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OPINION ARTICLE

THE 'SPREAD" OF JUNGLE YELLOW FEVER

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ABSTRACT

The saga of yellow fever has been recounted by several science historians. It is a chronicle of errors, fight for recognition, historical mis-interpretations, and human experiments that would be unacceptable today. But it is also a record of forecasts that would be later confirmed by sound field work and through laboratory and clinical research. It is also an example of the contribution of local native lore to sound scientific discoveries. In this paper we try to demonstrate how we are advancing towards the natural foci of the jungle cycles of a zoonosis, not the reverse.

KEY WORDS: Yellow fever; geographical distribution; epizootiology; epidemics.

The saga of yellow fever has been recounted by several science historians and is now known in great detail. It is a chronicle of errors (Nogush, 1920), fight for recognition, historical mis-interpretations, and experiments that would be unacceptable today (Kelly, 1906; de Kruif, 1926; Delaporte, 1989). But it is also a record of forecasts that were to be confirmed by sound field work (Lutz, 1930) and laboratory and clinical research. It is also an example of the contribution of local lore to scientific discoveries (Balfour, 1914).

The reader of this paper deserves to be spared tiresome repetitions. It is enough to recall that it arrived in Brazil, in the State of Pernambuco in the year of 1685, and in Rio de Janeiro, in 1894. A few references will be enough to introduce the subject of the present contribution to the knowledge of the jungle cycle of yellow fever in Brazil.

Adolfo Lutz, born in Brazil, educated in Switzerland, with a large scientific and clinical background acquired in his own country as well as in Hawaii, Continental United States, and elsewhere, predicted the existence of a jungle cycle of the yellow fever virus before it was officially confirmed. In the 1920' Lutz already showed a special interest in the biology and taxonomy of blood-sucking insects, and in the transmission of diseases by insect vectors. Working in the region of Campinas, São Paulo, he noted the absence of the

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urban *mosquito rajado*, abundant in that city but not present in neighboring rural communities. He commented on the role of railroads in spreading *Aedes*. In two localities where there were no railroads but where cases of yellow fever occurred, he credited the role of *probable* vector to wild mosquitoes, *possibly related* to the *estegomia* (Lutz, 1930).

The existence of jungle yellow fever was eventually recognized in 1932 by a team of researchers that included Adolfo Lutz, thanks to a sound zoological and epizootic investigation, following the method used by Battista Grassi in the identification of the malaria vector in the Mediterranean (Grassi, 1899 and 1901).

The history of the discovery of the sylvatic cycle teaches us important lessons – which remain valid nowadays. In a paper published by Soper et al. (1933) the authors assert that *Yellow fever was believed to be an urban disease which was transmitted by* Aedes aegypti*, and was expected to obey the epidemiological rules based on this belief*. This fact continues to be somewhat overlooked: *The discovery of yellow fever in the Valle do Chanaan was to a large extent fortuitous. The local health officer had seen yellow fever during the Rio de Janeiro epidemic of 1928-29, and was familiar with the typical mild cases as well as with the classical picture presented by medical textbooks. Fortunately, he did not know that* Aedes aegypti *was not prevalent in the Valle do Chanaan.*

The same error was made by A.M.Walcott, a consultant from the Rockefeller Foundation, who had a strong personality and very definite opinions (Zulawski, 2007). Soper et al. (1933) reported that: *Dr. A. M. Walcott visited the State of Espirito Santo to organize the service for the routine collection of liver specimens from patients with fatal fever cases of short duration. In discussing the distribution of this special service, the object of which is the discovery of otherwise unknown foci of yellow fever, Dr. Mello again mentioned Santa Thereza as an area requiring investigation. Dr. Walcott visited the town of Santa Thereza, lying more than six hundred meters above sea level, found no* Aedes aegypti*, and decided against installing a liver-collection service. Driving to the top of the pass beyond Santa Thereza he looked down upon the beauties of the Valle do Chanaan, hundreds of meters below, but, like Moses of old, who gazed upon but did not enter the Valley of Canaan, Walcott turned back.*

Aragão (1939) described in detail the differences in the epidemiology of the urban and the sylvatic cycles, and in Aragão (1943) reported on the establishment of a biological station in the State of São Paulo to put into practice the methods of field work introduced by the ecologist David E. Davis (1945). Davis worked in the region of Teresópolis, where cases of jungle yellow fever had been detected in 1938. He was assisted by Nelson Cerqueira, João Moojen, Herbert Berla, and Antenor L. de Carvalho from the Museu Nacional, Rio de Janeiro, Henrique Velloso and J.A Kerr, from the Oswaldo Cruz Institute.

Davis advanced two hypotheses: the first, that the virus *is spread as a wave through southern Brazil and does not remain in one locality long because the susceptible hosts either die or become immune*. The second hypothesis deserves to be reconsidered: *concerning the distribution of the virus in time and in space is that the virus is always present in the forest, but appears in humans only in response to certain specific conditions. Among these conditions may be suggested changes in the virulence of the virus or an unusual abundance of hosts and vectors resulting from climatic conditions.*

Davis did not foresee another factor we now suggest in this article.

There are two facts we must take into account. The first is the spreading out of the human population towards the borders of native forests and the establishment of city parks without a proper system of zoonotic vigilance and control. The other is a marked change in the public stance towards the preservation of our fauna. From an attitude of indifference or disregard towards the fate of animals, we now see a preoccupation with their well being, which is reflected in an increase in wild populations, especially of mammals and birds in urban and neighboring areas. Even in large cities as Rio de Janeiro, we now see groups of marmosets using electric cables to get at the food offered by people living in apartment blocks. Furthermore, hiking, camping, and rural tourism puts people in close contact with natural cycles of zoonoses. The city of São Paulo, for instance, has some 80 parks.

The statement by Soper et al. (1933) that it was a mistake to expect sylvan yellow fever to obey the epidemiological rules of the urban cycle involving *Aedes aegypti* and the human local population is still valid.

Mapping human interbreeding populations is not as difficult as mapping mammal populations, although there are detailed studies of the population distribution (home range) of certain species of primates (Bicca-Marques, 2008) and of other species.

Sylvatic yellow fever cycles are maintained by populations of certain species of primates, sympatric with populations of viable vectors – jungle mosquitoes of the genera *Sabethes* and *Haemagogus*, and the yellow fever virus, in suitable environments. This is a much reduced schematic model, as what we find in nature are biotic communities functioning as ecosystems. Monkeys, mosquitoes and viruses are part of complex trophic chains, whose elements change their [trophic] niches along their lives.

To be infected, a human being must become a vicariant element in the biotic community occupying the same ecological niche as the other primates.

The map of the geographical/ecological distribution of human cases of sylvatic yellow fever currently shows **the distribution of the enzootic foci**. Humans are hence their ecological indicators.

In conclusion, yellow fever is not advancing: we are advancing towards the natural foci.

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