REPORT OF BUREAU OF MALARIAL CONTROL

1926–27

Part II

The Campaign at Salinas.

During the Fall and Winter of 1925 an epidemic of malaria broke out at Salinas where the disease had always been known to be endemic. A survey followed by emergency and temporary control measures, was practiced in February, 1926. Conditions quieted down somewhat, but due to insistence of the local authorities another survey was made in November with the object in view of carrying on a campaign which would yield more or less permanent results. As shown in Table 4 the spleen rates in three surveys made there, one at the end of the epidemic, one six months later and the last one more than a year later have been rather constantly between 30 and 36 per cent, while the parasite rates have varied considerably, though reaching as high as 55 per cent in the last census which was made in school children alone and at the beginning of the campaign to control the disease. These rates as well as information obtained concerning sickness incidence show that malaria is rather highly endemic with a tendency to become epidemic.

The Problem.

A. albimanus is certainly the important vector, for thus far A. grabhamii has not been found in sufficient numbers in the region, to be of any importance. Vestitipennis has not been reported from that part of the island. It is a region of low rainfall, for sometimes the annual amount does not exceed 25 inches, but this may be concentrated in a short period so as to give the same effect on breeding conditions as is found in some regions with larger annual amounts but with more even distribution throughout the year. Irrigation of cane fields is practiced practically the entire year and reservoirs and numerous pump pits at sites of pumps are added, difficulties not found at Fajardo. Water is not so abundant, however, soil is more porous, and field men having suffered many of them from the effects of malaria, are very much interested in helping to stamp out the disease. The causes of breeding of malaria mosquitoes as a result of irrigation are more or less similar to those already found at Fajardo, with the additional ones just mentioned.

Seepage areas are much more abundant in this region than at Fajardo and in many areas near the ocean the small ditches with water in the canefields are found every ten to twelve feet. Many of these become covered with algal growths, so that breeding does not take place in large amounts while others sooner or later become covered over by the growing cane, but due to the great extent of the wet areas, the problem is very difficult.

The rivers back from the ocean are dry most of the year. After heavy rains and floods, the excess water runs off quite quickly, leaving small ponds which may remain for some time. Near the ocean, however, the main river near the town continually has water and it is a source of many anopheles mosquitoes. There are also numerous drainage outlets from seepage areas which continuously have water. The most difficult to handle, however, are the extensive lowlands near the ocean, some in pasture and others covered by mangrove trees or which are recently out over mangrove swamps. During the dry months these regions have very little water in most cases, but once rains become heavy enough to thoroughly flood them, several months may pass before they become dry again. Some of these areas are less than one kilometer from the town and a very extensive one is between one and two kilometers from the border.

Plan of Campaign—Treatment.

The same plan that has been followed at Fajardo is being used here in order to obtain as complete a record of sickness as possible and to treat as thoroughly as possible all who show parasites in the blood. A very cooperative public has been found so that treatment work has been quite easy.

Antilarval Campaign.

The plan in regard to handling irrigation water is very similar to that used at Fajardo. The resorvoirs are treated weekly with Paris green. Drainage work is done whenever possible by the property owners themselves and in other cases by peons on the malaria staff who are paid from funds contributed by property owners.

In many cases drainage to the ocean from many large seepage areas was not efficient, so that old drainage channels were cleaned, deepened and widened, and tidegates put at the opening into the ocean to keep out the tides. Water that could not be drained out has been treated with paris green at weekly intervals, seepage areas taking a great deal of time.

Results of Campaign.

The work is just getting under way, but irrigation seems to be giving much less trouble than at the beginning. Gates are very defective and a new type has been brought in for demonstration and trial. It takes considerable time to become familiar with the entire zone and to know in what direction the water drains from each low spot. Many wet areas previously overlooked are being found as the campaign becomes more thorough. Heavy rains just as the year was closing and into the month of July have greatly complicated the matter and have emphasized again the importance of lowlands near the ocean. Drainage outlets are being improved within the kilometer zone of control but indications are that in one instance at least the work will have to include a mangrove swamp with adjacent lowlands which is 1,800 meters from the town. Evidence is very strong that mosquitoes in large numbers are reaching the town from this region, but it will probably be only a temporary affair for the area is drying rapidly of its own accord. In periods of excessive rain it will need serious consideration. Mosquito catches within the zone are still not uniformly low, but considering the short time that the campaign has been in progress conditions are quite satisfactory.

In the two months of May and June 265 cases of malaria were reported in the zone which has less than 4,000 people. These are not the months of highest incidence of malaria so that it can be seen the sickness rate runs quite high. The local people have shown a great deal of interest in the work, money is available, and Dr. Antonio Arbona and staff have already had considerable experience in the work, so that success ought to come ultimately.

Surveys at Luquillo, Santa Isabel, Guayama and Yauco.

Luquillo is a small town of 1,500 people, relatively poor and located on the ocean. It is surrounded by cane fields and low swamp lands, but as there is no irrigation the problem is much simpler in many respects than at Fajardo. The spleen and parasite rates have already been given. Plans are being made to carry on a campaign stressing the antilarval work and only providing treatment when it is really wanted which in most cases is from four to five days. The campaign can be made much less expensive if intensive treatment is not necessary.

Conditions at Santa Isabel are very similar to those at Salinas though there appears to be even more malaria at Santa Isabel. Conditions are to be observed through the rainy months and a

campaign started there as soon as possible omitting the treatment work, for comparison with results at Salinas.

Guayama and Yauco are larger and more wealthy towns located on the coastal plain, but further from the lowlands near the ocean. Malaria is a problem in both, but not to the extent that it is in the towns already discussed. Irrigation and its effects seems to be relatively a much more important factor in these regions and as soon as possible these defects will be corrected.

The Isabela Irrigation Service.

The Legislature appropriated three million dollars for the purpose of constructing a dam in the Guajataca River so as to provide irrigation for some 15,000 acres of land in the municipalities of Isabela and Aguadilla. Work on the dam was begun in 1924 and is being completed this year. A little less than 1,000 acres will be covered by water in a portion of the valley of the Guajataca River about 600 feet above sea level in the central portions of the municipalities of Quebradillas and Isabela.

The reservoir is located in a rural area containing small property owners who use the land mainly for some sugar cane, pasture, and minor crops as bananas, plantain, etc. The hills rise abruptly from the river's margins and beyond the border of the valley it is very hilly with numerous sink holes and seepage outcrops. Some of the sink holes are more or less blocked so that numerous wet areas are found. In the valley, numerous small creeks lead down to the river and seepage outcrops are also found everywhere. Approximately 1,500 people live within one kilometer of the margin of the proposed reservoir.

The area was studied especially to determine if malaria already existed and to prevent the development of an excess of the disease if conditions within the reservoir, as it filled with water, favored the production of anopheles mosquitoes. During the late Fall and early Winter of this year the reservoir was partially filled so that opportunity was given to observe conditions as they would be later when the reservoir became filled permanently.

Incidence of Malaria.

Spleens were examined mainly in the rural schools located in the area while blood smears were taken there as well as at the time of taking of a census of the entire region. A spleen rate of 6.0 was found and a parasite rate of 5.1 (Table V). None of the spleens were more than barely palpable and none of those with

palpable spleens showed parasites in the blood. Further, only one of the positive blood smears was found in the group of school children examined. The parasite rate was somewhat higher, 7.7, in the labor group which had come in to help in the building operations and many of this group had come from known malarious regions. There was little sickness among the laborers during the time that they were working at the dam. It is seen, therefore, that the amount of malaria already present in the zone is very small, more or less as in previous areas studied in the mountainous districts and that laborers coming from malarious districts were unusually free from symptoms of the disease.

Breeding of Anopheles Mosquitoes Outside of Reservoir.

Most of the observations were made in December and January which is toward the end of the usual active season for albimanus and at the height of the season for grabhamii on the coast, where temperatures average two to three degrees warmer. In practically all of the seepage outcrops and blocked sink holes, varying numbers of anopheles larvae were found and in some instances pupae. The population was quite scattered, however, except for a group of houses about the Central Soller at the far end of the reservoir and another group, mainly for workmen, near the dam, so that only two or three houses at most would be near any one breeding area. None of the breeding areas were very extensive. In some of the larger creeks quite heavy breeding was found in the more stagnant grass-covered margins.

Conditions Within the Reservoir.

The land covered by the water was in its most part cleared and under cultivation with numerous patches of banana and plantain trees here and there. Royal palms were scattered over the area and along some of the creeks there were dense growths of shrubs, vines and small trees. The open margins of the reservoir exposed to wave action even in the presence of considerable fine floatage showed no breeding of anopheles mosquitoes. Except for a few trees sticking up in the center of the reservoir there was nothing to favor the breeding of anopheles mosquitoes in that portion. Under certain conditions, however, on the margins, heavy breeding of anopheles mosquitoes was found and often large numbers of pupae were encountered. Breeding was most abundant under the following conditions:

1. Protected grassy margins where bank was not steep.

2. Numerous bays and indentations, especially when there was much vegetation as when plantations of plantains were partially submerged. These were some of the heaviest breeding areas, but as a rule they were quite well localized.

3. At the mouth of creeks or where the margin of the reservoir just reaches a seepage area, breeding was especially heavy.

4. The banks of the rivers Gibao and Guajataca are quite high and abrupt before their union so that wind does not reach the surface of the water. There is a large amount of low vegetation in the margins and breeding was very heavy.

5. In a few areas logs were clumped together in the center of the reservoir and some breeding was found. As the reservoir filled more and more, however, submerging trees which stopped the logs, these clumps became fewer and fewer.

The margin of the reservoir nearest the dam was comparatively clean and the banks very steep, but in its central portions and in that part farthest from the dam, more of the above conditions were found. Of a little less than 1,000 larvae examined from this region one-third were albimanus and two-thirds grabhamii.

Examination in March after the reservoir had been emptied failed to demonstrate any breeding areas in the region formerly covered by the water but numerous larvae were found as previously in the creek and seepage areas above the former water line. The reservoir will be filled permanently in September of this year.

Preventive Measures Recommended.

In view of the fairly large rural population in immediate contacts with the reservoir and the fact that in certain portions of the reservoir breeding of anopheles albimanus was taking place in rather large numbers and probably would take place in larger numbers in the warmer months, it seemed imperative that some measures be taken to control breeding, when the final filling was to be made. In February the following recommendations were made to the Commissioner of the Interior:

1. The margins of the reservoir should be cleaned thoroughly in the small bays and bights protected from wind action and all debris burned or removed to above the high water mark. Large trunks could be tied to isolated trees in center of reservoir until such time as they might sink, but the job of cleaning should be especially thorough where banana or plantain plantations were found between the high and low water marks.

2. Above the junction of the two rivers it is probable that even complete cleaning of the margin would not control

breeding, because of protection from wind, but such trees and trunks as obstruct passage to margins to use larvicidae, should be removed.

3. Two peons with one boat should be assigned to spread Paris green in certain regions where cleaning cannot control breeding as in the region last mentioned.

4. As soon as possible after cleaning is completed, the water level should be raised to the high mark and maintained there until irrigation water is needed and then dropped down a few feet or as demands may indicate in order to strand as much of the floatage as possible. This will serve to kill off submerged vegetation so that the margin will be much cleaner later on. It may be found advantageous to catch and hold all floods as much as possible and then a short time later let water drop down a few feet, thus aiding to keep a clean margin.

5. Game fish should not be introduced into the reservoir at the present time; rather it would be better to introduce top minnows which may help destroy larvae.

6. Above all, it is important to establish cooperation between the Department of Health and those responsible for irrigation project, so that recomendations may be acted upon, the work recommended above being under the supervision of the Malaria Bureau.

The Irrigation Service has assumed responsibility for doing this work and it is hoped that the necessary cleaning can be accomplished before the reservoir is filled permanently. Studies are being made in the region on the coast which is to be irrigated in order to localize the foci which are already malarious and to prevent the increase of malaria because of irrigation. All indications are that the government canals will give little trouble, especially since an efficient type of gate is to be used for distribution of the water. The same precautions as in other irrigated regions will be necessary to prevent breeding in the water after it leaves government canals.

Humacao.

Attention was called in September to a small village on the beach of Humacao where it was reported that an epidemic of malaria was developing. Considerable sickness was found, but it was also determined that each year there was a large amount of malaria in this region. Since it was also found that the three species of mosquitoes were present here and the population a convenient one to study, observations were made to obtain more information on the relative importance of the three species of anopheles and upon the relative importance of examination of spleen and blood for parasites

in determining the amount of malaria. Adjacent to this region, though not affected by it was found another group of houses on high land between two low canefields which were drained by two 30-inch pumps. The colony about the Central Pasto Viejo was also available for observation and was removed from the region drained by the pumps. Thus, an opportunity was also offered to observe the effects of pump drainage on the mosquito problem and upon malaria in the people living in the pumped area.

TABLE IV

SPLEEN AND BLOOD INDEXES—SALINAS

1926-1927

	Spleen			Blood			Observations
	No.	Pos.	Percent	No.	Pos.	Percent	
1926 February.....	436	138	32	306	138	45	
1926 November....	716	257	36	681	190	28	
1927 May	303	92	31	303	167	55	School children only

TABLE V

SPLEEN AND BLOOD INDEXES

Region of Reservoir, Isabela Irrigation Service

	Spleen			Blood		
	No.	Pos.	Percent	No.	Pos.	Percent
1927 January.....	84	5	6	273	14	5.1