Febre amarela
1902 – 1903
Yellow Fever and the mosquito
Adolpho Lutz
1902 - 1903
Desenho – fêmea do mosquito *Aedes aegypti*.
Acervo DAD/COC/Fiocruz.

Drawing of a female *Aedes aegypti*. DAD/COC/Fiocruz.
On the 18th of this month we sent the following letter to Dr. Adolpho Lutz, Director of the Bacteriological Institute at the Isolation Hospital in the State of São Paulo:

Dear Sir,

Each of the two groups into which the hygienists of this country are divided in regard to the proper prophylaxis against yellow fever invokes your name in support of the doctrines defended by them.

 Those who deny that the striped mosquito is the transmitter of yellow fever cite a report in which you consider as valid the experiments carried out by Sanarelli that identify the ictheroid bacillus as the pathogen of this terrible disease. Disputing this argument, the others cite works in which you dispute Sanarelli’s theory and even the etiologic role of his bacillus, and in which you praise the work done by the Commission in Havana, which points to the mosquito as the sole known transmitter of icterical tiphus.

As you know, this question has become of the highest interest to us since the prophylactic measures proposed by the Director General of Public Health have been laid before Congress. It is now essential to shed all light possible on this important matter. As we are convinced that your opinion is of great value, because of the position you occupy and because of your knowledge of the subject, we appeal to you, requesting you to put forward your current views on yellow fever prophylactics, categorically yet succinctly.

Confident that you will not refuse to make this patriotic and valuable contribution towards the extinction of our worst enemy, we sign ourselves etc.

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1 In fact, director of Instituto Bacteriológico do Estado de S. Paulo.
2 Name usually given to Stegomyia fasciata in Brazil. [E.N.]
3 Name usually given to yellow fever in Brazil. [E.N.]
Owing to other duties, Dr. Adolpho Lutz was only able to answer us yesterday [Oct. 25], with the following letter:

Sir,

I cannot refuse your repeated requests for my views on the transmission of yellow fever by mosquitoes and I should very much like to help rid the city in which I was born of this scourge. I am sure that this will only be achieved by measures directed against its transmission by *Stegomyia*, which I consider a perfectly established fact.

I shall even go further and say that I have leaned towards the idea of this mode of transmission since the first great epidemic of yellow fever in Campinas (1889), during which I observed the coincidental occurrence of an enormous quantity of striped mosquitoes, extreme heat, and a pandemic of yellow fever. As a medical man and a naturalist, I have always been greatly interested in these mosquitoes and I know that they were very abundant in Rio and in Santos but very scarce in the interior of São Paulo. There they only became troublesome very rarely, in the places in which I have been or where I have lived. Campinas was the only place in which I was obliged to make use of a mosquito-net even in day time, when I wanted to snatch a few minutes rest in the house in which I lived and where some cases of yellow fever had occurred.

At that time all the elements needed for explaining the conditions of the transmission of yellow fever by mosquitoes were lacking. The striped mosquito was considered autochthonous and limited to the American countries, and to me the main problem were the epidemics observed on the shores of the Mediterranean and along the coasts of Africa. I was very much surprised, a few months later, to observe the same mosquito in the Sandwich Islands, not only in the capital but in distant plantations. Mosquitoes did not even exist there at the time of the discovery, and the date of their introduction is even known. I then realized that this mosquito is spread by shipping and should also be found in other hot countries, but I still did not know of its occurrence in southern Europe. This fact only came out later.

In 1887, the bacillus of Sanarelli was published and for a time it looked as if the problem of yellow fever had been solved, at least as to what organism caused it. (Speaking of Sanarelli’s bacillus, in 1897 I wrote: “The role that may be played by flies and blood-sucking insects in the transmission of this disease must not be overlooked.”) Sanarelli’s bacillus did not succeed in explaining the mode of transmission of yellow fever, and doubts concerning its etiologic role also gradually increased.

In 1898, the well-known Joseph Chamberlain, one of the Ministers of the British Empire, sent out a circular letter on behalf of the government to the colonies and to the British consulates abroad, asking that collection be made of all kinds of Culicidae and other blood-sucking insects, so that they could be studied at the British Museum.
This goes to show that clear-sighted men, far from considering such studies as worthy of ridicule, realized their importance in the investigation of the diseases of man and of domestic animals. As I was engaged in similar studies at the time, I also received an invitation to contribute to the project and responded by sending all my Culicidae, which amounted to over forty species. The cosmopolitan collection of the British Museum served as a basis for a monograph on the Culicidae of the world, in four volumes, by the British entomologist F. V. Theobald. One of the most interesting results of his studies was the discovery that our striped mosquito had occurred in Spain and Portugal already at the beginning of the last century; this furnished the explanation for the epidemics of Gibraltar and Lisbon. Generally speaking, the species was observed in all the countries where Yellow Fever has been rampant. It was often described as a new species, receiving various names, which have now been substituted by the generally accepted one of *Stegomyia fasciata*.

The study of mosquitoes was given its first impetus by the discoveries regarding filariasis and malaria. They were begun by Manson, who proved that our common night-mosquito played an important part in the propagation of filaria, which causes elephantiasis and endemic chyluria. Only later did Bancroft and others demonstrate that the transmission occurred during the bite of the mosquito, which contained the larvae in its proboscis, where they arrived after a lengthy evolution. The work done by Manson, Ross, Grassi, and others, proven through experiments of transmission in England, in Italy, and in some other countries, showed that malaria is transmitted by certain mosquitoes of the group of anophelids, which has at least five representatives in Brazil. In this case also, inoculation can only take place after prolonged incubation, during which the hematozoan has to pass through several phases of its life-history in the body of the mosquito. It ends by forming sporozoites, which are introduced through the saliva of the mosquito, injected during its bite.

It was formerly believed that mosquitoes only sucked blood once, then maturing and laying their eggs, and it was thought that, like many other insects, mosquitoes died soon after. This made it difficult to understand the transmission of parasitic diseases by mosquitoes. More recent studies have made it clear that many species of mosquitoes live for quite a while, sucking blood and laying eggs several times.

The work of Finlay (who since 1881 had propounded the theory of the transmission of yellow fever by mosquitoes) furnishes good proof of this but it has been very little known. Of late, it has been demonstrated many times that striped mosquitoes can easily live through two or three months of summer, provided that they are fed; it is even known that, not only here, but in cooler countries than ours, they may last through the whole winter. When the temperature is low, *Stegomyia* do not bite, and new infections cease until the hot weather returns. If the temperature rises a good deal in wintertime, they may come out of their hiding places.
and suck blood, and this is why some cases may be observed during that season. As a rule, the number of larvae and of adult mosquitoes is very much reduced during the winter, especially if it is long and cold, when they may be totally extinguished. For this reason, yellow fever is not permanent in São Paulo and does not spread through the entire city. The Stegomyia infected during the summer are perfectly able to multiply and thus to account for epidemics restricted to parts of the city, which have occurred several times. If an epidemic dies out at the end of summer and does not reappear the next year, this will be due to the lack of survival of infected mosquitoes and not to measures undertaken, which are unable to prevent the spread of natural epidemics.

These observations make it easy to accept the transmission of yellow fever by mosquitoes; they also supply an explanation for the characteristics of the disease, such as: its limitation to hot countries or cities, where there are long periods of hot weather; its preference for seaports, and, here, for towns served by railways; the cessation of epidemics when the cold weather begins; the lack of direct contagion; the interval observed between the first case introduced and the appearance of subsequent cases; the immunity of certain localities; and the inefficacy of prophylactic measures not directed against the mosquitoes, such as the disinfecting of clothes.

Moreover, the transmission of yellow fever by Stegomyia is no longer just a comprehensible and satisfactory theory, supported by many analogous facts, but it has been demonstrated experimentally. Twenty-five positive results have come from published experiments. One must indeed be demanding not to find these enough, all the more so because these experiments were carried out in three different countries and in the presence of many physicians. Their significance is gaining recognition day by day; this is evident in the recent medical literature, especially in the professional periodicals which deal with this subject.

Magnificent practical results were obtained in Havana, where five months of work were enough to do away with an endemic condition that had lasted for one and a half centuries. These results have withstood all attempts to deny their worth. At the Congress of Cairo they were not contested by anyone; likewise not contested was the formal statement that these results were due solely to the extermination of mosquitoes while the other sanitary measures (which led to a general decrease in mortality) proved useless against yellow fever.

For those who are familiar with parasitology, the transmission of yellow fever by mosquitoes precludes any other mode of transmission. The etiologic agent of yellow fever is so specialized that it can not reproduce even in Culex fatigans, our common night mosquito. This excludes the possibility that other species, diverging further from Stegomyia, might serve as intermediary hosts. It is still less possible to suspect transmission by air or water, which is in disagreement with the facts observed. The introduction of canalized water and sewers in Campinas did not prevent
the recurrence of a great epidemic, and in Rio the number of cases increased instead of diminishing after a disinfection-station was established.

I do not want to deny that there are other mosquitoes which are also able to transmit yellow fever. It is probable that this property is common to the whole genus *Stegomyia* and not peculiar to one species of it only.

I know two other species of mosquito belonging to our fauna which ought probably to be included in this genus. Fortunately, they are sylvan species, not very abundant and able to cause only small, disseminated foci.

Prophylactic measures should be directed firstly against all the mosquitoes which breed in or around houses; this does not offer insurmountable obstacles and may perfectly well lead to the disappearance of *Stegomyia fasciata*. One need not fear that yellow fever will only become extinct upon the death of the last mosquito. In this case as in many other measures of hygiene, a small effort may produce substantial results. Besides, the protection of both patients and healthy persons by the use of mosquito-nets will also help greatly to diminish danger.

If energy and money are not spared at the time of need, the difficulties and expenses will soon be diminished by the decrease in the number of victims. I feel certain that it is within our scope to give the world another example like that of Havana.

We would like to register here our thanks to the distinguished Dr. Adolpho Lutz, who responded to our request, in that it dealt with an issue of major importance, and who did so without the slightest intention of fueling controversies, for which he indeed has no time.