

THE EXPERIMENT IN SARDINIA

The International Health Division of the Foundation is in the midst of an intensive campaign to determine if a whole region can be rid of the mosquitoes which transmit malaria. The region chosen for the test is Sardinia, and the weapon of this warfare is DDT. The campaign is now in its second year; results in the reduction of the anopheline population have already been noted; and by November it is expected that the whole island may be free of this pestilential insect, perhaps for the first time in thousands of years.

One thinks of Sardinia in thousands rather than hundreds of years because its archaeological remains tell of a prehistoric people, the Protosards, who lived here in the New Stone Age, perhaps eight to ten thousand years ago. Some historians believe these cavemen came from Africa, and thus brought in the malaria from its ancestral home. Whatever the origin, malaria was already in the island when the Phoenicians came about 1,200 B. C. The Pontine Marshes are more celebrated as breeders of disease, having caused the death of kings, popes, and other mighty ones; but Sardinia tops them by a wide margin as the most intensely malarious region of Italy. In normal times, 125,000 Sardinians are down with the "fever" annually - an average of one out of every ten of the island's 1,200,000 population.

Not only is Sardinia very malarious, but its terrain is rugged. For the most part it is wild, desolate plateaus and mountains; and the conditions under which the mosquitoes must be fought demand the utmost of strategy and thoroughness. Less than a third of the area consists of cultivable plains and valleys, and more than ninety per cent of the people live in villages



scattered over the island's 9,187 square miles. There are marshy stretches in which mosquitoes breed with tropical fertility in spring and summer, and the larvae are also found in pools in the mountains up to 3,000 feet. Six anopheline species are native to Sardinia, but the most numerous and dangerous as malaria transmitters are the Anopheles labranchiae. In the surveys preparatory to the present campaign, hundreds of these mosquitoes were found resting in a single cottage during the day, waiting to fare forth and lay eggs at night. The preliminary studies also showed that some adults survive the winter, lying dormant until spring. All these circumstances taken together make Sardinia a tough test region.

The Sardinian campaign was planned in 1945; but, because of shipping delays and other troubles, materials were slow in arriving, so the project did not get under way until the autumn of 1946. To serve as the operating agency, the Italian government set up a special organization called ERLAAS, from the initial letters of its Italian name which means "Regional Anti-Anopheline Service in Sardinia." An agreement was entered between the Italian High Commissioner of Health and The Rockefeller Foundation by which the Foundation would provide the technical staff and supervision of the program, while the government would finance it from the Lire Fund provided by UNRRA and set aside for reconstruction and rehabilitation. Dr. D. B. Wilson of the International Health Division was appointed superintendent of ERLAAS, and served until May of 1946 when he was transferred to Egypt. He was succeeded by Dr. J. A. Kerr who continued in the work until his return to the United States last autumn. Since then Dr. John A. Logan has been in charge, and the other Foundation men working with him are T. H. G. Aitken, entomologist; Fred W. Knipe, engineer; and O. L. Peterson, M.D. An Italian medical man and



five former members of the UNRRA staff, the latter paid by the Foundation, also serve under Dr. Logan. For the purposes of the anti-anopheline campaign, Sardinia has been divided into three areas of regional organization. The three in turn are subdivided into districts, and these into sections, each section with its foreman, assistant foreman and five to six workers. The provincial health officers of the island also cooperate with the project, on a part-time basis.

The campaign was organized in two phases; one, the spraying of the interior of houses to kill adult mosquitoes; the other, the spraying of the marshes, the shores of lakes and streams, mountain pools, and other breeding places, to kill the baby mosquitoes, the larvae. The first stage, known as spray-painting, is carried on in the fall and winter months; the second, the outside spraying, in spring and summer.

During the spray-painting season of 1946-'47, eighty-five per cent of the villages and rural homes of Sardinia were visited by the spraying squads. The inside walls, and in many cases the ceilings, of the houses visited were subjected to a spray containing DDT in a water emulsion. This preparation not only kills the mosquitoes it touches, but on evaporation leaves the walls coated with a film of DDT, which remains potent for several months, and during that period kills any mosquito or other insect that chances to light on the surface.

Last summer's outside spraying was confined to an area of about 2,000 square miles. In fact, this part of the 1947 program was largely one of preparation for the island-wide campaign in the summer of 1948. The eradication technique which had been used earlier in Brazil and Egypt had to be adapted to Anopheles labranchiae, to the mountainous terrain of Sardinia,



to the psychology of Sardinian workmen, and, finally, to DDT. The necessary working methods were perfected and a sizeable nucleus of supervisory personnel were trained in them.

The preparation used in attacking the larvae is a five per cent solution of DDT in diesel oil or naphtha. So potent is DDT that one quart of this solution is enough for one acre of breeding area. But it has to be applied once a week during the hot summer months in which the larvae develop rapidly.

Meanwhile, during the winter just past, the inside spraying was resumed and carried to completion on an island-wide scale. Except for the central parts of the two principal cities, Cagliari and Sassari, every building in Sardinia has now been treated with the DDT emulsion. This includes the houses and stables whose walls were sprayed in 1946-'47, for the current program requires that all ceilings be coated as well as walls. Churches, schools, and other large buildings have been treated by a special fog-spray method. In this, a hose is introduced through a door or window, and then the DDT emulsion in the form of a smoke-like fog fills the entire space, depositing on all surfaces. Barns, chicken houses, pigsties, every man-made structure in the country has been sprayed - with the exception of the two city centers mentioned which were purposely omitted since they are not frequented by mosquitoes and can hardly be regarded as hazards.

The inside phase of the spraying program was completed in mid-February, and on March 6 the campaign shifted to its outside phase. For this anti-larval work the island has been carefully zoned according to altitude. Thus, the lands lying at or near sea level began to get attention first, in March. By April spraying will begin at higher elevations, squads being



organized at progressively higher altitudes as warm weather advances, until all the mountain springs and streams and other altitudinous breeding places are reached. According to the present schedule, the activity should be at its height by May, with 5,000 men employed and weekly spraying under way in all zones.

Most of this outside spraying is done from the ground, by men on foot using simple hand sprayers. Airplanes will be used to cover large marshes and to reach inaccessible spots in the mountains. Six planes have been procured for this service, and will be flown by pilots of the Italian National Air Force. Dr. Knipe is installing power sprayers in the planes and adapting them for this insecticidal warfare.

In addition to the spraying squads, there is an independent scouting service which checks on the results of the work and appraises its effectiveness. This service is under Dr. Aitken. No attempt is made to check every sprayed site, but when mosquitoes are seen or other circumstances raise doubts as to the efficacy of the treatment, the service goes into action. Scouts then visit treated houses in the neighborhood, scrape off a few square inches of the wall surface, and test the scrapings by dissolving them in a prepared chemical. If DDT is present the fluid turns red, and the depth of the color is a measure of the quantity of DDT present. If the test shows that a certain house is insufficiently protected, a spraying squad is sent to give it a second coating. The scouting service also checks on the work of the outside sprayers, and is continually on the prowl to see if any collections of water have been neglected and to make sure that those which have been sprayed are receiving sufficiently potent doses of the DDT.



While the main emphasis is on the use of DDT, the resources of engineering are not being neglected. It is probable, for example, that some effort will be made to drain marshes, and thus remove their areas from the category of mosquito-breeding. Dynamite ditching offers an economical and practical means of opening some of these stagnant swamps to drainage.

Dr. George K. Strode, Director of the International Health Division, visited the Sardinia project in February and reports that the whole program is moving quite satisfactorily. In fact, it is now a week or two ahead of its schedule. "The work is well organized; there is a splendid esprit de corps; and we have every reason to believe that this experiment will demonstrate whether or not the anopheline mosquito can be eradicated from a region," said Dr. Strode. "By next November or December, the returns should be in."

Assuming that the mosquito is eliminated from the Sardinian scene, there will remain the responsibility of seeing that its sisters and cousins are not brought in from other areas. It was by some ship or airplane that the deadly Anopheles gambiae was introduced into Brazil from Africa back in the '30's, and the same transports could easily reintroduce Anopheles labranchiae to Sardinia.

The Sardinian authorities are already discussing how best to quarantine their island against its ancient insect enemy. Plans are being prepared for submission to the World Health Organization of the United Nations in the hope that some international convention will be set up to require the spraying of airplanes before they land passengers or freight. To protect against incoming ships, the plan most favored is to make every port in Sardinia non-infectible. That is to say, each port would be made proof against the survival



of a mosquito should it chance to get ashore - and this mosquito-proofing would be accomplished by draining all potential breeding places and by keeping up a systematic program of DDT spraying, both inside buildings for wall protection and outside for anti-larval measures.

Corsica, north of Sardinia and separated by only ten miles, is the nearest body of land and the most likely source of infestation by wind, assuming that a mosquito can fly or drift that distance. But Corsica has ambitions to be a mosquito-free land itself. The French government is strongly impressed by the spectacle of Sardinia's eradication program; and if the latter succeeds, Corsica may be the next to follow the example.

The object of all these efforts, of course, is the reduction and, if possible, the elimination of malaria. It is too soon to give a verdict on the effect of the campaign as reflected in lower incidence of disease, but there are a few fragments of information. Thus, for the period from January to August, 1946, there were reported to the provincial health officer of Cagliari 1,775 new cases of malaria, and only 327 cases during the same period in 1947. For relapsing cases of malaria during the same period, the figures for 1946 were 7,858, and for 1947, only 3,064. There was also some reduction in the number of typhoid cases reported during the period, and possibly it is a reflection of what the DDT did to house flies, just as we like to believe that the lessened incidence of malaria is a consequence of DDT's destruction of mosquitoes. These inside sprayings have a deterrent effect on many different kinds of insects, and perhaps this immediate result in the relief from pests, rather than the less obvious result in reduction of disease, is what makes the campaign so popular. As the Sardinians say again and again, in expressing thanks for the house spraying, "Now we can sleep nights."