

THE CONTRIBUTION OF THE ENTOMOLOGY LABORATORY OF THE SCHOOL OF PUBLIC HEALTH TO THE KNOWLEDGE OF BRAZILIAN ENDEMIES

The Entomology Laboratory of the School of Public Health of the University of São Paulo is now completing fifty years of uninterrupted activity dedicated to research along the lines developed in the field of the great endemic diseases that devastate Brazil. Having begun with taxonomic studies, attention was then soon drawn to those relating to the biology and ecology of vectors, especially to Culicidae, phlebotominae and Triatominae. Thus our knowledge of the epidemiological pattern related to infections spread by these insects has been greatly enriched.

Many have been the contributions made on the genera *Anopheles*, *Aedes*, *Culex*, *Psorophora*, *Haemagogus*, *Sabethes*, Phlebotominae and Ceratopogonidae to the development of our taxonomic understanding. The treatises "American Sabethinae" (Lane & Cerqueira, 1942), "Neotropical Culicidae" (Lane, 1953), and "*Culicoides* of the neotropical region" (Forattini, 1957), as well as the four volumes of the "Medical Entomology" (Forattini, 1962, 1965 and 1973) are notable landmarks in this field. The morphological aspects of the text of these treatises deserve special emphasis, with their original illustrations or drawings, which, because of the faithful representation of these specific structures, together with the keys for the identification of the species, reveal the didactic nature of the work and the clear reflection of the concern for the teaching of Entomology. The works of Lane and Forattini are still much used by researchers and students who study the Brazilian or neotropical fauna - having been used, in fact, beyond our national frontiers. New taxonomic studies continue, increasingly, to be developed.

The delineation of the epidemiological contribution of the Entomology Laboratory arose from the circumstances which, at that time, brought about its establishment, in that its founders were fully involved in the fight against yellow fever and malaria in Brazil. Paulo César de Azevedo Antunes played an outstanding part in the coordination of the programs of the fight against these endemic diseases. Thus were born, from the very beginning, with the Laboratory, two great fields of investigation, which, "sensu lato" persist as areas of specialization: taxonomy, which makes possible the identification of regional fauna or exotic species, and Epidemiological Entomology, seeking to identify the mechanisms of transmission of arthropod-borne diseases.

In the course of subsequent decades, in the face of the increasing seriousness of malaria, leishmaniasis, trypanosomiasis and arbovirus diseases arose the plans to bring together in the Laboratory, new human resources which should make possible the increase in the volume of research and thus provide new light for the solution of the problems involved in the control of these diseases. In this way new members were attracted to the team and thus considerable research has been undertaken in the State of São Paulo.

In view of its scientific production and the availability of its human resources, the Entomology Laboratory has been able to collaborate with public institutions, as in the recent case of the identification, for the first time in Brazil, of the *Aedes albopictus*, as a result of a request from the Brazilian Ministry of Health. With a view to the stepping up of the training of human resources and the logistic support for the study of the endemic diseases, the "Centro Brasileiro de Estudos Entomológicos em Epidemiologia (CENTEP)" (Brazilian Center for Entomological Studies in Epidemiology) was created in 1977 by agreement with the same Ministry of Health. Despite the short period for which this agreement lasted, the CENTEP made possible the carrying out of research projects into the Culicidae and phlebotominae fauna of the southern coastal area of the State of São Paulo, under several aspects such as regional composition, diversity according to environment, their relationship with man and the definition of the epidemiological pattern, as will now be reviewed.

Malaria. The collaboration of the Laboratory with the activities of federal, state and municipal institutions, as also with other units of the São Paulo University, has always been given in the light of its experience and in the form of an effective contribution. It practically had its beginning in the Program for the eradication of the *Anopheles gambiae* in the Northeast of Brazil and became involved from that time on with that same endemic disease, dedicating its efforts, however, to the study of autochthonous vector species. In that direction, the identification of the anopheline fauna was of special importance, the value of which for that time can be summarized in the words of João de Barros Barreto (1940): "observations of Ayroza Galvão, the brilliant leader of the São Paulo research team, who has in such an outstanding way contributed to the greater understanding of our *Anopheles*". Beyond the systematic aspect, A.L. Ayroza Galvão was responsible for the first essays on the biology of the vectors of this disease, when he recorded activities about distribution of the Brazilian anophelines and experimentally tested the effect of DDT and Piretro on *Anopheles darlingi*. J.O. Coutinho also participated in the studies on this endemic disease with his observations on the biology and on the vectors of malaria foci in the States of "Rio de Janeiro, Espírito Santo and São Paulo" — his work on Bromelia-Malaria being deserving of special mention.

In the assessment of the attack-phase undertaken by the Malaria Eradication Campaign (CEM) in the State of São Paulo, the success would have been total had it not been for the difficulties met, in this phase, in the southern coastal area, corresponding to the region denominated Bromelia-Malaria. Even though previous research had demonstrated that the local anopheline vectors belonged to the sub-genus *Kerteszia*, the slight knowledge of its habits must have been a factor which made the spraying of dwellings of little effect. At the same time the Entomology Laboratory was to be found in the same region carrying out studies on the behavior of *Anopheles cruzii* and *Anopheles bellator*. O.P. Forattini and R.R. Corrêa demonstrated the great dispersive ability of the two *Anopheles*, extending to the islands Cananéia and Comprida, in both directions, thus demonstrating the impossibility of the simple destruction of the breeding places in Cananéia and the interruption of the local transmission of the endemic disease. Thus the contribution of the Entomology Laboratory resulted in the demonstration of the existence of barriers that had not been overcome by the CEM, which would account for the persistence of malaria in a residual form for some further time. One may add to this the contribution represented by the text-book on Medical Entomology (Forattini, 1962), volume I. The information contained in this treatise was of great value to researchers and technicians who used it as a source for their understanding of malaria and the *Anopheles* of the neotropical region.

After almost two decades, the malaria situation in the State of São Paulo has once again become a public health problem, because of the importation of the gametophore. However, as the Laboratory continues to investigate the behavior of the vector populations, irrespective of the existing epidemic situation, it places its new information at the disposal of those organs responsible for the control of malaria, in the conviction that this knowledge may govern practical future conduct. As an example one may quote the latest studies on *An.cruzii* and *An. darlingi*.

Leishmaniasis. The study of these endemic diseases dates from many years ago. Initially there arose the contributions of P.C.A. Antunes, A. L. Ayroza Galvão and J.O. Coutinho, between 1930 and 1940.

When cutaneous leishmaniasis lost its epidemic character in the State of São Paulo and its importance for public health declined as a result of the reduction in the number of human cases, the Entomology Laboratory became involved in the subject, carrying out its observations in the area where the disease was virtually endemic. It was in these circumstances that O.P. Forattini elaborated study programs on this disease, the results of which were significant for a the epidemiological surveillance program. This hypothesis was based on the endemic persistence of the disease due to the survival of the woodland enzootic in modified environments, with residual forests, and identified the vectorial role of *Psychodopygus intermedius* (= *Lutzomyia intermedia*) as a clearly anthropophilic species which showed the ability to survive the devastation of the primitive environment, as well as its participation in the biological cycle of the *Leishmania braziliensis*. Apart from this, this sandfly was seen to be in process of domiciliation whether breeding in household dependencies, or using human dwellings or the shelters of domestic animals as a refuge for the winged forms. D.G. Pattoli collaborated in the development of these biological and ecological studies, with their definition of the epidemiological aspect. This subject is expounded in a more comprehensive fashion in the Medical Entomology, volume IV, where one has a detailed and panoramic view of the leishmaniasis and sandflies of the neotropical region.

The description of the first focus of cutaneous leishmaniasis in the Ribeira river Valley fell to O.P. Forattini. His participation in new investigations in the region raised the suspicion of the local vectorial role's also being played by *P. intermedius*. On the basis of this hypothesis A. de C. Gomes investigated the question and proved that this species had the ability to survive and become dominant in the domiciliary environment, parallel to evidences which showed that human infection did not take place in the forest environment of the region. Under these circumstances the Entomology Laboratory accepted the responsibility for the delineation of the present epidemiological characteristics of cutaneous leishmaniasis in the State of São Paulo, in the belief that there are here at least two different aspects, that is to say, human transmission which occurs in the forest environment in the west and north-west region of São Paulo and the typically domiciliary transmission corresponding to the Ribeira Valley. One must also record, with regard to these latter investigations, the collaboration of E.X. Rabello and E.A.B. Galatti.

Trypanosomiasis. The decade of the seventies marks the beginning of studies on the Triatominae focussing on the possible domiciliation mechanisms of these insects. Thus the extent of domiciliary infestation by *Triatoma infestans*, which would be, later practically eliminated from human dwellings in the State of São Paulo, heads a long list of publications which appeared over two decades. The choice of the search for the knowledge of the habits of these populations served as the guiding principle for a research program entitled "Ecological Aspects of the American Trypanosomiasis". Within this context, the experience gained from a series of twenty publications, in which were discussed the mobility, dispersion, colonization of artificial ecotypes, feeding habits, natural infection by *T. cruzii*, domiciliation potential and other aspects, was enriched by the contribution of SUCEN (Superintendency for Endemic Disease Control) and the team was composed of O.P. Forattini, O. A. Ferreira, E.O. Rocha

e Silva and E.R. Rabello. Employing an original methodology it was possible to prove the possibility of the re-introduction of this parasite infection, after the elimination of *T. infestans*, due to the triatomines reinfection of the domiciliary environment, and this leads to the need for the maintenance of epidemiological surveillance. Such studies demonstrated the existence of Triatominae populations with sufficient ecological valency to take over ecological niches left unoccupied in this environment. One may add to this picture analyses of the behavior of *Triatoma sordida* and *Pantronylus megistus*, both in the immature as in the adult stages, which lead to the discovery of the existence of annual generation in the life cycle of these species, in the natural environment. On the basis of this knowledge, the efficacy of the program for the control of the endemic disease could make use of new data which, together with the determination of the endemic center of *T. infestans*, *T. sordida* and *P. megistus*, would make the measures taken to combat them, in their areas of domiciliary distribution, more rational.

Mention may, further, be made of the collaboration of SUCAM (Superintendency for Public Health Campaigns) with the Entomology Laboratory with regard to the first register for the knowledge of the distribution of triatomine anthropophily in the northeastern, central and southeastern regions of Brazil. O.P. Forattini, J.M.S. Barata and A.C. Silveira participated in this work.

Finally, it should be mentioned that all the collaboration referred to in this report contributed to the efficiency of the state and federal services involved in the control of American Trypanosomiasis in Brazil. In which case, to judge from the State of São Paulo, it seems clear that the control of this endemic disease has ceased to be a technical problem to become a problem of administrative policy.

Arbovirus diseases. This subject has been of interest to the Entomology Laboratory ever since the days of the studies on the identification of the vectors of the selvatic yellow fever under the responsibility of P.C.A. Antunes, in collaboration with the National Yellow Fever Service in the years from 1938 to 1948. Research on the mosquitoes Culicidae or on the identification of their vectorial activity, could not help taking into account the species involved in this endemic disease. It was because of his concern with this question and with the further effects of other possible virus infections that O.P. Forattini reviewed these diseases in 1961/2 and later disseminated the subject in a more complete form in his books, *Medical Entomology*, volumes II and III. Controversial questions were raised by this researcher, which reflect part of the present-day reality as lived by Latin-Americans. In this analysis of the *Aedes aegypti* Eradication Campaign Forattini (1964) expresses himself in this way: "What is it possible to expect of this species in the future, particularly in the American continent? The reply to this questions cannot be categorical, either in the sense of success, or in that of the failure of the elimination campaign, at least as far as our present knowledge goes. Everything suggests that we are dealing with a very unstable mosquito, with considerable capacity for adaptation to new habitats and geographical areas". Unhappily, we have to recognize that this latter situation has prevailed, as proved both on the genetic and on the ecological levels. Thus the Laboratory once more demonstrated its concern with the present without, however, having forgotten the future.

In the seventies the Ribeira Valley region was swept by an epidemic of encephalitis caused by *Flavivirus*, previously unknown. On the basis of the supposition that one was dealing with an arbovirus disease transmitted by mosquitoes, the Laboratory began its epidemiological investigations with the objective of bringing to light the possible transmission mechanisms of this infection. Thus, through the analysis of the first results obtained, it was possible to incriminate *Aedes scapularis* as the species epidemiologically associated with the local transmission of the encephalitis.

The studies on the Culicidae fauna and the habits of the adult forms in the conserved, modified and residual forests, cultivated field, pasture and domiciliary environments are still in full motion in the region, notwithstanding the fact that the incidence of the encephalitis has been reduced to nil. Emphasis has been laid on anthropophily, the rhythm of crepuscular activity and the ecological spectrum of the mosquito populations by means of the profiles of compositions of the variable ecological gradients for the region.

To sum up, it can only be concluded that the analysis of the information produced by the Entomology Laboratory of the School of Public Health of the University of São Paulo highlights the importance of its participation in the research into various of the endemic diseases of outstanding importance to public health in Brazil. In the field of the Entomology of Public Health, the areas of research are directed towards the identification of the causal factors involved in the occurrence, persistence or interruption of human infection. Thus, in the course of its fifty years of existence, the Laboratory has acquired a considerable tradition of scientific research. At the present time, the main line of research is represented by the study of the mechanisms of domiciliation of the vector populations, especially with regard to the Culicidae species in contact with the human environment. If Brazil is experiencing,

at the present time, an increase of the problems associated with diseases transmitted by arthropods, autochthonous and imported, the incidence and prevalence of these endemic diseases depends directly on ecological factors, particularly on the habits and population density of these vectors and the degree of contact or association with the human population. In this sense, the available infrastructure, schematized according to the diagram of the flow of material originating at the field stations, selected by the regional laboratory of Pariquera-Açú and processed by five specialist laboratories of the Central Laboratory in São Paulo, continues to achieve the progressively higher qualifications of its team as a whole. This is the reason why, though it began as a limited nucleus, the Laboratory has attained its present stage as a real center of reference. Nowadays, in view of its complexity, it may be considered a School of Entomology adequate to attend to the basic needs in this field, whether with regard to the elucidation of epidemiological patterns of arthropod-borne diseases and or to the training of human resources.

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