

REPORT ON A TRIP FOR THE PURPOSE OF STUDYING THE MOSQUITO FAUNA OF PANAMA

BY AUGUST BUSCK

In order to gain some knowledge of the mosquitoes of Panama, heretofore practically unknown, Dr. L. O. Howard, Chief of the Bureau of Entomology of the U. S. Department of Agriculture, instructed the writer to proceed to the Canal Zone on this mission.

It was arranged that I should report to Col. W. C. Gorgas, Chief Sanitary Officer of the Canal Commission, in order that the work might be carried out in conjunction with the Sanitary Department with reference to the economic aspects of the subject.

I left Washington April 12, 1907, and sailed the following day from New York on S. S. *Advance*, arriving in Colon a week later. After a few days of general inspection, during which I made myself acquainted with the general lay of the land, I made my headquarters in Tabernilla, about midway between the Atlantic and the Pacific coasts. A very suitable tent was constructed and equipped for me, which I occupied during the following three months, except when my work temporarily caused me to take other quarters.

Most of my work was done in the country around Tabernilla, but numerous trips to other localities along the Panama Railroad from Panama to Colon were made, and two more extended excursions were undertaken outside the Canal Zone, up the Chagres River in native dugouts.

In accordance with the time limit of my authorization, I was prepared to leave the Isthmus on July 21, but prolonged my stay on a telegraphic request from the chairman of the Commission in order to be able to give a preliminary verbal report to Colonel Gorgas, who had been absent from the Zone during the latter part of my sojourn there. I finally left Colon July 30 and reached Washington August 6, 1907.

During my stay I was given every courtesy and constant help in my work by the officers of the Sanitary Inspector's Department, especially by its Chief, Mr. J. Le Prince, and the Associate Chief, Dr. Herman Canfield, who thoroughly entered into the spirit of my investigations and fully realized their important bearing on the practical work of their department.

Mr. Allen H. Jennings, of the department, was detailed to be with me as much as possible in order to learn our methods in the routine work of collecting, breeding, and taking care of the mosquitoes; his frequent companionship in the field and in the laboratory was very pleasant and facilitated my work in many ways. He was good enough to take charge of my living larvæ on two occasions of more prolonged absence.

The several local sanitary inspectors along the Zone line gave me much assistance by collecting material and giving me facilities for work when I visited their stations.

Through the foresight of Doctor Canfield, a system was inaugurated whereby each sanitary inspector sent me weekly a bottle of mosquito larvæ, and though this material could not be expected to be of especial value, it furnished additional localities for the common species and occasionally yielded rarer ones. I must especially mention Mr. C. H. Bath, sanitary inspector at Las Cascadas, whose careful and regular sendings yielded several interesting larvæ.

The number of species of mosquitoes secured was 83, of which 30 species were new to science. Most of the species were bred from the larvæ. Besides these I have included in the following list, in order to make it as complete as possible, 7 additional species, previously received by the U. S. Department of Agriculture from Panama through other collectors, bringing the total number of species at present known from Panama up to 90. The collection was determined by Dr. H. G. Dyar and Mr. F. Knab.¹ All the types of new species are deposited in the U. S. National Museum, as well as all the other material, with the exception of a duplicate set presented to the Isthmian Canal Commission.

Large as this number of species is—the largest number recorded from any one limited locality—there is yet much work to be done before the entire mosquito fauna of the Zone is known.

It was impossible to work up thóroughly so large an area within three months, and only the immediate region around Tabernilla was at all adequately investigated. Even here additional species will undoubtedly be found, because the fauna changes considerably with the season, and some species may not have been active at all during the period of my visit, though this was intentionally arranged so as to cover both the end of the dry season and the early part of the rainy season. The appearance of different species of tropical mosquitoes at different seasons is a well-marked phenomenon and was repeatedly observed even during my short stay.

¹The new species were described in Journ. N. Y. Ent. Soc., vol. xv, 1907, pp. 197-214.

Aside from obtaining a more complete list of the species of mosquitoes, much additional work is needed on the biology of the species now known, both from a scientific standpoint and for practical reasons in connection with the fight against the mosquitoes in the Canal Zone.

The anti-mosquito work of the Sanitary Department is considered of prime importance and is carried on throughout the Zone. It is a gigantic undertaking, but even now shows remarkable results in the constantly improving health conditions, apparent from the health reports, which are more gratifying every month.

The Canal Zone proper is about 50 miles long by ten miles wide. It includes, as far as sanitation is concerned, the cities of Panama and Colon. The population of the Zone is about 100,000, of which the city of Panama has about 33,000, Colon 14,000, and the Zone proper 52,000. In the Zone proper this population centers at the towns La Boca, Ancon, Coracal, Miraflores, Pedro Miguel, Paraiso, Culebra, Empire, Las Cascadas, Bas Obispo, Matashin, Mamei, San Pablo, Tabernilla, Frijoles, Bohio, Lion Hill, and Gatun, with several native towns and camps for employees between, all of which lie along the line of the Panama Railroad. Anti-mosquito work is carried on throughout the area covered by these towns and settlements. The routine method is to brush, drain, and oil the whole area of a town or camp and its surroundings to a distance of not less than 200 yards from the last house in the town or camp. The same rule applies to isolated houses or native towns, but outside of this area no attempt is made to control the mosquitoes, on the correct supposition that these normally do not fly such a distance.

In the beginning the land is cleared by the removal of all brush, undergrowth, and grass; only shade and fruit trees are left, and these are thinned out to admit sunlight and free ventilation. Where possible, swamps and low land are filled in, the immense excavations at the Culebra cut furnishing abundant material. Then the whole area is drained to carry off the surface water or any constant flow from springs or seepage from the hills. This drainage is extended to all new work in the canal cut and to railroad work or dumps near settlements. The drainage is accomplished by subsoil tile drains, open ditches, and open concrete or stone and cement ditches. Drain tiling or cement ditches are made where possible, as they require very little care afterwards, while the open dirt-ditches must be constantly cleaned and regraded to prevent "pocketing" and the consequent formation of breeding pools for mosquitoes. In open dirt-ditches the algæ will form in two or three days after cleaning, and to prevent this drip-cans are placed at the head of those ditches with a

solution of sulphate of copper, five pounds to a barrel of fifty gallons of water. This is also used in all running streams after the removal of algæ.

Open ditches in which the water flows sluggishly have oil drip-cans at their heads. These oil drip-cans are raised three feet above the water to give a wide spread to each drop, and are arranged to drop about twenty drops to the minute. The oil used is a rather heavy dark grade, which costs the department \$4.34 a barrel. About 3,200 barrels of oil were used within the last year.

All streams are kept free from algæ and are kept within restricted banks as far as possible; this is done by blowing out the rapids or falls to produce a uniform flow, and the edges are filled in by hand.

All swamps, pools, or even temporary collections of water are oiled at least weekly, and in the rainy season oftener; this applies to the smallest collection of water, even animal tracks, ruts from wagon wheels, and crab-holes. It entails a great amount of work, which is done by colored labor under continual supervision.

All receptacles holding water must be screened or oiled. Water barrels are screened by covering with a board with a small screened opening in the center for the inflow. Below this board are two screened holes for overflow, and the water is drawn from a faucet at the bottom. Buckets and pails in daily use in a household are not permitted to stand filled more than twenty-four hours. All tin cans, bottles, etc., must be buried. No gutters are allowed on houses. There is a daily inspection of all water receptacles, and weekly the inspector at the head of the station must make a personal inspection and report any receptacle found containing mosquito larvæ. The second offense, after a warning, means the arrest and fine of the householder.

All old machinery, which is found in great quantity all over the Canal Zone, left from the French occupation, is drained by punching holes in any part that will hold water, or where this is not possible, such places are filled with dirt. Even patent car couplings on the trains in use must be inspected and oiled, as they are often found to contain mosquito larvæ.

When any house or camp is found to contain any number of mosquitoes, it is fumigated with sulphur by the dry method. All cracks or openings are pasted over with paper; enough pots, each containing five pounds of sulphur, are placed at intervals on the floors to make about one pot for each 1,000 cubic feet of space. After fumigation, the house is left closed from three to four hours.

All barracks, whether for white or black laborers, bachelor quarters, married quarters, offices, churches, lodge-rooms, and other

rooms used for sleeping, living, or eating quarters are screened; the Sanitary Department is responsible for all repairs of this screening and employs a large force of carpenters for this purpose.

The physicians in each district make a weekly report on the number of cases of malaria in the different camps; these reports are tabulated in the central office of the Sanitary Department and compared with the previous records, and if an increase of even a fraction of one per cent is shown for any locality, the local inspector is telephoned and ordered to locate the point of infection and eradicate the breeding places. Long-continued statistics show how nicely this system works. If any more serious increase occurs, a special mosquito inspector is sent out from the central office to locate the trouble and report on the best measures to be taken.

The difficulties of this work are numerous. The constant increase of population requires new sites for camps to be made in the unimproved brush-covered country; the ever-changing conditions due to the canal work are a continued source of trouble; the progress of each steam shovel or of each of the extensive dumps produces new problems to be solved in the way of drainage; and, above all, the recurring deluges of the rainy season cause rising creeks and rivers and overflow of lowlands so irregular as to be impossible to foresee.

The Sanitary Department has, aside from its office force, about thirty sanitary inspectors and employs between 1,200 and 1,300 laborers. The total cost of the Sanitary Inspector's Department is between three and four hundred thousand dollars.

With all due credit to the truly excellent work and the undeniably brilliant results achieved, the work is nevertheless done more or less in the dark, at present, from lack of accurate knowledge of the enemy. It could undoubtedly be made both more effective in some ways and less expensive in others through a more intimate knowledge of the mosquitoes concerned, toward which the present investigation has made but a small beginning.

At present the department deals with all mosquitoes as a nuisance to be done away with, whether they are good, bad, or indifferent; but the work could be more profitably done with an accurate knowledge of those species which are infectious, those which are merely annoying, and those which are harmless or even beneficial.

It is true that special attention is given the supposed malaria-carrying species, but even here there is little definite knowledge, and inferences may not prove reliable.

Thus, it is generally supposed that all the species of *Anopheles* are capable of carrying malaria; but no accurate experiments have been

made to prove it in the case of most of the species occurring in the Canal Zone. One of the species, *Anopheles ciseni*, has an abnormal life history. It breeds in tree-holes and similar places instead of open puddles. It is quite possible that this species is not infectious; but it is most important for the practical work that this should be investigated, as the usual methods of destruction by drainage and oiling of the ponds does not affect this species.

Another large group of mosquitoes not affected by the present methods are those breeding in the parasitic plants high up in the branches of trees. None of these are supposed to carry disease,¹ though it might be rash to take this for granted, with our present limited knowledge about them. At all events, the species of the genus *Wyeomyia*, which almost exclusively breed in such places, are among the few day-biting mosquitoes and are decidedly noxious, where they abound, as in the case of *Wyeomyia adelpha* around the I. C. C. Hotel in Tabernilla.

It might be difficult to arrange the work of extermination so as not to destroy the predaceous, and therefore beneficial, species of *Megarhinus*, *Psorophora* and *Lutzia*; in fact, this discrimination would be somewhat doubtfully warranted, as some of these are themselves aggressive biters. Some mosquitoes are known not to bite man, as the true crab-hole mosquito of the genus *Dcinocerites*. The tedious and at best uncertain work of oiling these numerous holes, as it is now done, might be saved if it were definitely ascertained, as it is reasonable to suppose, that the other crab-hole-inhabiting species also are harmless.

It would seem within the scope of the work of the Sanitary Department to utilize the unique opportunities on the Zone to work out some of the hundreds of problems of a similar nature which must be solved before our knowledge of these insects, so intimately connected with human welfare, is complete. With easy access to abundant material of many species of mosquitoes, now that the life histories of most of them have been studied; with the constant influx of malarial patients in the hospitals available for observation and experimentation, and with the large staff of medical men, among whom talents for bacteriological and systematic scientific work can not be wanting, the Sanitary Department on the Canal Zone has great opportunities to acquire knowledge which can not be gained except on the spot, and thus contribute this nation's full share in the solution of the world's problems in this important part of tropical medicine.

Such knowledge, though in its nature merely theoretical and purely scientific, would be of great practical value and would alone enable

¹ See footnote page 98.

truly intelligent work against this scourge of the tropics. When the Panama Canal is finished; most of the localities in which the present work is going on will disappear, submerged under the lakes of the canal. Even then these problems will not cease to exist, but will, if possible, be of added importance on account of the traffic through the canal and the possibility of carrying infectious diseases between two hemispheres.

It may be of value for the rediscovery of the many new species of mosquitoes obtained during the trip and for the continued study of these insects by the Sanitary Department that some general description of the localities in which the collections were made should be given as well as some of the methods employed in obtaining and rearing the mosquitoes.

The neighborhood of Tabernilla, in which most of the work was done, is low: from the Panama Railroad line the ground slopes gradually down toward the Chagres River. In the intervening country is the bed of the old French sea-level canal, which even in the dry season is covered by a series of shallow lakes connected by low meadows. Between this and the river the land is covered with tall bamboo, sparsely interspersed by large hardwood trees; the crowns of these latter are thickly covered with parasitic plants, such as *Tillandsia* and *Agave*, which constitute in themselves a thickly populated world for several species of mosquitoes.

A few neglected trails wind their way through the heavy underbrush to native villages on the other side of the river, where patches of land are burned off and cleared for pastures or for sugar-cane and banana fields. When passing through this region one finds, as everywhere on the lowland of the Zone, the old narrow-gauge railroad tracks left from the French works and quantities of old French machinery completely overgrown by heavy underbrush.

During the rainy season the Chagres River rises, and this entire area is covered with water and is only accessible by wading knee deep.

Here in the bamboo woods swarms of mosquitoes seek one out, and many species can be secured as adults, when they come to bite; but their larvæ are rarely accessible in nature, occurring as they do in broken bamboo joints filled with rain-water or in tree-holes, sometimes high up in the branches or difficult to reach through the tangle of underbrush and fallen bamboos. A good way to secure these larvæ is to clear spaces in the woods with a machete, fell a couple of bamboo trunks, and cut them up in short joints, which are then placed upright in the ground and filled with water. These bamboo

joints make ideal breeding places for the mosquitoes, and a large majority of the species, which have been attracted to you during this work, are induced to lay their eggs in these traps. The larvæ can be easily secured by a suction bulb or by turning the contents of the joints into a white enameled plate. Numerous larvæ of *Joblotia*, *Carrollia*, *Aedes*, *Sabethes*, *Hamagogus*, and the bamboo *Megarhinus* were obtained in this way, which otherwise could not have been found at all or only by hard work, in small numbers.

In the small pools in the woods and in the water-filled old French machinery, various *Culex* and *Anopheles* species were found, the former commonly preyed upon by the larvæ of *Lutzia bigottii*.

On the other side of Tabernilla the country is higher and hilly, partly cultivated and sprinkled with small native settlements. In the still pools of small sluggish streams between the hills, good collecting grounds are found, which yielded several *Culex*, *Uranotania*, and *Anopheles* larvæ. The trees in and around the villages, covered as they are by water-bearing epiphytic plants, furnish a rich fauna of mosquitoes, especially species of *Wyeomyia*, *Phoniomyia*, and *Megarhinus*. The best way to secure the larvæ in these plants is to carefully cut the plant off with a machete and turn it over and wash it out into a bucket half filled with water. In the case of the tall trees in the lowlands, the whole tree was felled in order to secure the epiphytic plants and their mosquito population. The corners of the leaves of the Spanish bayonet and other similar leaves holding water afford breeding places for several species of mosquitoes. The sharp spines on the leaves of these plants make it difficult to reach the mosquito larvæ. The best results in obtaining these are secured by cutting all the leaves off close to the stem, cutting the plant off near the ground, and turning the contents out into a bucket.

On excursions to more remote localities, where a bucket can not well be carried along, one must depend upon a suction bulb with a long glass tube with which to suck up the larvæ from these and other similar plants: but the small amount of water found in most of these plants makes it difficult to use the rubber bulb, and it is advisable to carry a bottle of water along from which to replenish the leaf corners and thus enable repeated suction. The suction bulb is indispensable in many other cases, as with tree-holes too narrow to admit a dipper.

Once secured, the mosquito larvæ should be taken home as soon and with as little shaking as possible, each lot in a separate bottle. In the laboratory each lot is given a serial number referring to the notes on their habitat: the larvæ are placed singly in breeding tubes with cotton stoppers. Each larva receives a separate isolation num-

ber. When it pupates, the cast skin is carefully preserved in alcohol in a small tube with this isolation number, which the adult specimen also will bear. In this way only is it possible to be sure of associating the adult with the correct larva.

Family CULICIDÆ

Subfamily CULICINÆ

Genus ANOPHELES Meigen

ANOPHELES PSEUDOPUNCTIPENNIS Theobald

This appears to be the commonest and most widely distributed *Anopheles* on the Zone, at least during the season of the year in which the present observations were made.

It was bred from larvæ from the edges of a slowly running stream near Gatun; from a large ill-smelling stagnant pool near Tabernilla, caused by dumping dirt across a small stream; from a small swamp near Culebra; from still pools of a clear, cold mountain brook near the Culebra cut at Empire; from the borders of a large stream near Empire; from a large open pool in a bend of the upper Chagres River, and from a stagnant pool near Panama City. Adults were collected at Las Cascadas, Culebra, Tabernilla, La Boca, and Colon.

ANOPHELES ALBIMANUS Wiedemann

This species was bred from stagnant pools at La Boca and near Panama City. After my departure, Mr. A. H. Jennings bred it from water in an old boat on Taboga Island, where we both had failed to find any *Anopheles* six weeks before, though we carefully searched for them. This is a striking example of the repeatedly observed periodicity in the activity of tropical mosquitoes.

Adults were also collected in large numbers by Mr. Jennings in the barracks at Gatun, and by the writer in houses at Tabernilla, Pedro Miguel, and Panama City. From its persistence in seeking human habitations for the purpose of biting, it is reasonable to suppose this species particularly concerned in the distribution of malaria.

At one time in July during my stay the species became excessively abundant in La Boca, breeding in a temporarily dammed-up swamp near the laborers' quarters. The subsequent increase of malaria in these barracks caused considerable anxiety as well as extra work for the Sanitary Inspector's office.

ANOPHELES TARSIMACULATA Goeldi

Two specimens were attracted to my tent at Tabernilla by the light. These specimens appear to have flown at least three hundred yards from the nearest possible breeding place, which was in the swamp back of the residence hill at Tabernilla. Their flight, however, was aided by the shelter of intervening trees and houses.

ANOPHELES EISENI Coquillett

This large white-kneed *Anopheles* was bred from larvæ taken in water in hollow trees and in bamboo-joints near Tabernilla. It was also bred from a palm leaf, lying on the ground and filled with rain-water, on the banks of the upper Chagres River. Other *Anopheles* larvæ, taken in water in the leaf corners of Spanish bayonet near Tabernilla, were not bred, but possibly belonged to this species.¹ The supposed *Anopheles* larvæ, reported to have been found in the leaf-corners of the banana, are probably all larvæ of small flies belonging to the genus *Corcthrella*. The small, triangular, often reddish, larvæ have a certain resemblance to those of *Anopheles* and were sent me from sanitary inspectors as such on two occasions. They are very abundant on the Zone and are sometimes found in bananas as well as in tree-holes and bamboo-joints, feeding in part at least on young mosquito larvæ.

The possibility of *Anopheles* breeding between the leaf-stalks of the banana might at times be of importance in the practical work against mosquitoes and has at least in one instance caused extra work and expense for the Sanitary Department on the Zone; but I have personally never found *Anopheles* larvæ in these plants, though I made it a point to investigate them, whenever an opportunity presented itself.

It would be of advantage in the practical mosquito work on the Canal Zone to ascertain whether this tree-hole-inhabiting *Anopheles* is capable of transmitting malaria. Its circumscribed breeding places necessarily limit its abundance, and the species can therefore at most not be a very important factor in the spread of the disease. The

¹*Anopheles bellator* D. & K. was bred from the leaf corners of Spanish bayonet in Trinidad, and this species may have to be added to the list. The present larvæ were not bred; no adults of *bellator* were captured. As this is going to press, Mr. Jennings has sent in an example of *Anopheles lutzii* Theob. (not Cruz), which he bred from larvæ in the water in *Tillandsia* leaves. If this should prove to be a malaria-carrying *Anopheles*, the removal of epiphytic plants from trees in the vicinity of habitations would be imperative.

specialized life habits and the consequent modifications in the anatomy of the larva suggests that this species also differs from the pool-inhabiting species in disease-carrying power.

ANOPHELES MALEFACTOR Dyar and Knab

Bred from black-headed larvæ in a still pool of drying mountain stream along the upper Chagres; also from a slow-running spring, full of leaves, near Tabernilla, containing numerous small fish, so many that each dip of the cup would bring one or several of the fish. Evidently the fish did not play any important rôle in the extermination of these mosquito larvæ.¹ The *Anopheles* larvæ and the larvæ of *Culex elevator* D. & K., found in the same spring, were present in considerable numbers.

Mr. Jennings obtained adults of this species inside the barracks at Gatun.

ANOPHELES GORGASI Dyar and Knab

Collected as adult at La Boca by Mr. A. H. Jennings. The larva is as yet undiscovered.

This species is named in honor of Colonel W. C. Gorgas, head of the Sanitary Department of the Canal Zone.

ANOPHELES APICIMACULA Dyar and Knab

A single specimen was collected at night on the outside of my mosquito-screened tent in Tabernilla.

ANOPHELES PUNCTIMACULA Dyar and Knab

There is a single specimen of this species in the collection of the U. S. National Museum from Colon, Panama, collected by Major W. M. Black.

ANOPHELES ARGYRITARSIS Desvoidy

Bred from larvæ in water in an old dump car near the Culebra cut. The water in this car was recent, clear rain-water with no trace of algæ: also bred from a shaded pool covered with algæ in the native village near Pedro Miguel and from a swampy pasture near Empire.

¹Thirteen specimens of these fishes were submitted to Dr. E. B. Evermann, who determined them as four species, *Tetragonopterus panamensis* Günther, *Rivulus godmani* Regan (?), *Gambusia episopi* Steindacher and *Platybacilus mentalis* Gill, of which the two latter were the predominating species.

Genus **MEGARHINUS** Desvoidy**MEGARHINUS TRINIDADENSIS** Dyar and Knab

Bred during May from water in bamboo near Tabernilla. The larvæ were feeding upon those of *Joblotia*.

MEGARHINUS HYOPTES Knab

Bred from the identical bamboo-joints near Tabernilla from which the foregoing species was obtained; the larvæ of this species also were observed feeding upon *Joblotia* larvæ.

The present species appeared a month later than *trinidadensis*, thus not interfering with it. Presumably another interesting example of the seasonal occurrence of mosquitoes in the tropics, though hardly convincing from the comparatively small number of specimens (seven of both species) reared.

The female of this species was not previously known.

MEGARHINUS SUPERBUS Dyar and Knab

Bred near Tabernilla from larvæ in the leaf corners of bromelia, growing on a calabash tree. The larvæ feed on those of *Wyeomyia circumcincta* and probably on the other mosquito larvæ present (*Culex jenningsi* and *Phoniomyia scotinomus*). The adult with its brilliant red abdominal tufts was seen on the wing in the tree-top, while I secured the larvæ.

Genus **MANSONIA** Blanchard**MANSONIA TITILLANS** Walker

Several adult specimens were captured in the palm-shaded swamp near Lion Hill, where they came in numbers to bite. Nothing is known of the life history of this common tropical mosquito; the larval habits must be peculiar to have so long escaped observation.

MANSONIA PHYLLOZOA Dyar and Knab

A small, very striking-looking species with spotted wings, bred from larvæ from water in the leaves of a bromeliaceous plant growing on a tree in the native village near Tabernilla.

Genus **DEINOCERITES** Theobald**DEINOCERITES MELANOPHYLUM** Dyar and Knab

This species is a geographic variety of the common West Indian crab-hole mosquito, *Deinocerites cancer*, but it appears very distinct, owing to its dark brown color.

It is identical in life-mode with the West Indian form and is found only near the crab-holes in which the larvæ live. During the day the adults remain within the holes. They come out in a swarm, if a stick is inserted into the hole, but return quickly to their hiding place when left alone. At dusk they come out and swarm above the hole for copulation. Though a few specimens alighted on my hand, which was held close to the hole, when I disturbed the mosquitoes, none attempted to bite, and I do not believe this species ever molests man. This is abundantly corroborated by earlier observations on *Deinocerites cancer* by Mr. Knab and the writer in Central America and the West Indies, against the observation of Dr. Grabham in Jamaica that "it is a voracious bloodsucker."

There are even good grounds for believing that none of the other crab-hole mosquitoes associated with this species bite man. This could be very easily determined by further observations on the spot, and if they should be found to be harmless, it would save considerable labor and expense at present spent by the Sanitary Department in oiling these crab-holes.

The species was bred and collected from crab-holes at La Boca and back of the wireless telegraph station at Colon.

The mosquitoes found associated with this species in the crab-holes, and whose proclivity for biting should be tested, are *Dinomi-metes epitedeus* and *Culex extricator*.

Genus URANOTÆNIA Arribalzaga

URANOTÆNIA GEOMETRICA Theobald

Bred from larvæ in the pool of a clear, cold mountain brook back of the Culebra cut, near Empire. The larva looks curiously like an *Anopheles* larva, but furnished with a long tube. I bred this species also from a slow-running stream near Gatun and from a swamp near Culebra. Mr. A. H. Jennings bred it from streams near Gatun and on Taboga Island.

In the U. S. National Museum there is also a single specimen of this species from Panama received from Dr. A. J. Kendall.

URANOTÆNIA CALOSOMATA Dyar and Knab

This pretty little species is one of the smallest mosquitoes found in the Canal Zone; it is easily recognized by its size and by the silvery lateral line and the silvery edging around the eyes on the otherwise dark body. It was bred from deep hoof-prints in a swampy meadow near Tabernilla. The larvæ are very elongate, with reddish body.

deep black head, and comparatively short tube; they are easily overlooked, as they go down at the least disturbance and remain at the bottom for a long time, burrowing in the mud.

URANOTÆNIA LOWII Theobald

This species, which is still smaller than the foregoing, was bred from similar black-headed larvæ in a small semi-stagnant stream near Las Cascadas.

URANOTÆNIA TYPHLOSOMATA Dyar and Knab

Bred by Mr. A. H. Jennings from a still pool in the small stream supplying the water-tanks of the Pacific Mail Steamship Company on Taboga Island.

Genus PSOROPHORA Desvoidy

PSOROPHORA IRACUNDA Dyar and Knab

The large predaceous larvæ of this species were taken in numbers near Las Cascadas in a newly flooded meadow covered with bushes and tall grass. They were preying upon the larvæ of *Culex lactator* and *Janthinosoma posticata*, which were very abundant in these temporary pools. The larvæ are very voracious, biting and even eating each other if confined together. Apparently their development is quick. All the larvæ taken pupated within a day, and adults issued from all of them within the next two days. This species was taken in May.

PSOROPHORA SÆVA Dyar and Knab

The larvæ of this species occurred sparingly at the same time and together with those of the foregoing species, but a month later it was the greatly predominating species in the same locality. It is a similar but longer and more slender larva, with longer tube than that of *iracunda*.

Genus TÆNIORHYNCHUS Arribalzaga

TÆNIORHYNCHUS COTICULA Dyar and Knab

A single specimen, caught, as it came to bite, in the black swamp near Lion Hill.

The larvæ of this and the following species may be expected to have a similar specialized life-mode to our *Tæniorhynchus perturbans*, which baffled entomologists for several years, before Prof. J. B. Smith lately discovered that it lives several inches down in the mud at the bottom of certain ponds, attached to the roots of plants.

The types of this species in the U. S. National Museum came from Bocas del Toro (P. Osterhaut, collector).

TÆNIORHYNCHUS FASCIOLATUS Arribalzaga

In the U. S. National Museum are specimens of this species from Panama (J. W. Ross, collector), from Colon (A. C. H. Russell, collector), and from Bocas del Toro, Panama (McKenney, collector). It was not met with by me.

Genus AÆDES Meigen

AÆDES TRIVITTATUS Coquillett

The extension of the range of this species to the tropics is interesting. It has hitherto been recorded only from the eastern United States. It was bred from large, dark, fat-tubed larvæ, which were found in enormous numbers, together with *Janthinosoma posticata*, in a newly flooded meadow near Las Cascadas.

The adult was also taken repeatedly at La Boca, Pedro Miguel, and at Colon.

AÆDES TÆNIORHYNCHUS Wiedemann

Bred from larvæ occurring in countless numbers in the brackish swamp at La Boca. Adults were collected by Mr. Jennings in the barracks at Pedro Miguel. The species is a well-known inhabitant of brackish marshes on both the Atlantic and Pacific coasts of the United States.

AÆDES POSTICATA Wiedemann

The large, fat-tubed larvæ of this species were taken and bred in numbers from a recently flooded meadow near Las Cascadas; also from still pools of a nearly dried-up mountain stream emptying into the upper Chagres River and from a shallow pool formed by a slow-running stream on Taboga Island. The adults were repeatedly captured, when they came to bite, in the bush around Tabernilla and Lion Hill.

AÆDES LUTZII Theobald

Several adults were taken in the bamboo and palm swamps around Tabernilla and Lion Hill, where they came to bite. The larvæ were not found, nor have they been bred in the United States.

AÆDES NIGRICANS Coquillett

The types of this species in the U. S. National Museum came from Panama (J. W. Ross, collector). No other record of its capture has been made and I did not meet with it.

AÆDES LITHÆCETOR Dyar and Knab

Bred from larvæ in a pot-hole in a rock at the edge of the upper Chagres River between Allehuela and San Juan. It is probable that the species breeds only in rock-holes, as in the case of the North American *Aedes atropalpus* Coq.

AÆDES INSOLITA Coquillett

Bred from larvæ in hollow trees in two localities along the upper Chagres River far from civilization. The larvæ are known to be normally inhabitants of hollow trees.

AÆDES SERRATUS Theobald

Bred by Mr. A. H. Jennings from a pool near Pedro Miguel.

Genus **HÆMAGOGUS** Williston**HÆMAGOGUS REGALIS** Dyar and Knab

The larvæ of this brilliant blue mosquito were taken in bamboo-joints and in several tree-holes near Tabernilla. One of these was a mere knot-hole holding only a spoonful of water. It was also bred from very foul water in old French machinery and from a wooden box near a house at Las Cascadas; also from a pot-hole in a rock, inhabited by a crab, along a small stream on Taboga Island, and from the rotten center of a cut banana trunk, filled with slimy juice, near Lion Hill.

The short-tubed larva reminds one of that of *Stegomyia* by its slow, snaky movements.

HÆMAGOGUS SPLENDENS Dyar and Knab

Bred from *Stegomyia*-like larvæ in a tree-hole along the upper Chagres River, far from civilization; also from bamboo-joints and tree-holes near Tabernilla.

HÆMAGOGUS AFFIRMATUS Dyar and Knab

Adults, collected as they came to bite in the palm-shaded black swamp near Lion Hill.

Genus *STEGOMYIA* Theobald*STEGOMYIA CALOPUS* Meigen

The scarcity of this, the yellow-fever mosquito, on the Canal Zone illustrates better than any other example the efficiency of the mosquito-work done by the Sanitary Department. To a person who has traveled in other parts of the tropics and who has experienced the noxious abundance of *Stegomyia* everywhere—in the best hotels as well as in the humblest negro hut—it is indeed gratifying to be able to live for weeks in the Canal Zone without encountering a single *Stegomyia*.

The yellow-fever mosquito is a strictly domestic animal, which is never found outside of man's immediate environment, and which only breeds in artificial receptacles, such as barrels, water-coolers, bottles, tin cans, etc., in and around human habitations. Due to these circumscribed habits, its control is comparatively easy, and it would be quite possible, with slight augmentation in the well-organized force of sanitary inspectors, to absolutely eliminate this dangerous mosquito from the Zone. The suggestion of such a radical attempt was enthusiastically received by the chiefs of the department, and their efforts will undoubtedly produce conditions within another year under which it can confidently be asserted that a yellow-fever epidemic on the Canal Zone is impossible, due to the total absence of the fever-carrying agent.

The two coast cities, Panama and Colon, the sanitation of which is as yet only nominally under American control, constitute the only really difficult localities to treat. The constant danger of infection through these cities should be sufficient reason for an arrangement under which the Sanitary Department of the Canal Zone should be given full power and responsibility in them.

The larvæ of *Stegomyia* was met with in barrels and tin cans in native villages near Pedro Miguel and Tabernilla; in a barrel with rain-water in Bas Obispo; in a barrel in a house in San Pablo; in water-holders in a private house in Panama; in several receptacles in a large hotel in Colon; in the bottom of an old boat, and in barrels on Taboga Island.

The adults were also taken in small numbers at La Boca, Panama, Las Cascadas, Culebra, Bohio, and occasionally on the passenger trains across the Isthmus. In Colon they were found in large numbers in several places, notably in one of the largest hotels.

Genus *LUTZIA* Theobald*LUTZIA* *BIGOTII* Bellardi

This large yellow species is prevalent on the Zone and comes quickly and unhesitatingly to bite whenever one visits shady places. The predaceous larvæ are found quite as commonly in artificial receptacles of water around human habitations as in shallow pools in the woods. The larva is easily recognized by its size and by the peculiar curved position it assumes, looking as if about to spring upon its prey. The larvæ are unquestionably beneficial in destroying other mosquitoes, though they are not a dependable factor for their control. They are very voracious during their growth, and they have, like the larvæ of *Mcgarhinus*, the habit of killing all surrounding larvæ before they pupate, so as to have quiet during the pupal period. In many cases I found *Lutzia* larvæ which had completely cleared the receptacle in which they lived of other mosquito larvæ. If the food supply runs short before they are ready for pupation, the *Lutzia* larvæ become cannibalistic, and thus in a measure counteract the value of the species by materially diminishing their own numbers.

The species was bred from the following localities: From hoof-prints in a meadow near Tabernilla, where the larvæ were feeding upon those of *Uranotenia calosomata*; from an open lagoon south of San Pablo; from a rusty iron bucket near a house at Las Cascadas, with no other mosquito larvæ present; from a small temporary pool near Bohio, without any other mosquito larvæ present; from old French machinery in the woods south of Tabernilla; here again a few full-grown *Lutzia* larvæ alone remained; from larvæ in an old tin can near a house in Pedro Miguel, feeding on *Stegomyia* larvæ; from large unused sugar boilers near Tabernilla; here the *Lutzia* larvæ were present by the hundreds, preying upon those of *Culex coronator*. In one of the boilers all the *Culex* larvæ had been eaten and the nearly full-grown *Lutzia* larvæ were feeding upon their weaker companions.

Genus *CULEX* Linnæus*CULEX* *INQUISITOR* Dyar and Knab

Bred from larvæ taken along the edges of a slowly running stream near Pedro Miguel; larvæ were also taken in a shaded pool of a drying-up mountain stream along the upper Chagres River. The adults were obtained at Las Cascadas by Mr. Jennings.

CULEX CUBENSIS Bigot

Bred from larvæ taken in very foul water in some old French machinery near Las Cascadas. It was also bred, both by Mr. Jennings and myself, from old boats on Taboga Island associated with *Culex coronator* and *Stegomyia calopus*.

CULEX CORONATOR Dyar and Knab

Bred near Tabernilla, from a stagnant ill-smelling pool, caused by recent dirt dumping, and from a rain-water barrel near there; from hoof-prints along a stream and from an old iron sugar boiler; also from a stream back of Culebra prison; from a cement trap containing sink-water in Las Cascadas; from a still pool of a shaded stream along the upper Chagres River; from a drinking-water tank at Allehuela; from a rain-water pool near Bohio; from a barrel in Pedro Miguel, and from an old boat on Taboga Island. Mr. Jennings also obtained this species from a boat on Taboga Island.

CULEX REGULATOR Dyar and Knab

Bred from an old boat on Taboga Island, and also by Mr. Jennings from a tub with water used for cattle, on the same island.

CULEX LEPRINCEI Dyar and Knab

Bred from larvæ taken from the grassy edges of a slowly running stream near Pedro Miguel, where it was associated with *Culex inquisitor*, and from a large ill-smelling pool caused by dumping of dirt near Tabernilla: associated with *Culex coronator* and *Culex conspirator*.

The species is named in honor of Mr. J. A. Le Prince, whose remarkable work against mosquitoes in Cuba and Panama is well known.

CULEX EQUIVOCATOR Dyar and Knab

Bred from larvæ taken near Lion Hill in the water-filled center of a cut banana trunk, where they were found together with the larvæ of *Culex lactator* and *Hæmagogus regalis*. The water was foul and slimy.

CULEX INTERROGATOR Dyar and Knab

Bred from larvæ associated with those of *Culex coronator* in a barrel with rain-water near Tabernilla, and from a stagnant pool near the same place, from which *Culex coronator* and *Culex leprincei* were also bred.

The species was also bred by Mr. Jennings and the writer on Taboga Island from larvæ taken in a boat filled with rain-water.

CULEX CONSPIRATOR Dyar and Knab

Bred together with *Culex leprincei* from grassy edges of a slow-running stream near Pedro Miguel.

CULEX LACTATOR Dyar and Knab

Bred from a barrel, from bamboo, and from a stagnant pool near Tabernilla; from a metal washtub and from recently flooded meadow at Las Cascadas; from a tin can and from a rotten banana trunk in the black swamp near Lion Hill; from a hollow tree-stump in an open field near Gatun, and by Mr. Jennings from a water-tub used for cattle on Taboga Island.

CULEX EXTRICATOR Dyar and Knab

The larvæ of this species were taken in crab-holes near the wireless telegraph station at Colon, and the species is clearly closely associated with these crabs, the adults remaining in the holes during daytime like those of the genus *Deinocerites*. A large series was bred, but neither adults nor larvæ were obtained in other localities.

This species was described from the larvæ collected and bred by the writer two years ago in Cedros, Trinidad. It is one of the several convincing examples justifying Messrs. Dyar and Knab in their classification of the mosquitoes, even to the extent of erecting new species on the immature stages alone. The closer study of the adults proved the distinctness of this species from the composite species "*pipiens*," and now the study of the habits of the species further emphasizes the correctness of the deduction from larval characters.

This species also illustrates the importance of exact observations of superficially unimportant details. The Trinidad specimens were bred from larvæ found in a small bucket used for holding live crabs; it was, in other words, an artificial crab-hole and thereby alone attractive as a place to oviposit for this crab-hole-inhabiting species.

The importance for practical work on the Canal Zone of definitely ascertaining, by further observations, whether this species sucks blood from man or not, has been commented upon under the genus *Deinocerites*.

CULEX JUBILATOR Dyar and Knab

Bred by Mr. A. H. Jennings from larvæ taken in an old tub in a pasture and from a slow-running stream on Taboga Island. Neither

this nor the following species were secured by Mr. Jennings and the writer during our visit to Taboga Island, six weeks previously to Mr. Jennings' last visit. As our investigations were careful and covered practically every water accumulation on the island, including the above-mentioned tub, this can only be explained by the periodicity of the activity of these mosquitoes. On Mr. Jennings' second visit he failed to secure several of the species I took during my stay on the island, which is not so large, but that it can be thoroughly explored in a few days.

CULEX REVELATOR Dyar and Knab

Bred by Mr. Jennings from an old rain-filled boat on Taboga Island.

CULEX HESITATOR Dyar and Knab

Bred from a small swampy stream near Las Cascadas.

CULEX ELEVATOR Dyar and Knab

The larvæ of this species are dark prettily marked with black, "zebra-striped." They were taken in a slow-running spring, full of leaves and small fishes, which evidently did not seriously interfere with the mosquito larvæ; it was also bred from the edges of a small stream full of fishes, near Tabernilla.

CULEX TÆNIOPUS Dyar and Knab

A single adult specimen was taken.

CULEX CORRIGANI Dyar and Knab

Bred from small larvæ with very long, slender tubes, taken in bamboo-joints near Tabernilla.

The species is named in honor of my friend, Mr. J. Corrigan, Sanitary Inspector at Tabernilla, whose efficient work has made that place one of the healthiest settlements in the Canal Zone. His constant courteous attention to my needs greatly facilitated my work and made my sojourn in Tabernilla very pleasant.

CULEX JENNINGSI Dyar and Knab

Bred from larvæ taken in water in the leaves of bromelias, *Tillandsia* sp., in a tree in the native village near Tabernilla, associated with *Phoniomysia scotinomus* and *Wyeomyia circumcincta*, and with these was preyed upon by the larvæ of *Megarhinus superbus*. This species is named in honor of my friend, Mr. Allen H. Jennings.

CULEX GAUDEATOR Dyar and Knab

Very close to and possibly merely a color variety of the preceding species, together with which it was found in a *Tillandsia* species on a tree near Tabernilla.

The eggs of this species are very remarkable, quite different from any mosquito-eggs at present known. They are laid in an egg-shaped gelatinous mass about 6 by 10 mm., which suggests a mass of frogs' eggs. The mass contained about twenty-five eggs, each of which is oblong, more pointed at one end and rounded at the other, and each surrounded by its own spherical gelatinous envelope, about 2.5 mm. in diameter. The egg-mass floats at the surface of the water, kept buoyant by small air-bubbles, one near the end of each egg. The gelatinous substance is consumed at least partly by the newly hatched larvæ.

CULEX FACTOR Dyar and Knab

Bred from leaf corners of a *Tillandsia* species, on a tree overhanging the water on the upper Chagres River. It was there associated with the larvæ of *Wyeomyia macrotus*. Also bred from bromelia water near Tabernilla.

CULEX FUR Dyar and Knab

The type of this species is in the U. S. National Museum and came from Colon, Panama (A. C. H. Russell, collector). I did not find the species.

CULEX (CARROLLIA) IRIDESCENS Lutz

This pretty, easily recognized little mosquito was bred on several occasions in large numbers from my bamboo traps in the neighborhood of Tabernilla. The species was not hitherto represented in the collection of the U. S. National Museum.

Subfamily SABETHINÆ

Genus SABATHES Desvoidy

SABATHES UNDOSUS Coquillett

A common species bred in large numbers from bamboo at Tabernilla, Lion Hill, and Gatun. The larva has a long air-tube and hangs perpendicularly from the surface of the water when at rest.

Adults of this species were also collected as they came to bite in the bamboo woods.

SABETHES IDENTICUS Dyar and Knab

The large, fat, milky-white larva of this species is strongly segmented and has a short tube; it hangs perpendicularly from the surface film when breathing; the adults were bred in two localities near Tabernilla, from my bamboo traps, and are very similar to those of the preceding species.

SABETHES LOCUPLES Desvoidy

A single specimen of this species, very conspicuous by its long-tufted legs, was caught by my friend Mr. H. Simms, Sanitary Inspector at Empire. Nothing whatever is known of the life history or larva of this curious species.

SABETHES LONGIPES Fabricius

Also one of the species with heavy tufts of scales on its legs. A single specimen in the U. S. National Museum was received from Bocas del Toro (P. Osterhaut, collector). The early stages are entirely unknown.

SABETHES CANFIELDI Dyar and Knab

This large, striking species, dark bluish green, with silvery belly, was the common mosquito in the black swamp from Ahoga Lagarto to Gatun, and came in numbers to inflict its rather severe sting, whenever one stepped into the shade of the brush. I was not able to locate its larvæ. These will probably be found to inhabit tree-holes or bamboo, or still more probably the inaccessible leaf corners of some palm.

This species was named in honor of my friend, Dr. Herman Canfield, whose broad comprehension of the problems of sanitation in general and of the bearings thereon, which insects may have, greatly adds to the efficiency of the work done by the Sanitary Department.

Genus SABETHOIDES Theobald**SABETHOIDES CYANEUS** Fabricius

Bred from larvæ taken in leaf corners of Spanish bayonet in a native village near Tabernilla.

Genus WYEOMYIA Theobald**WYEOMYIA APORONOMA** Dyar and Knab

Bred from larvæ in a hollow tree-trunk lying in the open field near Gatun, surrounded by a few bushes. The larvæ are long,

slender, and moniliform, with yellow head, short tube, and long anal appendages; they hang perpendicularly from the surface of the water when breathing, but can remain very long under water and burrow down into the sediment on the bottom when disturbed; they are thus easily overlooked.

WYEOMYIA ADELPHA Dyar and Knab

Bred from *Tillandsia* on a calabash tree near the railroad station in Tabernilla.

The mosquitoes of this genus are small sombre-colored insects, with silvery-white bellies, and generally escape detection, though they are very persistent biters during the daytime.

While nothing is known about this group of mosquitoes as possible carriers of disease, they are, on account of this day-biting habit, to be reckoned with as a nuisance and consequent detriment to humor and health, and it might be well worth while for the Sanitary Department to direct their efforts against them. The oiling and draining of surface water does not affect this group at all. Trees infested with plant parasites, as *Agave* and *Tillandsia*, should not be permitted in the immediate neighborhood of residences or working districts, or, if they are desired for shade, should be cleared of the water-bearing growth. The single small tree, now cut down, from which the present species was bred, contained about a hundred specimens of epiphytic plants, and the resulting mosquito fauna was large enough to be distinctly felt in the surrounding area, which in this case happened to be about the most frequented lounging place for the workmen in Tabernilla during noon hours.

WYEOMYIA GALOA Dyar and Knab

The very specialized larvæ of this species live in the conspicuous red flower-sheaths of a Bihai (*Heliconia*) species, common on the Zone. These flower sheaths contain but little water and that of a slimy character, but they harbor a number of dipterous and coleopterous insects. The mosquito larvæ of the present species are slender, flattened, strongly segmented with yellow head, short tube, and long anal appendages; they have the ability to move head foremost, more crawling than swimming through the sometimes thick fluid, in which they live; they are even able to crawl head first up the sides of the calyx above the fluid, and undoubtedly seek another lower and wetter flower sheath in this way, if for some reason the sheath in which they are goes dry.

This species looks very much like and has identically the habits of *Wyomyia pseudopecten* D. & K., bred from similar flowers in Trinidad and Santo Domingo. As in this species, the eggs, which are black, smooth, and elliptical, are laid singly, but in large numbers, in the uppermost, just-opening, and yet dry flower sheath, where they await a rain for their development.

WYEOMYIA LEUCOPISTHEPUS Dyar and Knab

Bred from *Tillandsia* on branches of a tree near Tabernilla.

WYEOMYIA CODIOCAMPA Dyar and Knab

Adults of this species were repeatedly taken in the bamboo woods near Tabernilla, where they came to bite. Only two larvæ were taken, both in the bamboo traps. These were the most extraordinary-looking mosquito larvæ, which have come under my observation, and resemble more young caterpillars than dipterous larvæ; they are short, fat and rotund, and covered with many long black spines in closely set clusters. The movement of the body is therefore short and slow, and they remain for long periods under water, quietly feeding in the decomposed vegetable matter on the bottom.

WYEOMYIA MACROTUS Dyar and Knab

The larvæ of this species were found, together with those of *Phoniomyia scotinomus*, in *Tillandsia* on trees along Bogueron River. Only a few specimens survived the upsetting accident on my way home. They have a very long, thin tube and lie on their backs, with the tube downward for long periods at a time. The species was also bred from bromelia water near Tabernilla. The pupæ of this species have very remarkable long, thread-like breathing tubes, quite different from the short, stout tubes normally found in mosquito pupæ. The length of these tubes keeps the pupa well under the surface of the water when it takes air, and this may likely be of value to the species in the limited and often crowded surface area of its habitat.

WYEOMYIA HOSAUTUS Dyar and Knab

Bred from bamboo near Tabernilla.

WYEOMYIA MELANOCEPHALA Dyar and Knab

Bred from a single larva taken, together with *Culex* and *Anopheles* larvæ, in a nearly quiet pool of a slow-running, cold, clear brook in the mountains back of Empire.

This is a very unusual breeding place for a larva of this genus, and it is probable that this single larva had been washed out by a rainstorm from a *Tillandsia* on an overhanging branch or from an overflowing tree-hole or bamboo-joint.

WYEOMYIA CHALCOCEPHALA Dyar and Knab

Bred from bamboo near Tabernilla.

WYEOMYIA BROMELIARUM Dyar and Knab

Bred in numbers from the bamboo traps around Tabernilla.

WYEOMIA CIRCUMCINCTA Dyar and Knab

Bred from larvæ in *Tillandsia* in trees along the Bogueron River and in a native village near Tabernilla.

WYEOMYIA PANAMENA Dyar and Knab

Bred from larvæ in bamboo near Tabernilla.

WYEOMYIA HOMOTHE Dyar and Knab

The adults were collected in bamboo woods near Tabernilla in the act of biting. The larvæ were not discovered.

WYEOMYIA AGNOSTIPS Dyar and Knab

Adult, collected, while biting, in bamboo woods near Tabernilla. No larvæ were found.

WYEOMYIA AUTOCRATICA Dyar and Knab

A single specimen of this species was received from Culebra (Wm. Black, collector). I did not meet with the species.

Genus **LIMATUS** Theobald

LIMATUS DURHAMI Theobald

This widely distributed little mosquito, which is easily recognized by its brilliant golden and royal-blue thorax, was bred from larvæ found in rain-water collected in a fallen palm-leaf on the bank of the upper Chagres River, where it was associated with *Anopheles ciseni*. It was also bred from an old tin can, full of rain-water and rotten leaves, in the woods near Tabernilla, and from a small wooden barrel in a native village near Tabernilla.

The larvæ are very long and slender and have a snaky movement; they are only found in water rich in decomposed vegetable matter.

Genus PHONIOMYIA Theobald

PHONIOMYIA PHILOPHONE Dyar and Knab

Bred from larvæ in *Tillandsia* on a tree near Tabernilla. The adults were also collected on Taboga Island by Mr. A. H. Jennings.

PHONIOMYIA CHRYSOMUS Dyar and Knab

Bred, together with the foregoing species, from *Tillandsia* in a native village near Tabernilla.

PHONIOMYIA SCOTINOMUS Dyar and Knab

Bred from leaf corners of *Tillandsia* on branches of trees along the Bogueron River, Panama. This species was secured and bred in large numbers, but most of my material was lost by the upsetting accident on the return trip; a vial with a few live larvæ had fortunately been placed in my valise, which was ultimately recovered after floating for a few miles through the rapids of the upper Chagres River, and they were bred to adults at my headquarters in Tabernilla. A single specimen of this species was also bred from *Bromelia* water in a native village near Tabernilla, where it occurred together with *Wyeomyia macrotus*.

Genus DINOMIMETES Knab

DINOMIMETES EPITEDEUS Knab

This peculiar mosquito, at once distinguished from all others except *Deinocerites* by the very long antennæ, was bred from crab-holes near the wireless telegraph station at Colon, where it was found associated with *Deinocerites melanophyllum* and *Culex extricator*.

Though possessing a well-developed proboscis, this species probably does not bite man; but this should be definitely ascertained by observations. (See note under *Deinocerites melanophyllum*.)

Genus LESTICOCAMPA Dyar and Knab

LESTICOCAMPA ULOPUS Dyar and Knab

Taken at Lion Hill and near Tabernilla. The larva lives between the stalk and the leaf stalk of a juicy large-leaved dark-green plant, which reminds one of *Monstera deliciosa*. The space in these leaf corners is so limited and the amount of water they hold so small and so slimy from the plant's juice that it would hardly be suspected to

harbor mosquitoes; and yet the plant probably has another Sabethid peculiar to it upon which the present species preys.

LESTICOCAMPA CULICIVORA Dyar and Knab

The larvæ are predaceous on those of *Wycomia galoa* in the red flower-sheaths of a Bihai (*Heliconia*) species. (See note under *Wycomyia galoa*.)

LESTICOCAMPA LEUCOPUS Dyar and Knab

In the U. S. National Museum are four specimens of this species received from Bocas del Toro (P. Osterhaut, collector). I did not meet with it.

Genus JOBLOTIA Blanchard

JOBLOTIA DIGITATUS Rondani

This and the following two species of this genus were abundant in bamboo woods. The adults were sure to come to bite, and the very similar looking, fat, short-tubed larvæ were to be found in any bamboo-joint, which contained the thick, saturated, often ill-smelling fermenting fluid, to which they seem partial.

The present species, which is the *Trichoprosopon nivipes* of Theobald, has a wide distribution within the moist tropics. The writer bred it in Trinidad from cacao husks, in which the fluid was as thick as gruel. Transferred to water, which is less rich in food, these larvæ remain alive unchanged for long periods. Some of my Trinidad larvæ lived for four months after reaching Washington, and some of the Panama material did nearly as well. The normal development, under natural conditions, with abundant food, takes about two weeks.

Eggs of the following species, which were laid May 1, produced the first adults on May 14, 1907:

JOBLOTIA TRICHORRYES Dyar and Knab

Bred commonly together with the above somewhat larger species from bamboo near Tabernilla. The eggs are laid singly on the surface of the water. They are elliptical, black, with four longitudinal fringes of short white hairs from tip to tip. The larva issued from one end. In a bamboo-joint, which I prepared and filled with water at 5 o'clock on the evening of May 1, I found the next morning at 9 o'clock some twenty such eggs, kept floating on the surface by the hair fringes. Some of these eggs were submerged during transit to the laboratory, and with the fringes once wet remained under water,

but these hatched nevertheless successfully, together with the non-submerged eggs, during the afternoon of the same day. The young larvæ were white, with black mouth-parts and black lateral hairs pointing forward on the anterior half of the body. They remained under water for several hours, eating of the vegetable matter at the bottom of the jar to which they had been transferred. The next morning the larvæ had doubled in size, and on the third day they attained their full size: they came regularly, though not very frequently, to the surface to breathe. When feeding on the bottom they would lie in the soft residue of vegetable matter in different positions, sometimes on their back, sometimes with the back up, or on the side. The first adult from this lot issued May 14.

The adults of this and other species of *Joblotia* are conspicuous objects in the bamboo woods, when they approach to bite, gracefully floating their long white-tipped middle and hind legs.

JOBLOTIA MOGILASIA Dyar and Knab

Bred with the two preceding species from bamboo near Tabernilla. While the larva and adult in a general way look much like the two other species, the pupa of this species is easily distinguished from the somber, dark pupa of the others; it is bright yellow, prettily marked with black cross-bands on the back of the abdominal segments.