

THE GORGAS MEMORIAL LABORATORY AND
PROBLEMS ENGAGING ITS ATTENTION

By HERBERT C. CLARK

Reprinted from TRANSACTIONS OF THE COLLEGE OF PHYSICIANS OF
PHILADELPHIA, Fourth Series, Vol. II, No. 2, September, 1934

70

MARCH 7

THE GORGAS MEMORIAL LABORATORY AND PROBLEMS ENGAGING ITS ATTENTION.* By Herbert C. Clark, Director, Gorgas Memorial Laboratory, Panama, R. de P.

In 1924 a site of ground located on the sea coast of Panama City was presented by President Porras of Panama to the Gorgas Memorial Institute of Tropical and Preventive Medicine, Incorporated. This is an American corporation having for its purpose the work of education along sanitary and health lines, and especially the study of tropical diseases and methods of prevention. The Gorgas Memorial Laboratory is the tropical subdivision of the Gorgas Memorial Institute. Our organization possesses a fine building and enough ground on which to expand.

We occupied our quarters in January, 1929. We have no hospital under our supervision but the courtesies of such institutions in Panama and the Canal Zone are extended to us. We have been extremely fortunate in adding a Veterinary Station where research work on large domestic and wild animals can be studied under quarantined conditions. Six temporary rural stations in various parts of Panama have been in use at intervals to supply our needs in the study of the major problems as well as in the study of the wild animal life.

Our charter permits us to study anything included in the diseases of plants, animals or human beings. Malaria control and equine trypanosomiasis are the two major features receiving attention. We have a small permanent staff, a staff on tour of duty from the Army, Navy and Public Health Services, and visiting scientists from other institutions who can find local material for the problems they have under consideration.

Thus far we have had 20 visitors for periods of one to three months from eight Universities: Johns Hopkins, Chicago, California, Tulane, Harvard, Yale, Rochester and Cornell. In addition to these sources of assistance we have at all times the important cooperation available from the various Services within

* Editorially condensed.

the Panama Canal Zone and the Republic of Panama. The Museum of Comparative Zoology at Harvard, the Bureau of Animal Industry in Washington and the Medical Department of the United Fruit Company have been of great assistance. Small sums from private sources have assisted in developing the library and Veterinary Station.

Our organization has just closed its fifth year of work and during that time 47 publications have been made or are in process of publication by the staff and visiting scientists on subjects investigated in the laboratory or its rural stations. Most of these studies fall under the head of protozoology, helminthology, mammalogy and zoology. Most of the so-called tropical diseases can occur in the temperate zones and as air, land and sea travel develop, reducing the transportation periods to shorter and shorter intervals, there will be a higher incidence of these so-called tropical diseases in the temperate zones. Only experience will tell us whether you have there important local vectors for these diseases.

Malaria: We consider malaria the disease of greatest economic importance to business operating in the lowlands and river valleys in our tropics. The Caribbean negro has a higher tolerance to this disease than the mainland native yet his labor efficiency, in exposed lowland agricultural regions, will probably not exceed 60 per cent if left under unsanitated conditions and without medical care. We know what the Panama Canal Zone has done and continues to do in the way of malaria control but few realize the difference in performing such work in the Canal Zone as compared to the regions operated by private tropical fruit companies, oil companies, etc. At the close of the construction period of the Panama Canal it was possible to reduce the force and to concentrate it at the terminal cities and at the lock sites. A private agricultural organization of such magnitude as the tropical fruit companies must, however, meet the following conditions: (1) Their personnel must be widely spread out through vast plantations in lowlands that cannot afford to be too thoroughly drained if the fruit is to thrive. This means favorable anopheline breeding places. (2) The degree of discipline is limited. (3) A wide radius of mosquito breeding control is too expensive in large plantations. (4) Screened labor quarters would be too expensive and would require good police protection to insure proper use and maintenance.

It was believed that with the close of the construction period in the history of the Panama Canal the cost of maintenance in mosquito control would gradually fall due to the permanent obliteration of water surfaces and to drainage. It now proves that as a result of the presence of the artificial bodies of water known as Gatun Lake and Miraflores Lake the need for mosquito control will increase rather than diminish so that the control of malaria must be approached as something to be indefinitely continued. Conditions can increase the range of flight of anopheline mosquitoes to a far greater distance than we would have admitted some years ago. Consideration of the cost of mosquito control and of mosquito proofing of quarters render many of the usual antimalaria measures impractical for the labor masses. It occurred to us that something of importance might be accomplished by attacking malaria control in labor camps as a dispensary disease rather than as a hospital disease or as a large sanitary problem. It seldom happens that the *human seed bed* of malaria is attacked as a whole. Sick people go in for treatment but the vast majority of laborers harboring malarial parasites never get sick enough to force them in for treatment yet they are below par as labor and furnish reservoirs of infection for the mosquito. To study this problem over a period of years it was necessary to have a body of such people living in an exposed location. Permission was granted us to use five native villages on the banks of the Chagres River between the boundary of the Canal Zone and the new Madden Dam now under construction. These five villages are without mosquito control of any character and the houses are mostly made of thatched roof, cane walls and dirt floors. They are in the midst of large anopheline breeding beds. We use as controls two other native villages on the Madden Dam Highway and in addition the personnel employed at the Madden Dam. These people at the Dam are supplied mosquito proofed quarters, short radius mosquito control and compulsory monthly blood film surveys followed by compulsory treatment of those showing malaria parasites. We are making monthly thick-blood-film surveys of all the people mentioned and treating with the new drugs atabrin and plasmochin, all found positive for malaria at our examinations. We have gradually reduced the parasite rates in these villages¹ during the past four years to about one quarter of the rate found on the original blood survey (60 per cent); but we are finding it difficult to make further reduc-

tion by this means alone. Most of the people caught in the monthly surveys now consist of the same individuals month after month. They seldom show evidence of illness other than a low hemoglobin index. The group of children is receiving special attention but without much success to date. We hope to find a compromise method of control that can be expected to be applied with a prospect of a return in labor efficiency that will meet the financial outlay. The ultimate hope is to reduce as low as possible the chance for mosquito infection from carriers and then perhaps add a short radius of mosquito control about camps. Also included in our malarial problems are studies in anopheline flight, biting experiments with new species of anophelines, trapping experiments and a study of monkey malaria. We do not consider monkey malaria transferable to man but the animal and its malaria supply good material for research. Details are in our published reports by Dr. Wm. H. Taliaferro.²

Trypanosomiasis: Trypanosomal infections are not uncommon in wild animal life but most of these are of a harmless form. The opossum and armadillo are frequently found carrying *T. cruzi*,³ and sometimes other animals show it. We have now seen 12 human cases of *T. cruzi* infection (Chagas's disease) but none of them have proven to be harmful infections and were found accidentally in routine blood-film surveys. Quite recently a 13th case was found in an 18 months old child that died without medical attention. Dr. Elbert DeCoursey, pathologist, at the Board of Health Laboratory, Ancon, Canal Zone, found Chagas's disease to be the cause of death in this case and will soon report it in detail.

Our only form of trypanosomiasis that has great economic importance is due to *T. hippicum* which produces a fatal disease in horses and mules. This disease is known locally as *murrina* or *derrengadera* and was first found and scientifically described by Dr. Samuel T. Darling⁴ in 1910 in the Panama Canal Zone. It is a disease that corresponds closely to the equine trypanosomiasis of the Philippines. Undoubtedly the disease had existed on the Isthmus for a long time if we can base our opinion on the clinical manifestations. It was always considered uniformly fatal to horses and mules and ran a course of from a few weeks to several months. In late years a number of trypanocidal drugs have been placed on the market, but we find tartar emetic the best, although very toxic when given alone in large enough dosage to kill the

parasites. With Bayer 205 (naganol), a highly recommended drug, we have experienced too many relapses when this drug is used alone. We now use⁵ for horses and mules over 600 lbs. in weight, 8 grams of naganol and 21 grains of tartar emetic divided into three doses. Each dose is dissolved in 200 cc. of distilled water and injected into the jugular vein by gravity. There is an interval of six days between doses. Occasional relapses occur and then further treatment is given. We now feel that we can cure from 50 to 60 per cent of the cases if treatment is started before the late stage of the disease.

Ever since Darling's report on the disease we have been seeking for reservoirs of the disease and for a natural vector. Insect life has been investigated with particular attention to the species of horse fly but no form of transmission other than by mechanical means had been found until Dunn⁶ began studies with the vampire bat, *Desmodus rotundus murinus* Wagner. He proved that this bat could acquire the disease by feeding on an infected horse or guinea pig and that after an incubation period of six to eight days its blood films became positive for trypanosomes. The disease proves fatal to the bat about one month after the parasites are found in its blood. The appetite of the bat, as is the case with the horse and mule, is not impaired by the disease. It is, therefore, capable of feeding nightly on one or more animals. A meal of blood for this bat in captivity will average about 16 cc. This fact should make it possible for them to infect themselves from relatively light carriers of the parasite.

An extended search has been made of wild and domestic animals for unharmed carriers of this infection and has indicated that the most important animal carriers commonly found in close contact with the equine stock are cattle.⁷ About 4½ per cent of the cattle ranging with horses and mules and tested by guinea pig inoculations where the disease is endemic have been shown to harbor the parasite. In addition, the domestic hog, sheep, goat and cat can carry it over long intervals as well as the two local species of deer and the collared peccary. Adequate protection from bats can be provided by illuminating the stables either by electricity or by clean oil-lanterns. The owner of a large herd of range animals that cannot be stabled over night and that range with cattle is confronted with a more serious problem. Dunn⁸ has been able to prove not only the vampire bat a vector for *T. hippicum* but also at least three reduviid bugs as local vectors of

T. cruzi in Panama: *Triatoma geniculata* Latr., *Rhodnius pallescens* and *Eratyrus cuspidatus* Stal.

Relapsing Fever: Our study of wild animal life in regard to trypanosomiasis and malaria afforded an accidental discovery of the spirochete of relapsing fever in a wild monkey⁹ of Panama. We were able to transmit the organism to human beings through ticks as well as by direct inoculation. We have since found this spirochete¹⁰ and others closely allied to it in the following animals: marmoset monkey, opossum, armadillo, cattle and horse. Dunn's¹¹ work on the tick vectors of this disease is noteworthy.

Our laboratory has increased knowledge concerning the larval stage of *Dermatobia hominis*¹² and concerning conveyors of the eggs of this fly. This worm infesting the skin is of great economic importance to the cattle industry and has some importance in human medicine. Some new ticks¹³ and mosquitoes¹⁴ have been described but their importance to medicine has not yet been determined. The work of the year now in progress will be largely connected with the further study of rural inhabitants of the type from which tropical labor is drawn in order to find their health index and what can be done to advantage and within financial reason to increase labor efficiency. Studies in malaria control will be continued.

We are already forced to admit that the *construction period* of the Panama Canal and the *period of operation and maintenance* present different problems in regard to exposure to malaria and the practice of anopheline control. During the first period the Canal Zone was practically uninhabited except along the railroad and contact villages on the border were few and small. Sanitation was confined to a narrow strip along the railroad and about the villages with an average radius of mosquito breeding control of about 200 yards. We were all inside screened quarters by the time the sun went down because there were no places for entertainment outside the homes and club-houses. There was no Gatun Lake nor Miraflores Lake.

The period of operation and maintenance began with a great reduction in the number of employees and these were concentrated in the terminal cities of the Zone and about the lock sites. This we thought would reduce expense of sanitation particularly when so many breeding grounds were gradually being obliterated by permanent drainage and filling operations. Two new features have appeared that developed trouble. First, an Act was passed

that threw open to settlers almost the entire limits of the Canal Zone, whereas it was not within financial reason to apply the usual method of mosquito control to those widely scattered farmers and border towns. Second, Gatun Lake¹⁵ and Miraflores Lake are now permanent bodies of water and the former contains 165 square miles of surface with a changing surface elevation that varies about six feet between flood season and dry season. This gives a shore line that varies with the seasons from about 1,000 miles to 1,200 miles. This lake has not given trouble as a breeding place for anopheline mosquitoes until recent years. The kind of aquatic growths that existed along the shore did not favor anopheline breeding; but now new plant life has crowded out the old species of plants and the present growth does favor anopheline development on one side of the lake during the last few weeks of dry season. It is a massive breeding bed at that season. Where did the new plants come from and how did the anopheline mosquito get its start in these remote arms of the lake? We do not know but we suspect migratory water fowl may have brought in the seed of these plants in their alimentary tract and perhaps egg mats of mosquitoes on their feet, bill and plumage. The very discouraging feature is that we suspect that the flight from this massive breeding bed, taken by interrupted night flights, is long enough to reach the terminal points of the Canal Zone during a month or two at the close of dry season. This means in a direct line, a flight of 15 or more miles. The settlers are abundant and scattered along these lines of flight and blood surveys average a parasite index of about 25 per cent. This provides opportunities for mosquito infection. Our old thoughts on the question of anopheline flight were anchored to a 200 yards idea, later a mile, then two miles and now under special conditions we are open to the belief that a flight of 15 or more miles can happen. We are making trapping experiments from this vast breeding ground to the terminal cities to collect facts on this suspected flight. It is also of interest to note that three species¹⁶ of anopheline mosquitoes are being found around the lake shore that never were there before and these must be tested for their ability as vectors. Our new segment of the international highway system is already encouraging the protected inhabitants of the Canal Zone to make long week-end automobile excursions outside the sanitized area and additional cases of malaria in employees that have been ac-

quired outside of the Canal Zone are recorded by the Health Offices.

Dárien Station: This station is located in the province of Dárien at tidewater level on the banks of the Tuira River and in the village of El Real. Dárien is the province in contact with Colombia on the Pacific coast. The station has been in charge of Lt. Comdr. Paul W. Wilson, M.C., U. S. N. It was his desire to follow his extended study of yaws in Haiti with a comparative study of the disease in Panama. He studied and treated 447 cases during the period from July 1932 to the end of September 1933. His report on "Atypical Yaws"¹⁷ will soon appear. We found here an endemic focus of filariasis that had not been previously recorded for Panama. This problem was placed in the hands of Dr. O. R. McCoy¹⁸ who identified the parasite and reported it as *Microfilaria ozzardi*. This parasite has not been found in other parts of Panama. It is the same form of filariasis found just across the border in Colombia. This station has been of assistance in the snake census that we are helping the Museum of Comparative Zoology at Harvard to carry on. We have shipped 2133 snake-heads from nine lowland locations of Panama and among them were 582 of the poisonous species or an incidence of 27.2 per cent. Our annual report¹⁹ for 1933 will analyze this census.

We trust that the Gorgas Memorial Laboratory, a philanthropic, pioneer outpost in tropical medical research will become a large center such as the Western Hemisphere deserves. It should be able to assist in the protection of the Panama Canal and our own country against the influx of diseases that might gain a foothold and, finally, it should be able to form a new bond of contact with Latin America. If the tropics are to be permanently entered by large private industries under the management of the white race there is much to be accomplished to make it safe for the race.

REFERENCES

1. Clark, H. C., and Komp, W. H. W.: "Observations on Malaria Incidence in Some Unsanitized River Villages in the Republic of Panama, with Special Reference to Proposed Construction Projects in the Canal Zone." (Covers work of 1931.) The Southern Medical Journal, 1932, 25, 642.

The progress reports for the years 1932 and 1933 were read before the National Malaria Committees of those years and reprints

- can be had on request to the Gorgas Memorial Laboratory, Panama, R. de P.
2. Taliaferro, W. H., and Taliaferro, L. G.: Reprints of their various publications on this subject can be had on request to the Office of the Dean, Division of Biological Sciences, The Chicago University, Chicago, Ill. Two other reports on the subject are available on request to the Gorgas Memorial Laboratory or by reference to American Journal Tropical Medicine, 1930, 10, No. 1; 1931, 11, No. 1. These are by H. C. Clark and L. H. Dunn.
 3. Clark, H. C., and Dunn, L. H.: "Experimental Studies on Chagas' Disease in Panama." The American Journal of Tropical Medicine, 1932, 12, No. 1.
 4. Darling S. T.: "Equine Trypanosomiasis in the Canal Zone." Bul. Soc. Path. Exot., 1916, 3, 6.
 5. Clark, H. C., Casserly, T. L., and Gladish, I. O.: "Equine Trypanosomiasis—'Murrina' or Derrengadera.' Some Notes on the Disease in Panama." Jour. Amer. Vet. Med. Assoc., 1933, N. S. 36, 358.
 6. Dunn, L. H.: "Experiments in the Transmission of *Trypanosoma hippicum* (Darling) with the Vampire Bat *Desmodus rotundus murinus* (Wagner) as a vector in Panama." Journal Prev. Med., 1932, 6, 415.
 7. Clark, H. C., and Dunn, L. H.: "Animal Susceptibility to *Trypanosoma hippicum*, the Equine Trypanosome of Panama, with Special Reference to Cattle as an Unharmful Host and Probable Reservoir of Importance." Amer. Jour. Trop. Med., 1933, 13, No. 3.
 8. Clark, H. C., and Dunn, L. H.: "Experimental Studies on Chagas' Disease in Panama." Amer. Journal Trop. Med., 1932, 12, No. 1.
Dunn, L. H.: "A Natural Infection of *Trypanosoma cruzi* Chagas found in *Rhodnius pallescens* (Barber) in Panama." Amer. Jour. Trop. Med., 1933, 13, No. 5.
The third report has been submitted to Amer. Jour. Trop. Med. for publication.
 9. Clark, H. C., Dunn, L. H., and Benavides, J.: "Experimental Transmission to Man of a Relapsing Fever Spirochete in a Wild Monkey of Panama—*Leontocebus geoffroyi* (Pucheran)." The Amer. Jour. Trop. Med., 1931, 11, No. 4.
 10. Dunn, L. H., and Clark, H. C.: "Notes on Relapsing Fever in Panama, With Special Reference to Animal Hosts." The Amer. Jour. Trop. Med., 1933, 13, No. 2.
 11. Dunn, L. H.: "Observations On The Host Selection of *Ornithodoros talaje* (Guern) in Panama." Ibid., 1933, 13, No. 5.
 12. Dunn, L. H.: "Rearing the Larvae of *Dermatobia hominis* (Linn.) in Man." Psyche, 1930, 37, No. 4. A general article on the "Prevalence and Importance of the Tropical Warble Fly, *Dermatobia hominis* (Linn.) in Panama," will appear soon in Parasitology (American Journal).
 13. Dunn, L. H.: "Two New Species of Ticks from Panama (*Amblyomma tapirellum* and *A. pecarium*)." Parasitology, 1933, 25, No. 3.
 14. Curry, D. P.: "Anopheles (*Anopheles*) *neomaculipalpus*. A New Species of the Arribalzagala Group of Anopheles from Panama." The Amer. Jour. of Hygiene, 1931, 13, 643.
Komp, W. H. W., and Curry, D. P.: "A New Culex From Panama (Dipt., Culicidae)." Psyche, 1932, 39, No. 3.
Komp, W. H. W.: "A New Culex, *Culex vomerifer* from Panama (Dipt., Culicidae)." Psyche, Ibid.
 15. Curry, D. P.: "Long Range Flights of Anopheles." Read before the National Malaria Committee, November 16, 1933 and will appear in the Southern Medical Journal.
 16. Curry, D. P.: "Remarks Concerning The Breeding of *Anopheles* among Aquatic Vegetation of Gatun Lake, Accompanied by Periodic Long

Flights of *A. albimanus* (Wied.)." Read before the 320th meeting of the Isthmian Canal Zone Medical Association, July 18, 1933. In this paper are mentioned the three species of anopheles: *A. albitarsis*, *A. bachmanni* and *A. strodei*.

17. Wilson, P. W.: "Atypical Yaws." Amer. Jour. Trop. Med., 1934, 14, 1.
18. McCoy, O. R.: "The Occurrence of *Microfilaria ozzardi* in Panama." Amer. Jour. Trop. Med., 1933, 13, No. 3.
19. Annual Report of the Gorgas Memorial Institute, 1933. Document No. 205, 73d Congress, 2d Session, House of Representatives.

