

## FROM SAN JUAN TO ARUBA

W. A. HOFFMAN

From the School of Tropical Medicine of the University of Porto Rico under the auspices of Columbia University.

With several objects in view I spent the past summer as a member of a biological expedition of the United States National Museum. The West Indies south of Porto Rico was our field. I was prompted to join this expedition first because I desired to collect mosquitoes and other biting flies of the region, which are at present not too well known, and also because of a desire to acquaint myself with the various diseases prevailing there, especially those of a parasitic nature. Lastly, the cultural value of such a journey played no small part in influencing me to go. During our expedition the great majority of the islands in this West Indies or Windward Island group were visited. Flags of five nations float over the various islands and they extend in a curved chain from Porto Rico to Aruba, the last very close to the oil deposits of northern Venezuela.

Our means of travel, the "Guillermite", a schooner or "goleta" of thirty-eight tons, was manned by a crew of five and an exceedingly prudent but able captain, Tomas Bonano. We sailed from Porto Rico July 10th. Dr. Bartsch of the United States National Museum, in charge; my assistant José Oliver González, whose industry and meticulous attention to detail were responsible for much of the success the expedition may have had, and the writer, formed the group.

Difficulties not previously considered made the collection and breeding of mosquitoes a more than arduous task. Of necessity stops had to be of short duration. Since the collection of such organisms even in a restricted area is at best a tedious and time-consuming operation, our catches had to be considered merely as fortuitous findings. Because of this we strove to specialize on certain types of environments, namely crab holes, tree holes, and the water in epiphytic plants. Mosquitoes encountered elsewhere however were of course gathered as well.

The vessel also presented an acute problem. Our catches represented chiefly larvae and pupae, from which adults, preferably males,



had to be bred to facilitate identification. These immature specimens brought from the field in small glass jars were transferred with the water in which they were taken to glasses covered with cheesecloth, which prevented the escape of adults. Darkness of the hole, the only available place for breeding operations, the motion of the ship, the penetration of sand and salt particles into the containers, all tended to exert a deterrent effect upon the developing insects. Partial burial of the glasses into the sand which served as ballast, gave a certain degree of stability. Despite these disadvantages a surprisingly large proportion of adults were bred out. It is hoped they will provide new and interesting information regarding the culicid fauna of the West Indies. I also obtained valuable material pertaining to the genus *Culicoides*, to which the "jejens" or "mimis" belong.

At St. Thomas, *A. albimanus* and *A. grabhamii* the two common anophelines of the Greater Antilles were taken during an afternoon trip. Along the shore *Culicoides furens* made life miserable.

Having examined representatives of this species from many regions a more detailed knowledge of its distribution constituted one of the entomological goals of the expedition.

My collecting in St. John, where we spent a Sunday was confined to a district known as Hurricane Bay. Here I fortunately located a small dirty pool, about the only natural fresh water deposit observed, teeming with larvae of an *Aedes* like mosquito and a gnat. Here too the tropical horse tick *Dermacentor nitens*, a relative of the transmitter of Rocky Mountain fever seemed to occur in abundance in the ears of horses. I have taken this form in Haiti, but thus far not in Porto Rico.

The few wet spots found in St. Croix contributed various mosquitoes. A *Culex* was collected from rock holes below the reservoir that supplies the city of Fredriksted, another from a culvert near the sea. Later that day after walking several miles through dry unpromising country I spied a little hole in a "Quenepa" tree trunk too small to permit the use of a dipper. A small bottle like that used for pathological specimens solved the problem, though even then the process proved decidedly laborious.

Tortola, the first British possession visited, gave interesting data. The island like many in the region consists chiefly of hills skirted by a narrow coastal fringe. Near Roadtown the principal municipi-



pality and port, sugar is cultivated on the few level areas. A number of the islands beginning with St. Thomas receive but scanty rainfall. Here the water falling upon the enclosing slopes is concentrated upon the flat plots, where it is held in depressions which alternate with elevated rows. The cane plants are placed upon the latter. Theoretically these depressions with grass fringed margins and an abundance of water, at least part of the year, should provide ideal breeding places for *Anopheles*. Larvae of *A. albimanus* were found in abundance, a dipperful frequently containing twenty. Information elicited from the natives indicated that malaria occurred. Its distribution owing to the irregular topography of the island must be limited to the areas described. The disease therefore could probably be easily stamped out.

Here I first examined crab holes. Besides finding the common crab hole mosquito of the West Indies, *Deinicerites cancer*, I recovered examples of *Uranotaenia*, a genus of non-biting culicids usually associated with Algae or green vegetation of ponds, springs and streams. This is probably the first record of its occurrence in such a habitat. The gnats paid us considerable attention, favoring Oliver particularly, probably because his dark trousers provided attractive shelter, which they occasionally deserted for a sanguineous meal.

Virgin Gorda the next stop in our itinerary, yielded only a crab hole inhabitant and *Culicoides*. Since the island is practically uninhabited the question that arises in one's mind is, "Can the latter rear generations without a blood meal, or if it be necessary for the development of ova, what constitutes the course of supply?" Certainly their vicious attacks indicate such a requirement. Birds and reptiles seemed the only organisms present that could supply such food. If this be so, then the punkie must be decidedly catholic in its tastes.

St. Martin, next in our path is divided between two nations, the northern half going to Holland, the southern to France. The only interesting entomological find was that of *Aedes (Stegomyia) aegypti* in a tree hole, its ancestral habitat, now largely deserted for the artificial containers provided by modern civilization. Monsieur Fleming the commissioner, also the local magnate, entertained us. From him I learned several interesting facts. The people possess good health to a remarkable degree. Only those returning from the Cuban cane fields suffer from malaria and tuberculosis, these diseases not being indigenous. Schistosomiasis is known from one district, Columbier, where in former days a sugar mill functioned.



To this day standing water persists there, which probably accounts for the presence of the disease. Ancylostomiasis obtains in a small fishing community.

St. Barts, likewise French provided us with but meager fare. Many *Culex* larvae were taken from a small depression in the rocks along the shore. Crab holes, chiefly of a small caliber which never yielded mosquitoes, were numerous. The others were protected by vegetation. Fortunately I obtained one male *Culex* which will provide a record. Both *Culex fatigans* and *Aedes aegypti* bred in water barrels. Filariasis occurs for I met one woman of Spanish birth, but a resident of long standing who suffered from elephantiasis. The most influential, and of course the most affluent resident, who incidentally spoke English, assured me that other cases existed. A little pond which supplements local rain catching devices was devoid of mosquito life, due to its complete cover of *Lemna*, a small surface growing aquatic plant. This same condition I have seen elsewhere.

St. Kitts the first island of any area since St. Croix, contributed little entomologically. I feel that a systematic search would disclose *A. albimanus*. Other specimens are doubtless to be found in the elevated forested portions. Lack of time prevented our visiting them. The two domesticated species *Culex fatigans* and *Aedes aegypti* abound. Filariasis occurs with some frequency. Dr. Branch born in St. Kitts told me his parents had eight children, none of whom were infected. The eight offspring of his wife's parents however were all affected, some symptomatically.

Here as elsewhere in the West Indies the cattle tick *Boophilus annulatus*, definitive host of the Babesia causing Texas fever and the pathogenic protozoan *Anaplasma marginale* attack cattle in countless numbers. One occasionally notes in various works the statement to the effect that the zebu or Indian cattle are practically immune to this ectoparasite, presumably because of the character of their sebaceous secretion. On a large sugar plantation animals of this breed were as heavily infested as others. Nor had the cattle overseer ever noticed any evidence of differential susceptibility.

Schistosomiasis apparently is well disseminated in St. Kitts, though to what extent, the chief medical officer could not inform me. Parts of the coastal plain are watered by numerous streams. Where they are of a permanent nature the snail host doubtless occurs. Not only man but the African green monkey *Cercopithecus sp.* functions



as a host, a fact recently established by Mr. Delisle a local amateur naturalist. These monkeys are a scourge to the agriculturist. They remove bananas as soon as they form. Other crops suffer proportionately. Consequently no one looks with disapproval upon the trapping or slaughter of these primates, which, as a rule the natives are too indolent to hunt. Since *Planorbis*, probably guadelupensis abounds in permanent streams at high altitudes, the principal haunts of the monkeys, infection probably takes place frequently. The monkeys along with the slaves, yams, hookworms, and schistosomes.

From here to Grenada water supply system is of the same type, namely a central reservoir in the hills from which it is distributed to various localities.

Recently according to the press an epidemic of filariasis had broken out at St. Kitts. Since a gradual rise, not a fulmination characterizes helminthic infections, I gave the report no credence. An item in the December 13th issue of the Public Health Reports shows that during the past four months forty deaths out of a total of 375 had occurred up to November 23rd. Bacteriological investigation indicated that the disease is filariasis complicated with streptococcal and staphylococcal infection. These findings will doubtless once more stir up the controversy regarding the etiology of lymphangitis and elephantiasis.

Nevis governed from St. Kitts lies nearby. Malaria had swept it and combative measures had been well employed in the vicinity of the island hospital. The physician in charge informed me that prior to my arrival a specialist sent from Trinidad had failed to find anophelines. Apparently he had not been conducted to the marshy shore adjacent to a densely populated portion of Charlestown, the main port. Here I took large numbers of *A. albimanus* larvae not only in pools, but even in crab holes a foot beneath the surface. Incidentally crab hole mosquitoes *Deinocerites cancer* were twice observed biting my guide. In texts this species is usually considered a non-biting form. Individuals living here seemed affected by malaria.

Cases of schistosomiasis had been met with. Monkeys also inhabit Nevis. Filariasis apparently is not uncommon. Yaws affects a number of inhabitants. While in the field I captured several blowflies. My little guide exclaimed "Blow flies bad". Upon being



pressed for an explanation he said they gave one yaws. According to Castellani and Chalmers the belief that insects transmit yaws is quite general among West Indian natives.

Montserrat, also nearby, seems one vast field of Sea Island cotton, and of the finest quality. Literally almost every available square foot is covered with this plant. Dr. Matheson a local practitioner educated in Canada told me that venereal diseases and yaws were the only maladies of importance. Tuberculosis affected those returning from the United States and Cuba, malaria the latter. Autochthonous malaria he said did not exist. A few cases of schistosomiasis he had found among his patients, contracted presumably on the well-watered windward side of the island. Dr. Bartsch claimed he had met a resident of twenty years who at the time had chills. A stream near his lands may have served as a good breeding place for anophelines. It also contained many *Planorbis*. Much to my surprise I found *A. albimanus* in crab holes at a depth of two feet. These were located in a dry marsh, and probably served as breeding places during periods of drought. This dangerous species apparently has not been recorded from Montserrat, nor does the crab hole habitat seem to have been previously associated with it.

Our craft required more than twenty-four hours to reach Pointe a Pitre, Guadeloupe. From this island potentially so promising I obtained but few specimens. The water supply conducted from the hills in large conduits is everywhere wasted, and in some localities considerable deposits accumulate. Such situations often provide excellent breeding areas for *A. albimanus*. I obtained some indication of the existence of malaria. Specimens of this important species were found among floating patches of *Chara* in limestone ponds. This aquatic plant has been shown to have a toxic effect upon mosquitoes. It probably comes about through an increase of the pH of the water. Wherever encountered in Guadeloupe it probably did not grow in sufficient abundance to produce this effect. *Planorbis*, supposedly *guadelupensis* occurred quite generally in such situations. Schistosomiasis has been known from Guadeloupe for many years. Filariasis can also be found. I photographed an excellent example of elephantiasis in Pointe a Pitre.

Portsmouth on Prince Rupert Bay in the northern Dominica has possessed an unenviable reputation as regards sanitary matters. However excellent progress against malaria has been effected through adequate drainage measures so necessary in lands of heavy precipitation. In the principal thoroughfares concrete gutters have been



constructed. Probably the best criterion as to progress made, lies in the unsolicited testimony of the inhabitants, some of whom aver quite emphatically that fevers prevail far less than formerly. Near the town limits I encountered an anopheline other than the usual two, namely *A. argyritarsis*. This then probably marks the most northern distribution of the species. *A. argyritarsis* is not considered a malaria carrier of importance. Possibly it and *A. albimanus* overlap here. Dr. Seegar of the Imperial College in Trinidad claims the latter is the responsible agent for malaria transmission throughout the Antilles, but the observations of Dr. Root and myself lead to a somewhat different conclusion.

At Roseau the capitol I met Dr. Crumpet, chief of sanitation. Malaria, he states, had been banished from the town, and the anophelines could no longer be found within its limits. The excellent natural drainage obtaining here must have served as a staunch ally in the campaign. I could unearth no mosquitoes though a number of potential breeding places were sought and examined.

From Dr. Crumpet I learned that tuberculosis was somewhat on the increase. Yaws occurred but not to the extent usually supposed. Hookworm and especially *Ascaris* were quite common. The Rockefeller Foundation had instituted a survey on the island several years ago. Some filariasis exists. No information concerning schistosomiasis and the dysenteries was forthcoming.

Martinique proved one of the most interesting and fruitful islands. Here one sees everywhere the typical rain forests accessible even at high altitudes. In these regions mosquitoes were found in various situations. Along the highways the species dwelling in the water of bromeliaceous and other plants attached to trees seemed to prefer the wild orange. The spines of the latter plus the stings of the adults made collecting difficult if not uninteresting. Even heavy showers failed to deter them from their blood meal. Larvae of one species I found in the aquatic accumulations in cut bamboo stalks, another in a cocconut stump, the hole containing them being so small that larvae and water could be removed only by means of a pipette.

I paid a short visit to Dr. Jospin, director of the Institute d'hygiene. The medical service is so understaffed that he must spend much of his time aiding the military physicians who also care for civilian employees. About four p. m. he attends to routine affairs at the institute laboratory, in the evening he cares for his private prac-



tice. Many of his patients suffer from lymphangitis and elephantiasis, which did not surprise me, for in addition to heavy rainfall the prodigal waste of water leads to the usual formation of deposits. At one point, incidentally near the institute and a hospital the accumulation in a catch basin beneath a hydrant, must have contained hundreds of thousands of *Culex* larvae. Across the street, water exceeding a foot in depth covered a yard. Dr. Jospin thought malaria was present in sections of the island. I took only *A. argyritarsis*, to which research workers on the mainland, notably Darling, accord a subordinate place in malaria transmissions. However *A. pseudopunctipennis* has never been a factor in the dissemination of malaria in California or Panama, yet in northern fever-stricken regions of Argentine it serves as the carrier. Further study might show *A. argyritarsis* to be an important factor in the malaria problem of some of these islands, on the other hand extended search will doubtless disclose other species.

Another menace to the island is *Bothrops atrox* the "fer du lance", also known on the mainland as "Barbo amarillo". In the Greater Antilles where no venomous serpents occur we need give no thought to such enemies. From all accounts this snake is becoming more abundant. According to Dr. Jospin the mongoose at one time caused a decrease in its numbers. He now has under consideration a project to import additional mongooses from South America.

Various stories are current to account for the presence of the snakes. One version is that the French brought them to Martinique to prevent the escape of their barefooted slaves from the plantations. Another legend has it that the French imported the "fer du lance" to St. Vincent to aid in combating the warlike Caribs. Probably they were at these points before the island formation of Antilles took place.

Though no information could be gained as to schistosomiasis, nevertheless the literature refers to Martinique cases. *Ascarias* and hookworm are common parasites, as one might expect from a humid country. Much chronic amebiasis is said to exist, this statement being based upon the frequency with which cysts are encountered. The same may be said for Porto Rico as regards cysts though up to the present we have been unable to implicate amoebae as an important factor connected with diarrhea or dysentery. Both venereal diseases and yaws are common.

Malaria presents an important problem at Santa Lucia. In certain areas at Castries the capitol, where the land is too low to



permit natural drainage a considerable portion of the natives are affected. There are indications of endemic schistosomiasis in the southern end. Several cases discovered in Panama were encountered in Lucians. In this section the leprosarium is located with plain but apparently adequate accommodations for perhaps a hundred persons. A hookworm campaign inaugurated by the Rockefeller Foundation some years ago is still prosecuted to a certain extent locally. According to my informant, progress along this line has been relatively slow. Machinery for the constant and thorough application of the fundamentals of rural sanitation appears to be lacking. At Castries nightsoil is removed and dumped into the sea. While a modern sewage disposal plant might be more desirable, the government lacks the funds needed for such an undertaking. Liver rot due to *Fasciola hepatica* causes as great a loss among cattle as in Porto Rico.

In St. Vincent, Dr. Stanley Branch, chief medical officer, a very capable administrator, showed me every courtesy. Here the usual ancylostome and ascarid infestations prevail. Schistosomiasis does not seem to be present. Malaria, while less prevalent than formerly, still constitutes a serious problem on the leeward side. Anophelines purported to be *A. albimanus* were shown me. A cursory examination convinced me they represented *A. argyritarsis* instead.

One noticeable feature was the number of one legged individuals. In my ignorance I attributed this to elephantiasis. Actually the condition is due to yaws. Dr. Branch estimates that of the 51,000 inhabitants thirty to forty per cent are afflicted with some stage of the disease. When therapeutic means no longer suffice there remains only amputation. Dr. Branch has advocated an intensive campaign based upon the mass treatment method used to combat ancylostomiasis. Requisite funds however are not available for such an extensive project. While *Wuchereria (Filaria) bancrofti* seems rare, another filarial parasite of man, *Mansonella (Filaria) ozzardi* can be readily found in blood smears. In one community many of the inhabitants are affected. I found this species in the blood of an elephantiasis case at Vieques, P. R. Microfilariae were also seen on several occasions in Haitian cases. As yet we do not know which organism functions as its intermediate host. St. Vincent would seem the logical place in which to prosecute such a study.

Dr. Branch is not certain whether tuberculosis is on the increase in St. Vincent, or whether the apparently greater number of cases results from an improved system of recording.



Between St. Vincent and Grenada lie a group of islets and rocks known as the Grenadines. In these, rainfall in the main is uncertain. Corresponding with this meteorological change hookworm fades from the picture while *Ascaris*, due to its resistant egg envelopes, and pinworm which has no stage in the open, and is therefore independent of climatic factors, persist. In two of these islands conclusive evidence of the biting tendencies of crab hole mosquitoes was forthcoming. The inhabitants of one of these, Mostique, are quite emphatic in regard to this matter. Boys have the habit of stirring sticks in the holes. If no mosquitoes emerge they feel certain of a restful night. At Petit Martinique a female *Deinocerites* engorged upon my arm which had been thrust into a hole to disturb its inhabitants. While collecting in a mangrove swamp at dusk in Carriacou, the largest and southernmost of the Grenadines, a swarm of *Aedes taeniorhynchus* caused a hasty retreat on my part. This form also occurs locally, and periodically enlivens the existence of Condado<sup>1</sup> residents. Another mosquito, *Haemagogus splendens*, a beautifully iridescent species, causes considerable annoyance in wooded areas. Its larva frequents water in tree holes. Some of these islands are almost denuded of their trees except for a vestige near the summits of the high hills where these biting flies are prepared to give one some moments of distress.

At Grenada Dr. Root of Johns Hopkins University, my former teacher, with a group of four other workers was conducting a malaria survey for the Rockefeller Foundation. Their investigations point quite definitely to the responsible agent. Three species *A. tarsimaculatus*, *A. argyritarsis*, and *A. pseudopunctipennis* compose the anopheline fauna of the island. The last occurs from sea level to an altitude of four hundred feet, usually not above three hundred. It frequents almost exclusively mats of green Algae in lagoons, and side pools of streams. *A. argyritarsis* may be taken at an elevation of six hundred feet, seldom at sea level, and then only when washed down by rains. This species prefers moving water, obtaining shelter in floating vegetation or that adhering to stream margins. In two areas under such conditions this species bred in abundance, yet no malaria could be found, nor had the disease ever been known from those localities. *A. tarsimaculatus* on the other hand seeks lagoons and mangrove swamps. In the presence of water hyacinth, larvae of this species tend to become extremely numerous. This plant does not seem to extend such aid to *A. quadrimaculatus* in the southeastern states. *A.*

<sup>1</sup>A residential suburb of San Juan, P. R.



*transimaculatus* also tends to seek shelter among surface debris. Like the fevers this form is restricted to the coast. In other words *A. tarsimaculatus* and malaria coincide. This study demonstrates the value of ecological investigations in relation to malaria transmission.

Infections are acquired for the most part outside, for the natives remain in the open until 9 o'clock, and then hermetically seal their dwellings so that lugaeros and jumbies, two types of malignant spirits cannot gain admission. For this reason house examinations for adult anophelines invariably result in failure.

Yaws, tuberculosis, venereal diseases, helminthic infections, and typhoid constitute other medical problems. The last could probably be found in practically all the islands. However, visits of short duration, and chance bits of information preclude anything even remotely resembling a comprehensive medical summary. As in Porto Rico, diarrhea and enteritis rank first as causes of death among children and infants. Amebic dysentery while not common, nevertheless exists. Here, as in a large part of the British West Indies the medical staff was at one time composed of Europeans. Now practically only the chief medical officer comes from overseas, or is a European born in the islands, while district positions are filled by local men. This evolution came about because the sons of plantation owners or the more influential merchants studied medicine, and it naturally followed that places had to be made for them. The majority received their training in Scotland, Canada and the United States. Some of these men studied at Howard University.

The presence of a diversity of mainland anophelines conclusively denotes that Trinidad is merely a detached piece of continent. At least ten members of the genus are known from the island. Of these *A. tarsimaculatus* doubtless plays an important part in malaria transmission. In the pitch lake area Dr. Vertieul, medical officer for the company exploiting the lake, devised an ingenious method for keeping ditches clear. Crude asphalt is heated to a molten condition, then permitted to flow on the side, and gravel is immediately added. This produces a permanent cover at relatively low cost. Such a method would probably not be practicable elsewhere. Here the battle with malaria goes on incessantly. During the rainy season innumerable pools favorable for anopheline development form, especially in depressions over the pitch bed. It must be borne in mind that a group of laborers works in a portion of the lake with pickaxes until the hole made becomes too deep for the convenient transportation



of the crude product to the trains of small cars on temporary tracks. They then work another section of the ninety-nine acre area. Gradually the cavity resulting from the removal of pitch is filled by pressure from below. However some time elapses before this happens. The importance these cavities bear to mosquito breeding is quite obvious. Dr. Vertieul has met the situation by continual oiling of all water deposits. In this way, combined of course with suitable medication a marked reduction in malaria incidence has been effected. Several years ago he tried Paris Green, but its application resulted in an outbreak of no mean proportions. The failure came about not because of any inherent defect of the material, but was due to the inability of the inspectors to ascertain when laborers neglected to place the arsenical on the surface. An oil film however is readily detected.

In the region adjacent to the lakes, malaria is prevalent. The asphalt in deposits there while not as pure as the commercial source, seems to be preferred for road surfacing. The holes made through asphalt removal seldom fill up again. Water naturally fills them, *Anopheles*, probably *tarsimaculatus* breeds, and the inevitable malaria follows in its wake.

In the three Venezuelan islands, Margarita, Orquilla, and El Roque nothing of special interest was discovered. The remaining three Bonaire, Curaçao, and Aruba, all under the banner of Holland present a decided xerophytic or desert like aspect. On the first of these (Bonaire), at least tuberculosis is fairly common. amebic dysentery also exists, Dr. Pollak, the island physician having found the active form on a number of occasions. During rainy spells at Curaçao this disease, so I am told, takes on almost epidemic proportions, owing to the tendency of the inhabitants to freely and carelessly use rain water when available. This commodity of course is not abundant, and therefore is expensive. The water throughout these three islands is of a very inferior quality. On the main island vendors sell two grades, which might be designated as salty and more salty. Prices differ accordingly. On Curaçao, too, there is said to be a plant for the distillation of sea water. Previous to our departure from Aruba we filled all our barrels. I had an excellent opportunity to witness the transportation of our supply. The water was drawn from a tank on a truck to a barrel by means of a five gallon gasoline can minus its cover, and reinforced across the top with a stout piece of wood that also served as a handle. Our captain, a frugal man, na-



turally insisted upon full measure. Therefore with each load the carrier's hand was immersed in the water. And I doubt whether these islanders wash or bathe too frequently. Nevertheless with no other source available one learns to take his medicine.

I found that gnats were quite abundant. In one community of the higher class on Curaçao they constituted somewhat of a plague. I also found them at Aruba. They breed in little pools along the shore or the water remaining in the beds of temporary streams. Because of this fact control methods could probably be successfully instituted.