I, Rao C K
1981
A newly designed device for sampling cyclops densities.
J Commun Dis, 13, 227-234

Sharma S K, Wattal B L
1981
Laboratory studies on the biology of Mesocyclops leuckarti (Claus).
J Commun Dis, 13, 115-120

Sharma S K, Wattal B L
1981
Faunistic studies on Indian cyclops with special reference to Delhi region.
J Commun Dis, 13, 8-16

Sharma S K, Wattal B L, Sharma S, Joshi G C
1981
Susceptibility status of Mesocyclops leuckarti (Claus) to synthetic insecticides under laboratory conditions.
J Commun Dis, 13, 222-226

Sharma V P, Rathore H S, Sharma M M
1979
Efficacy of metronidazole in dracunculiasis. A clinical trial.
Am J Trop Med Hyg, 28, 658-660

Shastry T S
1946
Guinea-worm.
J Indian Med Ass, 15, 362-364

Shircore J O
1951
A case of guinea-worm (Uganda).
East Afr Med J, 28, 292

Siberry E W
1904
A case of Dracunculus medinensis (guinea-worm).
J Roy Army Med Corps, 3, 65655

Siciliano
1892
French establishments in the Gulf of Benin.
Paris? FRE

Siegler H R
1946
Guinea-worm infestation of raccoons in New Hampshire.
J Mammal, 27, 179

Sigaud J F X
1844
About the climate and diseases of Brazil. Medical statistics of this dominion.
Paris, p133 FRE

Silberstein A J
1979
Hyperendemic dracunculosis.
Ann Soc Belg Med Trop, 59, 93-94 FRE

Simaga D, Menye P, Diop D, Sanou A
1071
A major complication of dracunculiasis: cancerous phagedenic ulcers. Concerning 50 observations.
Med Afr Noire, 18, 644

Simmons J W, Whayne T F, Anderson G W, Horack H M
1951
Global Epidemiology. A geography of disease and sanitation.
Lippincott: Philadelphia, Vol 2 (Africa and adjacent islands), p43

Sing D, Khera S
1979
Preliminary histochemical studies on the body-wall of the guinea-worm, Dracunculus medinensis (Linnaeus, 1758).
In H D Srivastava Commem Vol. Indian Vet Res Inst, Izatnagar, pp65-69

Singer C
1912
On certain early references to dracontiasis, the guinea-worm disease.
Ann Trop Med Parasit, 6, 386-392

Singh H
1979
Mycetoma in India.
Indian J Surg, 41, 577-597

Singh J, Raghavan N G S
1957
Dracontiasis in India, its public health importance and its control.
Bull Natn Soc India Mal, 5, 141-158

Sinton J A, Baily J D
1916
Eosinophilia in some cases of helminthiasis.
Indian Med Gaz, 51, 58-60

Sirus-Pirondi
1871
Guineaworm.
Marseille Med, 8, 238-242 FRE

Sita Devi C, Devasankaraiah, Narasiah I L, Reddy C R R M, Rao V
1969
Role of gastric acidity in guinea-worm infection.
Indian J Med Res, 57, 1850-1855

Sita Devi C, Murthy D P, Reddy C R R M
1969
Development of enzyme activity in the guinea-worm larvae.
Indian J Med Res, 57, 2092-2096

Sivakami S, Joseph N I
1983
The food and feeding habits of Rasbora daniconius.
Geobios; Jodhpur, 10, 211-218

Sivaramappa M, Reddy C R R M, Sita Devi C, Reddy A C, Reddy P K, Murthy D P
1969
Acute guinea-worm synovitis of the knee-joint.
J Bone Joint Surg, 51, 1324-1330

Skelton J M, Latham W J
1952
Calcified guinea-worms in a South African Indian.
S Afr Med J, 26, 918

Slawikowski A
1619
On worms in man.
Dissertation: Vienna, p23 LAT (also GER)

Sloane H
1725
Voyages to Jamaica, Madeira etc.
London; v 2, p 190

Smith D J N, Siddique F H
1965
Calcified guinea-worm in the broad ligament of a pregnant mother.
J Obstet Gynaec Brit Commonw, 72, 808

Smith F, Cobbold T S
1881
An equine guinea-worm.
Lancet, ii, 1102

Smith J B
1913
The prevention of guinea-worm infection.
Brit Med J, ii, 1610

Smyttan G
1824
(no title?)
Med J, Edinburg

Soh C T
1970
Epidemiology of human nematodes in Korea.
Off J Res Inst Med Sci Korea, 2, 27-31 (Eng summ pp 321-325)
KOR

Sonsino P
1883
On Filaria sanguinis hominis, lymphocoele, lymphuria, and other associated morbid disorders (with a hint of other worm diseases in Egypt).
Trans Epidemiol Soc London, ns, 1, 155

Soodan V M
1974
Guinea-worm cyst granuloma.
J Indian Med Ass, 63, 63

Soprunov F F
1981
The large island - impressions of a medical parasitological trip to Madagascar.
Angew Parasit, 22, 39-49 GER

Sorvillo F, Ash L R
1982
Parasitic diseases in Karamoja, Uganda.
Lancet (corr.), i, 912-913

Soulsby E J L
1976
Sero diagnosis of other helminth infections.
In Cohen S and Sadun E H (Eds). Immunology of parasitic infections. Blackwell: Oxford, pp152-161

Southwell T, Kirshner A
1938
Some observations on guinea-worm larvae.
Ann Trop Med Parasit, 32, 193-196

Spiers R E, Baum A H
1953
Dracunculosis (autochthonous in USA).
J Kansas Med Soc, 54, 553-554

Spire
1899
Medical notes on upper Oubanghi.
Ann Hyg Med Colon, 2, 334-345 FRE

Spix, Martius
1828
Journey in Brazil.
GER

Stambolski C T
1879
On guinea-worm, or Filaria medinensis etc.
Union Med Orient; Constantinople, 6, 58 + 66 + 76 + 84 + 92 + 98 FRE

Stambolski C T
1880
On guinea-worm.
Gazz Med Lomb: Milan, 40, 182, 191, 221, 231, 241 ITA

Stambolski C T
1896
On guinea-worm (Filaria medinensis).
2nd ed. Sophia, 29 pp. FRE

Stanfield J P
1978
Parasitic infestations.
In (Brimblecombe F and Barltrop D eds) Children in Health and Disease. London: Bailliere Tindall, pp 727-776

Stefanopoulo G J, Daniaud J
1940
Complement fixation and intradermal reactions during human Dracunculus medinensis infections.
Bull Soc Path Exot, 33, 149-153 FRE

Stefanopoulo G J, Payet M I
1938
The principal filarial infections and their biological diagnosis.
Gaz Med France, 43, 319-331 FRE

Stelling C B
1982
Dracunculiasis presenting as sterile abscess.
Amer J Roent, 138, 1159-1161

Stewart A D, Moorthy V N
1933
Lethal properties of aqueous extract of young bamboo shoots.
Ind Med Gaz, 68, 320-3

Stewart H
1924
X-ray photograph of a guinea-worm in the popliteal space.
J Trop Med Hyg (corr.), 27, 120

Stewart L W
1858
Observations on Dracunculus or guinea-worm.
Indian Ann Med Sci, 5, 88-96

Stewart L W
1866
Some remarks on Dracunculus.
Reports Army Med Dep, 6, 433-435

Stitt E R
1928
Our disease inheritance from slavery.
US Nav Med Bull, 26, 801-817

Stoll N R
1947
This wormy world.
J Parasit, 32, 1-18

Storrs R
1919
The white man's grave in the eighteenth century.
J Roy Army Med Corps, 53, 226-230

Strain R E
1942
Guinea-worm infestation.
Antiseptic; Madras, 39, 29-30

Stulz E, Fontaine R
1924
A case of guinea-worm infection.
Bull Soc Franc Derm Syph, 31, 88-91 FRE

Subrahmanyam B, Reddy Y R, Paul S
1976
Dracunculus medinensis (guinea worm) infestation in a dog and its treatment with "Flagyl". A case report.
Indian Vet J, 53, 637-639

Sukla R R
1940
Guinea-worm (dracontiasis).
Antiseptic; Madras, 37, 34-38

Sutherland W D
1897
Urticaria.
Indian Med Gaz, 32, 259-260

Sutherland W D
1898
(no title?)
Ann Dermat, p110

Szczgiel B, Talfi I
1973
Calcified guinea worms in x-ray pictures.
Przeglad Lekarski, 30, 696-698 POL

Tachon
1969
Dracunculiasis and thiabendazole.
Conf Techn OCEAC: 4th, Final Report, 2, 583-587 FRE

Tagantius J
1567
(Comments on Dracunculus).
De Chir Institutione Lugdoni, libri v, 8, lib I, p8 LAT

Talairach
1907
Filariasis epidemic observed in Timbuctoo.
Ann Hyg Med Colon, 10, 377-378 FRE

Talwalker V C
1983
Guineaworm: send in the fish.
Lancet (corr.), i, 361

Tapp E
1979
Disease in the Manchester mummies.
Manchester: Manchester Museum, Mummy Project, pp 95-102

Ten Eyck D R
1971
Report of an outbreak of dracunculiasis in Ethiopia.
Ethiop Med J, 9, 149-152

Teste J A
1881
(no title?)
Galenos; Athens, 6, 65-418 GRE

Testelin
1860
Observations on a case of Dracunculus seen in Brussels by Dr. de Faye.
Bull Acad Roy Med Belg, 3, 568-572 FRE

Tewari A K
1970
Incidence and ecology of guineaworm disease in Rajasthan.
Deccan Geog, 8, 1-14

Thaly
1867
Medical topography of Upper Senegal.
Arch Med Nav, 8, (Mar, May + Sept) FRE

Thevenot
1840
Diseases of Europeans in Senegal.
paris, FRE

Thevenot J de
1674
Continuation of a journey to the Levant.
Paris, pp257, 267 FRE

Thibaud G
1859
Observation of Dracunculus or guinea-worm.
Montpellier Med, 2, 521-523 FRE

Thibaud G
1862
Filaria medinensis.
Allg Wien Med Zeitg, 7, 161-162 GER

Thibaud G
1863
Filaria medinensis.
Schmidt's Jahrb; Leipzig, 119, 52 GER

Thierman-Duffaud D
1981
Developmental cycle of guineaworm.
Nouv Presse Med, 10, 2705 FRE

Thompson W E
1933
Strangulated hernia in association with dracontiasis and hydrocoele. (Memoranda.)
Brit Med J, ii, 528

Thompson W E
1949
Dracontiasis.
Brit Med J (corr.), i, 54-56

Thomson
1855
(No title?).
Brit and Foreign Med-Chir Rev, Oct

Thomson I G
1956
The pathogenesis of tropical ulcer amongst the Hausas of Northern Nigeria.
Trans R Soc Trop Med Hyg, 50, 485-495

Tilak C T
1949
Guinea-worm town of Gingee.
Indian Med Gaz (corr.), 84, 429

Tirgari M, Radhakishnan C V
1975
A case of Dracunculus medinensis in dog.
Vet Rec, 96, 43

Touchard
1864
The Gabon river and its diseases.
Thesis; Montpellier FRE

Tournier E
1922
The treatment of guineaworm by antimony salts.
Bull Soc Path Exot, 15, 809-815 FRE

Tournier E
1931
Chemotherapy of dracunculiasis.
Arch Med Pharm Colon, 29, 138-147 FRE

Tournier Lasserve C
1976
Place of lymphatic filariasis in arthopathies related to filariasis.
Med Trop, 36, 575-579 FRE

Trautmann M, Mravak S, Bruckner O
1982
Dracontiasis.
Hautarzt, 33, 502-504 GER

Travassos L P
1934
Dracunculus fuelleborni n.sp. a parasite of Didelphis aurita Wied.
Mem Inst Oswaldo Cruz, 28, 235-237 POR

Trewn H S
1937
Guinea-worm.
Indian Med Gaz, 72, 606-609

Trinkler N
1896
(No title?).
Trudi Kharkovsk Med Obsh, 1, 63-65 RUS?

Trucy C
1873
Notes on guinea-worm and in particular on its treatment.
Thesis; montpellier, 42pp FRE

Tufnell J
1869
A case in which septic infection, which terminated in death, was caused by the breaking of a Dracunculus or guinea-worm during an attempt made by the patient to extract it.
Dublin J Med Sci, 48, 45-52

Tufnell J
1871
Guinea-worm.
Proc Path Soc Dublin, 4, 123

Turk R D
1950
Guinea worm (Dracunculus insignis, Leidy 1858) infection in a dog.
J Am vet Med Ass, 117, 215-216

Turkhud D A
1913
Guinea-worm disease research.
Indian Med Gaz, 48, 28-29

Turkhud D A
1913
Dracontiasis. Proc 2nd All-India Sanit Conf.
Simla: Govt Central Branch Press, 3, 118-120

Turkhud D A
1919
Prophylaxis of dracontiasis.
Indian J Med Res, Spec Indian Sci Cong Number, pp217-225

Turkhud D A
1920
Dracontiasis in animals; with notes on a case of guinea-worm in a cobra.
Indian J Med Res, 7, 727-734

Turkhud D A
1914
The distribution of guinea-worm in India. Proc 3rd All-India Sanit Conf.
Indian J Med Res, 4 (Suppl), 124-125

Tutschek L
1845
Medical state in Tumale.
pp12-13 GER

Tutschek L
1846
(On Filaria medinensis).
Oesterr Med Woch, p208 GER

Tutschek L
1853
Ethnographical sketches of Tumale, in Central Africa.
Ausland, 26, 27-34 GER

Tutschek L
1853
On the "fathom-worm". Filaria medinensis, in the limbs of man.
Centralbl Naturw Anthrop Leipzig, 1, 481-484 GER

Twining W
1835
Cases of Dracunculus occurring in Calcutta.
Trans Med Phys Soc Calcutta, 7, 476-480

Tyugi R P S
1957
Two cases of dracontiasis in dogs.
Indian Vet J, 34, 214-215

Uganda Dept of Agriculture
1946
Soil-conservation report for 1944, part 5 - Water supplies
pp 36-37

Uganda Medical Dept
1934
Control of dracontiasis and schistosomiasis by the use of fruit of Balanites aegyptica.
In Annual Report of the Uganda Medical dept, p33

Vad B G
1963
Dracunculus medinensis (guinea-worm).
Maharashtra Med J; Poona, 10, 475-483

Valenciennes A
1856
Note on a new species of Filaria found under the skin of a jaguar.
C R Seanc Acad Sci, 43. 259-261 FRE

Valenciennes A
1856
(Filaria aethiopica).
Kordofan Institute; Paris, 24, 286

Van Andel N A
1931
Medicine and hygiene in the slave ships in the time of the West India Company.
Nederl Tijdschr Geneesk, 75, 614-637 DUT

Van Arman G G, Campbell W C
1975
Anti inflammatory activity of thiabendazole and its relation to parasitic disease.
Tex Rep Biol Med, 33, 303-311

Van Beneden P J
1863
Note on guinea-worm.
Bull Acad Roy Belge, 2 ser, 16, 3-4 FRE

Van der Berg
1882
Medicine in Dutch Indies.
Batavia, 1, 1-3 DUT

Van Harlingen A
1888
Filaria medinensis.
Med News, 53, 373

Van Harlingen A
1888
Notes on a case of Filaria medinensis.
Med Surg Reporter; Philadelphia, 59, 417-418

Van Harlingen A
1888
Notes in a case of Filaria medinensis.
Trans Am Derm Ass; Boston, pp45-46

Van Harlingen A
1898
Filaria medinensis.
Philadelphia Med J, 2, 96

Van Heutsz
1926
A native case of Dracunculus.
Geneesk Tijdschr Nederl Indie, 66, 35 DUT

Van Leent
1881
Dutch Guyana.
Arch Med Nav FRE

Van Oefele F
1901
Studies on ancient Egyptian parasitology.
Arch Parasit, 4, 481-530 GER

Van Someren
1853?
Summary of cases of Dracunculus treated in the hospital of the 15th Regiment N. I. in Secunderabad during 1852.
Proc Hyderabad Med Phys Soc, 1, 76-81

Varadarajan M G
1960
Dracunculus medinensis.
Punjab Med J, 10, 238-240

Vasistha
1977
(The winding worm which wounds the feet).
In Rig Veda, 7th book, (c 1350 BC) quoted by Kevan (1977)

Vaucher C, Bain O
1973
larval development of Dracunculus doi (Nematoda), a parasite of Malagasy snake, with a description of the female.
Ann Parasit Hum Comp, 48, 91-104 FRE

Vautrin
1854
Guinea-worm.
Bull Soc Anat; Paris, 29, 311-314 FRE

Vauvray
1873
Contribution to the medical geography of Port-Said (Egypt).
Arch Med Nav, 20, 161-190 FRE

Velikanov V P
1982
Helminth fauna of the snake Natrix tesselata in the Turkmen-SSR USSR.
Izv Akad Nauk Turkm SSR Ser Biol Nauk, (1), 46-50 RUS

Velo G
1890
Case of Filaria medinensis.
Ritforma Med Napoli, 6, 1545-1546 ITA

Velo G
1891
Case of Filaria medinensis.
Riv Veneta Sci Med, 14, 50-54 ITA

Velschius G H
1674
Essay on the Vena medinensis of Ebnsina or Dracunculus of the ancients (etc.).
Augsburg; Th Goeblius, 456pp LAT

Verhaeghe A, Delcambre B, Zylberberg G
1968
Aseptic arthritis associated with filariasis.
Rev Rheumat, 35, 514-520 FRE

Verma A K
1966
Ocular dracunculosis.
J Indian Med Ass, 47, 188

Verma A K
1968
Ocular dracontiasis.
Int Surgery, 50, 508-509

Verma A K
1969
Dracunculosis of the eye.
Vestn Oftal, 82, 91 RUS

Verma B B, Dinha B P
1976
Dracontiasis in a dog.
Indian Vet J, 55, 411-412

Verrill A E
1870
Internal parasites of domestic animals.
Ann Rep Connecticut Bd Agric (1869-70), p171

Verroust P J, Adam, C, Smith M D, Richard-Lenoble D, Kourilsky O, Morel-Maroger L J
1979
Circulating immune complexes and C3d in human parasitosis.
Kidney Internat, 16, 9-14

Vieira R A
1976
Human filariae.
An Inst Hig Med Trop, 4, 549-599 POR

Villault N
1669
Description of the coasts of Africa called Guinea.
Paris, p302 FRE

Vivie
1907
Sanitary conditions and diseases observed in Ivory Coast in 1905.
Ann Hyg Med Colon, 10, 128 FRE

Vogel C
1961
On the guinea-worm disease in Indian medicine.
Advar Library Bull, 25, 55-68

Vogt C
1878
Origin of the intestinal worms of man.
Rep Intern Congr Sci Med Geneva (1877); Basle, p11 GER (and FRE)

Vortisch H
1906
Experiences of a specific disease of the Gold Coast.
Arch Schiffs u Tropenhyg, 10, 537 GER

Voskresenski N M
1887
A case of *Filaria medinensis*.
Protok Zasaid Kaukazsk Med Obsh Tiflis, 24, 136-141 RUS?

Waddy B B
1956
Organization and work of the Gold Coast medical field units.
Trans R Soc Trop Med Hyg, 50, 313-336

Wagner R
1698
(No title?)
Nov lit maris Baltici, Febr. LAT?

Walker N S
1857
Flesh worm.
South Med Surg J, 13, 462-464

Waller
1859
(No title?)
Bombay Med Trans, 4, 64

Ward H B
1903
Guineaworm.
In Rev Handb Med Sci, rev ed, vol 6, pp210-211

Ward W B, Belcher D W, Wurapa F K, Pappoe M E
1979
Perception and management of guinea worm disease among Ghanaian villagers. A framework for differential health education planning.
Trop Geogr Med, 31, 155-164

Waring E S
1856
Notes on *Dracunculus*.
Indian Ann Med Sci, 5, 406

Waring J J
1867
Notes on *Dracunculus*.
Proc Roy Med Chir Soc Lond, 5, 316=319

Warner R S, Kallet S, Rowan R, Reddy M
1976
Calcified parasite in retroperitoneum.
Urology, 7, 214-215

Warrell D A
1976
Yellow fever, typhus fevers, kala-azar, trypanosomiasis and filariasis.
Medicine, UK, No 4, 207-216

Watson T
1845
Lecture on the principles and practice of physic, delivered at King's College London.
London; 814pp

Webster W A, Casey D A
1970
The occurrence of Dracunculus insignis (Leidy 1858) Chandler 1942 in a skunk from Ontario, Canada.
J Wildl Dis, 6, 71

Weihe J
1832
On Filaria medinensis (Gmel.) - short commentary.
Berlin; 25pp LAT

Weissner H
1863
(Annandale, Thibaut, Picipio, Defaye, Severance and Passauer on guineaworm).
Schmidt's Jahrb, Vol 119 GER

Wengler
1851
A case of guinea-worm in Europe.
Schmidt's Jahrb, 69, 358-360 GER

Wenyon C M
1908
Report of travelling pathologist and zoologist (dracontiasis).
3rd Rep Wellcome Res Lab; Khartoum, pp132-135

White G
1977
The main effects and problems of irrigation.
In (Worthington E B ed). Arid land irrigation in developing countries: environmental problems and effects.
Oxford: Pergamon Press, pp1-72

Wierus J
1660
(Comments on guineaworm).
In Opera omnia Amsterdam 4, obs lib II, p947 LAT

Wilcocks C
1944
Medical organization and diseases of Burma before the Japanese invasion.
Trop Dis Bull, 41, 621-630

Willemoes-Suhm R von
1874
On the relationship of the Filaria to Ichthyonema globiceps.
Ztschr f Wiss Zool, 24, 161-163 GER

Williams C L
1899
The prognosis of guinea-worm in its relation to the assurance of native lives in India.
Indian Med Gaz, 34 (7 July), 242-243

Williams D, Roy S
1981
Arthritis and arthralgia associated with toxocaral infestation.
Brit Med J, 283, 192

Williams D W
1886
A case of guinea-worm.
Lancet (corr.), ii, 711

Williamson J
1817
Medical and miscellaneous observations relative to the West Indian islands.
Edinburgh; Vol 1, 408pp

Wilson T
1975
The spread and control of worm infections.
In (Hobson W ed). The theory and practice of public Health. 4 ed, pp 335-340

Wilson W D
1958
The guinea-worm, Dracunculus insignis (Leidy 1858) Chandler 1942, in a raccoon, Procyon lotor, from Michigan, a new location.
Am Midl Nat, 59, 256

Witenberg G G
1951
Some unusual observations on helminthiasis in Israel (Dracunculus medinensis in a cat).
Harefuah, 41, 178-180 HEB

Witenberg G G
1964
Nematodiases.
In Zoonoses (Van der Hoeden ed), pp 529-601

Witting C, Drepper H
1975
Dracunculiasis.
Hautarzt, 26, 216-217 GER

Wittrock D D, Ulmer M J
1974
Helminths of badgers Taxidea taxus in northwest Iowa, USA.
Iowa State J Res, 48, 319-327

Wobeser G A
1970
Dracunculus insignis.
J Wildl Dis (corr.), 6, 88

Woodruff A W
1975
Clinical problems of preventive medicine, Toxocara canis and other nematodes transmitted from dogs to man.
Brit Vet J, 131, 627-632

World Health Organization
1979
Parasitic zoonoses. Report of a WHO Expert Committee with the participation of FAO.
World Health Organization Tech Rep Ser, No 637, 108 pp

Wotton Edward (of Oxford)
1552
Parasitic worms.
In De differentiis animalium libri decem. Lutetiae Parisiorum, fol 195 and 196 LAT

Wright F J, Baird J
1975
Tropical diseases.
Suppl to: Davidson's Principles and practice of medicine. 11th ed, (J Macleod ed). Edinburgh: Churchill Livinstone, 5th ed, 147 pp

Wright R E
1924
Encysted guinea-worm of the orbit.
Indian Med Gaz, 59, 458-459

Wurapa F K, Belcher D W, Ward R B
1975
A clinical picture of guinea worm disease in southern Ghana.
Ghana Med J, 14, 10-15

Wurtz R, Sorel F
1911
Massive epidemic of dracunculiasis seen in a village of the equatorial forest in Ivory Coast.
Rev Med Hyg Trop, 8, 149-154 FRE

Wurtz R, Sorel F
1912
Note on the léngth of the incubation period of guinea-worm.
Rev Med Hyg trop, 9, 123-124 FRE

Wyatt J L, Wyatt G B
1967
An analysis of the patients seen at Igbo Ora Rural health centre, Nigeria, during the year from July 1964 to June 1965.
Ann Trop Med Parasit, 61, 224-233

Xu J-N
1975
Animal parasitic nemaólogy.
Science Press: Peking, p56
CHI

Yakimoff W L
1914
Research on the human and animal tropical diseases in Turkestan VI. The leucocyte formula of the blood of patients with Filaria medinensis.
Bull Soc Path Exot, 7, 192 FRE

Yawalkar S J, Heigl L
1975
Indian dermatoses: leprosy, post-kalar-azar dermal leishmaniasis, tuberculosis cutis verrucosa, dracontiasis, filariasis.
Hautarzt, 26, 433-434 GER

Ziegler K
1969
Tropical medicine problems and experiences in the DDR demonstrated by Rostock medical records.
Z Gesamte Inn Med, 24 (5), Suppl pp67-71 GER

Zontides D
1880
A case of Dracunculus or Filaria medinensis.
Mitth Wien Med Doct-Coll, 6, 287-289 GER

Zontides D
1880
On a case of Dracunculus or Filaria medinensis.
Wien Med Presse, 21, 1606-1608 GER

Zur Strassen O K L
1907
Filaria medinensis and Ichthyonema.
Berhandl Deutsch Zool Gessellsch; Leipzig, 17, 110-129 GER

Zwicke C
1841
Entozoa of man
Dissertation; Beroline, p30 LAT

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