THE DOMESTIC MOSQUITOS OF ACCRA.

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(MAPS I & II.)

Samples of water containing mosquito larvae are collected at Accra by the Sanitary Inspectors, and are sent regularly to the Laboratory for identification. The number of samples submitted in this way is never very large, and varies considerably from time to time; but, recently, a careful examination has been made of all the specimens received during a complete year, and it is proposed to analyse in this paper the materials thus collected. In 1910-1911 Graham* made a similar study of the larvae found in native water-receptacles at Lagos, and it will therefore be interesting to compare our results with those obtained by him.

Accra, the capital of the Gold Coast Colony, is situated on the coast a few miles west of the meridian of Greenwich and about 330 miles north of the Equator. The town itself is divided into three portions, Accra proper to the west, Christiansborg where the Governor resides to the east, and the official residential area Victoriaborg between these two. The surrounding country is level for some miles, but the actual site of the town slopes slightly upwards as it recedes from the sea. Accra is a very dry and dusty town, almost completely denuded of vegetation. The rainfall is low; during the twelve months under consideration, December 1914 to November 1915, 21.75 inches of rain fell. During the same period the maximum shade temperature averaged 85.39°, the minimum 73.83°, and the relative humidity 72.46°. The physical features and climatic conditions of Accra differ therefore greatly from those of Lagos, a low-lying town surrounded by swamps with an average rainfall of about 70 inches.

Each of the samples containing mosquito larvae was marked with the number of the house and the division of the town from which it came. For the purposes of sanitary organisation Accra is divided into seventeen areas or blocks, and Christiansborg into seven. The positions of these are shown on the accompanying outline map (Map I). Victoriaborg is not divided into blocks, but each house is numbered. Practically, however, Victoriaborg may be disregarded, since with the exceptions of one or two samples all the larvae submitted had been found in the native compounds in Accra and the village of Christiansborg. A few samples were also collected from such situations as the lagoon and the Victoriaborg Reservoir and these are included in Table III, but are excluded from Table I, which summarises the identifications of the purely domestic mosquitos.

* Bull. Ent. Res., ii, p. 127.

During the twelve months selected for this investigation (December 1914 to November 1915), 417 samples containing mosquito larvae were submitted for examination (see Table I). For the first seven months a considerable number of samples were received monthly, but in July the numbers fell off abruptly and during the last three months very few indeed were submitted. Several causes may have contributed to bring this about. At the beginning of the investigation the co-operation of the Medical Officer of Health was obtained and he very kindly promised to send us as many samples as possible. This no doubt led to a stimulation of the Inspectors and consequently to an increase in the number of prosecutions, and as the fine imposed for harbouring mosquito larvae is a considerable one to the native, it probably brought about a greater care on the part of householders in the course of a month or two. The fact that we were away on leave from August until December may also have had a bearing on the case, as it may have been supposed that the maximum number of samples was no longer desired. On the other hand the falling off in the numbers might have been due to a seasonal variation in the incidence of the mosquitos themselves, but for the reasons stated later on we consider this to be improbable.

The Species of Mosquito Larvae Identified.

Ten different species of mosquitos were found in the 417 samples, namely, one Anopheline, four Stegomyias, and five other Culicines. *Stegomyia fasciata* was found in 373 of the samples (88.44 per cent.), *Culex fatigans* in 62 (14.86 per cent.), *Anopheles costalis* in 4 (0.95 per cent.), *Culex decens* and *Culiciomyia nebulosa* each in three (0.71 per cent.), *Stegomyia luteocephala* and *Stegomyia metallica* each in two (0.47 per cent.), and *Culex invidiosus*, *Culex tigripes* var. *fusca*, and *Stegomyia unilineata* each in one (0.23 per cent.). It is evident therefore that there were only two species that could be said to be common domestic mosquitos, namely *Stegomyia fasciata* and *Culex fatigans*, and that of these two the former preponderated.

Only six of the 417 samples were from Victoriaborg; all the rest were from native compounds. In the samples from Victoriaborg, however, six species were found, namely, *Stegomyia fasciata* and *Culiciomyia nebulosa* each thrice, *Stegomyia luteocephala* twice, and *Culex fatigans*, *Stegomyia metallica* and *Stegomyia unilineata* each once. Thus only seven species were found in the native compounds, namely, *Anopheles costalis*, *Culex decens*, *C. fatigans*, *C. invidiosus*, *C. tigripes* var. *fusca*, *Stegomyia fasciata* and *S. metallica*.

In 1,043 samples from the native compounds at Lagos Graham found six different species—*Stegomyia fasciata* in 92.5 per cent., (*Pectinopalpus fuscus*) *Culiciomyia nebulosa* in 21.6 per cent., *Culex duttoni* in 8.3 per cent., *Culex tigripes* var. *fusca* in 5.3 per cent., and (*Culex nigrocostalis*) *C. decens* and (*Pyretophorus costalis*) *Anopheles costalis* each in 1.8 per cent. It is interesting to contrast these results with those obtained at Accra. In the native compounds of both towns *Stegomyia fasciata* is by far the most common species. The only other species that was at all common at Accra, *Culex fatigans*, was not found at Lagos in a single sample; and *Culiciomyia nebulosa* which came second in Graham's list was not found in the native compounds of Accra although it was found thrice in Victoriaborg. The four species common to the two lists are *Anopheles costalis*, *Culex decens*, *Culex tigripes* var. *fusca* and *Stegomyia fasciata* (see Table II.).

TABLE I.
The various species of mosquitos of which larvae were found during twelve consecutive months.

Month ..	Dec. 1914.	Jan. 1915.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov. 1915	Totals.	Percent- ages.
Number of samples sub- mitted	45	56	51	62	40	42	68	18	15	4	10	6	417	
I.—Anopheleine larvae.														
<i>A. costalis</i> in ..	..	..	..	2	..	..	..	1	1	..	..	..	4	0.95
II.—Stegomyia larvae.														
<i>S. fasciata</i> in ..	45	53	49	55	36	37	52	15	14	3	10	4	373	89.44
<i>S. luteocephala</i> in ..	..	..	..	..	..	2	..	..	..	..	..	..	2	0.47
<i>S. metallica</i> in ..	..	..	..	1	1	..	..	..	..	..	..	..	2	0.47
<i>S. unilineata</i> in ..	..	..	..	1	..	..	..	..	..	..	..	..	1	0.23
III.—Other Culicine larvae.														
<i>C. decens</i> in ..	..	..	..	2	1	..	..	..	..	..	..	..	3	0.71
<i>C. fatigans</i> in ..	..	5	4	8	5	6	27	4	..	1	..	2	62	14.86
<i>C. invidiosus</i> in ..	..	..	..	..	..	1	..	..	..	..	..	..	1	0.23
<i>C. tigripes</i> var. <i>fusca</i> in ..	..	1	..	..	..	..	..	..	..	..	..	..	1	0.23
<i>Culicomyia nebulosa</i> in ..	..	..	..	2	..	1	..	..	..	..	..	..	3	0.71

TABLE II.

The percentages in which the larvae of the various mosquitos occurred in the native compounds at Accra (411 samples) and at Lagos (1043 samples).

Species of Mosquito.	Accra.	Lagos.
<i>Anopheles costalis</i>	1.0%	1.8%
<i>Culex decens</i>	0.7	1.8
<i>Culex duttoni</i>	..	8.3
<i>Culex fatigans</i>	14.8	..
<i>Culex invidiosus</i>	0.2	..
<i>Culex tigripes</i> var. <i>fusca</i>	0.2	5.3
<i>Culicomyia nebulosa</i>	..	21.6
<i>Stegomyia fasciata</i>	90.0	92.5
<i>Stegomyia metallica</i>	0.2	..

In the Annual Report of the Medical Research Institute, Yaba, for the year 1914, Connal and Coghill summarise the results of their examinations of mosquito larvae sent to them from Lagos by Dr. Dalziel. The larvae of ten species were obtained, the six recorded by Graham, and in addition *Culex insignis*, *C. grahami*, *Ochlerotatus irritans*, and *O. nigricephalus*. It is not definitely stated, however, that all these species were found breeding in native compounds, and it is possible that some may not have been, for they specially mention the fact that *O. irritans* was found in crab-holes, a situation in which it occurs at Accra also.

Seasonal Distribution.

The number of samples examined at Accra during the twelve months from December 1914 to November 1915 was insufficient to reveal any seasonal variations, even if they had occurred, especially as there was such a marked falling off in the number of specimens during the last five months of the investigation. At the laboratory, however, there were records of the examinations of the larvae sent by the Medical Officer of Health extending back to 1912, and although these were imperfect and discontinuous it was found possible to summarise them broadly as identifications of Anopheline, Stegomyia, and other Culicine mosquitos. The examination of the larvae submitted during twelve consecutive months showed that *A. costalis* was the only Anopheline mosquito found in such samples, *S. fasciata* almost the only Stegomyia, and *C. fatigans* by far the most common other Culicine. If then there had been any marked seasonal variations in the incidence of these three species of mosquitos at Accra it would almost certainly have appeared in the combined results of the examinations of larvae for the four years 1912 to 1915.

TABLE III.

The monthly proportions in which larvae of the three types—Anopheline, Stegomyia, and other Culicines—have occurred in the samples (from all sources) sent for examination 1912 to 1915.

	Anopheline.					Stegomyia.					Other Culicines.				
	1912.	1913.	1914.	1915.	Totals.	1912.	1913.	1914.	1915.	Totals.	1912.	1913.	1914.	1915.	Totals.
January ..	..	..	..	1	1	..	..	12	53	65	..	..	10	7	17
February ..	..	..	..	..	0	..	..	150	49	199	..	..	30	6	36
March ..	..	..	1	2	3	..	7	33	57	97	..	..	8	14	22
April ..	..	1	3	..	4	..	28	20	37	85	..	6	2	9	17
May ..	..	..	1	..	1	..	20	12	39	71	..	..	3	8	11
June ..	..	..	..	..	0	..	2	..	52	54	..	4	..	27	31
July ..	..	..	..	1	1	..	..	..	15	15	..	..	..	4	4
August ..	..	..	..	1	1	4	1	..	14	19	2	1	..	..	3
September ..	..	..	..	..	0	15	1	..	3	19	9	1	..	1	11
October ..	1	2	..	..	3	28	29	..	10	67	5	17	..	..	22
November ..	..	2	..	..	2	21	11	16	4	52	..	6	8	2	16
December ..	..	..	..	..	0	3	16	45	7	71	1	7	..	1	9
Totals ..					16					814					199
Percentage ..					1.6					79.1					19.3

The monthly proportions in which larvae of the three types—Anopheline, *Stegomyia*, and other Culicine—have been found in the samples sent to the laboratory from all sources during the years 1912 to 1915 are shown in Table III. It cannot be said that any clear indication is given of seasonal variation, unless it is a diminution in the numbers of both *Stegomyia* and other Culicine mosquitos during July and August, that is just after the height of the rains. The very small number of Anopheline larvae identified during these four years indicates that their occurrence in the native compounds was incidental, as, indeed, might have been expected.

Table IV, which shows the distribution of the samples containing *Stegomyia* larvae during the year 1915, might also have given some evidence on this point. It records indeed a very marked falling off in the number of the samples from July onwards, but there does not appear to have been any condition associated with the rainfall, the temperature, or the humidity of the atmosphere (see Chart I) that would explain why a large number of larvae should have been found from December to June, but very few from July to November. On the whole it is probable that this diminution in the number of specimens submitted for examination was due to causes unassociated with the habits of the mosquitos, and with this exception the Table does not seem to show anything that might be interpreted as seasonal variation.

There is no great variation in temperature or humidity at Accra during the year, and domestic mosquitos are probably independent of the rainfall, since they breed in collections of water provided for them by the hand of man. There seems in fact to be no real reason why there should be any seasonal variation in the distribution of such mosquitos, and so far as the evidence here collected goes, there does not appear to be any such variation.

Other factors must of course be taken into consideration, such as a possible seasonal variation in the food supply of the larvae or in the numbers of their natural enemies. Such factors probably have but little influence on such dominant species of domestic mosquitos as *Stegomyia fasciata* and *Culex fatigans*. *Stegomyia fasciata* has been stated to breed mainly in clean water, and the presence of these larvae has even been regarded as a proof of purity. This popular error has been exposed by Boyce, and it may be mentioned that very many of the samples found at Accra were thriving in exceedingly impure fluids containing food refuse and various kinds of animal and vegetable debris. Neither *S. fasciata* nor *C. fatigans* is dependent on any particular species of algae for its diet. In the laboratory larvae of both these species have been bred in broth media which were sterile at the start, but of course became in a very short time rich cultures of bacteria. Provided the medium did not become actually foul-smelling, when the larvae perished, the richer it was, the larger (within narrow limits) the mosquitos that were bred from it. Few, if any, of the samples collected in the native compounds contained natural enemies visible to the naked eye; but Vorticellas, ciliates, flagellates, and other microscopical organisms were frequently seen when examining the larvae. Whether any of these organisms, or of the various bacteria found in water, are pathogenic or not seems to be uncertain. Vorticellas certainly accumulate in considerable numbers on larvae whose development has been delayed, and ciliates are usually found infesting the corpses of larvae that have died, but in any case it is unlikely that they would determine a seasonal variation in the mosquitos, since they are found in suitable samples of water all the year round.

CHART I.

The rainfall and mean temperatures and humidity at Accra from December 1914 to December 1915; Ma., maximum shade temperature; Mi., minimum shade temperature; H., relative humidity; R., rainfall.

The Distribution of the Larvae in the various Divisions of Accra and Christiansborg.

Accra is divided into seventeen blocks, and Christiansborg into seven. These areas are of different sizes and very different characters, some being crowded with small native compounds, others being almost rural. It seemed important therefore to determine whether there were any numerical or specific differences in the distribution of mosquitos in them. It would have been more instructive if the distribution could have been followed house by house, but this was found to be impracticable, owing to the alterations constantly taking place in the town.

The majority of samples containing larvae that were examined were labelled with the number of the block of the town in which they had been found. In the year 1915 it was possible to ascertain the exact block in which four out of the five samples containing Anopheline larvae were found, 328 out of the 339 in which *Stegomyia* larvae were found, and 65 out of the 76 in which other Culicine larvae were found.

TABLE V.

The specimens of larvae (1912-1915) distributed according to the areas from which they were derived.

Town ..	Acera.																	Christiansborg.							Totals.
	i.	ii.	iii.	iv.	v.	vi.	vii.	viii.	ix.	x.	xi.	xii.	xiii.	xiv.	xv.	xvi.	xvii.	i.	ii.	iii.	iv.	v.	vi.	vii.	
Blocks ..																									
Stegomyia ..	13	3	11	22	22	7	33	38	15	19	50	28	19	30	41	88	65	24	5	34	11	10	21	1	610
Other Culicines	2	2	5	3	7	1	11	7	5	7	17	6	9	16	6	14	6	5	1	5	1	..	2	1	139
Anophelines..	..	..	1	1	..	..	1	..	1	1	1	..	..	1	2	1	1	..	1	..	1	..	..	..	13
Totals ..	15	5	17	26	29	8	45	45	21	27	68	34	28	47	49	103	72	29	7	39	13	10	23	2	762

In the Annual Report of the Accra Laboratory for the year 1914 the records of the examinations of mosquito larvae from 1912 to 1914 were similarly dealt with and the distribution of the specimens amongst the various blocks was shown in tabular form. Nine samples containing *Anopheline*, 282 *Stegomyia*, and 74 other *Culicine* larvae were thus located. By combining these with the 1915 specimens we were able to locate the blocks in which 13 samples containing *Anopheline* larvae, 610 containing *Stegomyia* larvae, and 139 containing other *Culicine* larvae had been found (see Table V.).

The distribution of these samples is shown by means of conventional signs on the attached map (Map I). This map has been prepared from the latest map of Accra, and on it the various blocks into which the town is divided are marked and numbered, but for the sake of clearness almost all other features have been excluded. As the very small number of samples found to contain *Anopheline* larvae would have been entirely lost amongst the *Stegomyias* had each sample of larvae from each block been represented by a separate sign, some means had to be devised by which the numerical distribution of the larvae could be shown approximately without allowing one type to obliterate another. It was found that this could best be done by using one sign for every ten entries; thus one solid circle in any block indicates that *Anopheline* larvae have been found in this area, but that less than eleven such samples have been received, or two crossed circles in a block indicate that any number of samples of *Stegomyia* larvae from eleven to twenty have been received from this area. Both *Anopheline* and other *Culicine* larvae therefore figure in this map in undue proportions, but it was necessary to allow this to occur, as in their true proportions they would have been hardly distinguishable.

Looking at this map then we see that mosquitos breed most freely in the middle of Accra in the neighbourhoods of blocks iv and vii. This part of the town is crowded with native compounds, and is the most densely populated. In the outskirts of the town and in the village of Christiansborg relatively fewer larvae are found, a fact readily accounted for by the less congested nature of these districts.

With regard to the distribution of species, *Stegomyia*, which practically means *S. fasciata*, occurs in every block in proportions such that it altogether outnumbers all others. *Culicine* larvae, that is practically *Culex fatigans*, occur in smaller numbers in every part of Accra, and in six of the seven blocks of Christiansborg. *Anopheline* larvae, that is *Anopheles costalis*, on the other hand have only been found in very small numbers, once or twice in a block, but they have been received from all the blocks with the exceptions of blocks i, ii, v, vi, xii, and xiii of Accra, and blocks i, iii, v, and vii. of Christiansborg. How it is that *Anopheles costalis* comes to be found breeding in the compounds in water-receptacles is not quite clear. It has been suggested that owing to the arid nature of Accra the mosquitos are compelled to deposit their eggs on water contained in domestic vessels for lack of a more favourable situation, but there are in the neighbourhood of the town pools suitable for the breeding of *Anopheline* mosquitos, and in which as a matter of fact the larvae of *A. costalis* are generally to be found. Graham at Lagos similarly found this mosquito breeding in "the domestic pots and barrels of native yards," and as Lagos cannot be called arid, it seems probable that *A. costalis* does voluntarily breed in such situations. Graham, however, notes that there was a rise in the percentage of vessels

harbouring these larvae in February, and suggests that possibly this " was caused by the absence of suitable puddles or pools at the end of the dry season."

In the second map (Map II.) all the samples of larvae that were collected in native compounds during a complete year, 1915, so far as it was possible to locate them, are shown in full, so as to give some idea of both their actual numerical and specific distribution. Each conventional sign indicates one sample containing larvae of the particular species shown, and the signs in each block are distributed evenly, as it was not possible to localise the compounds accurately.

A Comparison of the Adult Mosquitos collected at Accra with the Larvae found breeding in the Compounds.

A large number of different species of mosquitos have been collected at Accra. According to the pamphlet entitled " Distribution of Mosquitos in West Africa," which was printed for the Yellow Fever (West Africa) Commission in August 1913, no less than thirty-one species had been recorded up to that time, and to these the collections made by us in 1915 added nine new names, bringing the total up to forty-one. These species were *Anopheles costalis*, *A. funestus*, *A. pharoensis*, *A. umbrosus*, *Culex decens*, *C. duttoni*, *C. fatigans*, *C. grahami*, *C. guarti*, *C. insignis*, *C. invidiosus*, *C. ornatothoracis*, *C. quasigeliidus*, *C. thalassius*, *C. thalassius* var. *fuscus*, *C. tigripes*, *C. tigripes* var. *fusca*, *Culiciomyia nebulosa*, *Cyathomyia* (*Protomelanocnion*) *fusca*, *Mansonioides africanus*, *M. uniformis*, *Micraedes inconspicuus*, *Mucidus mucidus*, *Ochlerotatus albocephalus*, *O. irritans*, *O. domesticus*, *O. minutus*, *O. minutus* var. *biannulatus*, *O. minutus* var. *stenoscutus*, *O. minutus* var. *tarsalis*, *O. nigrocephalus*, *O. punctothoracis*, *Stegomyia fasciata*, *S. luteocephala*, *S. metallica*, *S. unilineata*, *Uranotaenia balfouri*, *U. connali*, *U. mashonaensis*, *U. mayeri*. Formidable as is this list, it is nevertheless incomplete, as we have found by the examination of some specimens collected recently. It is somewhat remarkable that of all these mosquitos known to occur at Accra only ten were represented in the samples of larvae from compounds sent for examination by the Medical Officer of Health.

Graham in his paper referred to above speaks of " The superior accuracy and finality obtained by dealing with the larvae breeding in the native yards " and states that by employing " this method of ascertaining the mosquito fauna of a native town . . . the results have proved more accurate and complete than those obtained by other methods." Whilst agreeing with him that " The catching of mosquitos in native yards and houses is difficult, and offers none of the advantages gained by dealing with the larvae," we cannot support his statements as to the accuracy and finality of the method in view of our experiences at Accra. It may be pointed out too that Graham's own study of the larvae found in domestic vessels revealed the presence of only six species (see above) at Lagos, although, quoting again from the pamphlet printed for the Yellow Fever Commission, forty-one species have been recorded as occurring in this town, namely, *Anopheles costalis*, *A. funestus*, *A. mauritanus*, *A. pharoensis*, *A. umbrosus*, *Aedomyia catacticta*, *Banksinella lineatopennis* (*luteolateralis*), *B. puncto-costalis*, *Culex consimilis*, *C. decens*, *C. duttoni*, *C. grahami*, *C. insignis*, *C. invidiosus*, *C. quasigeliidus*, *C. rima*, *C. thalassius*, *C. tigripes* var. *fusca*, *C. univittatus*, *Culiciomyia nebulosa*, *Eretmopodites inornatus*, *Mansonioides africanus*, *M. uniformis*, *Micraedes inconspicuus*, *Mimomyia mimomyiaformis*, *Ochlerotatus caliginosus*, *O. domesticus*,

O. irritans, *O. longipalpis*, *O. nigricephalus*, *O. punctothoracis*, *Stegomyia africana*, *S. apicoargentea*, *S. fasciata*, *S. luteocephala*, *Taeniorhynchus annetti*, *T. aurites*, *T. metallicus*, *Toxorhynchites brevipalpis*, *Uranotaenia balfouri* and *U. mashonaensis*, and to these no doubt a considerable number of additions have been made since 1913.

During eight of the twelve months selected for this investigation, namely, from December 1914 to July 1915, one of us was living in a small bungalow not far from the laboratory (see Map) and collected all the mosquitos he could. Owing to preoccupation with other work no systematic collection was undertaken, but any mosquitos that obtruded themselves were secured if possible, and his servants were instructed to capture any that they they found in the kitchen and their sleeping room. In this way 280 specimens referable to fourteen species were collected, which are enumerated in Table VI, and beside them is placed a list of the larvae found breeding in compounds during the same period. The contrast is rather a remarkable one.

TABLE VI.

The mosquitos, arranged in order according to the frequency of occurrence, found at Accra, (a) as adults in bungalow A. 1, December 1914 to July 1915, and (b) as larvae in the samples sent to the laboratory by the Medical Officer of Health during the same period.

Adults.			Larvae.		
Species.	Number caught in bungalow.	Per. centages.	Species.	Number of samples in which they were found.	Per. centages.
<i>Mansonioides africanus</i> ..	129	46.0	<i>Stegomyia fasciata</i> ..	342	82.0
<i>M. uniformis</i>	81	28.9	<i>Culex fatigans</i> ..	59	14.1
<i>Culex thalassius</i>	31	11.7	<i>Anopheles costalis</i> ..	3	0.7
<i>Anopheles pharoensis</i> ..	11	3.9	<i>Culex decens</i>	3	0.7
<i>A. costalis</i>	10	3.5	<i>Culiciomyia nebulosa</i> ..	3	0.7
<i>Culex fatigans</i>	6	2.1	<i>Stegomyia leuteocephala</i> ..	2	0.5
<i>Anopheles funestus</i> ..	3	1.0	<i>Stegomyia metallica</i> ..	2	0.5
<i>Culex duttoni</i>	2	0.7	<i>Culex invidiosus</i> ..	1	0.2
<i>Ochlerotatus irritans</i> ..	2	0.7	<i>Culex tigripes</i> var. <i>fusca</i> ..	1	0.2
<i>Culex decens</i>	1	0.3	<i>Stegomyia unilineata</i> ..	1	0.2
<i>Culex insignis</i>	1	0.3			
<i>Culex invidiosus</i>	1	0.3			
<i>Micraedes inconspicuus</i> ..	1	0.3			
<i>Stegomyia fasciata</i> ..	1	0.3			

Only five species are common to the two lists, namely, *Anopheles costalis*, *Culex decens*, *C. fatigans*, *C. invidiosus*, and *Stegomyia fasciata*, and whereas *Mansonioides africanus* and *M. uniformis*, by far the commonest mosquitos in the bungalow, do not figure at all among the larvae, *Stegomyia fasciata* which heads the list of larvae is last on the list of mosquitos.

There were of course good reasons for these differences, some of which it was not difficult to ascertain. The bungalow in which the mosquitos were caught was situated in the European quarter, and no mosquitos were allowed to breed in the compound. There can be little doubt indeed that the considerable numbers of mosquitos usually to be found in this house must have come from a distance, as there was no place in the immediate vicinity where they could have been bred. But *Mansonioides africanus*, for example, is known to have a considerable range of flight, and as it breeds in pools in association with the water-weed *Pistia stratiotes*, it is natural that its larvae were never received in the samples collected in the compounds.

It is not easy to account for the rarity of *Stegomyia fasciata* in the bungalow. This mosquito, the house-haunting mosquito *par excellence*, which breeds in domestic water-vessels and is known to require feeds of blood for the maturation of its eggs, one would naturally expect to figure largely in any collections made in human habitations at Accra. In a bungalow in the European quarter, however, where every precaution is taken to prevent the breeding of mosquitos its absence might be explained, since it is said not to fly far, and in any case a long flight in search of blood must seldom be necessary for it. But recently a number (156) of mosquitos have been collected for us in a native's house in block xvii. of Accra, a locality in which *Stegomyia fasciata* abounds (see Table V. and Maps), and yet not a single specimen of this species has been caught up to the present.* It is possible that *Stegomyia fasciata* may prefer to bite in the open and may be disinclined actually to enter dwellings, but the occurrence of this mosquito in houses in large numbers has repeatedly been recorded by others, and one of us, in the Gold Coast, has frequently taken it in Europeans' bungalows in Ashanti and the Northern Territories, but usually in the afternoon between 3 and 6 p.m., and not at night. A more probable explanation of the facts recorded above is therefore that *Stegomyia fasciata*, whilst entering houses to obtain feeds of blood, does not roost indoors.

A consideration of the two lists shown in Table VI. convinces us that an examination of the larvae found in the compounds not only fails to give any adequate idea of the mosquito fauna of a town, but also fails to indicate the species of mosquitos to the attacks of which the inmates of the houses are liable. It also furnishes proof of the necessity for extending anti-mosquito measures so as to reach the species that breed far afield.

A Note on the Distribution of certain of the commoner Mosquitos found on the West Coast of Africa.

It is not easy to state what are the exact natural conditions which determine the presence of a particular species of mosquito in one locality and its absence from another. An adequate supply of food for the growing larva is generally regarded

*The mosquitos referred to have been identified as follows :—*Anopheles costalis*, *Culex fatigans* and *Mansonioides africanus*.

as the main factor. That this is the sole factor is unlikely, as already pointed out in this paper with regard to those larvae which are reared in domestic pots; for if it were, it would be difficult to account for the relatively greater frequency of *C. duttoni* amongst the domestic mosquitos of Lagos as compared with those of Accra, or to explain the presence of *C. fatigans* in considerable numbers amongst the domestic mosquitos of Accra and its absence from the collections made at Lagos. Again *C. tigripes* var. *fusca*, the larva of which is carnivorous and is not particular as to the species of larvae it preys upon, occurs in the proportion of 5.3 per cent. amongst the domestic mosquitos of Lagos, whereas its proportion is only 0.23 per cent. amongst similar mosquitos at Accra.

If the food supply of the larva is the preponderating factor in determining the distribution of the adult mosquito and if, as seems probable, the growth of the minute organisms, chiefly of a vegetable nature, which constitute the food of the larva are just as dependent upon varying conditions of atmosphere and the composition of the medium in which they grow as are the higher plants of the country, then it should be possible to indicate roughly in a table, which gives a return of the mosquitos taken in different districts that vary in their physical conditions, a corresponding variation in the distribution of the mosquitos. Table VII., which has been drawn up from the "Distribution of Mosquitos in West Africa" and from our own experience of the prevalence of certain species in different districts, is of interest in this connexion.

It has been shown by one of us* that certain mosquito larvae are very tolerant of salt in the medium in which they live. As there is a considerable amount of chlorides in Accra water, its presence may have some bearing on the anomaly in the distribution of *C. duttoni* and *C. fatigans* in this district. *C. fatigans* is capable of breeding in brackish water, while *C. duttoni*, according to Graham† is intolerant of even a moderate amount of chlorides. Mosquitos such as *O. irritans* and *C. thalassius*, which breed by preference in brackish water, are not found far from the coast.

Graham‡ has pointed out that larvae of *A. costalis* failed to increase in size when placed in clear tank-water, but that growth proceeded upon the addition of small quantities of human urine (the addition of which may, however, have transformed the clear tank-water into a culture medium) which contains sodium chloride, and that the water of Accra and Sekondi, where *A. costalis* is the dominant Anopheline, is slightly brackish. *A. costalis* certainly appears to be more common on the coast than it is inland, where its place as a carrier of malaria is taken by *A. funestus* (cf. Stephens and Christophers).

Some mosquitos appear to flourish best in an atmosphere which is humid, e.g. *Eretmopodites*, *Toxorhynchites*, and *Taeniorhynchus*. Others such as *C. ager* var. *ethiopicus*, *C. consimilis*, and *C. annulioris*, the larvae of which are generally found embedded in flimsy algae, do not appear to be found on the coast. *Anopheles squamosus* and *A. rufipes* also seems to prefer inland stations, as does *Stegomyia suguens*. *Stegomyia fasciata* on the other hand is a lover of the coast, but as this is a domestic mosquito, the explanation of its wider distribution near the sea is probably that given by Boyce,§ who states that *S. fasciata* follows "the tin invasion which extends up from the coast to the interior villages," the discarded tins favouring the development of this particular species.

* Bull. Ent. Res., vi, p. 225. † Bull. Ent. Res., ii, p. 132.

‡ Report upon Entomological Observations made in Southern and Central Ashanti. 1907. p. 14. Colonial Office, Miscellaneous No. 236.

§ Bull. Ent. Res., i, p. 236.

TABLE VII.

The distribution of certain mosquitos. +++ indicates a very common species, ++ a common species, + a rare species, and — that the occurrence has not been recorded up to the present.

Mosquito.	Accra ; arid, sandy soil, old sea bed. Rainfall, 29 ins.	Lagos ; low-lying, swampy, surrounded by a lagoon. Rainfall, 71 ins.	Ashanti ; thick forest except northern portion which is transitional. Rainfall, 56 ins.	Northern Territories ; open orchard "bush." Rainfall, 47 ins.
<i>Anopheles costalis</i>	+++	+++	++	++
<i>A. funestus</i>	+	+	+++	+++
<i>A. mauritanus</i>	—	+	++	++
<i>A. pharoensis</i>	+	+	—	—
<i>A. rufipes</i>	—	—	+	+
<i>A. squamosus</i>	—	—	+	++
<i>A. umbrosus</i>	+	+	+	—
<i>Aëdomyia catacticta</i>	+	+	—	++
<i>Banksinella lineatopennis</i> ..	—	+	+	—
<i>B. punctocostalis</i> ..	—	+	+	—
<i>Culex ager</i> var. <i>ethiopicus</i> ..	—	—	+	+
<i>C. annulioris</i>	—	—	+	+
<i>C. consimilis</i>	—	—	++	++
<i>C. decens</i>	++	++	+	+
<i>C. duttoni</i>	+	++	+	++
<i>C. fatigans</i>	+++	—	—	—
<i>C. grahmi</i>	+	++	++	+
<i>C. insignis</i>	+	+	++	—
<i>C. invidiosus</i>	+	+	+++	+++
<i>C. quasigelidus</i>	+	+	—	+
<i>C. thalassius</i>	+	+	—	—
<i>C. tigripes</i> var. <i>fusca</i> ..	+	++	++	++
<i>C. univittatus</i>	—	+	+	+++

TABLE VII.—continued.

Mosquito.	Accra ; arid, sandy soil, old sea bed. Rainfall, 29 ins.	Lagos ; low-lying, swampy, surrounded by a lagoon. Rainfall, 71 ins.	Ashanti ; thick forest except northern portion which is transitional. Rainfall, 56 ins.	Northern Territories ; open orchard "bush." Rainfall, 47 ins.
<i>Culiciomyia nebulosa</i> ..	++	+++	+++	+++
<i>Cyathomyia fusca</i>	+	—	—	—
<i>Eretmopodites chrysogaster</i> ..	—	—	++	—
<i>E. inornatus</i>	—	+	++	—
<i>Mansonioides africanus</i> ..	+++	+++	++	+++
<i>M. uniformis</i>	+++	+++	++	—
<i>Micraëdes inconspicuus</i> ..	+	+	+	—
<i>Mimomyia hispida</i>	—	—	++	+
<i>M. mimomyiaformis</i> ..	—	+	+	+
<i>M. plumosa</i>	+	—	++	+
<i>M. splendens</i>	+	—	—	++
<i>Mucidus mucidus</i>	+	—	+	—
<i>Ochlerotatus cummingsi</i> ..	—	—	+	—
<i>O. domesticus</i>	+	+	+	—
<i>O. irritans</i>	+++	+++	—	—
<i>O. minutus</i>	+	—	+	—
<i>O. nigeriensis</i>	—	—	+	++
<i>O. nigricephalus</i>	+	+	—	—
<i>Stegomyia africana</i>	—	+	+	—
<i>S. apicoargentea</i>	—	+	+	—
<i>S. fasciata</i>	+++	+++	++	++
<i>S. luteocephala</i>	+	+	+	—
<i>S. metallica</i>	+	—	—	—
<i>S. simpsoni</i>	—	—	+	—
<i>S. sugens</i>	—	—	+++	+++
<i>S. unilineata</i>	+	—	—	—

TABLE VII.—*continued.*

Mosquito.	Accra; arid, sandy soil, old sea bed. Rainfall, 29 ins.	Lagos; low-lying, swampy, surrounded by a lagoon. Rainfall, 71 ins.	Ashanti; thick forest except northern portion which is transitional. Rainfall, 56 ins.	Northern Territories; open orchard "bush." Rainfall, 47 ins.
<i>Taeniorhynchus annetti</i> ..	—	+	—	—
<i>T. aurites</i>	—	+	—	—
<i>T. metallicus</i>	—	+	—	—
<i>Toxorhynchites brevipalpis</i> ..	—	+	+	—
<i>Uranotaenia balfouri</i> ..	+	+	+	+
<i>U. connali</i>	+	—	+	—
<i>U. mashonaensis</i> ..	+	+	+	—
<i>U. mayeri</i>	+	—	—	—

SUMMARY AND CONCLUSIONS.

1. An examination of the mosquito larvae found in domestic water-receptacles, etc., in native compounds at Accra shows that two species, *Stegomyia fasciata* and *Culex fatigans*, predominate, and that of these the former is by far the most common.

2. Such an examination, however, fails to give a true idea of the mosquito fauna of the town, or of the species to the attacks of which the inhabitants are exposed. Many of the species most common in the houses do not breed in the compounds, but come from further afield, where their larvae should be sought out and destroyed.

* * * *

[With reference to the supposed non-existence of *Culex fatigans* in Lagos, Dr. J. M. Dalziel, who has recently been investigating the domestic mosquitos of that town has kindly supplied the following records of the occurrence of that species :—

" July 1914. One adult caught in neighbourhood of the golf course marsh.
 Sept. 1914. One adult caught in Government House or environs.
 Aug. 1915. Bred from larvae from wells — twice.
 Sept. 1915. " " " " a well, with *Culex tigripes*.
 Sept. 1915. " " " " a boat, with *S. fasciata*.
 Jan. 1916. " " " " a well.
 April 1916. " " " " a canoe."—ED.]

Map I. - Map of Accra showing the distribution of mosquitoes (1912-1915) in the various blocks into which the town is divided.

Stegomyia....⊕ Culex....⊙
Anopheles....●