

National Health Problem Series—3

FILARIASIS

IN

INDIA



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Directorate General of Health Services
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NEW DELHI

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IN
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FILARIASIS IN INDIA

INTRODUCTION

Filariasis, commonly known as elephantiasis, is known to be prevalent in India from very ancient times. This disease has been recorded in all the States of India except Jammu & Kashmir, Himachal Pradesh, Punjab and Rajasthan. Nearly 5 crore people live in filarious areas of the country.

The disease leads to the permanent swelling of the legs and of certain other parts of the body, besides causing recurring attacks of fever and inflammation of the lymphatic system. Though the disease does not cause death, it is responsible for a considerable amount of preventable suffering and disability.

Although many forms of animal life are known to have filarial infections of different types, man is known to be the victim of chiefly six types of filarial infections transmitted by various blood-sucking insects including mosquitoes. In India only two types of filarial infections are prevalent. They are, *Wuchereria bancrofti* and *Wuchereria malayi* and both of them are transmitted by mosquitoes. The possibility of inter-transmission of animal and human filariasis infection is under study.

The only effective measures against the disease known at present are those which are concerned with the control of carrier species of mosquitoes. The National Filaria Control Programme was launched in 1954 for controlling the carrier mosquito and administration of drugs on a mass scale in the filarious areas to reduce the reservoir of infection in human beings.

Scientific study of filariasis may be said to have commenced in 1863, when Demarquay in Paris first demonstrated the microfilariae, the embryos of the filarial worms, in the hydrocele fluid of a patient from Havana.

In 1866, Wucherer found microfilariae in the chylous urine of a Brazilian patient, and in 1872 Lewis in India recorded the microfilariae in the peripheral blood of a man. In 1876-77 the first lot of adult female worms (five in number) were secured from the lesions in the arm by Bancroft in Australia. Lichenstein reported that the microfilariae in a person from Achin, Sumatra was refractory to *C. fatigans* (the carrier of *W. bancrofti*) indicating the possibility of its being a new species. Following this, *Microfilaria malayi* was first reported by Brug in 1927. The adult worms of *W. malayi* were described by Rao and Maplestone in 1940 from specimens obtained from the former Travancore State.

The study of the transmission of filaria by Manson in Amoy (China) during 1878-79 led to one of the earliest discoveries incriminating an insect as a vector (carrier) of human disease. Two decades later, Ross unravelled the mystery of malaria transmission by mosquitoes.

At first, Manson thought that the fully developed infective larvae escaped into the water at the time the mosquitoes laid their eggs and then men contracted the infection by drinking such water. Low in 1899-1900 discovered that the larvae underwent further development in the mosquito and eventually passed on to man through the skin when the infected insect bites him.

In 1880, Manson also recorded the phenomenon known as "filarial periodicity" or the cyclic appearance and disappearance of the

microfilariae from superficial blood vessels of the infected persons. The microfilariae appeared during nights and disappeared during the day time. This necessitated the obtaining of blood samples for detecting filarial infection only at nights.

Geographical Distribution

The disease is known to be prevalent in various parts of the world. *Wuchereria bancrofti* has an extensive distribution and occurs practically throughout the tropical countries. It has been found in the western hemisphere as far as Argentina in South America and in the eastern hemisphere from southern Spain to as far south as Queensland, Australia. It is especially prevalent in India and South China extending up to Japan, Indonesia and other Islands in the Pacific where, in some localities, the incidence of the disease is known to be very high. It is reported that filariasis in American Samoa probably causes greater damage than any other disease by its disabling effects and the undermining of the general health which may expose the patient to other infections. Filariasis is common in West and Central Africa and is also prevalent in parts of Arabia.

Wuchereria malayi has been reported from Malaya, East Indies, Sumatra, Borneo, New Guinea, India (especially Kerala State), Indo-China, Ceylon, Thailand, South China and Japan. *W. malayi* is often associated with elephantiasis of extremities only, while *W. bancrofti* affects the external genitals also.

CHAPTER II

FILARIASIS PROBLEM IN INDIA

Filariasis has been reported in India from ancient times (Sushruta, 6th Century B. C.). Fryer, a doctor of East India Co. in 1673, reported elephantoid legs in St. Thomeans in Madras. Clarke, in 1709, described the presence of elephantoid legs in Cochin as "Malabar leg". The disease is known to be prevalent along the coastal areas and in some parts of the interior country also.

Many fanciful theories and erroneous impressions are current on the causation of the disease. There is also the fear that members of certain families were prone to the disease and that the disease might lead to sterility. The disease is a social stigma, particularly in the young adults, especially, unmarried girls. The swellings of the extremities may increase to unwieldy proportions resulting in physical incapacitation and loss of earning capacity.

Survey of Prevalence

In spite of the wide prevalence of filariasis in India, no concerted effort had been made until recently, to determine the extent of the problem or to carry out connected studies on its epidemiology. Only patchy surveys had been carried out from time to time. Between 1929 and 1946 small scale surveys were carried out under the then Indian Research Fund Association, currently called the Indian Council of Medical Research. Iyengar in 1938 carried out surveys in the former Travancore State and found that *W. malayi* infection was predominant there. Megaw and Gupta (1927) were the first to publish a "filaria map" of India. Recently Jaswant Singh and Raghavan (1953) have brought out the salient points of filariasis in India with a "filaria map" based on reports received from States and other published reports. It will be noted that filarial infection is absent in the Punjab, Jammu and Kashmir, Rajasthan and greater part of Mysore State, but is prevalent in varying degrees in West Bengal, Bihar, Bombay, Orissa, Madras, Kerala, Andhra Pradesh, Madhya Pradesh, Uttar Pradesh and Assam. Recently, foci of infection have come to light in the Andaman, Nicobar and Laccadive Islands and in the former French settlements.

The types of filarial infections occurring in India, as stated earlier, are *W. bancrofti* and *W. malayi*. The former infection has been reported for a longer period and is also more extensively prevalent while the latter has been reported since 1929 and has only a few localised foci. The largest single tract of *W. malayi* infection so far reported in India is in Kerala where over a million persons are exposed to the disease.

In 1947, Norman Stoll estimated that there are about 15.3 crore persons exposed to the risk of filarial infection in Asia, which *pro rata* would mean about 5 crores in India. From reports received from the different States of India, Jaswant Singh and Raghavan in 1953 estimated that there were at least 2.5 crore persons living in the filarious areas in India. From the surveys so far carried out under the National Filaria Control Programme and other reports, it appears that this is an under-estimate.

CHAPTER III

FILARIA PARASITE—ITS LIFE-CYCLE

The adult filaria worms inhabit the lymphatic system.* These worms are slender and whitish, measuring a few centimeters in length. The sexes are separate, the males being shorter than females. The young ones known as microfilariae measure about a fifth of a millimeter and can be detected in the fresh blood and identified in stained smears. The microfilariae do not cause any damage and can develop only in a suitable mosquito. The adult worms, however, are believed to be the cause of the manifestations of filarial disease. When the mosquito sucks blood from an infected individual the microfilariae pass into the stomach of the mosquito together with the blood meal. Further development takes place inside the vector mosquito. Depending upon the climatic conditions, they grow in 10-20 days into infective larvae which measure about 1.2 mm in length.

Each microfilaria taken in by the mosquito develops into an infective larva and then the mosquito becomes infective. There is no multiplication in number of microfilariae in the mosquito as in the case of malaria parasite.

These infective larvae move in different directions in the body of the mosquito, chiefly towards the head and proboscis (biting mouth parts) from where they escape when the mosquito bites next. Only mosquitoes having these forms are capable of transmitting the infection. When they bite a person, the infective larvae get deposited on the surface of the skin from where they make their way through the capillaries (from blood vessels) to reach some part of the lymphatic system. Here they develop into adult worms. The female worms become fertilized by the male and the broods of microfilariae later reach the blood stream. It is not definitely known how long it takes for the infective larvae to develop into adult worms and produce microfilariae in the man, but in India the period is estimated to be about a year.

Stages

There are generally four stages in the filarial infection in the human host.

The first stage, that of "*invasion*", is one where the infective forms invade the body and undergo early development. The defensive mechanism of the system puts up antibodies against the invading worms and a state of allergy (sensitization) develops. This may be manifested by attacks of pruritus (scratching sensation) or urticarial (rash etc.) at varying intervals. The infective larvae can only grow sexually into adult worms and reach sexual maturity in man. Only then they produce the microfilariae. Therefore, persons freshly infected are not capable at that stage of infecting fresh mosquitoes.

*There is a circulation of fluid from the blood to the tissues and back to the blood through a system of small tubes known as lymphatics. These lymphatics have fine walls and form a network in the body. This system of circulation supplies nutrition to the different parts and also plays a protective role. In the course of this circulation are placed the 'Lymph nodes', (lymphglands) which can be felt easily under the skin, as in the armpit and the groin which get swollen when there is a septic injury in the hand or the foot.

FILARIA PARASITE : ITS LIFE-CYCLE

After some time, the infective larvae become sexually mature adults ; fertilization takes place and the female worms produce microfilariae which are released into the blood circulation. Such persons are usually "symptomless" but are a source of a "public health danger" of a high order, as they harbour the microfilariae and are capable of infecting the mosquitoes.

Some of the persons described above pass through, the "*acute phase*" of disease and exhibit intermittently signs and symptoms of the filarial fever, lymphangitis, orchitis, etc. It may be difficult to find microfilariae in such acute conditions, though they may be positive during the symptomless intervals. Thus, these persons vary in importance in their capacity to infect the mosquito vector.

Some of the infected persons proceed from the acute to the *chronic stage*, when most of them usually become negative for microfilaria, and constitute the least public health risk. Though suffering themselves, they are practically of no importance from the community point of view as they do not have the microfilariae circulating in their blood for infecting the mosquitoes.

CHAPTER IV

NATURAL HISTORY OF DISEASE

Obstruction of lymphatic vessels by adult worms and bacterial infection are the two most important factors to be recognized in the causation of elephantiasis. The important pathological conditions associated with infection are related to the lymphatic system. Acute manifestations are fever, painful swellings of the lymph glands or lymphadenitis, reddish streaks on the limbs or lymphangitis. These are often accompanied by painful swellings or oedema of the extremity, soft and pitting, which often subside leaving a persistent residual swelling, referred to as lymphoedema. In addition, in *W. bancrofti* infections, genito-urinary lesions like chyluria (milky urine) or swellings of the scrotum or hydrocele are some of the manifestations often noticed.

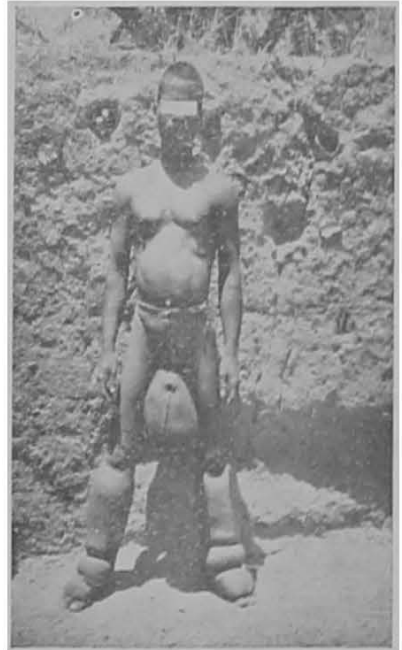
The filarial fever may occur at varying intervals of weeks, months or years. In India this form of recurrent fever has been attributed by the people in the area to mysterious lunar influence, though this has not been proved scientifically. The onset of fever is usually sudden and temperature may reach 102° to 104° F often accompanied by rigor (shivering) and sweating. The temperature may return to normal within 24 hours or may last for 2 to 3 days. In many cases, fever is associated with swellings as mentioned earlier.

With repeated attacks of fever, the above-mentioned 'acute' conditions worsen and become 'chronic'. Further dilatation (enlargement) of lymph vessels resulting in oozing out of lymph giving rise to conditions like lymph scrotum may also occur. If the lymphatics rupture, then conditions, like chyluria (milky urine) chylous ascites (collection of milky fluid in the abdomen) and chylous diarrhoea may result depending upon the site of rupture of the lymphatics. Thickening of skin and changes often in the subcutaneous (tissues) take place giving rise to massive elephantiasis of legs, scrotum, arms, mammae (breasts) and other parts of the body. The swellings of such parts in this stage is hard, non-pitting and irreversible, i.e., the disease gets established.

Elephantiasis is the commonest lesion due to the filarial infections prevalent in India. The legs are most commonly affected with the arms coming next. The swellings may attain enormous dimensions. In the male, the scrotal enlargement may sometimes reach big sizes, weighing about 10 to 20 pounds. The penis is also sometimes involved. In the female, the mammae (breasts) and the external genitals may also be affected.



Swelling of the legs : Elephantiasis due to *Wuchereria* infections.



The genitals are often involved, especially in *W. bancrofti* infections. The scrotum sometimes becomes unwieldy large.

CHAPTER V

VECTOR MOSQUITOES AND THEIR LIFE-CYCLE

C. fatigans is the primary vector (carrier) for *W. bancrofti* and *Mansonioides sp.* for *W. malayi*. *Anopheles sp.* are known to transmit both the infections, but only very rarely.

C. fatigans breeds usually in dirty water collections, e.g., sullage, kutchra drains, cesspits, soakage pits and the like. They can, however, breed in all types of water. The eggs laid are cemented to each other and form rafts, as the individual egg cannot by itself float in the water surface as in the case of an anopheline egg which floats singly. The larvae have a long siphon tube and hang obliquely from the surface of water. The larvae change into pupae which in turn give rise to the adults. This ubiquitous species is a strong winged mosquito and can fly even over two miles. They bite at nights and are usually found resting on walls of houses underneath furniture, inside empty pots and the like as also on hanging clothes. They are the common "nuisance mosquitoes".

Mansonioides sp.—The members of this species are peculiar in that in their aquatic phase, (egg, larval and pupal stages) their biology is associated with some aquatic plants, e.g., water lettuce (*Pistia stratiotes*) or water hyacinth (*Eichornia* species). These plants usually float on the surface of water and have fine rootlets immersed in it. The eggs are laid in starshaped clusters which stick on to the under-surfaces of the leaves of these aquatic plants. The larvae escape by breaking open the free ends of the eggs. The larvae and pupae attach themselves to the rootlets with their modified siphon tubes of trumpets (breathing tubes). When about to become adults, the pupae come to the water surface and the mosquitoes emerge and escape.

The aquatic phase of these mosquitoes usually takes about 10-14 days, depending upon prevailing climatic conditions.

CHAPTER VI

EPIDEMIOLOGY

Filarial infection affects all people with no consideration of race, sex, age or trade or occupation. The infection has been noted even in infants though it is commonly prevalent above the age group of 5-10 years. Disease processes have been noted even as early as three years but are more common beyond the tenth year of life.

Spatial Distribution

Formerly, *W. bancrofti* infections were supposed to be prevalent in urban areas with insanitation and overcrowding where favourable breeding conditions were available for the vector *C. fatigans*. For a similar reason *W. malayi* was supposed to be rural (Iyengar*, 1938). However, with the carrying out of more surveys, *W. bancrofti* has been recorded in suburban or even rural areas, while *W. malayi* has been found in the peripheral parts of urban areas.

Climate

Climate plays a vital role in the prevalence of the infection in any area by influencing the breeding and consequent origin or birth of the vector mosquitoes, its longevity which determines the development of the parasite in the mosquitoes. Places with favourable climate as in coastal areas or places near the equator like South India with hot and humid climate for the greater part of the year and many other areas where similar conditions prevail are highly endemic to filaria. The infection in many cases, e.g., the tea gardens of Assam, is introduced by settlers from endemic areas. The same is also possible by 'passive transportation'. For example, infected and often symptomless boatmen plying country crafts between Saurashtra ports and the heavily-infected Malabar Coast have provided the reservoir of infection to local mosquitoes. Thus, areas (usually with low levels of sanitation) with a hot and humid climate for the greater part of the year and with constant movement of population between other infected areas have to be viewed as 'potentially' filarious areas.

Co-existence of Filaria and Other Infections

Though, formerly, malaria and filaria were supposed to be antagonistic to each other and could not co-exist, it has now been conclusively proved that the two infections can co-exist in the same person, place and vector mosquito. As a matter of fact, any infection can co-exist with filaria in the same person.

Diagnosis

Detection of microfilariae is the unequivocal proof of filarial infection. In the early stage of 'invasion', no microfilariae are to be expected in the peripheral blood. Some skin tests using antigen from adult filarial worms from animal sources have been used to detect the early stages of invasion in human being with varying results. Any positive indication by this test and a history of the residence in endemic areas may be useful to make a provisional

*Iyengar M.O.T. (1938) Ind. Med. Res. Mem. No. 30.

diagnosis. In the next 'symptomless stage', it is relatively easy to find microfilariae. Due to the nocturnal periodicity, it is easier to detect the infection by examining a drop of blood obtained during the night by pricking a finger of the person. The blood drops thus obtained, can be covered with a cover slip (a piece of very thin and transparent glass) ringed with vaseline and examined in this "wet" stage either immediately or the following morning. In positive cases, the actively moving microfilariae will be seen disturbing the superimposed blood cells. For identification of species, the blood drop is to be smeared (spread out as a thin layer), dried and examined after staining by suitable techniques. In the acute stage, blood examination may often be negative for microfilariae. The history of residence in endemic areas, the recurrence of symptoms like lymphoedema, (being present in one limb or other, rather than bilateral), usually all point to a positive diagnosis. In between attacks, such persons may often be positive for microfilariae. In the chronic stage, other causes of oedema like heart or kidney disease, anaemia, malnutrition, etc., have to be eliminated. In the latter cases, the oedema will be soft and pitting as opposed to the hard, non-pitting oedema of chronic elephantoid cases due to filarial infection and in addition in such systemic diseases the swelling will invariably be bilateral.

CHAPTER VII

FILARIASIS SURVEY

To determine the extent of prevalence of filariasis in a community a survey is needed. The first handicap in such surveys is that by necessity the blood tests have to be carried out only by nights, due to the characteristic "nocturnal periodicity" of the microfilariae. Secondly, adequate representative samples of all age-groups and both sexes should be included in the survey. Thirdly, the people should not be asked to assemble at a central place, then only persons with filaria will come forward, as they will be keen that something must be done about their disease. It is essential that the persons should be at rest to increase the chances of detection of the microfilariae. Most of the carriers are unaware of the infection they are harbouring and are apparently healthy. In addition, as the survey is carried out at night, many women and children will be reluctant to come to a central place and hence age and sex representation will be selective. To avoid this, house-to-house surveys of the selected areas, examining as far as possible all the persons in each of the houses, should be carried out.

Apart from ascertaining details of the persons examined and obtaining blood from a pricked finger the details of the prevalence of disease processes in them should also be collected and recorded. The collection of data on disease processes is difficult involving tact on the part of the persons conducting the survey.

From the collected data, the infection and disease-rates are calculated, which when added together gives the endemicity-rate.

The degree of endemicity of an area will naturally be judged by the people and the amount of manifest disease in the local inhabitants, since filariasis becomes a public health problem only due to its prevalence. However, various degrees of endemicity hyper, moderate and low have been described, correlated with the infection and disease-rates determined by surveys.

Treatment

Treatment of filarial infection in any individual will depend on the stage of development of the infection in him. In the *invasion stage*, where only allergic manifestations are noted, the treatment will be symptomatic ; *i.e.*, use of anti-allergic drugs and calcium, etc., to relieve the symptoms. In the "symptomless" stage naturally no treatment will be sought.

For the acute phase symptomatic treatment, *i.e.*, rest, saline purgative (Magnesium Sulphate etc.) to relieve constipation, poultices or compresses for the painful lymphadenitis or painting the inflamed part with emollients like ichthol glycerine have been practised with varying degrees of relief. Sulpha-drugs and antibiotics like penicillin have also been used. If the lymph glands suppurate (develop pus), surgical intervention may be needed. Non-specific fever therapy or proprietary preparations like Arseno-typhoid or mixed vaccines of 'cocci' help to prolong the intervals between the attacks.

Recently, a synthetic drug 'Diethyl-carbamazine' has been prepared for the treatment of filariasis. Following the infections acquired by the U.S. Marines within a few months of their stay in the highly endemic areas in the Pacific during the World War II, researches were started in the U.S.A. to find out suitable therapeutic agents for filariasis. A group of workers including the late Dr. Yellapragada Subba Rao at the Pearl River Laboratories of Messrs Lederle Laboratories synthesised this compound, which, when orally administered was noted to act as a powerful microfilaricide. It has, therefore, a great utility in public health programmes as it reduces the quantum of infection that could be transmitted by mosquitoes. It appears to have no lethal effect on the adult worms, though it is stated to sterilise them. But it probably has some action on some of the developing forms. It has some beneficial effect on early cases, but does not appear to have any effect on established filarial disease.

There is no specific treatment for filariasis. A number of drugs have been tried with varying results. Organometallic salts of arsenic, antimony and lithium have been used. These are to be injected over a long period of time and as such are not useful for treatment on a large scale.

Chronic Stage

The main disease process is lymphoedema, *i.e.*, accumulation of lymph due to blockage of the lymphatic channels with consequent infection and tissue proliferation. Attempts at removal of extra tissues and possible restoration of lymph vessels have been practised by various surgical procedures. In addition to operative risks in removing these massive swellings, recurrence is likely to happen. In a few cases, another drug, cortisone, has been noticed to soften swellings, but its cost is prohibitive and the course has to be administered under medical supervision and repeated. Use of sodium fluoride has been suggested, but opinion is sharply divided about its efficacy. Considerable further work is necessary to develop a safe and satisfactory drug for treatment of the infection. With the availability of animal infections such as cotton rat filaria, such studies are being undertaken at various centres, including the Malaria Institute of India.

CHAPTER VIII

W. MALAYI FILARIASIS

Filaria endemicity due to *W. malayi* infection is known to be prevalent in restricted areas in India, the largest single endemic tract being along the coast of Kerala State. The concentration of the *W. malayi* incidence in Kerala State is in the districts of Quilon, Alleppey, Kottayam, Ernakulam and Trichur and on many islands on the Vembanad lake. It is estimated that about 1.5 million people live in the endemic areas, stretching over 650 sq. miles.

The carrier mosquito is *Mansonioides* sp. It breeds exclusively in water collections containing certain types of aquatic vegetation. The breeding is facilitated by organic contamination, e.g., retting of coconut husks for production of coir by the local people where coir-making forms a major cottage industry. Thus, it would be seen that *W. malayi* infection and disease are restricted to a geographically limited area.

Aquatic Vegetations

It would be no exaggeration to state that the existence of the disease (*malayi filaria*) and its vector is totally unwarranted. Certain types of aquatic vegetations are indispensable for the vector mosquitoes to complete their life-cycle. The aquatic vegetation serves no purpose in reality excepting to satisfy the age-old local belief that it clears the turbidity of the water and keeps it cool. This vegetation also serves as a cheap source of manure. The usual practice in this area is for every household to provide itself with several small shallow ponds and stock each one of these deliberately with floating vegetation. When such wells are used for soaking the coir, the organic pollution offers increased attraction for the breeding of these mosquitoes. Therefore, the coir industry *per se* does not contribute facilities for the breeding of the vector in the absence of the aquatic vegetation. Consequently in its primordial simplicity, the removal of the aquatic vegetation from all the tanks in this area and maintaining them free from them should eliminate for ever the mosquito and, therefore, the disease.

The incidence of the disease varies. Surveys carried out in the past (Iyengar¹ 1938, Jaswant Singh *et al*² 1956) have revealed that in some of the affected areas the microfilaria-rate ranges between 20 to 38 per cent. while the proportion of persons with visible filarial disease ranges from 12 to 42 per cent. The efficiency of the affected persons is considerably lowered. The production of coir and coir products, one of the major cottage industries of Kerala, definitely suffers a set-back due to loss of manpower resulting from the crippling sequelae of this infection. Apart from the crippling effect of the disease and the social discrimination the affected individual has to suffer, the disease has a profound adverse influence on the domestic and the national economy.

¹ Iyengar, M.O.T. (1938) Indian Medical Research Memoirs No. 30

² Jaswant Singh, Krishnaswami, A. K. and Raghavan, N. G. S. (1956) Ind. Jour. Mal. Vol. 10, p. 317.

Earlier studies on *W. Malayi* Control in India

Iyengar¹ (1938) described the intimate association of the *Mansonioides* mosquitoes, the vectors of *W. malayi* infection with the aquatic vegetation, *Pistia stratiotes*. The removal of pistia from the ponds in the area has been attempted in localised areas of Shertallai and Ambalapuzha taluks. Practical difficulties in successful elimination of this water-weed are due to popular opposition to clearing of the vegetation.

Field trials were instituted by the Malaria Institute of India in 1954-55 and later by the State Health Department to test the efficacy of the synthetic insecticides in intercepting transmission of *W. malayi*. The results indicated that *Mansonioides* sp. are highly susceptible to BHC. At a dose of 40 mgm. gamma isomer per sq. ft. the residual effect of a single spray was observed to last over 20 weeks.

A field enquiry under the Director, Malaria Institute of India (financed by the Indian Council of Medical Research) recently completed the investigations on the optimum dosage schedule of Diethyl-carbamazine for mass administration in *W. malayi* areas. The enquiry revealed that the optimum dosage would be 4 mg/kg. once daily for five days. The administration of the drug was observed to be followed by varying degrees of reactions in some persons. In general the reactions were more severe than those in persons with *W. bancrofti*. It is felt that *W. malayi* control by insecticidal application alone is practicable, in view of the high susceptibility of *Mansonioides* mosquitoes to the residual insecticides tested, and the innate difficulties in carrying out a mass drug administration campaign.

¹Iyengar, M.O.T. (1938) Indian Medical Research Memoirs No, 30.

CHAPTER IX

FILARIASIS CONTROL

Though filariasis has been prevalent over centuries, studies on the control of this infection have been limited. This was due to various factors, unlike most other diseases, neither the infection, nor the disease produce a dramatic effect ; deaths directly due to the infection are negligible. The nocturnal periodicity of the appearance of the microfilariae necessitate the collection of blood at night. Above all, the lack of practicable, economic and potent tools against the vectors or the parasites was an important handicap. With so many other pressing and acute health problems, the filariasis problem has not received sufficient attention.

Filariasis becomes a public health problem when there is a considerable prevalence of filarial disease in the community. The disease is the result of repeated infection of man through bites from infected mosquitoes. The rational approach to check the spread of filariasis will, therefore, be to control (a) the mosquito (in its aquatic and/or adult stages) and (b) the parasites in the human beings. It is neither necessary nor feasible, economically, to eradicate either the mosquitoes or the parasites in the human beings. The first obvious thing to do is to prevent mosquito breeding places (mosquito-genic conditions) in the neighbourhood of human habitation. Such conditions are mostly man-made such as housing, industrial, agricultural undertakings. Thus, the pressing need is for the improvement of environmental sanitation though such methods have their limitations under rural conditions.

W. bancrofti is prevalent to a great extent in urban/semi-urban areas, though it is not altogether absent in rural areas. *C. fatigans* is the primary vector. This mosquito prefers water with high organic contamination generally associated with insanitary conditions. The permanent methods of control against *C. fatigans* would be the installation of a proper drainage scheme. As enormous amounts of money and material are needed for such a large scale programme this has to be necessarily phased. The following 'recurrent' methods are in vogue so far in most places.

Early attempts were made at controlling the breeding places of *C. fatigans*. Soakage pits were built to find a cheap and efficient answer to the problem of individual household water-disposal. They most often failed due to faulty construction, or the high water-table prevalent in the areas and due to poor maintenance.

The use of oil as a larvicide has so far yielded most consistent results in larva control. Initially, crude or waste engine oil was used but, it was soon found that it did not spread well on the highly polluted water surfaces. Thus spreading-agents were added to oils later made more toxic by the addition of toxicants. The handicaps in using oils as larvicidal agents were lack of uniform quality, uniform spread, and instability of such films and variations in mortality among the larvae. The presence of a surface scum (impurities) in some areas, needing removal prior to oiling, is an added handicap. As yet, no oil composition has been found which will meet all requirements for ensuring control of culicines.

FILARIASIS CONTROL

The extensive breeding grounds, the long flight-range of the mosquitoes which transmit this disease and the tendency of the local bodies to limit control activities within their boundaries, are practical difficulties experienced. An added difficulty is the enormous quantity of oil which needs to be hauled, stored, distributed, transported and applied. For a population of 100,000 the approximate annual requirement would be about 20,000 gallons to achieve satisfactory larval control measures. Further, while larval control is the method of choice in urban/semi-urban areas, in rural areas the provision of effective supervision renders the method very expensive.

As an anti-adult mosquito measure pyrethrum, as a space-spray has been used with some effect. There is, however, one difficulty and that is the need for frequent spraying of all houses for effective interception of transmission which poses economic and administrative problems. While construction of drains will ensure more permanent control, in most cases however, the drains when constructed are open and made without considering the peak and off season discharges, without a cunette¹ so that the flow is neither properly maintained nor disposed of. Poor maintenance of such drains leads to even greater mosquito-breeding than the absence of such measures. It is essential that provision is made for the proper maintenance of drainage systems and an agency set up for the purpose.

As for measures against *Mansonioides* for the control of *W. malayi*, the most rational thing is to deny favoured environments for the vector by removing aquatic vegetation, with which it is closely associated. This was suggested by Iyengar² in 1931—34 in Shertallai, a highly infected *W. malayi* area in Kerala State. The utility of such a method of control in pilot studies was scientifically proved by Sweet and Pillai³ (1937). This method practised for about 15 years, showed that there were practical limitations for its continuous use. In 1950, the Director, Public Health of Travancore State, therefore, requested the Government of India to suggest efficient, practicable and economical alternate methods of control. The reasons for such a change were the rising labour costs and the people not being in favour of removing the *Pistia* plants growing in small ponds. These plants serve as green manure, and are believed to keep the water clean for drinking purposes as also to prevent rapid evaporation of water in summer. In other areas with *W. malayi*, e.g., Assam, such manual removal of *Pistia* may be possible, though not practicable, due to the existence of extensive breeding grounds in comparison with the low density of population to be protected.

¹A narrow, small, central ditch built in the bed of a large drain.

²Iyengar, M.O.T. (1938) Indian Medical Research Memoirs, No. 30.

³Sweet and Pillai V.M. (1937) Ind. Med. gaz Vol. 72, p.730.

CHAPTER X

NATIONAL FILARIA CONTROL PROGRAMME

As a result of the Second World War potent insecticides and a powerful filaricide became available for civilian use since 1947. The availability of these tools raised fresh hopes among the Public Health workers towards successfully fighting the scourge of filariasis which had so far remained a challenge.

A pilot scheme under the Director, Malaria Institute of India, sponsored jointly by the Orissa State and Indian Council of Medical Research, was set up in Orissa in 1949, to study the relative efficacy of the anti-larval, anti-adult measures against *C. fatigans* and mass treatment with Diethyl-carbamazine in the control of bancroftian filariasis. The results of these studies and observations in other areas of the world showed that filariasis could be controlled by a combination of mass treatment with Diethyl-carbamazine and recurrent anti-mosquito measures.

In spite of increase in the health consciousness amongst the people, and the availability of potent insecticides and a powerful filaricide, a large scale execution of filariasis control was limited due to lack of financial resources. In 1953, the Filariasis Advisory Committee of the Indian Council of Medical Research, recognizing the magnitude of the filariasis problem and its socio-economic effects in India, discussed a programme (National Filaria Control Programme) drawn up by the Director, Malaria Institute of India based on the results of the Orissa Studies and experiences gained in other parts of the world. The Committee recommended the Plan to the Government of India for consideration and acceptance in the first Five-Year Plan period as phase I, to be extended during the second plan period with suitable modifications from the experiences gained. During its working in the first plan the programme envisaged that the Union Government should make available free supplies of equipment and material and the participating States should bear the operational costs. The willingness of the U.S.T.C.M. Advisers to support and aid the implementation of the programme helped in taking a final decision.

Objectives

The objectives of the National Filaria Control Programme are (1) to delimit the extent of filariasis in the country along with the types of prevalent infections and their vectors by establishing 22 survey units in the States where filariasis was a public health problem, (2) to evaluate the known methods of control limiting the scope to areas with *W. bancrofti* infections only and (3) imparting of training in filariology to Medical Officers and Inspectors engaged in this programme by the State Governments concerned. The programme envisaged the setting up of a number of control and survey units, each control unit to cover 3 lakh people and so phased as to afford protection to an estimated 25 million people by the end of the second plan period.

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The Indo-U.S. agreement was signed on 25 March, 1955 and the programme started in the last year of the first Five-Year Plan period. The programme was to be run by the participating State Governments with an assistance from the Central Government which arranged for aid from the U.S.-Technical Co-operation Mission. The Government of India with the foreign aid made available the necessary quantities of insecticides, drugs, larvicides, spraying equipment and vehicles. The responsibility for the operational costs and the execution of the programme in the field was vested with the State Governments. The programme was to be jointly financed by the State and the Central Governments—the latter being partly met through aid from the U.S.T.C.M. The break down of the annual expenditure on the project is presented in Appendix II. The aid from the U.S.T.C.M. has been discontinued with effect from 1958-59. The methods of control were (1) a single round of mass therapy with Diethyl-carbamazine in a dose schedule of 4 mg/kgm of the citrate salt for five days covering as many persons as possible among the population to be protected under each unit in urban and rural areas and (2) recurrent mosquito measures: (a) weekly anti-larval measures with one round of insecticidal application to tackle the peak season of *C. fatigans* in urban areas and (b) three rounds of insecticidal application only in rural areas. The larvicide recommended was B.H.C. 50% w.w.p. and Dieldrin was to be the insecticide against the adults applied in a dose of 50 mgms. per sq. ft.

PROGRESS

Training

The Filariasis Training and Research Centre set up at Ernakulam in August 1955 has been periodically holding a six-week course (since changed to 8 weeks) for Medical Officers and a four-week course for Filaria Inspectors. So far 70 Medical Officers and 121 Inspectors have been trained in Filariology.

Survey Units

22 survey units were allotted in 1955-56 of which only 18 have functioned. Filariasis survey units have the exclusive assignment of getting the correct appraisal of the extent of filariasis and epidemiological data regarding the incidence of filariasis in the participating States. This was expected to be completed by the end of the First Plan period. If, however, the surveys were not completed within the specified period, it was the responsibility of the State to continue maintaining the survey units till such time the delimitation was completed. In addition, no further aid towards the survey was planned to be given to the States beyond what was offered during 1955-56.

The results of the surveys carried out indicate that the originally anticipated size of the problem was an under-estimate. Large areas of Bombay State, the eastern parts of Uttar Pradesh, the former Bundelkhand areas as also areas under the Corporations of Madras, Calcutta and Bombay have still to be surveyed. The population currently estimated to be at risk is about 40 million.

Control

So far 46 ³/₅ control units have been allotted to the States participating in the Programme, of which all except one in Assam have been established. The details of the work carried out in various States is set out in Appendix I.

For the efficient working of the units and proper assessment of results, working notes prepared by the Malaria Institute of India, have been made available to the units. Close liaison between the Institute and the units operating in the States is maintained by frequent visits by the officers of the Institute.

Appendices II and III set out the details regarding the allotment, the cost, the material and equipment made available to each unit and the financial implications of the programme.

N.F.C.P.—Its Problems

Any infection becomes a public health problem when the resultant disease affects a large section of the population in the community. The efficacy of any control measure or measures carried are to be judged by their effect on the "disease" processes. Paradoxically enough, in filaria the persons with the diseases have few or no microfilariae and are not capable of infecting the mosquitoes. On the other hand, "symptomless" but infected persons who are positive for microfilariae are the real danger to public health. From the point of view of the individual, however, the person with disease wants to be relieved of his burden although the apparently healthy microfilaria carrier is averse to being drugged. There is as yet no specific cure to relieve or eliminate the swellings. Thus, in filaria control there is a great need for health education of the public and research for remedies. Further, there are some technical problems; more detailed information in relation to the vectors and the parasite can only be elucidated by planned field studies.

Experiences in Mass Therapy

Diethyl-carbamazine has a quick and dramatic effect in reducing the numbers of circulating microfilariae to zero or very low levels. This zero or low microfilarial level is maintained for varying periods of time following therapy, depending usually on the dose-schedule adopted.

One serious drawback in the use of this drug is that a great number of microfilariae are destroyed in a relatively short time resulting in reactions varying in their degree of severity. These reactions are mainly due to the amount of foreign matter (protein) suddenly released in the body due to destruction of microfilariae. The reactions start 24-36 hours after the initial dose and consist of nausea, vomiting, headache, fever, body pains, gastro-intestinal (stomach) upsets, occasionally pruritus (scratching), and in a very small number of cases, urticaria and abscess formation of the lymph-glands. Some complain of exacerbations of their filarial conditions, e.g., lymphoedema or lymphadenitis. Most of the reactions are transient and disappear despite continuing the therapy with or without symptomatic treatment, though, a small percentage of those with reactions need some medical attention. Apart from affording relief from the reactions, such attention helps to ensure better public co-operation in the programme. The reactions are generally noted in persons with microfilariae, many of whom are usually 'symptomless'. Thus, the sickness, apart from personal discomfort, even for a few days, especially in persons who were asymptomatic, poses a bigger problem. It is because it results in the loss of wages of apparently healthy persons during the sickness. This is really acute in the poorer sections of the population.

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The fever and reactions, the likelihood of abortions in pregnant women (already in substandard state of health), or exaggeration of existing troubles in persons with chronic illnesses, e.g., heart or kidney trouble or mental ill-health, makes it necessary to provide for attention.

From the point of view of economy, and because the drug is not found to be beneficial in advanced cases, there is a feeling that it may be withheld from such cases. It has also been suggested that the drug be given only to microfilaria-positive persons. From the public relations angle and expediency in the field, it is recognized that it is preferable to give it to as many as possible i.e., as a "mass therapy".

Other difficulties noted in carrying out mass therapy are due to adverse propaganda by local interests adding to the normal general antipathy to take drugs when one is apparently normal. Many drugs have been tried to relieve or eliminate the reactions. A cheap, efficient and practicable remedy is yet to be found. Mass therapy is only an adjuvant to mosquito control and the objective is to get a reduction in the reservoir of infection in the community in as short a time as possible. Besides, diethyl-carbamazine is the only available known drug. So, mass therapy is still an advantage.

A proper sewerage system is a permanent solution for the *C. fatigans* problem in urban areas. As there are a large number of urban areas having the filaria problem schemes for providing drainage in each of them will necessarily have to be phased. Priorities under the National Water-Supply and Sanitation programme, however, are expected to be given to State Governments' programmes in respect of such urban areas as have the filaria problem. In such areas, water-supply schemes should invariably be considered with collateral drainage schemes. As for rural areas, drainage presents a problem and should receive earnest attention from the Public Health Engineers.

RECURRENT MEASURES

Larva Control

Application of larvicides is attended with a number of difficulties. Breeding grounds vary in their types and extent in different places. Patna (Bihar) and Surat (Bombay) can be quoted as instances. With almost the same population in the two areas, in the latter a maximum of about 100 acres would need weekly anti-larval treatment, while in the former probably it would be in the neighbourhood of over 800 acres. In addition, the turn out of work per *mazdoor* varies. The habits of the people differ in urban/semi-urban areas and the domestic and para-domestic breeding areas present a continuous problem.

Adult Control

For rural areas, three rounds of insecticidal spraying at 50 mgm/sq. ft. of Dieldrin are provided. In areas where malaria co-existed with filaria, the question of avoiding duplication of spraying has been taken into account. For filaria control, a higher dose and more frequent spraying of insecticide is required.

Based on reports from abroad and of small-scale studies in India, Dieldrin was selected as the insecticide under the National Filaria Control Programme.

Applied at a dose of 50 mg. per sq. ft. this insecticide was observed to have a residual effect lasting over a period of about 14 weeks against *C. fatigans*, while B.H.C. was observed to have similar effect at a dose of 44 mg. gamma-isomer per sq. ft. Dieldrin was chosen for indoor residual spraying as its application on the walls was comparatively easy, due to the high concentration (50%) of the water-dispersible powder available, while B.H.C. being of low concentration (6.5%) needed to be sprayed twice over to give the required dosage. In view of the encouraging reports about the larvicidal efficacy of the B.H.C. formulation, it was planned to use this preparation as a larvicide under the National Filaria Control Programme.

Results

The results following the use of Dieldrin under the programme have not been encouraging. The residual effect has not lasted more than 3-4 weeks and reports of toxicity among the workers and domestic animals have been received. Increase in fly prevalence following Dieldrin spraying has also been reported from some municipal areas.

B.H.C., as a larvicide, has not given uniformly good results due to wide variations in the breeding places. In addition, reports of larval resistance have also been received from Madras State, where B.H.C. was used as a larvicide in an urban area. General scientific opinion is that the chances of resistance among mosquitoes increase with use of synthetic insecticides both for larva and adult control. It is now proposed to supply oil for use as arvicide in future under the National Filaria Control Programme.

CHAPTER XI

SOCIAL AND ECONOMIC EFFECTS OF FILARIASIS

Filariasis and its *sequelae*, i.e., of elephantiasis of parts of the body including the genitals, have been recognised in India from ancient times. The mortality directly due to filaria is negligible. The morbidity, though considerable, is not readily assessable due to (1) the social stigma attached to persons having the disease and (2) lack of a remedy. For these reasons, even hospital statistics do not present a true picture. Further, as no data on quantitative estimates of time lost in man-days for illness due to filaria are usually available, it is difficult to state the economic loss due to this infection. However, the following account reflects the general trend in regard to the social and economic aspects of filariasis in India.

Sir Frank Connor¹, (1927) stated "Filariasis may be compared to an evil genius, whose stakes are human lives and whose dice are heavily loaded. Surely, we must do something to destroy the genius or at least to unload the dice. The incidence of filarial disease at present, is incalculable."

Commenting on the filaria situation in Orissa, he said, "Leprosy is a disease of much smaller incidence causing less misery and much lower mortality, yet leprosy claims abundant funds and highly skilled workers. These efforts are most praiseworthy in their attempt to prevent and cure a most disgusting disease, but they leave one wondering more at a comparative neglect of a disease of greater importance."

Knowles and Basu² (1934) in a report on the mosquito prevalence and mosquito-borne disease in Calcutta city, reported filariasis to be a serious economic problem in Calcutta where a large proportion of the Anglo-Indian and Hindu population of the city were infected. Anglo-Indian girls—stenographers, typists, employees in the telephone exchanges—were infected in large numbers and the disease caused them much loss of pay and employment.

Relevant extracts from the report of the World Health Organisation study group in filariasis held in December, 1955 at Kuala Lumpur are produced below:—

Social and Economic Effects

The importance of this disease as an injury to the welfare of a community may be considered from three aspects:

- (a) the economic loss,
- (b) the amount of deformity and other 'sequelae' produced, and
- (c) the psychological injury caused by fear and anxiety.

Quantitative estimations of the injuries caused are difficult to make in the case of filariasis, but illustrative examples may be cited to show that these are considerable.

¹Frank Connor P. (1927) Far Eastern Assoc. Trop. Med. 7th Congress Br. India Vol. 1, (205).

²Knowles R. and Basu B. C. (1934) Rec. Mal. Sur. Ind. Vol. 4, p. 291.

Economic Loss

Quantitative measurements on the economic loss due to filaria are more readily made in certain industrial communities than in rural communities affected by filariasis. In Cochin 20 per cent. of the adult males have elephantiasis of the legs while recurrent attacks of lymphangitis and the more chronic disabilities resulting from elephantiasis cause considerable loss of earning capacity among coir workers.

Deformities and Sequelae

The production of deformities by elephantiasis is too well known to need description. The extreme cases are a challenge to society. The less extreme cases are probably still more important because of their greater number. In heavily infected areas in India 30 per cent. or more of the adult population may be affected by elephantiasis or hydrocele of varying degrees. The disease is not fatal, but the constant impairment of their activity and happiness can easily be observed.

In patients with chyluria, health is impaired by loss of blood and protein in the urine and by secondary bacterial infections of the bladder.

Fear and Anxiety

In the endemic areas of filariasis fear and anxiety are often considerable. The psychological disturbances caused due to fear of filarial infection are well known. Elephantiasis of the legs is dreaded by young women since it would ruin their prospects of family life.

In many countries, sufferers with elephantiasis are thought to be capable of infecting their contacts and they are accordingly shunned as social outcasts. Many cases of suicide among the sufferers are reported.

While no exact figures can now be given, there seems no doubt that the social and economic effects due to filariasis in India are considerable. With a population of over 40 million at risk and with about 4 million sufferers with one or more types of disease processes and more being added from year to year, the magnitude of the problem can easily be guessed.

APPENDIX I
NATIONAL FILARIA CONTROL PROGRAMME
DISTRIBUTION OF FILARIA CONTROL UNITS SANCTIONED

Serial No.	Name of the State	1955-56	1956-57	1957-58	1959-60	Total units allotted
1	2	3	4	5	6	7
1	Andhra Pradesh ..	2	—	—	—	2
2	Assam	—	—	1	—	1
3	Bihar	2	2	4	—	8
4	Bombay	3	1	4	—	8
5	Kerala	1-3/5	2	3	—	6-3/5
6	Madhya Pradesh ..	1	—	—	—	1
7	Madras	—	2	2	—	4
8	Mysore	2/5	—	—	3/5*	1
9	Orissa	1	4	—	—	5
10	Uttar Pradesh ..	1	2	5	—	8
11	West Bengal	1	—	—	—	1
12	Pondicherry	—	—	—	1	1
TOTAL ..		13	13	19	1-3/5	46-3/5**

*Transferred from the second surplus unit of West Bengal.

**The total number of units allotted is 47. The remaining 2/5 units is to be accounted for against the Islands Administration.

APPENDIX II

NATIONAL FILARIA- CONTROL PROGRAMME

Statement showing the year-wise assistance given by the Centre to the States during the Second Five Year Plan

(Rs. in lakhs)

Serial No.	Name of the State	1955-56	1956-57	1957-58	1958-59	1959-60
1	Andhra Pradesh ..	1.92	4.56	4.43	1.72	1.27
2	Assam	—	—	1.39	0.31	0.59
3	Bihar	4.43	9.01	16.87	4.99	11.39
4	Bombay	1.39	6.12	19.63	3.33	8.05
5	Kerala	1.85	5.56	12.81	4.84	12.73
6	Madras	1.92	2.97	8.74	2.33	3.14
7	Madhya Pradesh ..	1.86	3.00	1.83	0.05	0.62
8	Mysore	—	0.83	0.70	0.28	1.54
9	Orissa	2.18	7.18	13.64	4.12	3.56
10	Uttar Pradesh	2.02	4.68	18.20	3.46	9.39
11	West Bengal	2.01	0.84	3.24	—	0.37
12	Andaman & Nicobar Islands.	0.59	0.60	0.36	0.40	0.50
13	Laccadive and Minicoy Islands.	—	—	0.25	0.32	0.36
14	Pondicherry	—	—	—	—	—
15	Malaria Institute of India	—	0.07	—	—	1.41
TOTAL ..		19.17	45.42	102.14	26.15	54.92*

*Approximately represents Central assistance made available to the States. The bills for the entire amount were, however, not submitted by the firms before 31st March, 1960.

APPENDIX III
NATIONAL FILARIA CONTROL PROGRAMME

New Pattern supplies (from 1958-59)
(Government of India)

Serial No.	Name of article	Quantity	Approximate rate (inclusive of customs duty, etc.)	
			Rs.	Rs.
<i>New Control Unit</i>				
1	Station Wagon	1	15,000	15,000
2	Jeep	1	13,000	13,000
3	Jeep Trailer	1	1,500	1,500
4	Microscope	1	2,000	2,000
5	Hand Compression Sprayers	32	200	6,400
6	Stirrup Pumps	25	100	2,500
7	Insecticides	6 tons.	16,000	96,000
8	Mosquito Larvicidal Oil	30,000 gallons.	2	60,000
9	Diethyl-carbamazine tablets 100 mgm. each	1.6 million tablets.	—	79,600
TOTAL ..				2,76,000
<i>Continuing Unit (After first year)</i>				
1	Insecticide	12 tons.	16,000	1,92,000
2	Larvicide	30,000 gallons.	2	60,000
TOTAL ..				2,52,000
<i>States share of expenditure per unit</i>				
1	Salaries of staff			77,000
2	Handling charges etc.			4,000
TOTAL ..				81,000*

*In case of Bihar State, the provision is Rs. 92,000.00 per unit as proposed by the State.

APPENDIX IV
NATIONAL FILARIA CONTROL PROGRAMME
Statement showing work done up to 31-3-60

State	Population covered with survey	No. of persons given drug	No. of houses sprayed				Total
			1st round	2nd round	3rd round	4th round	
1	2	3	4	5	6	7	8
Andhra Pradesh	10,94,488	2,30,658	2,36,886	61,049	45,066	—	3,43,001
Bihar	24,37,347	13,77,979	3,90,014	2,39,433	27,291	—	6,56,738
Bombay	12,33,640	3,02,990	3,36,689	1,43,388	36,550	—	5,16,627
Kerala	15,66,211	5,80,042	3,86,112	2,07,262	1,20,397	402	7,14,173
Mysore	2,09,562	81,883	29,831	7,852	—	—	47,683
Madhya Pradesh	25,66,540	1,98,826	3,651	—	—	—	3,651
Madras	29,63,285	5,59,836	71,481	—	—	—	71,481
Orissa	91,70,000	5,29,270	10,83,966	4,47,259	18,427	—	15,49,652
Uttar Pradesh	21,71,218	12,83,652	41,195	33,294	17,225	—	91,714
West Bengal	2,660	—	—	—	—	—	—
Assam	—	—	—	—	—	—	—
Andaman	6,790	867	7,636	1,925	48	—	9,609
	2,34,21,741	51,46,003	25,87,461	11,51,462	2,65,004	402	40,04,329

APPENDIX V

NATIONAL FILARIA CONTROL PROGRAMME

Statement showing the year-wise Central and State Expenditure

(Rs. in lakhs)

Year	Central Expenditure		State Expenditure
	T.C.M.	Govt. of India	
	1955-56	14.48	0.83
1956-57	32.38	15.48	9.43
1957-58	64.38	43.09	16.45
1958-59	0.18	29.16	29.14
1959-60	0.61	31.09	32.08
TOTAL	112.03	119.65	91.85

APPENDIX VI

NATIONAL FILARIA CONTROL PROGRAMME

Cost of a Continuing unit under the old Pattern up to 1957-58

Name of item of expenditure	T.C.M. Share		Government of India Share		State Share	
	Recurring	Non-Recurring	Recurring	Non-Recurring	Recurring	Non-Recurring
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1. 12 tons of Dieldrin	—	—	2,25,000	—	—	—
2. 11 tons of B.H.C. ..	—	—	18,700	—	—	—
3. Customs duty of Dieldrin.	—	—	—	—	—	—
4. Salaries of staff, etc.	—	—	—	—	77,000	—
5. Handling charges ..	—	—	—	—	4,000	—
TOTAL	—	—	2,43,700	—	81,000	—

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