apparent lack of suitable food made me wonder if they can lay fertile eggs without blood meals.

Most of the observations recorded were made close to the northern limits of tree growth, where **Aedes nearcticus** and **A. cataphylla** were numerous. Plant specimens collected from this region were determined as follows by S. F. Blake, senior botanist in the United States Department of Agriculture: Willow, **Salix** sp.; Labrador tea, **Ledium groenlandicum**; sedge, **Carex** sp.; lousewort, **Pedicularis** sp.; Alpine bearberry, **Arctostaphylos rubra**; buffaloberry, **Shepherdia canadensis**; crowberry, **Empetrum nigrum**; mountain avens, **Dryas integrifolia**; reindeermoss, **Cladonia rangiferina** group; sweet coltsfoot, **Petasites sagittata**; whortleberry, **Vaccinium uliginosum**; black spruce, **Picea mariana**; birch, **Betula glandulosa**; and larch, **Larix laricina.**

At the end of the trip the group voted unanimously in favor of the repellents over head nets and heavy clothing as a means of protection against the mosquitoes encountered in muskeg country.

MALARIA

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THE DISEASE

Malaria is a disease in which the fever rises periodically. It was recognized many centuries ago and because it occurred most frequently among people living in low-lying areas covered with swamps and marshes, it was thought to be due to bad air. This explains the derivation of the name. Malaria means literally "bad air."

It was not until 1880 that the real cause of the disease was discovered by a French physician (Laveran) to be a single-celled parasite (protozoan) which attacks and lives inside red blood corpuscles where it divides into

During a 4-day hike in the muskeg the men were constantly surrounded by swarms of 500 to 1500 mosquitoes. Head nets, gloves, and heavy clothing were indispensable when the best mosquito repellents were not used.

numerous new parasites. Eventually, the corpuscle is destroyed and the parasites attack new red corpuscles. The length of this cycle varies with the different varieties of malarial parasites. The variety (Plasmodium vivax) prevalent in the United States completes the cycle in 48 hours so that there is a rise in temperature every second day at the time the parasites are breaking down the red cells. According to the Italian way of computing time, this occurs on the third day and this type consequently was called by them tertian malaria. The most dangerous type of malaria which occurs in tropical areas is not characterized by a regularity in the occurrence of fever, largely due to the fact that the people are exposed repeatedly to malaria and there are new crops of parasites breaking out of red cells every few hours.

Until after the discovery of America, there was no satisfactory method of treating the disease. The Spaniards learned from the natives of Peru that the bark of a certain tree could be used to stop the progress of the disease. Thereafter, the use of Peruvian bark, from which we now obtain quinine, rapidly spread throughout all the world. Modern chemistry has supplied additional drugs (atabrin, plasmochin, etc.) which are useful as substitutes or in conjunction with quinine. Unfortunately, these drugs do not always rid the blood of the parasites. A few may lurk in the body for weeks or months and cause the disease to recur when resistance is lowered.

METHOD OF SPREAD

It was not until 1898 that the method of spread of malaria was known. At that time, an English physician (Ronald Ross) working in India, proved that certain varieties of mosquitoes could transfer the disease. Up until that time, mosquitoes had not been very carefully studied and were classed with other small flies in the family of gnats. It is now known that there are numerous varieties of mosquitoes which have been classified into several

DALFERES PENNINGTON CURRY

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while he was serving the army and located at Camp Raritan, New Jersey. From this preliminary study he was catapulted into the intensive and extensive mosquito control effort of the Panama Canal Zone. Dr. Curry went deeply into the taxonomy, biology and disease-carrying characteristics of the mosquito fauna of the Canal Zone and the Republic of Panama.

His successful handling of these problems is amply indicated by two facts: first, yellow fever, which the early work in Panama had eliminated, was never able to stage a return during the twenty-three years of Dr. Curry's service; and, second, the reduced malaria prevalence records of the employees of the Panama Canal Zone. Dr. Henry R. Carter estimated that the malaria rate in 1904 was in the neighborhood of 3,000 clinical cases per 1,000 employees. In 1906 when accurate record of these matters began, the showing was 821 cases per 1,000. From this point the rates dropped steadily year by year until 1916, when a rate of 16 per 1,000 was achieved. The average rate of the next 24 years was about 17 per 1,000, with variations in that time from a low of 10 in 1938 to a high of 31 per 1,000. Under the feverish turmoil of construction at the present time the rate for 1942 was about 25 per 1,000. The story of the death rate from malaria is even more encouraging. In 1906 the death rate was 8.78 per 1,000. By 1916, it dropped to 0.06 per thousand and for the next 24 years the rate averaged 0.04 per 1,000. These statistics cover all employees on the Isthmus of Panama of every color and race and include many hundreds or thousands who spend their off hours in their homes in the unprotected parts of the Republic of Panama.

Dr. Curry's work has made a great contribution to the solution of public health problems in the Tropical Americas.

THOMAS J. HEADLEE.

November 13th, 1943.

tribes. The tribe known as Anopheles is the only one which can spread malaria. The members of this tribe vary with the zone and country. The only important member of the tribe east of the Rocky Mountains in the United States is the species called **Anopheles quadrimaculatus.** This species prefers to breed in ponds of still water and thrives best where the water is filled with vegetation. Another variety (Anopheles Punctipennis), not important in spreading malaria, prefers the edges of running streams.

When the mosquito bites a person who has malaria, the parasites contained in the blood of the stomach of the mosquito migrate to the outer wall of the stomach where they rapidly multiply and soon migrate to all parts of the body of the moquito without producing any harm. Among other places, they accumulate in the salivary glands. This cycle takes about ten days to two weeks. Until the migration of the parasites has taken place, the mosquito cannot transfer the parasite to another human. Once it becomes infectious, however, it remains so for a long period of time and may spread the disease to each new person bitten.

It will be seen that in order for malaria to be spread, several conditions must be fulfilled. First, there must be persons who have malaria in the area. Second, there must be the proper species of Anopheles mosquitoes present. Third, it must be possible for the mosquitoes to get to and bite the person with malaria. Fourth, the mosquito must live at least ten days to two weeks before it can transmit the disease. Since thousands of mosquitoes are killed by enemies, winds, rain, and other environmental conditions, usually a large number must bite a person with malaria in order for a few to survive long enough to pass the disease to other people.

METHODS OF CONTROL

The control of malaria can be directed along three lines: (1) curing of the disease in all the persons living in an area; (2) keeping mosquitoes away from people, particularly those infected with malaria; (3) eradication of the Anopheles mosquito.

It is difficult to find and treat all of the cases of malaria because the disease varies in intensity. Even if all of the cases could be found, the drugs now available do not in every instance entirely eliminate the malarial parasites from the blood. It is not unusual for persons who have had malaria to have the disease recur after treatment has been stopped. It is evident, therefore, that the treatment of the disease cannot be depended upon to eliminate it from any particular area.

Protection against mosquitoes by careful screening of houses, staying indoors after dusk, spraying dark corners to kill off mosquitoes which may have gotten by the screens, the use of nets when it is necessary to go into swampy areas, the use of repellents, etc., can all be used to prevent access of the mosquito to possibly infected persons, and also to prevent infected mosquitoes from biting well persons. It is evident, however, that if these measures were to be effective, very little work could be accomplished in a mosquito-infested area.

One of the most effective ways of controlling the disease is to attack the mosquito itself. Fortunately, we can direct our efforts against the most dangerous species (in eastern United States, **Anopheles quadrimaculatus**). There are many other varieties of biting mosquitoes but many of them will be breeding in places unfavorable for the Anopheles and consequently control measures can neglect the less dangerous varieties. It is usually economically impossible to attempt to control all mosquitoes, particularly in low-lying areas.

Fortunately, the mosquito is very vulnerable in certain stages of its life history. The Anopheles mosquito deposits her eggs on the surface of ponds.

The eggs hatch within a day or two and the small aquatic larvae, called "wrigglers," begin to swim around the water usually just under the surface. They grow rapidly in size and by the end of a week are almost ready to go into the second stage of aquatic life. This second stage (pupa) is a resting stage in which feeding does not take place. The mosquito is formed inside the shell of the pupa. Within three or four days it cracks the upper portion of the shell and emerges as a full grown mosquito.

While living in the water, the larvae and pupae are devoured by the thousands by their natural enemies (small fishes, larvae of beetles and many other insects, etc.). If they swim into open water, the buffeting by waves will frequently drown them. Often the shallow water in which they have hatched out will dry up before they have passed through the pupal stage and thousands more perish. It will be seen, therefore, that these little aquatic animals have a difficult time to survive, but in spite of this large numbers eventually reach the adult stage.

In planning control measures, we take advantage of many of these natural conditions to aid in eliminating mosquitoes. Often water levels are purposely raised and lowered in order to allow the eggs to hatch in shallow water and insure that the larvae perish by drying before they reach the adult stage. Although the larvae are aquatic animals, they must breathe air. To obtain the air, they push their breathing tubes through the water surface. This makes them very vulnerable to the application of a film of oil on the surface. The oil interferes with their obtaining air, both by making it difficult to push the breathing tube through the surface and by clogging the breathing tube itself. Another method of attacking the larvae is to spray dust containing Paris green on the surface. The larvae feed on the particles of dust and the poison kills them.

The author's back is covered with hundreds of mosquitoes. On the march they were constantly annoying in spite of light rain, temperatures as high as 86°F., and winds of about 10 miles per hour.

The most permanent method of control is to eliminate as many collections of water as possible by filling them in or by draining them off into nearby streams or ponds. Rain barrels should be covered with screens; tin cans, buckets and other vessels buried or turned bottom up. Any kind of a water collection can serve as a breeding place for mosquitoes.

MALARIA IN MASSACHUSETTS

Malaria was quite prevalent periodically in New England in Colonial times. It seems to have almost disappeared between these times of high prevalence. There was a rise in the disease in Massachusetts after both the Civil War and the Spanish-American War, due to soldiers returning from southern areas still infected with the parasites. In recent years the disease has practically disappeared. It has been re-introduced in small areas when laborers have been imported from malarial districts. The disease has promptly died out again in each instance, however.

Each year sees Massachusetts become more unfavorable for the breeding of Anopheline mosquitoes. Our ponds are being kept cleaner of protecting vegetation; the marshy areas around the edges of the ponds are being filled in; each time a new house is built the land is graded and water holes are eliminated. These factors together with excellent screening of houses and the prompt treatment of all cases of malaria will undoubtedly insure that the disease will never become a major problem in this State.

It is to be expected that many of those in the armed forces and civilians taking part in the present war will become infected with malaria while on foreign shores. Some of them will have the disease recur after they return home. A few individuals in their households or among their neighbors may acquire the disease. Physicians will be on the alert to discover such cases and the prompt use of drugs will prevent the disease from being any serious problem. Undoubtedly, there will be an increase in the disease within the next two or three years, but the cases will be numbered in tens or scores and not in hundreds of thousands.