



The mosquito-proof hut in the Roman Campagna in which Dr. Low and Dr. Sambon carried out their experiment

## Fighting Malaria

By Herbert Hamilton

**A**T the present time a stern warfare is being waged against that terribly fatal and widely spread disease known by the name of Malaria.

The name Malaria comes from the Italian "*Mala aria*," *i.e.*, "bad air," and up till a few years ago it was generally considered that it was due to a poison generated by damp soil and rank vegetation under a hot sun.

It was known that malarial fever could not pass either directly from man to man like small-pox or scarlatina, or indirectly through the agency of drinking-water like cholera and typhoid; it was in fact, an "endemic disease," *i.e.*, one adherent to certain localities.

It is now so common a matter of knowledge that certain forms of disease are due to the presence in the body of the patient of certain lowly types of life known by the

name of micro-organisms, that we need not enlarge upon it.

Micro-organisms are of two kinds, animal and vegetable. The latter are called "Bacteria," and they are by far the more common. They are present in water, in the air, and in the soil, and it is through their agency that beers, wines and spirits, butter and cheese, etc., are produced.

To Alphonse Laveran belongs the credit of discovering the living organism which is the cause of malaria.

The first step in the discovery was made in the middle of the nineteenth century, when it was ascertained that the seat, or as doctors express it, the "distinguishing pathological product" of the disease was a black substance in the blood and organs of malarial patients; this is the malarial pigment or "melanin."

In the year 1880 Laveran was able to



make the announcement that melanin is produced within the bodies of vast numbers of minute parasites which live in the red blood-corpuses of the patient. For some time after the establishment of the germ-theory of disease it was not quite clear why the presence of a particular organism caused a particular disease. At first it was thought that the microbes fed upon the nutrient fluids or tissues of the body, but it is now quite certain that the causes of the disease are to be found in the poisons or "toxins" which they either secrete themselves or cause the tissues to secrete.

In the case of malaria, the fact was established that the melanin-secreting parasites were the cause of the fever, and the next question which had to be decided was, "How do the parasites effect an entry into the body?"

Before Laveran had shown that malaria was due to a parasite of the blood it was very generally thought that the disease was caused by the noxious emanations proceeding

from the earth, and the natural tendency was to search for the parasite in the water or soil of malarious places. But the difficulties of the search were well nigh insuperable.

In the first place, the organism was not a "bacterium," or plant growth, but an animal parasite, and could not therefore be taken from the living blood and sown on a film of gelatine, as is done with bacteria. When taken from their natural habitation, the blood, the parasites simply perished, and the method of identification common in bacteriological research was therefore of no avail. Direct search in soil or in water seemed to promise no reward, because if the parasite lived in either of these elements it would possess some other form from that which they possessed in the blood. The seeker was in the unenviable position of being totally unaware of the appearance of the object for which he sought.

Some observers endeavoured to solve the problem by attempting to produce



How Italian peasants think to avoid malaria. The aerial dwellings in which they live



malaria by each one in turn of the numerous species of "Protozoa," or single-cell organisms, found in the water and soil of

in the life-history of the malarial parasite the intervention of a blood-sucking insect was necessary. This parasite has a curious and



Tending malarial patients in the Roman Campagna

malarious places, but no success rewarded their labours.

"Such was the state of things at the end of the year 1894. Speaking for myself I can well remember the hopeless feelings with which I then regarded the problem. Fortune, however, was to be kinder to us than I had dared to believe. At this very moment the key to the solution of the problem had already been indicated by Dr. Patrick Manson."

These words were spoken by Major Ronald Ross in a recent lecture before the Royal Institution, and it will be seen that he had a

eventful career. A tiny unicellular organism, it begins its life in a red corpuscle in the body of a patient suffering from malaria. It moves, it grows, it absorbs and assimilates food material, and reproduces itself, and its method of reproduction is by far the most interesting feature in its life-history. It possesses two modes of reproduction, one "endogenous" and the other "exogenous." The former, a non-sexual process, is by spore formation, and the parasite attains maturity in man without the intervention of the mosquito.

The latter is a sexual process which can



The Italian Red Cross Society at work

great deal to do with the final solution of the problem.

Dr. Manson's investigations showed that

only be completed by passage through a certain genus of mosquito, *i.e.*, Anopheles. The necessity for the mosquito mode of



reproduction for the perpetuation of the organism is quite evident, for if the parasite did not pass from its host into the mosquito it would die on the death of the host, and thus the genus would in time become exterminated.

Dr. Manson's researches showed clearly that in order to attain full development the parasite required to enter the stomach of a blood-sucking insect.

The next step was to discover the insect. The mosquito (the "gnat" of tropical regions) was suggested because of its geographical distribution, its habits and its limitation to swampy areas.

A suggestion is a very different thing from a proof, and accordingly Major Ronald Ross, an officer in the Indian Medical service, set to work, and after years of patient labour succeeded in transforming a brilliant theory into an established truth of science.

The method adopted was to feed gnats of various species on persons suffering from malaria, and then to examine the insects carefully for the parasites which they should contain. The examination of each individual insect was a work of at least two or three hours, but the actual labour involved was the smallest part of the difficulty.

"Both the form," says Dr. Ross, "and the appearance of the object which I was in search of and the species of gnat in which I might expect to find it were absolutely unknown quantities. We could make no attempt to predict the appearance which the parasite would assume in the gnat; while owing to the general distribution of malarial fever in India, the species of insect concerned in the propagation of the disease could scarcely be determined by a comparison of the prevalence of different kinds of gnat at different spots with the prevalence of fever at these spots. In short I was forced to rely simply on the careful examination of hundreds of gnats, first of one species and then of another, all fed on patients suffering

from malarial fever in the hope of finding the clue I was in search of."

To enumerate the difficulties and failures of the search is unnecessary here; at length success rewarded Dr. Ross's tireless efforts and the human parasite was found growing in the body of the mosquito of the genus *Anopheles*.

The *Anopheles* in biting a malarial patient sucks into its system the parasite which inside its stomach undergoes various developments, and finally on the mosquito biting a healthy individual the parasite is injected into his body and malarial fever results.

Although the majority of medical men were already convinced that malarial infection was transmitted from man to man by means of *Anopheles* it was thought



A hut with a mosquito-proof door

advisable that some conclusive test should be made.

Mr. Joseph Chamberlain, who has evinced a practical interest in tropical diseases, and to whom the London School of Tropical Medicine owes its origin, consented to provide a mosquito proof hut which was to be set up in the most malarious region of the Roman Campagna if the Council of the School could find two skilled observers willing to occupy it for the whole of the malarial season.

Drs. Louis Sambon and G. C. Low volunteered their services, and accordingly in May 1900, they, together with Signor



Terzi, an Italian artist, and two Italian servants took up their residence in the hut, all the doors and windows of which were protected by wire netting.

From May to October the experimenters lived in the hut. During the daytime they went abroad and mixed with the peasants but an hour before sunset they retreated within the hut and did not leave it again until an hour after sunrise, the reason for this being that *Anopheles*, in Italy at any rate, bites between these hours and very rarely, if at all, during the daytime.

The result of the experiment was that not one of the occupants of the hut during the months of the test had the slightest touch of malaria. That this immunity was due solely to the precautions taken to avoid being bitten was fairly obvious; but still one more experiment was necessary before the mosquito-malarial theory could be considered as established on a firm basis.

It had been demonstrated that if a man took care not to be bitten by *Anopheles*, he could live in a malarial district without contracting the fever. It now remained to be proved that malarial fever could be taken by a perfectly healthy person who had never been in a locality where malaria was common, provided he were bitten by the malarial parasite bearing mosquito.

Mr. P. T. Manson, a son of Dr. Patrick Manson, nobly offered himself as the subject of the experiment. He was bitten vigorously

by *Anopheles* mosquitoes which had been fed on patients suffering from malaria in the Sano Spirito Hospital in Rome; he contracted the fever and malarial parasites were found in his blood. Mr. Manson, fortunately, soon recovered, the parasites in his blood being destroyed by quinine.

It may therefore be taken as proved that mosquitoes (and only *Anopheles* mosquitoes) are capable of transmitting malarial fevers, and that protection from their bite implies absolute immunity.

It remains to describe the methods that are now being employed in almost all parts of the world where malaria is prevalent for the stamping out of this terrible disease.

Up till now no practicable method of producing artificial immunity from malaria has been devised and the prevention of the disease may thus be best accomplished in the following ways:

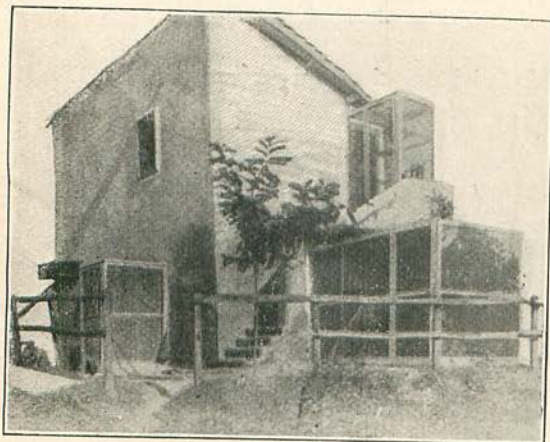
- (1) Suppression of Mosquitoes;
- (2) Prevention of Infection of Mosquitoes;
- (3) Prevention of Infection by Mosquitoes.

A word may be said on each of these three methods.

(1) *Suppression of Mosquitoes*.—The extirpation of mosquitoes in districts where malaria is common appears a very gigantic task, but serious attempts in this direction are now being made in many of our colonies and in foreign countries.

The Liverpool School of Tropical Medicine has sent out several "Anti-*Anopheles* Crusades" to West Africa, and the crusaders are making a great effort to banish the mosquito from certain malarious areas in those Crown colonies which have been called "The White Man's Grave." Major Ross is confident that in time West Africa will be made as healthy as India.

The chief work of the Crusaders will be the abolition and the prevention of the formation of the special type of pool in which the mosquitoes breed by drainage, and the destruction, both of the mosquito larvæ and of the places where they breed.



A house with mosquito-proof doors and windows



If a town can be kept clear of mosquitoes, the necessity for such disagreeable things as quinine and window screens will be obviated, and all classes of the community will be benefited. The addition to the mere comfort of life in the tropics will be great owing to the disappearance of these terrible pests, and it is even likely that the destruction of mosquitoes will bring about the destruction of other noisome insects, such as sandflies, etc.

(2) *Prevention of Infection of Mosquitoes.*—If Anopheles is unable to bite a malarial patient it cannot transmit the disease to any human being.

Malaria, or "Ague," as it is termed, was once common in England; it has now died out, and although there are as many Anopheles in England to-day as ever, they cannot produce the disease, simply because they can obtain no fresh supply of the parasite.

In certain German colonies quinine has

been given to a whole community with the object of eradicating the germs of malaria in infected human beings. This measure is both expensive and disagreeable and under British law can hardly be enforced.

All malarial patients should be scrupulously guarded from mosquito bite by the use of nets, etc., and care should be taken to prevent Anopheles from gaining access to hospitals.

(3) *Prevention of Infection by Mosquitoes.*—This can be accomplished by making all dwellings mosquito-proof, by filling in doors, windows, ventilators and all similar openings by wire gauze and by advising all who have to be about at night, to wear gloves, veils, etc.

Although absolute security from mosquito-bite in ordinary life cannot be obtained, it is quite possible by judicious, and not very irksome, protection enormously to reduce the liability and so minimise the chances of malarial infection.



## How Lord Rosebery's Speech was Reported

By John Pendleton

LORD ROSEBERY is a serious statesman, but he could scarcely refrain from smiling at the inadvertent comment made by one newspaper on his speech in Edinburgh, four years ago. The proof-reader, getting the last paragraph, when weary, long after midnight, wrote "Thank God" at the end of it. The compositor, faithfully following the "copy," dealt with the thankful exclamation as a correction, and tacked it on to the paragraph, which, in the next issue, read: "At the conclusion of his speech Lord Rosebery left for the south—thank God!" Probably the proof-readers in other daily newspaper offices were in a similar frame of mind on the night Lord Rosebery visited Chesterfield, and delivered, in the railway shed near the historic West Bars, his notable speech on "Efficiency and

Empire." Whatever the political effect of his lordship's utterance, it was unusually interesting, because of the difficulties that Nature flung in the way of the journalists instructed to record it, and the enterprise they showed in overcoming hindrances to its transit.

### WIRES BROKEN BY STORM

The snowstorm in the middle of December wrought havoc among the overhead wires throughout the kingdom, and for several days telegraphic communication was interrupted, or altogether impossible between London and many of the northern cities. In consequence of the telegraphic breakdown the newspapers were obliged to express regret at the scantiness of their news supply. Business men were in a worse plight. They