Malaria Control

Introduction

According to Sir Malcolm Watson, a prominent malariologist who has worked intensively in Malaya, malaria is considered the world's public enemy No. 1. In India alone, malaria affects directly or indirectly about 150 million people and is responsible for 2 million deaths a year at a cost of over 100 million pounds. It was stated that there is little hope for improvement in agriculture in India so long as the rural population continues to bear this enormous burden of sickness.

Sir Watson showed that the reduction in mortality due to malaria was accompanied by a striking reduction in mortality due to other diseases.

That malaria can be controlled even in hopelessly malarious places has now been established. A few classical examples are:

a. The Zambesi Bridge construction in Africa.

b. The Panama Canal construction.

c. The Singapore Naval Base construction.

Rural malaria in scattered indigenous populations in the tropics presents at first sight an insoluble economic problem, but the number of victories over this disease by the use of nature's own simple methods is growing in an encouraging way. It is now becoming evident that passive acceptance of malaria as a necessary evil is out of date and should be replaced by an active interest in the part of the community who alone can help medical authorities to achieve best results.

Nature of Malaria

1. Three groups of parasites.

The quartan—72 hours and fever every 4th day.

The benign Tertian—48 hours and fever every 3rd day.

The malignant Tertian—48 hours with irregular occurence of fever.

2. Terminology.

As a help to the fundamental knowledge of malaria a few terms need explaination here:

a. *Parasite Index*—Percentage of children having parasite in their blood and determined by using microscope and prolonged work. In gives important information but spleen rate is usually preferred.

b. *Sexual Cycle*—Each group of parasites has sexual forms which go through a cycle of development in the mosquito lasting about 10 days. When the mosquito bites a person at this stage it injects into the blood the parasites which after another 10 days begin a new attack and so the vicious circle is completed.

c. *Spleen Rate*—When a child is repeatedly infected with the parasite his spleen becomes enlarged. An enlarged spleen may be easily felt by pressing the fingers through the walls of the abdomen. The spleen rate is the percentage of children, preferably those born and bred in the area between the ages of 2 and 10 years whose spleen are enlarged and can be felt.

Spleen rate which is determined among children only (adults do not show enlargement of the spleen caused by malaria) is a good indication on the degree of malaria endemicity in any particular malarious area. The malaria intensity of an area may be determined by the spleen rate as:

Spleen Rate:

Under 10%—healthy

10%—25%—low or moderate endemicity

25%—50%—high endemicity

over 50%—higher endemicity

Lecture given by Mr. F. A. Maclang at the Mechanical Logging Training Centre, Los Baños, Laguna, last March 12, 1953. Mr. Maclang, formerly with the U. P. College of Agriculture, Bureau of Plant Industry and Gregorio Araneta, Inc., is now employed as entomologist of the Shell Company of the Philippines. He has many years of field experience in the control of insect pests affecting agriculture.

N. B. Due to an oversight, for which the editorial staff expresses its regrets, the authorship of the article entitled "Malaria Control" was wrongly ascribed to Prof. Teodoro Delizo.

A short explanation is here given on the terms used above. Endemicity is the degree of malaria incidence in an area as measured or shown by the spleen rate. Where the endemiates are over 50% the area is known as having higher endemic incidence.

Endemic malaria is usual in regions where the spleen rate is more or less constant all throughout the season.

Seasonal malaria is usual in areas where the transmission period is not more than 6 months of the year. Here pre-immunity is not established and there is a marked swing in the spleen rate with tendency to epidemics especially during the presence of increased anopheline vectors.

CONTROL OF MALARIA

Since the parasites affect man and mosquito in its normal cycle, the disease can be attacked therefore at two points:

a. *The parasite in man.*

By the use of drugs as treatment and preventive.

(1) Quinine
(2) Mepacrine (Atabrine)
(3) Pamaquine
(4) Aralin

The use of these drugs as treatment is best explained by medical malariologists. Sir Malcolm Watson, who is also an M.D., concluded after extensive trials using quinine that:

a. Quinine acts on the individual either by attenuating the virus or by increasing the resistance of the host.

b. That the infected persons, though freed from clinical symptoms by quinine, might still remain infective so that in the presence of the vectors and new arrivals of newly born and imported labor, it will be impossible to eradicate malaria.

After a considerable amount of experience on the action of the newer drugs mepacrine and pamaquine, an international committee on malaria control concluded that:

In large malarial areas especially in the tropics, man's treatment using these drugs is impossible for various reasons, principal of which is financial.

In places where these drugs are being used often the treatment is carried out by laymen and practically no medical supervision is possible.

In short, therefore, Sir Malcolm Watson said that eradication of malaria by drugs and prophylactic treatment is practically impossible at present because it is always hard to reach in sufficient time all inhabitants of an area or even of a small village.

Another important point is that control by drugs in considerable quantities is more expensive than the control of the mosquito.

Personal Safeguards

1. The use of repellents.
2. Mosquito nets and boots.
3. In static conditions—screening of the windows and doors.
4. A regular dose of 5 to 10 grains quinine —a dosage found to reduce frequency of cerebral malaria and blackwater fever.

   Dosing must be regular, otherwise it will be dangerous because of gastric disturbances.

CONTROL OF THE VECTOR

This is the most practical method of controlling malaria and since this will mean control of the anopheline vectors, a short note is being given here to show that there are only 17 species known to be dangerous carriers.

There are about 1700 species of all kinds of mosquitoes in the world. Of these, 170 are anophelines. Out of this 170 species only 17 are capable of transmitting malaria parasites. Of this 17 species only one or two species afflict any particular locality.

To control malaria then, it is only necessary to concentrate efforts against the one or two species concerned and this involves a process known as "species sanitation."

Advantages for Larval Control as Opposed to Adult

Experience shows that it is much better to seek out and destroy the mosquito in its larval or aquatic stage in the breeding grounds than to control the adults. The new chemicals, however, such as DDT and Dieldrin may revise this contention in the near future. In the meantime, we give below the advantages of larval control.

1. Organization and supervision are more easily and exactly conducted in the open than in people's home.
2. It frequently brings in its train advantage to the community other than freedom from malaria—that is the improvement of the land by drainage.
3. Certain methods of biological control may be classified as permanent, in that the recurring cost of upkeep is cut down to a minimum.

Approach to Control

Before setting down to the control proper of malaria mosquitoes, certain preparations are required. First and foremost is the question "Is malaria control necessary at all and if so to what extent is it economically justifiable."

Malaria is frequently a very local problem. Areas not widely separated in distance may vary considerably in healthiness, according to their respective suitability for the propagation of the local vector.

We should, therefore, have an idea of the density of malaria in the area or a picture of the ebb and flow of the malarial tides within a given area as revealed by the study of the spleen rate in relation to the sick, birth and death rates.

As we have discussed earlier, the spleen rate is a good index to determine the malarial intensity of a given place. Spleen rate in areas of high endemicity is more or less constant, but in places where malaria is seasonal it is subject to fluctuation and the area is liable to epidemics that may show a fairly well defined periodicity.

Aside from the spleen rates we should also plot on squared paper the morbidity, mortality and birth rates of the place. Consideration of these data compiled over a series of years will enable one to form a fair estimate of the general level of health in the area in the past and perhaps to foretell something of its course in the future. As malaria is the dominating factor in the health of the community, the curves of morbidity and mortaliy will show the seasonal incidence and occurence of epidemics. They should also be correlated with the rainfall humidity and temperature records.

Another indication of the intensity of malaria in a given place is the parasite rate. Children form the main reservoir of parasites and the percentage of those between 2 and 10 years of age who harbor parasites in their blood gives an indication of the amount of infection in the community. This index, however, is not so reliable as the spleen rate because of the frequent fluctuations both in the community and the individual.

After considering the above and having properly determined the degree of malarial intensity then the next move will be to decide on the type of control needed. Should the control call for larval control, then 4 main points must be determined, namely:

1. The size of the area in which control will be necessary, that is the zone of protection.
2. The distribution of malaria within the area as shown by spleen rates.
3, The species of anopheline responsible for carrying malaria within the area as shown by dissection of the guts and salivary glands.
4. The breeding places.

METHODS OF CONTROL

At this stage we know now the vector and its breeding places. We are now in a position to choose an appropriate method of control. As hints we should consider that anophelines in general breed in clean water and different species show preference for varying degrees of stagnation or current, of shade or sunshine, or of other factors such as salinity.

The essence of control is water management in the broad sense, which includes any alteration in its nature to make it unsuitable for anopheline breeding, as well as mechanical interference with its area or flow.

For purposes of discussion we will group the above methods to:

1. Natural
2. Mechanical

The natural method embraces a variety of methods, some of which require aids from mechanical group. The first are:

a. *Alteration of Salinity* — Either by increase or decrease. This method is more adaptable in coastal areas.

Decrease of Salinity

The reclamation of land Zuider Zee in Holland. As reclamation proceeds, the brackish dikes become fresh and *A. maculipennis var. atroparvus,* the vector, was replaced by *var. messeae,* a non-vector.

Increase of Salinity

The conversion of a brackish marsh in Durazzo, Albania into a salt water lagoon by regulating the inflow and outlet of the sea and the consequent elimination of *A. elatus* the vector, and the creation of a profitable fishing industry.

b. *Alteration of Larval Food Supplies.* The periodic emptying and drying of the sea water fish ponds on the coast of Java, whereby the thick surface growth of green algae, wherein both the fish and *A. aundaicus* larvae maintain themselves, was replaced by a bottom growth of blue-green algae which provided no shelter for the larvae but abundant nourishment for the fish.

c. *Alteration of Character of Breeding Pools.* By trampling or throwing in cut grass and shrubs to convert a pool of clean water suitable for anopheline into a foul fermenting swamp from which they turn away.

d. *Alteration of Light and Shade.* By planting suitable thick growing shrubs along the banks of narrow streams to turn their sunlight channels into dark tunnels, or by encouraging a dense growth of vegetation in the swamps. This method is effective against *A. minimus* in Assam.

e. *Introduction of Natural Enemies.* The top feeding minnow, Cambusia, is the only one worth serious attention. It is a prolific fish in any climate but is handicapped by running water or matted vegetation. It is rarely that it can achieve complete control single handed but in time under favorable conditions it can exert a notable influence.

THE MECHANICAL METHOD

(The regulation of water flow or level)

1. *Irrigation*—In Java *A. aconitus* is the vector in the extensive rice growing areas. The irrigation ditches and field lying fallow were the breeding places and not field under cultivation. The problem was solved by keeping the ditches free from woods and cutting off the water after rice harvest.

2. *Flushing*—Professor K. B. Williamson in Malaya had controlled *A. maculatus,* a stream-breeding vector, by a system of periodic flushing. A dam at the head of the stream releases at intervals and the sudden flush of water strands or drowns the larvae. Judiciously applied, it gives complete protection at a low cost.

3. *Damming*—Swamps and levels too low for successful draining may in suitable locations be dammed and converted into lakes. In effect this is a limitation of breeding area by substituting a large sheet of open water where anopheline will not breed.

4. *Filling*—All holes capable of breeding anophelines should be filled. Examples of these holes are:

a. Crab holes—These are dangerous breeding places and also because they may weaken embankments of a drainage scheme.

In cases when these holes are numerous —poison the crabs using poison baits (Aldrex baits).

b. Free holes—These are rarely dangerous in malaria work.

c. Rock holes—Flushing or filling up.

5. *Draining*—Rain water follows two main routes:—

a. A certain amount flows over the surface as "storm water" and passes out to the sea via rivulets and stream passes to the rivers and thence to the sea.

In passing it may damage malaria drains but in regions afflicted by stream-breeding vectors it does a lot of good by acting as a natural flush.

b. The remainder sinks into the earth and emerges at lower level as seepages which unites to form swamps. Seepages themselves are favorite breeding places of dangerous vectors. These areas should be drained.

Rules to be Observed in Plotting Out a Drainage System.

1. First of all find the proper outfall. Walk around the area and if necessary beyond the boundary in order to have a free flow. At sea level tide gates may be necessary.

2. Plot out the levels and course of the drain.

3. Work out the subsidiary drains.

4. Work out from below upwards with intention of avoiding too much subsidiary drains.

Drainage by Dynamites.

This is extensively used in the U. S. A. Its value in anti-malaria work is seen from a recent report from Palestine. The charges are laid in a series of holes 18 inches apart —the size and the depth of the charge regulating the size of the resulting drain.

Dynamiting is cheaper and quicker than hand digging. Other methods of draining that require mention are vertical and subsoil draining.

LARVICIDES

The last method of malaria control discussed in this paper is the use of larvicides. As discussed earlier, the use of larvicides should be an adjunct to the other methods of control. The first larvicide to be discussed is oil.

Oil

Advantages of Oiling. Oiling is a term used to describe the spraying of oil on water to create a film. This film acts in various ways. The oil for anti-malarial mixture should have the following qualities.

1. It has a direct toxic action on larvae.

2. It changes the flora of a stream. In a stream that has been regularly oiled, the algae growing on the surface die away, and are replaced by bottom growing algae.

3. It burns the weeds growing along the banks of the side pools and seepages to facilitate subsequent spraying.

Example of an Anti-Malariol Oil—Malariol

Malariol is an approved mixture of petroleum oils for the destruction of mosquito larvae by spraying on the water. It is approved by the Ross Institute of Tropical Hygiene Inc. in the London School of Hygiene and Tropical Medicine with which the Shell Group of oil companies is in constant collaboration on this and kindred problems.

Researches on How an Oil Film Works.

It was shown that the toxicity of oil to larvae and plants and the spreading power on water depends on the aromatic contents. Mr. G. I. Watson tried to explain the mechanism of the lethal action of oil on larvae by giving the hypothesis that heart muscle is affected.

Properties of Larvacidal Oil.

1. There should be quick penetration into the breathing tubes (Not to exceed 10 minutes).

2. It should have a high spreading quality when sprayed on water.

3. It should also, as discussed already, change the flora of a body of water and burn the grasses along the edges of the same body of water.

Technique of Oiling.

It is important that the supply of malariol go as far as possible. Field experience shows that a film of a thickness of 18 microns is

attainable in practice and gives good results. This thickness of film gives a measure of 2,750 sq. feet to 1 gallon of malariol.

To achieve this we must train the personnel working the sprayers. He should:—

1. Keep the nozzle clean.
2. Build the proper pressure before the trigger shut-off is opened, to insure steady atomization.
3. Direct the nozzle upwards to get advantage of spread.
4. When oiling drains and streams, he should walk upstream at the rate of 2 to3 miles/hr. taking care to spray both sides of the stream.
5. Seepages and pools away from the channels should be marked with flags previous to the visit so that they will not be missed.

Paris Green

Effective for surface feeding mosquitoes such as malaria mosquitoes but not against bottom feeders such as the culicines and mosquito pupae. Diluted in fine dust 2 to 5% in large areas and 1% in small areas. This strength has no ill effects on domestic animals, fish or crops. Its disadvantage is that it is not visible on the surface of the water. The Rockefeller Foundation uses it extensively in the extirpation work.

Pyrethrum

Gives a quick known knockdown effect. It must be in very fine mist. DDT—as used by MSA, WHO & UNICEF as an insecticide and larvicide (50%) with malariol, gives very promising results.

Dieldrex/Diesel Oil/Sawdust Mixture . . . .

This method controls both larvae and pupae. It is a mixture broadcast along sides of streams. The mixture consists of 4 fl. oz. Dieldrex 15 in 1 gallon diesel fuel. This oil solution is then mixed with 1 sack of sawdust or fine sugar cane bagasse.

DISCUSSIONS

Q. Mr. Maclang, has altitude anything to do with the susceptibility of man to malaria? We have experienced this on the hill. We found that there are more malaria cases among those laborers staying below the hill than among those on the hill.

A. Are the said laborers imported, I mean, are they not native in the area?

Q. No, they are not.

A. In malarial areas, imported laborers, especially those coming from non-malarial areas are the first to be affected by malaria. On the other hand, residents born in malaria areas have acquired pre-immunity so that they have more tendencies to resist malaria.

Q. You said malaria is mainly a tropical disease. Is there no malaria in temperate countries? In the Mt. Province, it is said that there are no mosquitoes.

A. In Holland, a temperate country, there was malaria but they were able to control it. There are mosquitoes in the Mt. Province.

Q. Is there any possibility of a person contacting malaria by drinking water from a breeding area?

A. According to the malaria cycle, the parasite is found in the mosquito vector or in an infected man. In order to have malaria you have to get it therefore from either one of the above.

Q. Since they are the carrier of the disease, could other mosquitoes get malaria from another mosquito?

A. Not directly.

Q. Does a carabao contact malaria?

A. That I do not know. I have not seen a carabao chilling.

Q. How long will it take for a person bitten by a malaria mosquito to contact the disease?

A. According to the film "Malaria", 10 days.

Q. Some people think that contacting malaria is dependent on the resistance of the person. I know a fellow who was bitten by malaria mosquitoes 5 months ago but contacted the disease just now.

A. That may be possible, but generally it is 10 days.

Q. How long is quinine effective in the

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Advice to Freshmen

By BENJAMIN M. BATOON '55

The forestry campus is beautiful but life on it is not a joke. Seriousness of purpose and great determination are great essentials. Like a loving mother she opens her arms in welcome. Take advantage of her healthful environs.

Like most college students here, you will have to work and study hard through the course. You must carefully budget your time. A student who succeeds is one who plans out his work and follows the schedule strictly. He is one who undertakes the tedious task of learning something; understands his duties and responsibilities; believes in advance preparation to insure good results in the work he does and knows why he is in college.

Be courageous. There are many obstacles on the way waiting to challenge you. Accept the challenge. Roll up your sleeves and tackle the task you have to do. Don't envy the upperclassmen. They have gone through the same situations that you face now. They took up the challenge and fought. They expect you to do the same. The good assets which you have built in the years past must be guarded well.

Life in this college is entirely different from the easy home life that was yours before you came here. Subjects are brain-wracking and field work is back-breaking but always bear in mind that there is no rosy path to success. The tougher they come the stronger you should be. You may not like your professors and instructors but later on, you will learn to like and love them. The skull cap on your head is without doubt, a bother. Traditions are part of this college; they really belong, you must follow them. To become the Foresters that you dream to be, at the very start, mold and train yourselves; be diligent and persevering in your studies; observe traditions and follow regulations; engage in healthful recreations. Follow all these and your dream will become a reality

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MALARIA . . .

(*Continued from page* 15)

body? Won't a person get stomach disorder taking this drug?

A. A physician could very well explain the answer to your first question. With regard to the second question, provided you take it regularly you will have no gastric trouble.

Q. Can we use quinine in blackwater fever?

A. According to Dr. Watson, we can use it.

Q. Is it true that a drunkard does not get malaria?

A. Maybe he gets malaria, but because he is drunk perhaps he cannot feel it.

Fogging & Spraying Equipment

As per arrangement made by Technical Department with the National Merchandising Corporation, their Mr. Fabian also gave an on-the-spot demonstration on malaria and other insect control with their Microsol fogging and spraying equipment.

NATURE'S BEST

"If I were to choose the sights, the sounds, the fragrances I would want to see, hear, and smell, among all the delights of an open world on a final day on earth, I think I would choose these: the clear ethereal song of a white-throated sparrow singing at dawn; the smell of the pine trees in the heat of noon; the lonely call of the Canada geese; the sight of a dragon fly glinting in the sunshine; the voice of a hermit thrush far in a darkening woods at evening; and—most spiritual and moving of sights—the white cathedral of a cumulus cloud floating serenely in the blue of the sky."

E. W. Teale