THE RESULTS OF HOOKWORM DISEASE PROPHYLAXIS IN BRAZIL.

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Rural sanitation in the tropics is a problem of absorbing interest that has occupied the attention and stimulated the enthusiastic research of a large group of men. The members of the International Health Board, working in Brazil in cooperation with various federal, state, and other agencies, have devoted much effort, time and money for the past four years to the solution of some of these problems in Brazil.

We have arrived at some definite conclusions which are of special interest to Brazil, but which we believe have a wide application, and are of far-reaching importance in the practical solution of some of the sanitary problems of other tropical and sub-tropical countries.

One of the big problems in rural sanitation which has occupied our attention is hookworm disease, and after four years of labor the following questions have most urgently presented themselves:

1. Are the *results* of the intensive hookworm campaigns of permanent or temporary value?

2. If the results of the campaigns are of temporary value only, for how long a time are the benefits of the campaigns appreciable in the betterment of the health of the people?

3. At the present time we believe that the two most important factors in hookworm disease prophylaxis are intensive treatment and latrine construction.

- A. Which of the two is of greater relative importance?

- B. What relation should one factor bear to the other, e.g., which should have precedence?

The correct answers to these basic problems are essential if we are to carry through hookworm disease prevention to a successful conclusion. Here in Brazil, after four years of enthusiastic devotion

to a cause—working under difficulties and subjected to a steady fire of criticism, one's greatest stimulus has been the self-assurance that the work could not fail, because it was based on a true knowledge of the disease. It has been extremely disheartening to learn that the results we have obtained appear to be far from satisfactory. The degree of hookworm infection by microscopic examination in Ilha do Governador, for example, before work was begun was 71.2 per cent. Four years later, after a successful intensive campaign and installation of latrines in more than 80 per cent. of the houses, the microscope shows an infection rate of 70 per cent.

Similar results are reported from other tropical countries, where similar work has been carried on for a period of years—in Ceylon, Porto Rico, various islands in the West Indies, to mention only a few.

There are three alternatives left to us in interpreting such discouraging data that have been accumulated and presented from various sources.

A. Our knowledge as to the mode of spread of hookworm disease is at fault.

B. Our methods used in combating the disease have been inefficient.

C. The data from which we are drawing our conclusions as to our failure are incomplete and misleading.

In order to meet these issues squarely, we planned a re-survey of hookworm disease in a typical community in which:

A. The International Health Board had carried an intensive campaign to a successful conclusion, more than 3 years previously.

B. The Federal Government had followed the treatment campaign with the installation of sanitary latrines, so that at the present time more than 80 per cent. of the homes have a functioning latrine.

The Ilha do Governador (or Governor's Island) was chosen for this re-survey.

A brief summary of conditions on the Ilha demonstrates clearly why it was a satisfactory field for this study. The Island is situated in the Bay of Rio de Janeiro and has a stable population of about 9,000 people. The population is widely distributed, there being only two or three villages. Many trades and occupations are represented, such as fishermen, tradesmen, factory workers, farm laborers, store keepers, truck gardeners, soldiers, sailors, etc. Most of the people are poor, living in small mud-walled houses with dirt floors.

Four years ago, when sanitary work was begun, the Island was

notorious as an unsanitary place; epidemics of dysentery had caused many deaths, malaria was extremely prevalent, latrines were almost unknown, and typical cases of severe hookworm disease were to be found on every hand.

Dr. L. W. Hackett, International Health Board Director for Brazil, began the intensive hookworm campaign treatment in August, 1917. The microscopic examination of the stools of all the inhabitants, including different stations of life, all ages, and various races, showed a hookworm infection rate of 71.2 per cent. The campaign was carried to a successful conclusion in August, 1918, more than 90 per cent. of the infected individuals receiving treatment. Coincident with the campaign the Federal Government enforced sanitary regulations, requiring all homes to construct sanitary latrines. This measure was slowly enforced so that when the International Health Board withdrew, about 25 per cent. of the houses were still without latrines.

Dr. Hackett cooperated with the Federal Government at the same time in beginning anti-malaria prophylaxis, by drainage and quinine treatment of carriers, and all surface wells were filled.

When the hookworm treatment campaign ended, the Federal Government left a dispensary post in its place, which continued the enforcement of latrine construction, continued drainage operations, and maintained a consulting clinic for all types of disease.

This dispensary had an interesting regulation. This regulation refused medical consultation for any disease, until the individual had first submitted a stool specimen for examination. In case hookworm ova were found, chenopodium treatment was given. In this way the authorities hoped to cure the few refractory cases left from the campaign, and to catch any infected newcomers who might bring infection to the island after the campaign.

A few months after the campaign had closed the dispensary physician noted that many individuals who had been treated during the campaign and pronounced as cured, were again infected with hookworms. At the end of two years, on calculating his statistics, he was discouraged to find that the percentage of infection with hookworms in dispensary patients was about 70 or practically equal to that found before the campaign was carried out, and this despite the fact that more than 70 per cent. of the homes had installed sanitary latrines.

Malaria had rapidly diminished in intensity and frequency, following drainage and treatment of plasmodia carriers; dysentery and ty-

phoid had been checked by the closing of all shallow wells, and installing a pure water supply, yet the incidence of hookworm infection had not diminished, despite a thorough, intensive treatment campaign and extensive installation of latrines.

What was the explanation of this baffling problem?

One suggestion offered was that the soil had been teeming with hookworm larvae, that the people were too poor to buy shoes, and thus, despite intensive treatment and latrines, had become re-infected, and that thus conditions had returned to those existing before the campaign was begun. If this were true, it is obvious that the destruction of larvae in the soil and wearing of shoes are not of minor importance, but are two important factors in the control of hookworm disease, and that hookworm prophylaxis is much more difficult than we had imagined.

In any case the problem could only be answered by a careful resurvey, using the worm count method as an index of the degree of infection of the people. The worm count method used was that of Darling (1). The technique has been described in various former publications (2), and need not be reported in detail. In brief it consists in choosing a group of 25-30 people, representing all ages, both sexes, various occupations, etc., and giving them a massive dose of a vermifuge which removes 98-99 per cent. of the hookworms harbored. *Chenopodium*, in divided dosage of 3 c.c., is usually given, preceded and followed by a heavy saline purge. All stools are saved for a period of 48 hours, the worms are picked out, counted and classified. The worm count method has a disadvantage in that only small groups of people can be examined. To be effective the group must be representative, and great care must be taken in the choice of individuals, so that a true cross-section of the community may be obtained. Young children and elderly people cannot be included because of the vigorous nature of the treatment, but this is not a serious source of error since we have already shown that hookworm infection is seldom a serious factor in the lives of the old or very young.

EXPERIMENTS.

Three groups were chosen for treatment:

1. A group in one of the villages consisting of families of fishermen, shopkeepers, dock laborers, street sweepers, etc.
2. A group from the zone between the village and farm, consisting

of the families of market gardeners, day laborers, washer-women, etc.

3. A group from the center of the island, consisting almost entirely of the families of farmers and day laborers, many of whom had no latrines or did not use the one they had.

Approximately equal numbers of men and women were chosen. There were people of all ages, of different race and color, different occupations, social status, etc. The only factors in common to all were:

1. They had lived on the island continuously since 1917.
2. They had taken hookworm treatment during the campaign three years previously.
3. They had taken no vermifuge since the campaign treatment three years previously.

RESULTS.

In all, 86 cases were carried to a successful conclusion. Four of these were controls; e.g., they had lived continuously on the Island for more than two years, and had never taken hookworm treatment.

The hookworm infection rate by the microscopic examination of the stools was as follows (Table I):

TABLE I.

Results of the microscopic examination of the stools for hookworm ova. Ilha do Governador, July, 1921.

Sanitary campaign I. H. B., 1917-1918.....	71.2%
Federal Government Dispensary, 1920-1921.....	70.0%
Our Re-survey, Institute of Hygiene, July, 1921.....	69.0%

The results of these microscopic examinations are apparently very discouraging, for we were able to verify the findings of the Federal Dispensary, namely, that the microscopic examination shows a diminution of only 1 or 2 per cent. in the hookworm infection rate on the Island, after four years of sanitary work.

The results obtained by the worm count method revealed quite a different picture (Table II and Chart I).

TABLE II.

Results of worm count method, as an indication of the degree of hookworm infection. Ilha do Governador, July, 1921.

Total number of hookworms harbored, 86 cases.....	1,242 worms
Average number of hookworms per case.....	14 "
Total number of hookworms harbored, 4 controls.....	1,299 worms
Average number of hookworms harbored per case.....	324 "

CHART I. Sanitation of Ilha do Governador—Brazil. Chart comparing the average number of hookworms harbored by residents of the Island with the number harbored by the average Brazilian.

CHART II. Sanitation of Ilha do Governador—Brazil. Chart comparing average number of hookworms harbored by various groups of Ilha with number harbored by a average rural Brazilian of the same age and sex.

Contained in this table is the answer to our problem. It shows that we have not been working on a false basis, our efforts have not been in vain, but on the contrary are highly satisfactory. Our mistake was in the interpretation of our data. We had fallen into the common error of forgetting the fact that hookworm infection does not mean hookworm disease. An average of 14 hookworms each, harbored by the average resident of the Island, is an insignificant degree of infection, whereas the average of 329 hookworms each, in the four controls that had never received treatment, is definite hookworm disease.

We do not know the average worm count of the Island before the treatment campaign began. Our four controls give a fair index, though all of these were adult farm laborers, and thus they followed an occupation which we have previously shown to be subject to heavy infection (3). We can fairly estimate, for purposes of comparison, that the degree of infection of the Island was probably similar to the average degree of hookworm infection for all rural Brazil. Judging by the information received from the staff who assisted in the treatment campaign, the degree of severity of hookworm disease was greater than the average for Brazil. The contrast between the present degree of infection on the Island and the degree of infection of the average rural Brazilian is strikingly shown in Table III and Chart II.

TABLE III.

Table illustrating the degree of hookworm infection of Ilha do Governador, after 4 years of sanitation, as compared with the average infection for rural Brazil.

	Number of cases.	Average age.	For Ilha do Governador.	For all rural Brazil. Same age groups.	Controls on Ilha.
Adult men	20	29 yrs.	21.3	228	362
Boys 8-15	15	9½ yrs.	15.0	191	216
Adult women	28	27 yrs.	13.0	89	—
Girls 8-15	19	10 yrs.	11.0	80	—

The maximum number of hookworms harbored by various individuals is of interest, for it is an index of the severity of infection in all the community. We have previously shown that an infection of even 50 hookworms in adults does not lower the hemoglobin index even 1 degree, whereas in children 25 or more hookworms may begin to affect

the organism in a detectable way. The re-survey of the Island showed no instance of heavy infection in those cases that had been treated 3 years previously. A very few had more than an insignificant infection, as is shown by Table IV.

TABLE IV.

Table showing the maximum number of hookworms harbored, in various age and sex groups, on the Ilha do Governador.

Adult males harboring more than 50 hookworms.....	3 of 20
Adult females harboring more than 50 hookworms.....	2 of 28
Boys, 8-15 years, harboring more than 25 hookworms.....	4 of 15
Girls, 8-15 years, harboring more than 25 hookworms.....	1 of 19

Furthermore, I made a careful search of the whole Island, and in no instance could I find a single case which was obviously suffering from hookworm disease, presenting all the characteristic clinical symptoms, except in individuals that had recently come to the Island from other places and had never received hookworm treatment. I believe, therefore, that we are justified in saying that the results achieved on Ilha do Governador, after four years of hookworm disease prophylaxis, are most satisfactory. Except in the case of a few immigrants, we can truthfully say that hookworm disease as a *disease* has been wiped out on the Island. Hookworm infection still exists in about 70 per cent. of the people, but the degree of infection is of little consequence, is now diminishing, and I predict will continue to diminish.

One interesting bit of evidence that the degree of hookworm infection is diminishing on the Island is illustrated by the following facts. I noted long ago that when an individual who is infected with hookworm disease goes to a place where continued re-infection is no longer possible, as in prisons, industrial centers, institutions, etc., his degree of infection gradually decreases because the hookworms in his intestines die a natural death after a certain period of time. The females survive the males, so that on treatment of this individual, after 2 or 3 years, one will find that the patient harbors a greater proportion of female than male hookworms. Individuals who are constantly being infected, however,—cases which have never had the benefit of sanitation or treatment—harbor a slightly larger number of males than females, though the difference is very slight. This is what might be called the normal ratio of males and females.

What is true of individuals is, I believe, true of whole communities.

When proper sanitary measures are being applied so that they affect the whole community, the results should be shown after an interval of 2 or 3 years, not only by a decrease in the total number of hookworms, but also by a change in the ratio between the female and male hookworms harbored.

A comparison table of the ratio between females and males, in the cases treated on the Ilha do Governador, is suggestive (Table V).

TABLE V.

Table showing the ratio between the male and female hookworms harbored by 86 individuals on the Ilha do Governador.

	No. of cases.	Hookworms		
		Females.	Males.	Ratio between females and males.
Cases receiving benefits of sanitary measures.....	82	662	483	1 : 0.7
Controls—cases which have not received either treatment nor used latrines.....	4	669	673	1 : 1.1
Average for Brazil, 279 cases chosen at random.....	279	25,564	26,188	1 : 1.02

This table indicates, I believe, that re-infection with hookworms is not occurring to any extent on the Island, and that the few hookworms still harbored are decreasing from natural causes.

If then we believe that the results achieved on the Island are satisfactory we must next consider what factor was most important in bringing about this striking change in four years. To approach the question from various points of view, a division of the cases was made into four groups.

Group I.—Individuals that had received treatment during the campaign three years ago, that had also installed latrines at once and had used them—complete cases.

Group II.—Individuals that had received treatment three years ago and had not installed latrines at once, or if they did install them, used them only part of the time—complete treatment and incomplete latrines.

Group III.—Individuals that had received treatment but had not installed latrines, or if they did install them by compulsion, had never used them—complete treatment factor only.

Group IV.—Individuals that had lived on the island for more than two years and had neither received treatment nor installed latrines—controls.

A summary of the average hookworm counts of these four groups is given in Table VI and Chart III.

TABLE VI.

*Comparison of the average number of hookworms harbored by various groups.
Ilha do Governador, Brazil.*

	Number of cases.	Average age.	Average hookworms harbored.
Group I. Treatment and latrines	44	19	2.2
Group II. Treatment, and latrines part of the time	25	20	24
Group III. Treatment, but no latrines	13	19	31
Group IV. No treatment and no latrines	4	25	324

This table demonstrates, first, that our methods of attacking hookworm disease have been sound and have produced good results; second, that the two big factors in the prophylaxis of the disease are latrine construction and intensive treatment; third, the effects of the intensive treatment campaign are clearly evident in the case of those individuals who installed no latrines (Group III), even after a period of three years. It is probable that, in part at least, these people of Group III derived protection from their neighbors who have installed latrines. On the other hand, the results show that a treatment campaign in itself should be of more than passing value. This is due to the fact that hookworm infection, as a rule, is slowly re-acquired, and rapid massive infections are rare. Fourth, the results are suggestive as to the length of time the hookworm larvae may remain in the soil in an infective stage. The soil of the Island was undoubtedly teeming with hookworm larvae when the campaign began, since latrines were almost unknown on the whole island. These larvae certainly have not survived a three- or even two-year period, for if they had, a heavy re-infection of the population would have occurred, despite latrine construction and treatment, since nearly everyone goes barefoot. The results suggest that it is the continual addition of fresh, living larvae to the soil that is a menace, and that this factor is cared for by the installation of latrines. It is unnecessary to in-

CHART III. Sanitation of Ilha do Governador—Brazil. Chart showing average number of hookworms harbored by various groups of people.

CHART IV. Sanitation of Jacarepagua—Brazil. Chart showing average number of hookworms harbored per individual in a zone of heavy infection 2 years after treatment.

stitute soil disinfection in hookworm prophylaxis, for our results show that if soil re-infection is checked, the few hookworm larvae that may survive their environment for twelve months or more are not important factors in re-infection to a degree productive of hookworm disease.

The results of the re-survey of the Ilha do Governador seem to give us clear-cut and convincing evidence that our hookworm prophylaxis program is an effective one. There is one serious defect in the method of re-survey, namely, the number of cases from which we are drawing general conclusions is small.

In order that we might put our methods of procedure in hookworm prophylaxis in Brazil to a severe test, I desired to choose for re-survey another area which had all the elements necessary for the production of *heavy* hookworm infection. Such a place was found in the Municipio of Jacarépagua.

EXPERIMENTS IN A HEAVY INFECTION ZONE—JACARÉPAGUA.

The groups of people chosen for these experiments were market gardeners, most of them living on small farms, in mud houses with thatched roofs. They were very poor, using no shoes, working continuously in moist, sandy, highly cultivated soil. These conditions are typically productive of the highest degree of hookworm infection, as we have found it in Brazil. All cases, except controls, were treated two years ago by the intensive method of the International Health Board, under the direction of Dr. L. W. Hackett and the supervision of Dr. Thomas Alves. Some of them constructed latrines at once and have used them ever since, others did not.

The procedure in the re-survey of Jacarépagua was exactly as described for the Ilha do Governador.

TABLE VII.

Average number of hookworms harbored per case—Jacarépagua, Brazil. Zone of heavy infection.

	Number of cases.	Average age.	Average number of hookworms per case.
Cases receiving treatment two years ago...	52	24 years	42
Controls, cases without treatment or latrines.....	9	20 years	198

The preliminary microscopic examination of our re-survey showed a hookworm infection index of 83 per cent. Table VII and Chart IV give a summary of the average worm counts of all the completed cases.

The results of the hookworm counts in the group of cases treated two years ago show that these individuals have re-acquired a moderate degree of re-infection, for they harbor an average of 42 hookworms each. The nine controls are heavily infected with an average of 198 hookworms each. These controls are a better index of the degree of former average infection of the zone than the controls of the island experiment, for here various ages and both sexes are represented.

The study of the distribution of the re-infection by age and sex groups of the 52 cases is illuminating. A summary is given in Table VIII and Chart V.

TABLE VIII.

Showing the degree of hookworm infection in the various age and sex groups in Jacarépagua.

	No. of cases.	Average age.	Average no. of hookworms.	Percentage of cases harboring 50 hookworms or more (children 25 or more).
Adult men	22	33	66	40
Adult women	13	21	28	30
Boys 8-15 yrs.	10	11	36	20
Girls 8-15 yrs.	7	11	10	0

Table VIII shows that the men and boys which were treated two years ago are slowly re-acquiring infection, whereas the women and girls have a much lesser degree of re-infection. This was to be expected, for it is in accord with our previous findings that hookworm infection is acquired in a degree proportionate to the number of hours spent working in the soil. Men spend more time than boys, boys more than women, and women more than the girls.

The most interesting comparison is that of the groups, divided according to whether the individuals used latrines or not. These results are summarized in Table IX and Chart VI.

How do results differ from those of Ilha do Governador?

A. Group I, which received treatment and used latrines, shows the same results as Group I of the Island, for after a period of two years the individuals have re-acquired only an insignificant infection.

CHART V. Sanitation of Jacarepaguá—Brazil. Comparison of degree of hookworm re-infection of various age and sex groups 2 years after the campaign.

CHART VI. Sanitation of Jacarepaguá—Brazil. Comparison of average number of hookworms per case of various groups in a heavily infected zone.

B. Group II consists of individuals who received treatment two years ago, but have used latrines only part of the time and are re-acquiring infection to a considerable degree.

TABLE IX.

Comparison of four groups, divided in relation to use of latrines. Jacarépagua.

	No. of cases.	Average age.	Average no. of hookworms.	Percentage of cases harboring 50 hookworms or more.
Group I. Treatment and latrines . . .	9	37	6	0
Group II. Treatment, latrines part of the time only	12	23	25.5	16
Group III. Treatment only, no latrines	31	21	59	35
Group IV. Controls, no treatment, no latrines	9	20	198	90

C. Group III is composed of those who received treatment two years ago but have not used latrines and are acquiring infection more rapidly than Group II, though they have not yet acquired even one third as many hookworms as the controls who received no treatment two years ago.

These results prove that the intensive treatment alone, without the employment of other factors, is of demonstrable value for a period of at least two years, in a zone where every condition is favorable for a *severe* degree of hookworm infection. The results also show that latrine construction and use is all important in the permanent elimination of hookworm disease in heavily infected communities, for only in Group I can our end results be considered entirely satisfactory.

SUGGESTIONS FOR FURTHER DEVELOPMENT OF SUCCESSFUL HOOKWORM DISEASE PROPHYLAXIS.

I believe that the re-surveys of Ilha do Governador and Jacarépagua are of value not only in that they prove that our methods of attack have been productive of good results, but also because they suggest certain "follow-up" methods that may be employed with benefit in the successful prophylaxis of the disease. The results show that we should not have a set plan for all communities, but rather that our plan of campaign should be somewhat elastic, depending upon

the social conditions of the people, their occupation, the density of population, per capita wealth, the degree of infection with hookworms and many other factors.

In a type community, such as the Ilha do Governador, with a population of 50 or more per square kilometer, with good means of communication with the people working at various occupations, with a per capita wealth sufficient to enable them to construct sanitary latrines, and with a hookworm infection rate of 60 to 70 per cent. by microscopic test, the following method should be economical, efficient in stamping out hookworm disease, and should be not simply an entering wedge of hygienic betterment, but a firm basis upon which to establish a future permanent rural sanitary unit.

A. The work should be begun by a general hookworm treatment campaign as at present; treating all positive cases twice and all soil workers three times, with a standard treatment of oil of chenopodium or other efficient drug.

B. Coincident with the campaign, latrine construction should be instituted. This always takes more time than the treatment campaign for obvious reasons that do not need to be detailed.

C. When the treatment campaign is completed, withdraw all but a small nucleus which shall continue fiscalization of latrine construction, and treatment of all newcomers. Certain days of the week should be devoted to general dispensary work, where anyone who comes to the clinic who has hookworm ova in the stools may be given a single chenopodium treatment. This small unit could serve as a base from which to extend permanent rural sanitary activities. Hookworm infection will not disappear, and if one uses the microscopic examination of the feces as a criterion of success, the results obtained will be most discouraging. Though *hookworm infection* will not disappear, *hookworm disease* will disappear in a very short time, and if latrine construction and maintenance is conscientiously and consistently carried forward, the end results will be all that can be desired.

In communities subjected to very heavy infection, the methods employed in hookworm prophylaxis should be somewhat different. In communities where almost all the people are soil workers, as market gardeners or farm laborers; poor, ignorant, always barefoot, spending ten to twelve hours a day in the fields; subjected to all the factors that tend toward a heavy infection and with a hookworm index of 80 to 90 per cent. by the microscope, the plan of campaign should vary somewhat in its details.

1. The preliminary treatment campaign should be carried out as at present giving three treatments of oil of chenopodium to all soil workers.

2. The construction of latrines should accompany the treatment and should continue until 70 or 80 per cent. of the houses are sanitized. In each community this will require a considerable period of time—probably two or three years.

3. When 70 or 80 per cent. of the houses have sanitary latrines, there should then be a second hookworm treatment campaign, giving every positive case a single treatment only. Special emphasis should be placed upon treating all *soil workers*.

4. A small health unit should then be permanently maintained to fiscalize the construction and upkeep of latrines, treat newcomers, and serve as a basis for a future rural health unit.

It will be noted that I have given the treatment campaign the precedence over latrine construction in both types of community. I realize that many authorities are not in accord with this procedure, but my reasons are practical and convincing:

1. The intensive treatment campaign in itself undoubtedly alleviates a great deal of suffering and saves some lives.

2. Though of temporary value only, the re-surveys prove that its effects are clearly demonstrable even two or three years after a campaign. This two or three years' interval allows a reasonable time for latrine construction in 70 to 80 per cent. of the houses.

3. If properly carried through, the treatment campaign is a very important propaganda which demonstrates the cause and mode of transmission of hookworm disease. It is the logical and natural precursor of latrine construction, for it explains why latrines are necessary and convinces the people of the importance of their daily use.

What should be the method of attacking the problem in case one is working with a community which has a high degree of hookworm infection and in which it is impossible to convince the bulk of the community of the necessity of latrine construction and use? This is not a mere hypothetical case, but an actual condition with which everyone who has worked in the tropics is familiar. In this case we have only one important weapon of attack—the treatment.

Our previous results have shown that two standard chenopodium treatments are sufficient to free the average individual from 98 per

cent. of his hookworms. We may say in general that if the individual returns to the same conditions in which he acquired his infection, he will not re-acquire a heavy infection before three years. Therefore, the method applied in large plantations in the East Indies, of giving all individuals a standard chenopodium treatment once a year, may be used in the above contingency. Undoubtedly this method is an efficient prophylaxis against heavy hookworm infection in zones where latrine construction and use are not practicable. Our results show that in Brazil one standard chenopodium treatment every two years would be quite effective, even in those areas subject to heavy infection.

This method of prophylaxis yields temporary and not permanent results, it has no great educative value, and, to be effective, it requires a paternalistic form of government, such as is so commonly found on the large plantations with contract laborers.

CONCLUSIONS.

Ilha do Governador.

1. A re-survey of Ilha do Governador after four years of hookworm disease prophylaxis shows us that hookworm disease, as a disease, has disappeared from the Island. The infection index, as demonstrated by microscopic examination of the stools, has scarcely diminished at all during the period.

2. The two effective factors in this prophylaxis have been the intensive treatment campaign and the installation of latrines.

3. The individuals who took treatment, yet who had not installed latrines or who had used them only part of the time, harbor a much smaller number of hookworms than the control cases, manifesting that the benefits of the treatment alone are maintained for a period of more than three years.

Jacarépagua.

A re-survey of Jacarépagua shows that the soil workers in the heavily infected zone of Jacarépagua have a beginning re-infection with hookworms two years after an intensive treatment campaign. This re-infection is chiefly occurring in those individuals who have not installed or used latrines.

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