FURTHER OBSERVATIONS ON MOSQUITO BREEDING IN TREE-HOLES AND CRAB-HOLES.

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FURTHER OBSERVATIONS ON MOSQUITO BREEDING IN TREE-HOLES AND CRAB-HOLES.*

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The following article includes the results of observations on the number and species of mosquitos breeding in two tree-holes during a period of more than ten months.

The two holes selected for observation were somewhat different in type and were designated according to their formation as " bottle hole " and " basin hole."

Bottle Hole.

The bottle hole was in a dika nut tree, *Irvingia barterii*, growing in the compound of the West African Yellow Fever Commission at Yaba, near Lagos, Nigeria. This hole was situated in the first fork of the tree, at a distance of 3½ feet from the ground, and extended vertically down into the trunk to a depth of 6½ inches. It was about two inches in diameter at the top, or external opening, and widened to nearly five inches at the bottom. It had a water capacity of about 355 cc.

The tree in which this hole occurred stood in the centre of a small clump of closely growing trees at a distance of 16 yards from the Commission Staff House. The thick foliage of the tree prevented water from accumulating in the hole during light rains, but when fairly heavy rains occurred the water trickled down the two main branches forming the first fork and entered the hole. The foliage of this tree and those surrounding it formed a sufficient canopy to protect the hole from sunshine at all times. The constant shade and the form of the hole tended to retard the evaporation of the water which collected.

A small mass of partly disintegrated leaves at the bottom of the hole was left there during the observation in order to avoid changing the natural conditions in the hole. These leaves retained moisture for several days after the water was removed.

Basin Hole.

The basin hole was situated in a mango tree, *Mangifera indica*, in the Commission compound at a distance of 60 yards from the bottle hole tree. This tree had previously been cut down to a height of three feet above the ground. The stump had callused around the edge at the top and new growths more than 10 feet high had sprung up on one side. Insects, decay or other factors had formed a hollow in the centre so that the top of the stump resembled a basin, the callused edge forming the rim. This hole was 8 inches in diameter and 3½ inches deep in the centre. The bottom was quite hard and there were no leaves or débris to retain moisture after the water was removed.

The tree stood at the edge of a large thicket of trees with a small open area in front. This caused the hole to receive so little shade that it was exposed to the sunshine during a considerable part of the day. It was also exposed to the prevailing winds. These factors, combined with the wide and shallow shape of the hole, caused the evaporation of water to be more rapid from this hole than from the bottle hole. Its capacity was approximately 900 cc.

Observations on the mosquito breeding occurring in these two tree-holes were begun on 24th May, 1926, and continued to 14th April, 1927, a period of 325 days.

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The holes were examined at five-day intervals. All water present at the time of examination, whether mosquito larvae could be noted or not, was collected with a piece of glass tubing and a rubber bulb. After all the water was removed, a small amount was always drawn up into the bulb and squirted around the inside of the hole to give it a slight rinsing and remove some of the larvae that might be left stranded. This water was again collected and returned to the sample. The rinsing was not sufficient to remove many of the eggs that might be adhering to the inside of the hole.

All water taken from the holes was placed in covered breeding dishes in the laboratory. Collections in which no larvae were present at the end of five days were discarded. All larvae obtained were bred out to the adult stage.

Each hole was examined 66 times. The bottle hole contained water at 32 examinations, and larvae were present in 30 of the collections. The total quantity of water taken from this hole was 6165 cc.

Water was collected from the basin hole 34 times, and all but two of the collections contained larvae. The total water removed from the hole amounted to 11,352 cc.

The following table gives the species of mosquitos, and the number of adults of each, that were bred out from the larvae collected from the two holes during 325 days :

Species of Mosquitos.	Bottle Hole.	Basin Hole.	Total.
	Number of adults.	Number of adults.	
Aëdes (*Stegomyia*) *apicoargenteus*, Theo. ...	167	394	561
Aëdes (*Stegomyia*) *aegypti*, Linn.	4	218	222
Aëdes (*Aëdimorphus*) *apicoannulatus*, Edw....	46	118	164
Aëdes (*Stegomyia*) *luteocephala*, Newst. ...	50	92	142
Aëdes (*Finlaya*) *longipalpis*, Grünb. ...	44	12	56
Cyathomyia fusca, Theo.	50	—	50
Aëdes (*Stegomyia*) *africanus*, Theo.	20	22	42
Aëdes (*Finlaya*) *wellmani*, Theo.	36	—	36
Aëdes (*Aëdimorphus*) *simulans*, N. & C. ...	10	19	29
Culex (*Culiciomyia*) *nebulosus*, Theo. ...	3	—	3
Totals	430	875	1,305

Mosquito Breeding in Crab-holes.

The large number of crab-holes along the margins of the lagoon in the vicinity of Lagos, Nigeria, prompted the writer to carry out an investigation regarding their importance as a breeding place for the yellow fever mosquito, *Aëdes* (*Stegomyia*) *aegypti*, Linn. This investigation was carried on at intervals throughout the period from 11th August to 5th November 1926. During this time collections of water, and mosquito larvae when present, were taken from 200 crab-holes in Lagos and Ebute Metta.

At the beginning of this work the holes were dug out and the water removed with a piece of glass tubing and a suction bulb. Since it was sometimes necessary to dig a distance of more than four feet in order to reach the pocket of water at the bottom of a hole, this method was found to involve a considerable amount of labour. It also frequently happened that while digging out a hole some of the loose earth would fall into the pocket of water with the result that we were unable to collect the sample.

After a number of holes had been dug out it was decided to try another means of obtaining the samples. An automobile pump, with the diaphragm reversed, and the lower valve removed, connected to a large suction bottle having a long piece of rubber tubing attached was arranged, after a plan submitted by Dr. Allan M. Walcott, a member of this Commission. This apparatus proved to be quite satisfactory for pumping out the water without the necessity of digging. In using this apparatus the water from the hole was first pumped into the suction bottle and then transferred to other bottles. The suction bottle and rubber tubing were washed well with clean water after each sample was collected.

Naturally, it cannot be assumed that all the larvae in a hole would be removed either by means of the pump or by digging, since it is quite likely that some of the larvae sank into the soft mud at the bottom of the water pocket and remained there. The number collected, however, was sufficient to permit a very fair estimate to be made of the amount of breeding occurring and the species of mosquitos selecting the crab-holes as a place of oviposition.

The quantity of water obtained from a hole varied from 1 to more than 120 ounces. A few of the holes contained more than 120 ounces, but since this was the maximum quantity desired for a sample, all the water present was not taken when more was found. The total collections from the 200 holes amounted to 58·8 gallons.

Mosquito larvae were found in 113, or 56·5 per cent., of the holes, and 4,356 adults were bred out. The occurrence of the various species and the number of adults reared are shown in the following table :—

Species and Number of Adult Mosquitos bred from Larvae collected from 200 Crab-holes.

Species.	Number of of holes.	Percentage of holes.	Number of of adults.
Aëdes (*Aëdimorphus*) *irritans*, Theo.... ...	64	32·0	715
Uranotaenia annulata, Theo.	47	23·5	621
Culex (*Culiciomyia*) *cinerellus*, Edw. ...	28	14·0	2,012
Culex insignis, Carter	27	13·5	730
Aëdes (*Aëdimorphus*) *nigricephalus*, Theo. ...	11	5·5	160
Anopheles gambiae, Giles	8	4·0	26
Culex decens, Theo.	4	2·0	45
Culex pruina, Theo.	3	1·5	20
Aëdes (*Stegomyia*) *aegypti*, Linn.	3	1·5	10
Culex fatigans, Wied.	1	0·5	17
		Total	4,356

The largest number of adults to emerge from one sample was 562, consisting of 464 *C. cinerellus* and 98 *C. insignis.* The second in abundance was 556, which included 429 *C. cinerellus*, 50 *A. irritans*, 47 *C. insignis*, 22 *U. annulata* and 8 *C. pruina*.

It may be noted from the foregoing table that *A. aegypti* was found in only three of the holes. One of these, at Ebute Metta, was situated 45 yards from the nearest habitation, and only two yards from the edge of the lagoon. Eight adult *A. aegypti* were bred from this sample and no other species was present. The second, which was also at Ebute Metta, and only three yards distant from the previous one, yielded 1 *A. aegypti* and 3 *U. annulata*. The third was in Lagos and was situated 15 yards from a habitation and 20 yards from the margin of the lagoon. The larvae taken from this hole produced 46 *C. insignis*, 15 *U. annulata*, 2 *A. nigricephalus* and 1 *A. aegypti*.

One hundred and twelve of the holes from which larvae were collected were not more than 100 yards from habitations, the remaining hole being 200 yards distant.

The finding of *A. aegypti* larvae in these three crab-holes demonstrated that, in Nigeria at least, this species does occasionally breed in collections of water where at the water's edge there is nothing but mud. This is somewhat at variance with some of the opinions in regard to the breeding habits of this species in the Americas.

Owing to the small number of *A. aegypti* found during this investigation it is perhaps justifiable to believe that crab-holes produce but few adults of this species and have but little importance in relation to yellow fever control. This view, however, is based only upon the results obtained from work carried out in Lagos by the writer and during only one season of the year. It is possible that observations in other localities, or at other seasons, might result in findings that would call for modification of this belief.