THE SUB-GENUS *STEGOMYIA* (DIPTERA: CULICIDAE) IN THE ETHIOPIAN REGION

I. A PRELIMINARY STUDY OF THE DISTRIBUTION OF SPECIES OCCURRING IN THE WEST AFRICAN SUB-REGION WITH NOTES ON TAXONOMY AND BIONOMICS

BY

P. F. MATTINGLY

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SYNOPSIS

This paper deals with the distribution of the species of *Stegomyia* occurring in the West African sub-region. All the species of wide distribution in the Ethiopian Region are, however, included and the topographical data therefore cover most of the region. *Aëdes aegypti* is treated very briefly since it is regarded as a special case meriting a separate paper. Zoogeography is discussed mainly in relation to rainfall and altitude. Temperature and vegetational relationships will be discussed in later papers. Such notes on taxonomy and bionomics are included as appear to be necessary for an understanding of distribution. These also will be discussed at greater length in later papers in the series.

INTRODUCTION

THE objects of the present study are firstly to render possible a more rational approach to the taxonomy of the sub-genus *Stegomyia*, and incidentally of other African insects, and secondly to discover what light may be thrown by this comparatively well-known group on general problems concerning the distribution of the Ethiopian fauna. It is perhaps not too much to hope that some small quota may be added to the growing accumulation of evidence regarding past climates in Africa which is of fundamental importance for the understanding of phylogeny and of the human, plant, and animal geography of the continent.[1] Ernst Mayr (1942) has clearly shown that it is as a population that the species is encountered in nature, and it is upon population studies that our knowledge must ultimately be based. A taxonomy based solely on the arbitrary selection of morphological types, while indisputably essential, can only be of ancillary importance. In the author's opinion the greatest need for mosquito studies at the present time is the application of genetical methods (on this point see Bates, 1949).

The upper limit to our knowledge of distribution is imposed by the supply of collectors. In the present instance records are available from more than 600 localities (Fig. 1), but not all of these have been investigated with equal thoroughness. In general the British territories have rendered the best service, but it is unhappily true that the most serious gap in our knowledge at the present time is provided by Tanganyika, of which only a narrow fringe along the northern border and along the coast is known. Vast areas of unknown territory exist in Angola, the Cape Province, and French Equatorial Africa, but these are so situated that discoveries there would be likely to add to rather than to integrate our existing knowledge. From the phylogenetic point of view most knowledge could probably be gained from the study of high-altitude faunas. At present only those of Ruwenzori, the Kigezi district, and a few parts of Kenya are known.

The present paper deals only with those species occurring in the West African sub-region. Those which are known only from the East and South African sub-regions will be dealt with in a later communication. This does not mean that only the West African districts are considered. All the *Stegomyia* species of wide distribution in Africa enter this sub-region, and these species must necessarily be considered in relation to their range as a whole if their distribution is to be understood. The distribution of one species, *Aëdes aegypti*, is so artificial and so many records are available that to deal with these in full, as has been done for the other species, would serve little useful purpose, besides taking up a wholly disproportionate amount of space. Details of the distribution of this species may be found in Kumm (1931*b*) supplemented by Edwards (1941) and by the notes on recent records given below. Some small attention is paid, in the section on breeding-places, to the occurrence of wild populations. It is possible that some idea of the natural distribution of the species, which is almost certainly Ethiopian in origin, might be gained if more records of this kind were available.

Apart from one or two important collections which the author has not as yet had the opportunity to examine, all known sources of distribution records have been tapped. It is not believed that the collections in question will add to any great extent to our knowledge, as much of the material which they contain has been published. Great difficulty has been experienced in tracing many localities and in ascertaining the known facts regarding their climate and topography. In order to save others this labour the best available data have been included in tabular form. The major factors affecting distribution may be considered to be rainfall, temperature, humidity,

[1] For a summary of this work see Zeuner (1944).

and vegetation. The last named is itself dependent to so large an extent on the other factors that it is preferred to discuss it separately in a later communication. It is here referred to only where, as in the case of the Guinean forests, it appears to constitute a gross physical barrier to distribution. Attention has been paid to the possible influence of human transportation, but this is considered to be only a minor

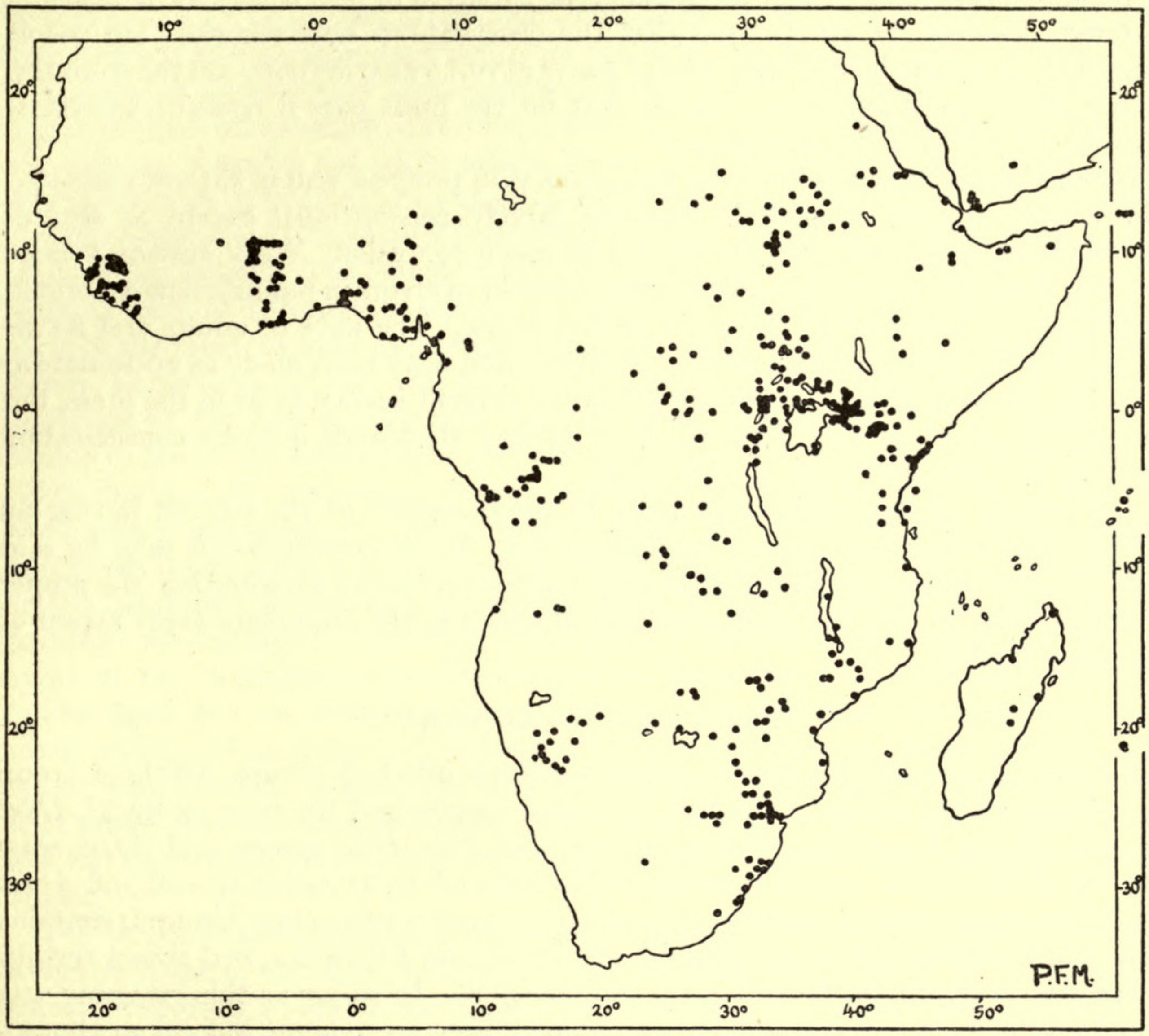

FIG. 1. Distribution of collectors of *Stegomyia* spp. other than *Aëdes aegypti*.

factor. Its importance for the mosquitoes is very liable to exaggeration and only the merest handful of species can be shown ever to have become established outside their natural boundaries, while very striking cases of failure to become established even under apparently favourable conditions can be quoted. Among the species here discussed only the domestic *Aëdes aegypti*, and *Aëdes simpsoni* which commonly breeds in the leaf axils of food plants, show any sign of having been affected in this way. Man as a destroyer of forests is perhaps more important, but this factor has relatively little significance for the present study, which is concerned rather with distribution at the present time and the factors by which this is controlled than with distribution in the past. The consideration of temperature and humidity has had to be postponed for a subsequent communication owing to the relative inaccessibility of the necessary data, but altitude is considered for the sake of the light which it throws on temperature limits. Rainfall, for which quite abundant figures have recently become available, is considered in full, and rainfall boundaries are found to provide a surprisingly, in some cases almost dramatically, accurate fit with known *Stegomyia* distributions, especially when the seasonal distribution of rain is taken into account. It must, however, be emphasized that the observations here recorded are purely empirical. It is not claimed that rainfall *per se* governs distribution. On the contrary, such evidence as is available suggests that for the most part it operates indirectly through its influence on vegetation.

Detailed taxonomic study of the sub-genus is in progress and is not yet complete. The treatment here adopted is therefore largely conventional except as regards *dendrophilus*, which has been the subject of much confusion. Work already carried out has, however, revealed a considerable number of errors in published descriptions, and these are corrected in the notes on taxonomy. The keys to adults and larvae cover all Ethiopian members of the sub-genus and have been made as up-to-date as possible. No descriptions of new species are at present known to be in the press, but the position of a new form from the East African Highlands is under consideration and will be discussed in the second paper.

The section on bionomics is confined to those aspects of the subject having an obvious and immediate bearing on distribution. In this connexion it may be said that the most serious gap in our knowledge concerns seasonal distribution, the proper understanding or even the mere recording of which would illuminate every aspect of mosquito studies.

NOTES ON TAXONOMY

Edwards (1932) divided the sub-genus *Stegomyia* into four groups. Of these, group A contains all the purely Ethiopian mainland species and the cosmotropical *Aëdes aegypti*. Group B contains certain Oriental and Palearctic species and *Aëdes mascarensis* of Mauritius. Group C contains Oriental and Australasian species and *Aëdes albopictus*, *granti*, and *unilineatus*, part of whose range is Ethiopian. Group D contains only *Aëdes vittatus*, which is Palearctic, Oriental, and Ethiopian, and shows certain characters anectant to the sub-genus *Aëdimorphus*. In so far as this grouping was based on the male terminalia it appears to have been a good one, but colour characters in *Aëdes* are somewhat unsatisfactory and *mascarensis* should perhaps have been placed in group A. In any case a new system of grouping has been rendered necessary by the discovery of *Aëdes amaltheus* (De Meillon & Lavoipierre, 1944), which is anectant between groups A and B, having the colour characters of one and the male terminalia of the other, the discovery of certain aberrant species of *Stegomyia* in the Mariana Islands (Bohart & Ingram, 1948), and the proposed transfer to this sub-genus of certain species hitherto assigned to *Armigeres* (Brug & Bonne-Wepster, 1947). Such a regrouping is, however, beyond the scope of the present paper, and the following notes refer only to matters of detail.

Aëdes apicoargenteus. Specimens from Kampala have a number of pale scales on the lateral lobes of the scutellum. Edwards (1941) states that in the 'typical form' these lobes are entirely black-scaled but gives no further explanation. This has led to some confusion. Other specimens with the lateral lobes white-scaled are recorded from Kenya (Van Someren, 1946), and Wolfs (1949) notes that they are white-scaled in ssp. *denderensis* from Costermansville. This is a rather unstable species, perhaps of comparatively recent origin, and the occurrence of this type of peripheral variation does not seem to have much taxonomic significance. It is, however, noteworthy that pale scaling has only been recorded from the higher parts of the range, above 3,000 ft. As will be shown below, *apicoargenteus* seems to be more strictly confined to low altitudes than, for example, *africanus*, whose range is otherwise similar. Its highland counterpart, *schwetzi*, has white lateral lobes. The occurrence of pale scales on the lateral lobes in *apicoargenteus* unfortunately renders separation from *fraseri* rather more difficult since this species frequently exhibits a number of dark scales in this position (see below). The extent of the pale area on the posterior surface of the hind femur is used by Edwards (1941) as a key character, but this is so variable in different parts of the range as to be extremely unreliable. The best diagnostic character from *fraseri*, as pointed out by Van Someren (1946), is the metallic sheen on the pale markings of the femora; *schwetzi* is easily separated by the very extensive pale scaling in the pre-scutellar region, but the differences in the male terminalia given by Edwards (1941) do not appear to be significant. The twisting of the style observed in *schwetzi* is due merely to the angle from which this was drawn and *apicoargenteus* also shows it when drawn from the same angle. The number and length of the bristles on the basal lobe is very variable in *apicoargenteus* and overlaps with that found in *schwetzi*. An average figure would perhaps be 8, but some specimens may have as many as 12. West coast specimens sometimes have fewer bristles than those from farther East, but the difference is not constant. The only genitalic character which seems to be of much diagnostic value concerns the IXth tergite, which is rather more deeply excavated in *schwetzi*, but even here there is some variation in both species. It is rather doubtful whether *schwetzi* should be treated as more than a sub-species, but further material is required from intermediate localities before the point can be settled.

The larvae of *apicoargenteus*, *fraseri*, and *schwetzi* are all very similar and closely resemble those of the East African *calceatus*, *soleatus*, and *langata*. As far as can be ascertained from available material, *apicoargenteus* and *fraseri* can generally be separated from the other species on the position of the antennal bristle. In *fraseri* this arises at 0·82–0·85 × the distance from base to apex of the antenna. In *apicoargenteus* the corresponding figure is 0·67–0·82. Specimens of this species from Uganda show a rather greater average displacement from the base than do those from Nigeria, Cameroons, and Belgian Congo, and this may be an altitudinal effect comparable to that described in connexion with the scutellar lobes. Average positions in material so far available are 0·80 for Uganda, 0·74 for Nigeria, and 0·75 for Belgian Congo and Cameroons, but the samples are too small for proper statistical analysis. In all specimens of the *calceatus* group examined the figure is less than 0·70. *schwetzi* overlaps the two groups. As noted by Van Someren (1946), those larvae of *fraseri* so far examined can be separated from *apicoargenteus* by the greater reduction of the median denticle of the comb spines (with proportional emphasis of the lateral fringe), but all specimens so far available come from Kenya and it is by no means certain that this character would be diagnostic for West Coast larvae. From all other members of the group, except ssp. *denderensis*, *calceatus* can be separated by the possession of a wholly dark siphon. This character is not mentioned in the type description of *denderensis* (Wolfs, 1949), but it is shown by both larvae available for examination and is very probably constant. It is a striking character, and although the differences from the type form with respect to male terminalia given in the type description are not constant, it is considered that this form should be named as a sub-species. Further material from the Kivu Highlands and Ruanda-Urundi would, however, be very welcome. Differences in colour characters between the sub-species and West Coast specimens of the type form include smaller anterolateral scutal patches, more frequent occurrence of pale scaling on the lateral lobes of the scutellum, narrower pale bands on third hind tarsi, and reduced pale scaling of fifth hind tarsi. None of these are, however, absolutely diagnostic from Kenya and Uganda specimens of the type form.

Aëdes fraseri. This species has already been discussed, but a further word is perhaps necessary regarding the scaling of the lateral lobes of the scutellum. Edwards (1941) states that the scales in this position are 'always white', a statement belied by his figure (Fig. 39). In fact some dark scales are usually present. It is probable that West Coast *apicoargenteus* can be reliably distinguished from *fraseri* by having the lateral lobes wholly or very largely black, but the distinction does not hold good in the eastern part of their range. As noted by Edwards (1941) and Van Someren (1946), the shape of the anterolateral pale scutal patches and the extent of the pale area on the posterior surface of the hind femur are subject to much variation.

Aëdes dendrophilus. This species has been misidentified by Van Someren (1946) and others by reason of the misleading description given by Edwards (1941). This description should be ignored and that given by Van Someren (loc. cit.) substituted for it. Edwards appears to have been misled by the very striking sexual dimorphism occurring in *dendrophilus*. This is an unusual phenomenon in *Stegomyia*, although a small degree of dimorphism with respect to, for example, the abdominal tergites is common. An even greater degree of dimorphism characterizes some oriental *Finlaya*, however (see photographs in Barraud, 1934). The characteristic markings of the male as described by Van Someren for the Kenya and Uganda forms are also shown by the Gold Coast form, and Edwards's type ♂, although damaged, shows them well. By reason of the same error of observation Edwards failed to recognize the identity of *dendrophilus* with *Aëdes trinidad*. Through the kindess of Dr. Ceballos and Dr. Peris of the Madrid Museum it has been possible to examine the two cotype males of this species and it is clearly conspecific with *dendrophilus*. It should be noted that the white spot on the clypeus referred to in the type description of *trinidad* (Gil Collado, 1935) is due to frosting of the integument and not to the presence of scales. *Aëdes aegypti* thus remains distinguishable from all other *Stegomyia* by the presence of scales in this position. A careful comparative study reveals that Edwards's type series of *Aëdes demeilloni* from Eshowe, Zululand, contains a specimen of *dendrophilus* which can be recognized by the character given in the key. The correctness of this diagnosis was suggested by the fact that the specimen in question was bred out from a tree-hole, whereas all those of *demeilloni* came from axils of *Dracaena* or 'Fern Tree'. Both the identity of the Eshowe specimen with *dendrophilus* and the distinctiveness of the breeding-places of the two species have been confirmed by the receipt of further specimens of both sexes kindly sent by Dr. De Meillon, and Mr. Muspratt has made extensive collections of both in Natal which add further confirmation. This curious but by no means unique distribution is discussed more fully in the appropriate section. The Kenya–Uganda, Sierra Leone–Gold Coast–Nigeria, Fernando Po, and South African forms all show minor differences in colour markings, and the latter at least should perhaps be named as a sub-species. The point will be discussed in a later paper to be devoted to taxonomy. The problem is complicated by the fact that Edwards's type series of *dendrophilus* consists of a number of dwarfed specimens, some with slightly atypical markings. These have the appearance of specimens bred out in the laboratory on an inadequate larval diet. The presence of thickened, spine-like setae on the inner angle of the basal lobe of the male terminalia of *dendrophilus* is not sufficiently indicated either by Edwards's drawing or by his figure. Such spines are characteristic of a number of species in this group (*dendrophilus, deboeri, bambusae, heischi, demeilloni, keniensis, angustus*) which cannot safely be separated either by the degree of development of the spines or the shape of the lobe, both of which are very variable. The larva of *Aëdes deboeri* is not constantly separable from that of *dendrophilus*. Kenya and Uganda specimens of the latter commonly have the sub-ventral seta of the siphon single (usually double in *deboeri*), but it is frequently double in the Gold Coast form. The best partial character appears to be the possession of more than one pecten tooth beyond the subventral seta. This is of freqent occurrence in *deboeri* but has never been observed in *dendrophilus*. In *bambusae* the subventral seta is commonly bifid but may be single, and there may be either 1 or 2 pecten teeth beyond it.

Aëdes africanus. Edwards (1941) gives a number of striking colour differences between this species and *luteocephalus*. Most of these differences are, however, very inconstant and this has led Haddow and Mahaffy (1949) and others to suggest that the two forms are interbreeding sub-species. With this opinion the present author is in strong disagreement. An examination of a large series of both species from many parts of their joint range shows that the extent of the pale basal marking on the hind femur affords an absolutely constant diagnostic character. Even in the most extreme forms the difference is striking, and in almost the whole of the material it is so gross as to be easily detectable with the naked eye (Fig. 2). Of the other characters proposed by Edwards the most reliable is perhaps the extent of the antero-median silver stripe on the mesonotum. Unfortunately, however, too many of the available specimens are rubbed in this position to be certain on the point. A fairly reliable character is the extent of the pale scaling at base of the 4th hind tarsal. This nearly always forms a complete ring in *africanus*, but in a few specimens from peripheral parts of the range the ring is interrupted ventrally. In *luteocephalus* the whole segment is commonly dark, but a small basal pale spot may be present on the dorsal surface, and in some specimens from the West Nile Province of Uganda this is fairly extensive and resembles the rather narrow pale interrupted band sometimes found in *africanus*. The remaining characters are of local value only, although their totality, in the great majority of cases, renders identification both certain and easy. The larval characters proposed by Hopkins (1936) are very largely unreliable and should be ignored except where experience has shown them to be locally applicable.

Aëdes pseudoafricanus. The small difference from *africanus* with respect to scutal markings noted by Chwatt (1949) appears to be constant in all available specimens. The whole of these, however, come from the Lagos area, and it is by no means certain that the character would prove constant should the species be discovered elsewhere. All male specimens attributed to *africanus* in the British Museum collection have been dissected and these have yielded only a few *pseudoafricanus* from Yaba. The resemblance of the male terminalia to those of *fraseri* is striking but it is not absolute. The

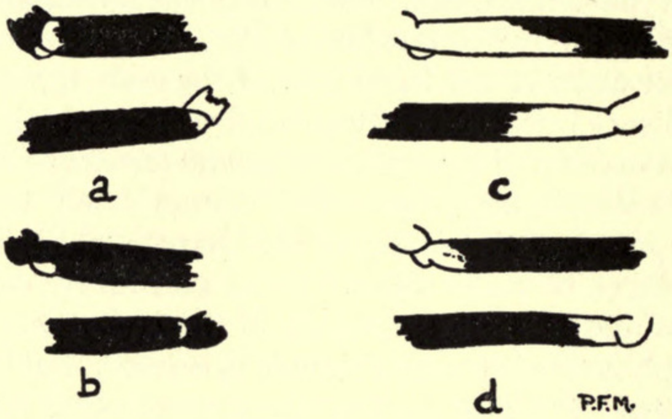

FIG. 2. Left hind-femur. *a–b. Aëdes africanus*; *c–d. Aëdes luteocephalus. a* from Ndola, *b* and *c* from Godia, *d* from Likoma Island. *d* is very exceptional.

posterior edge of the IXth tergite, for example, is quite different in shape in the two species. The combination of colour characters resembling those of one species with male terminalia resembling those of another is not unique among the Ethiopian *Stegomyia.* It is also shown strikingly by *amaltheus* (De Meillon & Lavoipierre, 1944). In view of the very curious results of cross-breeding experiments between certain species of *Stegomyia*, such cases must necessarily carry a suggestion of naturally occurring hybridization, and this is lent some colour in the case of *pseudoafricanus* by the distribution of the species concerned. In the experiments concerned Toumanoff (1937, &c.) showed that hybrid offspring of *Aëdes aegypti* and *Aëdes albopictus* exhibit all the morphological characters of the female parent in whichever direction the cross is made. This was confirmed for the *aegypti* ♀ × *albopictus* ♂ cross by Hoang Tich Try (1937) and for the reverse cross by Downs and Baker (1949). The genetical and cytological background is obscure, although some light is thrown on the problem by the discovery that in the mosquitoes, or at least in those species so far examined, there is no differentiation of sex chromosomes (Sutton, 1942; Callan & Montalenti, 1947; White, 1949). Gilchrist & Haldane (1947) consider that sex in these insects is determined by a single dominant gene for male. Downs & Baker (1949) have suggested that the phenomenon is one of parthenogenesis following mechanical fertilization of the ovum. This would not, however, explain the very interesting observation made by Bonnet (1950) that hybrid offspring of *aegypti* ♀ × *albopictus* ♂, although themselves identical with *aegypti*, produce offspring with *albopictus* characters when back-crossed to pure line *albopictus* ♂s. While these observations are of considerable interest in relation to the phylogeny of the sub-genus it is by no means certain that hybridization takes place in nature. Rozeboom and his fellow workers are of the opinion that it does not since females of *aegypti* and *albopictus* in cage colonies show an exclusive preference for males of their own species when given the choice, even though they may mate with males of the other species when no others are available (Mattingly *et al.*, in press). In the present author's opinion the most probable explanation of the occurrence of these intermediate forms is that they are genuinely anectant in the phylogenetic sense. The Lagos populations of *africanus* and *pseudoafricanus* are effectively sympatric at the present time, since, although the larval breeding-places are segregated, adults of both sexes of both species are taken together near the fringes of the mangrove swamps (Mattingly, 1949*b*). It does not, however, follow that this is a case of sympatric speciation. The area of low rainfall occurring between Lagos and Cape Three Points and serving to separate the Upper from the Lower Guinean forests is commonly supposed to result from a comparatively slight change in the direction of the coastline in relation to the direction of rain-bearing winds. If this is true, then small changes in the level either of the sea or of the land may well have served in the past to isolate extensive areas of mangrove 'forest' from the true forest with consequent speciation of mangrove and true forest *Stegomyia*, an interesting example of the possible effect of small changes of elevation on the climate, flora, and fauna.

Aëdes simpsoni. Haddow, Van Someren, *et al.* (in the press), note that this is a very variable species and express doubts as to the usefulness of applying the name 'var. *lilii*' to one among many varieties. It would seem, however, that the *simpsoni* of the Transvaal, Natal, and Cape Province may be largely isolated from those occurring in the rest of Africa (Fig. 12), and it is felt that if good representative collections could be assembled these would repay careful study. It is proposed to consider the matter from this angle in the course of the taxonomic work on the group. For a note on variation in this species see Edwards (1941).

Aëdes luteocephalus. This species has already been discussed under *africanus*. The type locality is wrongly quoted in the type description (see under 'Doubtful Records', p. 257).

Aëdes unilineatus. Difficulties experienced in identifying the larvae of this species (De Meillon & Lavoipierre, 1944; Lewis, 1945) were due in part to an error in the legend to Fig. 61 of the first volume of *Mosquitoes of the Ethiopian Region* (Hopkins, 1936). An examination of the original drawings for this figure and the specimens on which they were based shows that the comb and pecten spines attributed to *unilineatus* were in fact drawn from a specimen attributed by Ingram & De Meillon (1929) to *pseudonigeria* and reassigned by Edwards (1936) to *demeilloni*. The identity of this specimen is still uncertain, but it is certainly not *unilineatus*. The larva illustrated, in the same figure, as *demeilloni* is in fact *angustus*, and neither *demeilloni* nor *unilineatus* is figured. Typical comb spines of *unilineatus* have very small secondary denticles which are almost or quite invisible under low powers of the microscope. An occasional spine may have one or two large denticles, but such spines are clearly aberrant and should cause no difficulty. An extreme example is shown in Fig. 3

together with a normal comb spine. The pecten spines are very variable. The larva of *unilineatus* is very distinctive and should not be confused with any other occurring on the mainland. It can be recognized by the characters given in the key. The degree of development of the barred area of the ventral brush varies even in specimens from the same locality, but it is never as well developed as in the majority of species. Barraud (1934) notes that in Ethiopian *unilineatus* the saddle hair is usually 5-branched while in Indian larvae it is usually bifid. Such South African larvae as have been examined, however, show the bifid condition. Sudan and West Nile larvae have 4–5 branches, but Gold Coast larvae appear to produce either type of

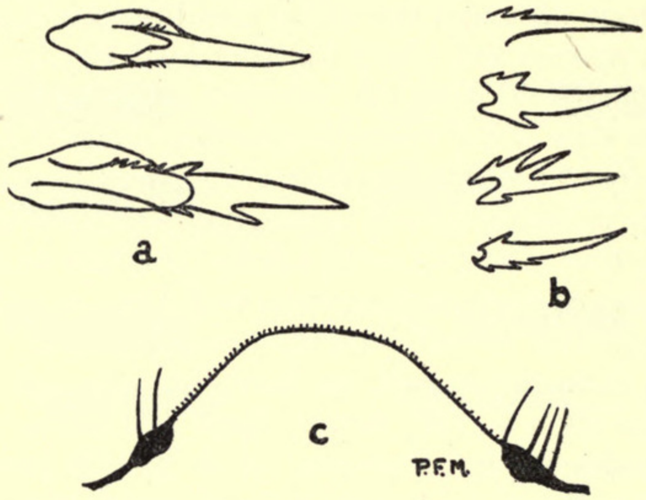

FIG. 3. *Aëdes unilineatus*. *a*. Comb spines. *b*. Pecten spines. *c*. IXth tergite of male. The lower comb spine is aberrant. This condition is only seen in an occasional spine.

saddle hair at random. The descriptions of the male terminalia given by Edwards (1941) and Barraud (1934) are misleading since both appear to have overlooked the presence of two small, very strongly sclerotized setiferous lobes on the outer edges of the IXth tergite (Fig. 3). These are not shown in the only dissection left by Edwards in the British Museum owing to the way in which this is mounted, but they show clearly in fresh mounts from the same locality (Accra) and from Gadau, Erkowit, and Lahore.

KEY TO ADULTS

1. Scutum with 3 pairs of small white spots; tibiae white ringed near middle; proboscis usually pale in middle . . . . . . **vittatus** Bigot[1]
   Scutum and tibiae otherwise; proboscis dark 2
2. Proboscis and tibiae with white lines . . . . . . *granti* Theobald
   Proboscis all dark; tibiae dark except, in some cases, at base . . . 3
3. Front half of scutum white scaled . . . . *mascarensis* MacGregor
   Scutum otherwise marked 4
4. Front half of scutum with a median white stripe only 5
   Scutum otherwise marked 6

[1] Species dealt with in the present paper are shown in heavy type.

5. Middle femur with a white spot in middle in front . **unilineatus** Theobald
Middle femur without such a spot . . . . . . *albopictus* Skuse
6. Middle femur with a white stripe in front reaching nearly to tip; clypeus of female scaly . . . . **aegypti** Linnaeus
Middle femur without such a stripe; clypeus bare 7
7. Third hind tarsal much more broadly pale than the others . . . 8
Third hind tarsal only narrowly pale 11
8. Hind femur with a well-marked pale patch at base broadly expanded below and behind (Fig. 2) . . . . **luteocephalus** Newstead
Hind femur at most with a small pale spot at base 9
9. Posterolateral lines of scutum broad, deep yellow, conspicuous, reaching forward almost or quite to the posterior ends of the anterolateral patches; thorax laterally compressed . . . . . . *ruwenzori* Haddow & E. C. C. Van Someren
These lines shorter, less conspicuous; thorax of normal width . . 10
10. Anterior median stripe of scutum very short; antero-lateral patches on scutum slightly crescentic, concave behind . . **africanus** Theobald
This stripe longer; scutal patches wedge-shaped, straight-edged behind . **pseudoafricanus** Chwatt
11. Fourth hind tarsal segment all black 12
Fourth hind tarsal segment pale at least at base 14
12. Lateral lobes of scutellum white scaled; anterior median spot on scutum composed of broad or narrow scales 13
Lateral lobes of scutellum dark scaled; this spot composed of narrow scales only . . . . *woodi* Edwards
13. Hind tibia all dark below . . . . **simpsoni** Theobald
Hind tibia extensively pale below at base . . . *strelitziae* Muspratt
14. Prescutellar area of scutum covered with broad metallic scales **metallicus** Edwards
This area with narrow, non-metallic scales 15
15. Posterior half of scutum with pale scales forming three or four narrow longitudinal lines 16
Posterior half of scutum with pale scales not aggregated into lines *chaussieri* Edwards
16. Median area of scutum with paired yellow longitudinal lines inside the usual posterolateral lines 17
This area with a single median line 18
17. Fourth hind tarsal segment white at base only . . *subargenteus* Edwards
This segment all white . . . *subargenteus* ssp. *kivuensis* Edwards
18. Each tibia with a narrow pale ring slightly removed from base *pseudonigeria* Theobald
White marks on tibiae confined to extreme base (except sometimes on the hind leg) 19
19. Hind tibia all dark (occasionally with a very small number of pale scales at base below in *keniensis*) 20

Hind tibia with a well-marked pale patch at base, at least on the under surface 22

20. Third hind tarsal pale all round on at least the basal $\frac{1}{7}$th *keniensis* E. C. C. Van Someren

Third hind tarsal all dark or, at most, with one or two pale scales at base below 21

21. Median longitudinal line of scutum white; prescutellar bare patch with a conspicuous border of pale scales . *amaltheus* De Meillon & Lavoipierre

Median longitudinal line yellow; pale scales round prescutellar bare patch reduced or absent . . . . *masseyi* Edwards

22. Pale basal patch on 6th abdominal tergite prolonged backwards nearly to the apex of the segment 23

This patch shallower, at most half the depth of the segment 26

23. First mid-tarsal pale behind nearly to the tip, pale in front on only about the basal $\frac{1}{5}$th . . . . *soleatus* Edwards

This segment pale above on at most the basal $\frac{2}{5}$ths, usually much less, more narrowly pale below, without any noticeable extension of pale scaling behind 24

24. Pale markings of femora snowy white . . . . . . **fraseri** Edwards

These markings metallic silver 25

25. Prescutellar bare patch with a broad border of yellow scales; 5th hind tarsal entirely dark . . . . *schwetzi* Edwards

Prescutellar bare patch with at most a very narrow border of pale scales; 5th hind tarsal at least narrowly pale at base above (except sometimes in ssp. *denderensis*) . . . . **apicoargenteus** Theobald

26. First mid-tarsal segment pale behind for most of its length 27

This segment more or less uniformly ringed at base, without any noticeable extension of pale scaling on the posterior surface 28

27. 5th hind tarsal entirely dark . . . . . . *calceatus* Edwards

5th hind tarsal pale at base . . *heischi* E. C. C. Van Someren (in part)

28. Hind femoral knee-spot suppressed, represented by at most two or three pale scales; mid-femoral knee-spot, where present, at most very small, not reaching to the tip of the femur 29

Hind femoral knee-spot well developed; mid-femoral knee-spot reaching to the tip of the femur above 30

29. Thorax laterally compressed; mid-femur nearly always with a white spot on the anterior surface at about half-way between base and apex *angustus* Edwards

Thorax of normal width; mid-femur without such a spot *bambusae* Edwards

30. Mid-femur with a conspicuous white spot on the anterior surface at about two-thirds the distance from the base; 5th hind tarsal dark . . 31

Either with the anterior surface of the mid-femur dark except for the knee-spot or with the 5th hind tarsal pale at base or both 33

31. Middle tibia pale below on at least the basal $\frac{1}{6}$th . . . . *poweri* Theobald

Middle tibia usually all dark, at most with a small pale spot at base . 32

32. Hind tibia pale below on at least the basal $\frac{3}{10}$ths, this pale stripe expanded distally; median longitudinal pale line of scutum expanded in front of prescutellar bare patch and fused with the pale border round this patch; posterolateral lines of scutum yellow; second mid-tarsal pale above on at least a half, usually more . . . *langata* E. C. C. Van Someren
Hind tibia pale on at most $\frac{1}{4}$, the pale stripe at most very slightly expanded distally; median pale line of scutum of uniform width throughout, not fused with the pale scales at the sides of the prescutellar bare patch; posterolateral lines usually white or whitish; second mid-tarsal pale above on at most $\frac{1}{2}$, usually less . . . . *contiguus* Edwards
33. Fifth hind tarsal largely dark, at most narrowly pale at base; anterior surface of mid-femur dark except for knee-spot . . *deboeri* Edwards
Fifth hind tarsal pale on at least the basal $\frac{1}{3}$rd, often more, or, if not, then anterior surface of mid-femur with a silvery spot at about $\frac{2}{3}$rds . . 34
34. Pale streak at base of hind tibia at most $\frac{1}{5}$th the tibial length, usually less; 2nd mid-tarsal broadly pale above on at most the basal half, apical half dark or at most with a very narrow dorsal line of pale scales . . 35
Either with the pale streak at the base of the hind tibia much more than $\frac{1}{5}$th the tibial length or with the 2nd mid-tarsal broadly pale above nearly to tip or both 36
35. Anterior surface of mid-femur usually with a spot of silvery scales *heischi* E. C. C. Van Someren (in part)
Anterior surface of mid-femur usually dark except at tip *demeilloni* Edwards
36. Anterolateral scutal patches pointed in front, varying in colour from bright yellow to creamy white; basal bands on abdominal tergites yellowish . . . . *bambusae* ssp. *kenyae* E. C. C. Van Someren
Anterolateral scutal patches rounded in front, snowy white; tergal bands white . . . . **dendrophilus** Edwards

Key to Fourth-stage Larvae

1. Ventral brush with at least the great majority of setae single . . 2
Ventral brush with at least the great majority of setae branched . . 5
2. Lateral seta of saddle and subventral seta of siphon single . . *angustus*
These setae each with at least 2 branches 3
3. Comb spines with a small number of well-developed lateral denticles, at least the submedian ones easily visible under low powers of the microscope; antennal seta with 2–4 branches . . . . *amaltheus* (in part)
Comb spines with the lateral denticles less strongly developed, invisible or visible only with difficulty under low powers of the microscope; antennal seta single 4
4. Barred area of ventral brush absent or poorly developed; saddle hair often with more than 2 branches . . . . *unilineatus*
Barred area of ventral brush well developed; saddle hair bifid . *albopictus*
5. Ventral brush with 2 or more isolated tufts arising proximal to the barred area 6

Ventral brush without unpaired tufts proximal to the barred area . . 7

6. Antenna lightly spiculate; setae of ventral brush with numerous branches; comb spines with lateral denticles only moderately developed . *vittatus*

Antenna smooth; setae of ventral brush single or bifid; comb spines with submedian teeth strongly developed, often appearing trifid *amaltheus* (in part)

7. Comb consisting of elongated scales fringed around the apex . *africanus*, *pseudoafricanus*, *luteocephalus*

Comb consisting of spines with the median denticle more strongly developed than the lateral denticles 8

8. Comb spines with a small number of rather coarse lateral denticles of which the submedian are usually visible under low powers 9

Comb spines with a fringe of more delicate denticles on either side of the main median denticle, these lateral denticles usually invisible under low powers and often almost invisible under high 19

9. Pecten spines very deeply cleft, typical spines with two or more large median denticles subequal in size; saddle hair and subventral seta of siphon single . . . . *subargenteus*

Pecten spines otherwise; saddle hair usually and subventral seta always with at least two branches 10

10. Pecten teeth with poorly developed secondary denticles invisible under low powers of the microscope 11

Pecten teeth with well-developed secondary denticles visible under low powers of the microscope 14

11. Lower caudal seta with 2 or more branches 12

Lower caudal seta single 13

12. Typical pecten teeth short and broad, not more than $4\times$ as long as their breadth at base . . . . *simpsoni*, *demeilloni*

Typical pecten teeth longer and narrower, at least $6\times$ as long as their breadth at base . . . . *strelitziae*

13. Spines at bases of pleural setae large and curved . . . . . *heischi*

These spines smaller . . . . *keniensis*

14. Distal edge of saddle with a group of coarse spicules near the base of the caudal setae, easily visible under low powers; antennal seta with 2–4 branches . . . . *amaltheus* (in part)

Distal edge of saddle smooth or at most with very minute spicules not or scarcely visible under low powers; antennal seta single 15

15. Saddle hair with at least 3 branches; pleural spines very large and conspicuous . . . . *metallicus*

Saddle hair with at most 2 branches; pleural spines smaller 16

16. Submedian denticles of comb spines strongly developed, giving the majority of these spines a trifid appearance under low powers . . 17

Submedian denticles not so strongly developed, only an occasional spine appearing trifid under low powers 18

17. Pecten with 8–12 spines . . . . *mascarensis*

Pecten with 14–20 spines . . . . *aegypti*

18. Upper caudal seta with about 6 branches; saddle hair with 3–4 . *granti*
    Upper caudal seta with 2–4 branches; saddle hair bifid . . . *contiguus*
19. Pecten spines arranged in discontinuous groups . . *bambusae kenyae*
    Pecten spines more or less equally spaced, at most with one or two terminal spines detached 20
20. Pecten spines with at least one secondary denticle near the base easily visible under low powers 21
    Pecten spines often almost simple, secondary denticles, when present, visible only under high power . . . *bambusae, dendrophilus, deboeri*
21. Siphon more or less uniformly dark 22
    Siphon dark only on about the basal $\frac{4}{5}$ths, apical $\frac{1}{5}$th pale . . . 23
22. Subventral seta of siphon with 3–4 branches; antennal seta situated at not more than $\frac{7}{10}$ths the distance from base to apex; saddle hair bifid or trifid . . . . *calceatus*
    Subventral seta of siphon bifid; antennal seta at more than $\frac{7}{10}$ths the distance from base; saddle hair single or bifid *apicoargenteus* ssp. *denderensis*
23. Median denticle of comb spines much reduced, lateral denticles well developed forming a fringe which is visible under low power . *fraseri*
    Median denticle strongly developed in relation to the fringe which is invisible under low power . . *apicoargenteus, schwetzi, langata, soleatus*

DISTRIBUTION RECORDS

The list which follows is believed to contain all published records except those which are merely repetitive and do not indicate that a species has been found more than once in a particular locality but merely that the same record has been published on more than one occasion. Doubtful records are marked with an asterisk and are discussed in a separate section. Records clearly based on misidentifications are omitted and are discussed in another section. Some of the records are based on unpublished specimens in various collections. For these collections the following abbreviations are employed. B.M. British Museum (Natural History); Berl. Berlin Museum; H.D. Hope Department, Oxford; H.I. Tropical Institute, Hamburg; L.S.H. London School of Hygiene and Tropical Medicine; Liv. Liverpool School of Tropical Medicine; M.L. Entomological Laboratory, Morogoro, Tanganyika. Records from the Washington Museum were kindly supplied by Dr. Stone. These are marked W.M. All references are listed in full in the bibliography. Addresses of correspondents who have sent records are given in the acknowledgements.

Aëdes apicoargenteus

SIERRA LEONE. Daru (Simpson, 1913; Evans, 1925), Batkanu, Koinadugu (Butler *et al.*, 1915), Mabang (Gordon, 1929), Moyamba, Pujehun (Davey, MS.). LIBERIA. Du River (Bequaert, 1930). GOLD COAST. Kumasi, Obuasi (Theobald, 1909), Lorha (Carter, 1916), Nsawam (Macfie & Ingram, 1923*a*), Accra (Macfie & Ingram, 1923*b*), Aburi, Sunyani (Edwards, 1941), Asuboi (Mattingly, 1947). TOGOLAND. Klein Popo (= Anecho, as *Aniella togoensis*, Enderlein, 1923). NIGERIA. Lagos (Wesché, 1910;

Dunn, 1927*b*; Philip, 1931), Yaba (Graham, 1911; Dunn, 1926; Mattingly, 1947), Bende (Simpson, 1912*b*), Kaduna*, Katagum*, Zungeru* (Johnson, 1919), Aba, Ibadan, Ikeja (Mattingly, 1947), Itowolo (Mattingly, 1949*b*), Agbor (L.S.H.). BR. CAMEROONS. Misselele (Zumpt, 1937). FR. CAMEROONS. Kribi or Wuri (as *Kingia maculoabdominalis*, Enderlein, 1923), Yaoundé (B.M.). BELGIAN CONGO. Unnamed locality (as *Kingia albertii*, Theobald, 1912), Kayembe Mukulu (Rodhain & Bequaret, 1913), Kabinda (Edwards, 1926), Leopoldville (Duren, 1929), Stanleyville (Schwetz, 1930*a*; Liégeois, 1944), Lomami River between Obenge-Benge and Isangi (Schwetz, 1930*b*), Eala, Kisantu, Ponthierville (Edwards, 1941), Mongbwalu (Schwetz, 1944), Aba, Aketi, Ango, Basoko, Bayenga, Bondo, Buta, Irumu, Kimvula, Libenge, Niangara, Titule, Yangambi (Liégeois, 1944), Coquilhatville (Wolfs, 1946), Maluku, Nta, Pongwema (Fain & Henrard, 1948), Kimbao (Edwards, MS.), Luluabourg (B.M.), Katompe (Liv.). RUANDA-URUNDI. Kisenyi* (Seydel, 1929*a*). UGANDA. Unnamed locality (Neave, 1912), Entebbe (Bequaert, 1930), Kilembe (Edwards & Gibbins, 1939), Chagwe, Kampala (Edwards, 1941), Bundibugiyo (Haddow, 1945*a*), Bubukwanga (Haddow, 1945*b*), Mongiro (Smithburn & Haddow, 1946), Mamirimiri (Haddow, 1947), Zika (Entebbe area, Haddow & Dick, 1948), Budonga and Siba Forest, Bugala I., Bugoma Forest, Bujuko Forest, Busi I., East and West Busoga Woodlands (Jinja and Busia areas), Buvuma I., Bwamba Lowlands and North Spur Ruwenzori to 5,000 ft., Fort Portal, Itwara Forest, Kalinzu Forest, Kasyoha and Kitomi Forests, Kiansonzi, Kibale-Hima Forest, Kitgum, Kome I., Kyenjojo, Masaka, Masindi Port, Mubende, Mukono, Sango Bay Forests (Kaiso, Malambigambo, Namalala and Toro) (Haddow, in litt.), Mpumu, Namanve Payida (B.M.). SUDAN. Khor Kobkwa (= Khor Kobwa, as *Kingia maculoabdominalis*, Theobald, 1913). KENYA. Kaimosi Forest, Kisii (Garnham *et al.*, 1946), Kakamega (E. C. C. Van Someren, 1946), Kabwoch, Sondu River (E. C. C. Van Someren, in litt.). TANGANYIKA. Bukoba (McHardy, 1932; Harris, 1942).

Aëdes fraseri

FRENCH GUINEA. Dubreka (B.M.). SIERRA LEONE. Freetown (as *fraseri*, Bacot, 1916; as *fraseri* and *blacklocki*, Evans, 1926), Daru (as *blacklocki*, Evans, 1925), Njala (Edwards, 1941), Mabang, Moyamba Town (Liv.). GOLD COAST. Takoradi (Edwards, 1941; Mattingly, 1947). NIGERIA. Unnamed locality in the south (Edwards, 1917), Oshogbo (L.S.H.). UGANDA. Unnamed locality (Neave, 1912), Mpumu (Edwards, 1912), Kampala (Hancock, 1930), Mamirimiri, Mongiro (Haddow, 1947), Bubukwanga (Smithburn *et al.*, 1949), Bukakata, Bwamba lowlands, and North Spur Ruwenzori to 5,000 ft., Bwigi I., Masindi Port (Haddow in litt.). KENYA. Kaimosi Forest, Kakamega (E. C. C. Van Someren, 1946), Sondu River (E. C. C. Van Someren in litt.).

Aëdes dendrophilus

SIERRA LEONE. Freetown (as *fraseri*, Edwards, 1917; as *dendrophilus*, Edwards, 1921*a*), Kissy (Liv.). GOLD COAST. Aburi, Nsawam, Oblogo (Edwards, 1921*a*), Dodowah (Macfie & Ingram, 1923*b*). NIGERIA. Lagos (Philip, 1931), Ibadan (Edwards, 1941). FERNANDO PO. Santa Isabel (as *trinidad*, Gil Collado, 1936).

UGANDA. Bwamba County (as *deboeri demeilloni*, E. C. C. Van Someren, 1946), Mongiro (as *deboeri demeilloni*, Smithburn & Haddow, 1946), Mamirimiri (as *deboeri demeilloni*, Haddow, 1947), Bubukwanga (Smithburn *et al.*, 1949), Bugoma Forest, Bujuko Forest, Busi I., Bwamba lowlands to 5,000 ft., Kitgum (*fide* Harper) (Haddow in litt.). KENYA. Kaimosi Forest (as *deboeri demeilloni*, E. C. C. Van Someren, 1946). ZULULAND. Eshowe (as *deboeri demeilloni*, Edwards, 1936). NATAL. Isipingo Beach, Margate (B.M.), Amanzimtoti (Muspratt in litt.). CAPE PROVINCE. Embotyi (Muspratt in litt.).

Aëdes africanus

FRENCH GUINEA. Kindia (Wilbert & Delorme, 1927). SIERRA LEONE. Freetown (Theobald, 1901; Evans, 1926; Davey, 1933), Koinadugu (Butler *et al.*, 1915), Daru (Evans, 1925), Mabang (Gordon, 1929), unnamed localities (Davey, 1939), Moyamba, Port Loko, Pujehun (Davey, MS.), Segbwema (Liv.), Bo (B.M.). LIBERIA. Kaka Town (Bequaert, 1930), Roberts Field, Kakata (Briscoe, 1947). GOLD COAST. Ashanti (Macfie & Ingram, 1916*b*), Tamale, Yape (Simpson, 1918), Broomassie* (Liv.). DAHOMEY. Bismarckburg (as *Aniella africana*, Enderlein, 1923). NIGERIA. Old Calabar (Theobald, 1901), Bonny, Duke Town (Theobald in Annett *et al.*, 1901), Lagos (Theobald, 1901; Wesché, 1910; Connal, 1916; Dalziel, 1920; Dunn, 1927*b*; Philip, 1931; Kerr, 1933), Oshogbo (Mayer, 1911), Yaba (Graham, 1911; Dalziel, 1920; Dunn, 1926; Philip, 1929; Mattingly, 1947), Bende, Forcados (Simpson, 1912*b*), Opobo (Connal, 1915), Afaka, Kaduna, Ubassa (Johnston, 1916), Brass, Ikom (Connal, 1917), Ikoyi (Dunn, 1926; Kerr, 1933), Ibadan (Kumm, 1931*a*; Kerr, 1933), Iwonran, Mushin (near Yaba, Kerr, 1933), Kateri (Edwards, 1941), Aba, Apapa, Ikeja (Mattingly, 1947), Itowolo (Mattingly, 1949*a*), Ogbomosho (Bugher *et al.*, in press), Sapele (L.S.H.). FR. CAMEROONS. Duala and unnamed localities (Grünberg, 1905), Yaoundé (B.M.). FR. EQUATORIAL AFRICA. Brazzaville (Sicé & Vaucel, 1928). BELGIAN CONGO. Ruwe (Theobald, 1907), Kabinda (Schwetz & Carter, 1915), Elisabethville, R. Vakila (Schwetz, 1927*a*), Stanleyville (Schwetz, 1927*b*; Liégeois, 1944), Tshela, Thysville (Schwetz, 1938), Coquilhatville, Lualaba River, Matadi (Edwards, 1941), Ilambi (Schwetz, 1942), Aba, Aketi, Bondo, Buta, Inongo, Irumu, Kimvula, Niangara, Titule, Yangambi, Yatolema (Liégeois, 1944), Balumi, Banningville, Black River, Dumi-Mato, Edudu, Pongwema, Tsunikitoko (Fain & Henrard, 1948), Costermansville, Lembwa River, Luluabourg (B.M.). RUANDA-URUNDI. Dendezi (B.M.). UGANDA. Kampala (as *Kingia africana*, Theobald, 1911*a*; as *Aëdes africanus*, Hancock, 1930), unnamed locality (= Chagwe, Mabira Forest, Neave, 1912), Bugomolo (Hancock, 1930), Kilembe (Edwards & Gibbins, 1939), Entebbe (Edwards, 1941; Haddow & Dick, 1948), Bundibugiyo (Haddow, 1945*a*), Bubukwanga (Haddow, 1945*b*), Mongiro (Smithburn & Haddow, 1946), Mamirimiri (Haddow, 1947), Kitinda, Zika (both near Entebbe, Smithburn *et al.*, 1948), Amagburugburu, Manjuguja North, Mbango (Smithburn *et al.*, 1949), Kyarumba (Haddow & Van Someren, 1950), Dwaji I. (Gillett in litt.), Budonga & Siba Forests, Bugala I., Bugoma Forest, Bujuko Forest, Bukasa I., Busi I., East and West Busoga Woodlands (Jinja and Busia areas), Buvuma I., Bwamba Lowlands, and North Spur Ruwenzori to 5,000 ft., Bwigi I., Fort Portal, Itwara Forest, Jana I., Kalinzu Forest, Kasyoha and Kitomi Forests, Kiansonzi, Kibale-Hima Forest, Kiryandongo, Kitgum, Kome I., Kyenjojo, Masaka, Masindi Port, Mityana, Mubende, Muhangi Forest, Mukono, Nyamugasani Valley, Sango Bay Forests (Kaiso, Malambigambo, Namalala and Toro) (Haddow in litt.), Godia, Kabarole, Kitasa, Midia, Payida (B.M.), Jinja, Mboga Stream (Jinja–Mumias Road) (Liv.). SUDAN. Li Rangu, Sopo (Lewis, 1945). ABYSSINIA. Sidamo Prov. (Bevan, 1937). KENYA. Chepalungu, Fort Ternan, Kaimosi Forest, Kisii (Garnham *et al.*, 1946), Kabwoch, Kakamega, Kibigori, Kisumu, Kitale, Koru, Lela, Maseno, Mugusi River, Muhuroni, Sondu River (E. C. C. Van Someren in litt.). TANGANYIKA. Bukoba (McHardy, 1932; Harris, 1942), Ukara I.* (B.M.). MOZAMBIQUE. Unnamed localities* (Howard, 1912). NYASALAND. Zomba* (Theobald, 1901). ANGOLA. Bihé (as *Stegomyia africana* and *Stegomyia dubia*), Katemar (= Katema's, Bihé area, as *S. dubia*) (Theobald, 1910), Kibokolo do Zombo (Gamble, 1912). N. RHODESIA. Ndola (Robinson, 1950).

Aëdes pseudoafricanus

NIGERIA. Yaba (as *africanus*, Graham, 1911), Lagos area (as *africanus*, Connal, 1915, &c.; Kerr, 1933; Edwards, 1941; as *pseudoafricanus*, Chwatt, 1949), Mushin (near Yaba, as *africanus*, Kerr, 1933), Itowolo (as *africanus*, Mattingly, 1949*a*), Ilado, Middle Point (both in Lagos area, Chwatt in litt.), Apapa, Gbohun–Gbohun, Ikoyi, Onigbongbo (Lagos area) (B.M.).

Aëdes simpsoni

GAMBIA. Bathurst (Edwards, 1941). SIERRA LEONE. Freetown (Kennan, 1915; Bacot, 1916; Evans, 1926), Daru (Blacklock, 1925), Kaballa (L.S.H.), Makeni, Port Loko, Pujehun (Davey, MS.). GOLD COAST. Dodowa (Simpson, 1914), Accra (Macfie, 1917), Takoradi (Pomeroy, 1932), Aburi (Edwards, 1941), Asuboi, Kumasi (Mattingly, 1947). NIGERIA. Afaka, Kudemsa (Johnston, 1916; Johnson, 1919), Yaba (Dunn, 1926; Philip, 1929; Mattingly, 1947), Ibadan (Philip, 1931; Kumm, 1931*a*; Kerr, 1933), Oshogbo, Shaki (Philip, 1931), Lagos (Kerr, 1933), Gadau (Taylor, 1934), Ikeja, Kaduna, Port Harcourt (Mattingly, 1947), Ogbomosho (Bugher *et al.*, in press). BR. CAMEROONS. Kumba (*fide* Macnamara), Babango (L.S.H.). FR. CAMEROONS. Yaoundé (B.M.). GABOON. Mayumba Forest (Galliard, 1931). BELGIAN CONGO. Kasongo, Tshumbiri, Wathen (Newstead *et al.*, 1907), Leopoldville (Newstead *et al.*, 1907; Duren, 1929), Matadi (Newstead *et al.*, 1907; Duren, 1938), Kivanda Kapepula (Rodhain & Bequaert, 1913), Kabinda (Schwetz & Carter, 1915), Stanleyville (Schwetz, 1927*b*; Liégeois, 1944), Katanga Prov. (Seydel, 1929*b*), Popokabaka (Schwetz, 1938), Karimi (as Karumi, Uganda, Edwards, 1941), shores of Lake Kivu (Schwetz, 1944), Costermansville (Schwetz, 1944; Wolfs in litt.), Aba, Aketi, Basoko, Bondo, Buta, Irumu, Kimvula, Niangara, Titule, Yangambi, Yatolema (Liégeois, 1944), Coquilhatville (Wolfs, 1946), Kingangati, Kwamouth (Fain & Henrard, 1948), Kimbao (Edwards in litt.). RUANDA-URUNDI. Usumbura (Edwards, 1941). UGANDA. Kampala (as *bromeliae*, Theobald, 1911*a*; as *simpsoni*, Hancock, 1930), unnamed locality (Neave, 1912), Kilembe (Edwards & Gibbins, 1939), Bundibugiyo (Haddow, 1945*a*), Bubukwanga (Haddow, 1945*b*), Bundinyama (Smithburn & Haddow, 1946), Soroti (Hopkins, MS.), Budongo and Siba Forests, Bugala I., Bugoma Forest, Bujuko Forest, Bukakara, Bukasi I., Busi I., East and West Busoga Woodlands (Jinja and Busia areas), Bwamba Lowlands and North Spur Ruwenzori to 5,000 ft., Entebbe, Fort Portal, Itwara Forest, Jubiya Forest, Kalinzu Forest, Kalungu, Kasyoha and Kitomi Forests, Kiansonzi, Kibale-Hima Forest (= Mpanga Forest auctt.), Kiryandongo, Kitgum, Kome I., Kyenjojo, Masaka, Masindi Port, Mityana, Mubende, Muhangi Forest, Mukono, Nyamugasani Valley to 5,000 ft., Sango Bay Forests (Kaiso, Malambigambo, Namalala, and Toro) (Haddow in litt.), Godia, Metu, Midia, Rumogi (B.M.). SUDAN. Bor (as *lilii*, Theobald, 1910), Khartoum* (Whitfield, 1939), Juba (Edwards, 1941), Kau (Findlay, Kirk, & MacCallum, 1941), Heiban, Kauda, Malakal, Meridi, Roseires, Sennar (Lewis, 1945), Torit (Knight in litt.). ABYSSINIA. L. Hardin (Edwards, 1941). ERITREA. Nefasit (Lewis, 1943*b*). KENYA Digo, Eldoret*, Kiambu*, Meru*, Nairobi* (Symes, 1935), Kisumu (Symes, 1935; Haddow, 1942), Kakamega, Kilifi (Symes, 1935; E. C. C. Van Someren in litt.). Mombasa (Symes & Roberts, 1937; Wiseman *et al.*, 1931; Teesdale, 1941), Fort Ternan, Kaimosi, Kisii (Garnham *et al.*, 1946), Gede (Bailey, 1947), Taveta (Heisch, 1948), Butere, Kerio Valley, Luanda, Makindu, Malindi, Msambweni, Tiwi, Yala (E. C. C. Van Someren, in litt.). TANGANYIKA. Unnamed locality (Neave, 1912), Dar-es-Salaam (Pomeroy, 1920; Edwards, 1923; McHardy, 1927; Harris, 1942), Lindi, Tanga (Haworth, 1924), Moshi (McHardy, 1932), Mtibwa Forest (Harris, 1942), Morogoro (Harris, 1942; Hocking, 1947), Amani (Berl.), Mwanza (M.L., E. C. C. Van Someren in litt.). PEMBA I. Unnamed locality (Edwards, 1941). ZANZIBAR. Various localities including Zanzibar Town (Aders, 1917*b*). MOZAMBIQUE. Mozambique, Nampula (De Meillon & Rebelo, 1941), Lourenço Marques, Umbeluzi (Rebelo & Pereira, 1943), Busi R., Guara Guara, Mambone, Nhemancone, Quelimane (W.M., *fide* Stone), Chindio (Liv.). NYASALAND. Unnamed locality (Neave, 1912), unnamed locality in uplands (Lamborn, 1930), Fort Johnston (Edwards, 1941), Fort Maguire, Likoma I. (L.S.H.). N. RHODESIA. Livingstone (Muspratt, 1945), Balovale (Robinson, 1948), Ndola (Robinson, 1950). ANGOLA. Bihé (Theobald, 1910), San Salvador (Gamble, 1914). S. RHODESIA. Shamva, Umtali (Leeson, 1931), Salisbury (Edwards, 1941), Bulawayo, Ndanga, Sinoia, Umtali, Victoria Falls (Meeser in litt.). TRANSVAAL. Unnamed locality (Theobald, 1905), Abundant in low veldt (Bostock & Simpson, 1905), Onderstepoort (Theobald, 1911*b*), Roberts Heights (Pratt-Johnson, 1921), Leysdorp Road, Nelspruit (Ingram & De Meillon, 1929). ZULULAND. Empangeni (Ingram & De Meillon, 1927), Mhlatuze, Ntabanana (Bedford, 1928). NATAL. Durban (Pratt-Johnson, 1921; Ingram & De Meillon, 1927; Bedford, 1928), Margate (Muspratt 1950), Amanzimtoti (Muspratt in litt.). BECHUANALAND. Kasane (De Meillon, 1947*a*). CAPE PROVINCE. Mkanduli (De Meillon & Lavoipierre, 1944).

Aëdes luteocephalus

GAMBIA. Bathurst (Edwards, 1941). FRENCH GUINEA. Dubreka (B.M.). SIERRA LEONE. Freetown (Bacot, 1916; Evans, 1926; Davey, 1933), unnamed localities (Davey, 1939), Bonthe, Makeni, Moyamba, Port Loko, Pujehun (Davey, MS.), Kissy (Liv.), Aberdeen (L.S.H.). LIBERIA. Roberts Field (Briscoe, 1947). GOLD COAST. Accra (Macfie & Ingram, 1916*a*), Ashanti (Macfie & Ingram, 1916*b*), Christiansborg (Accra area, Ingram & Macfie, 1917), Tamale, Yape (Simpson, 1918), Nsawam

(Macfie & Ingram, 1923*a*), Saltpond (Edwards, 1941), Aburi (B.M.). NIGERIA. Bende (Simpson, 1912*b*), Yaba (Simpson, 1912*b*; Dunn, 1926; Kerr, 1933; Mattingly, 1947), Lagos (Connal, 1915, &c.; Dalziel, 1920; Dunn, 1927*a*; Philip, 1931; Kerr, 1933), Adun (Connal, 1917), Ibi (Connal, 1924), Ikoyi (Lagos area, Dunn, 1926; Kerr, 1933), Oshogbo (Kumm, 1931*b*), Ibadan (Kumm, 1931*a*; Kerr, 1933; Mattingly, 1947), Iwonran, Kano, Mushin (near Yaba) (Kerr, 1933), Gadau (Taylor, 1934), Lokoja (Edwards, 1941), Ikeja (Mattingly, 1947), Ogbomosho (Bugher *et al.*, in press), Badagry (Liv.). BELGIAN CONGO. Kumba* (Newstead *et al.*, 1907), Jadotville (De Meillon, 1943), Kasongo (Liv.). UGANDA. Mpumu (as *Kingia luteocephala*, Theobald, 1910), unnamed locality (Neave, 1912), Mamirimiri (Haddow, Smithburn, *et al.*, 1948), Bwamba Lowlands and North Spur Ruwenzori to 5,000 ft. (Haddow in litt.), Godia, Laufori, Metu, Rumogi (B.M.). SUDAN. Bor (Theobald, 1910), Juba (Hewer, 1934; Edwards, 1941), Khartoum* (Whitfield, 1939), Heiban (Lewis, 1943*a*), Danaglia, Malakal, Sennar, Wad el Magdub (Lewis, 1945), Jebel Marra (Abbott, 1948), Singa (B.M.). ERITREA. Nefasit (Lewis, 1943*b*). KENYA. Fort Hall, Kerio Valley, Kisumu (E. C. C. Van Someren in litt.). N. RHODESIA. Balovale, Livingstone (Robinson, 1948), Ndola (B.M.). NYASALAND. Likoma I. (L.S.H.). S. RHODESIA. Victoria Falls (Meeser in litt.). BECHUANALAND. Kasane, Maun (De Meillon, 1947*a*).

Aëdes unilineatus

GOLD COAST. Accra (Macfie, 1916), Tamale* (Ingram, 1919), Aburi (Edwards, 1941). NIGERIA. Kaduna, Katagum, Zungeru (Johnson, 1919), Ibadan (Philip, 1931), Gadau (Taylor, 1934), Baro, Lokoja (Edwards, 1941), Ogbomosho (Bugher *et al.*, in press). UGANDA. Metu, Rumogi (B.M.). SUDAN. Bahr-el-Ghazal (Theobald, 1906), Jebelein (Theobald, 1910; Lewis, 1948), Erkowit, Juba (Edwards, 1941), Heiban (Lewis, 1943*a*), El Fasher, Jebel Moya, Sennar, Tembura, Wad el Magdub, Wad Medani (Lewis, 1945). KENYA. Unnamed locality (Neave, 1912), Dolo, Juba River (Edwards, 1941). NYASALAND. Port Herald (Edwards, 1941). N. RHODESIA. Livingstone (De Meillon & Lavoipierre, 1944). S. RHODESIA. Fort Victoria (De Meillon, 1943). TRANSVAAL. Letaba, Tzaneen (Ingram & De Meillon, 1929).

Aëdes metallicus

SENEGAL. Dakar (Kartman *et al.*, 1947). GOLD COAST. Accra (Macfie, 1916), Navarro (Ingram, 1919), Asuboi (Mattingly, 1947). NIGERIA. Kano (Kumm, 1931*a*), Gadau (Taylor, 1934), Maiduguri (Mattingly, 1947). BELGIAN CONGO. Jadotville (De Meillon, 1943). UGANDA. Mbarara (Edwards, 1941), Soroti (Haddow in litt.). SUDAN. Bor (as *dubia*, Theobald, 1910), Darfur Prov., Juba (Edwards, 1941), Nuba Mts., Wad el Magdub (Lewis *et al.*, 1942), Heiban (Lewis, 1943*a*), Abu Usher, Dagu, El Fasher, Kadugli, Kalora, Kassala, Khartoum, Kheiwok, Kudring, Malakal, Mug, Nahud, Raga, Roseires, Sennar, Shaloat, Sheikh Gamal, Sheikh Karim, Wad Banda, Wad Ganatir, Wad Medani (Lewis, 1945), Dueim, Kosti (Lewis, 1948), Yambio (Abbott in litt.), Umm Sunt (B.M.). KENYA. Mombasa (Wiseman *et al.*, 1939; Teesdale, 1941), Kisumu (Haddow, 1942), Fort Ternan (Garnham *et al.*, 1946), Isiolo (Heisch, 1947), Gede (Bailey, 1947), Garissa, Garsen, Gotani, Kakamega, Kerio Valley, Kibos, Kilifi, Kipini, Koru, Langata Forest, Makindu, Malindi, Maseno, Msambweni, Taveta, Witu (E. C. C. Van Someren in litt.). TANGANYIKA. Dar-es-Salaam (Edwards, 1923; Scott, 1926; McHardy, 1927), Tanga (Nixon, 1923; Haworth, 1924), Lindi (Haworth, 1924), Morogoro (Harris, 1942), 'Widely distributed from coast to Moshi and Mwanza' (Harris, 1942), Mwanza (M.L., E. C. C. Van Someren in litt.). ZANZIBAR. 'Various localities' (Aders, 1917*a*), Zanzibar Town (Aders, 1917*b*), Mnazi Moja (= European Club, Zanzibar Town, Edwards, 1941). MOZAMBIQUE. Nova Choupanga (Séguy, 1931). N. RHODESIA. Livingstone (De Meillon & Lavoipierre, 1944). ANGOLA. Bihé (as *Quasistegomyia dubia*, Theobald, 1910). S. RHODESIA. Bindura, Gatooma, Shamva (Leeson, 1931), Fort Victoria, Odzi, Salisbury (Meeser in litt.). TRANSVAAL. Komatipoort, Letaba (Ingram & De Meillon, 1929). ZULULAND. Mhlatuze, Ntabanana (Bedford, 1928). BECHUANALAND. Francistown, Kasane, Maun, Nata (De Meillon, 1947*a*). S. W. AFRICA. Fransfontein, Grootfontein, Karabib, Okahandja, Okimbahe, Omatjette, Otjimbingwe, Outjo, Usakos (Muspratt in litt.).

Aëdes vittatus

GAMBIA. Bathurst (Theobald, 1903). SIERRA LEONE. Freetown (Theobald, 1901; Butler *et al.*, 1915; Bacot, 1916; Evans, 1926; Davey, 1939), Batkanu, Benikoro, Firiwa, Kaballa, Serakolia, Sonkonia, Tirikoro, Waliki (Simpson, 1913), Koinadugu (Butler *et al.*, 1915), Daru (Edwards, 1941), Kamabai, Yiraia (B.M.), Boala Karafaia, Kamasiki (L.S.H.), Bo, Kailahun, Makeni, Moyamba, Port Loko (Davey, MS.), Dunkiawallia, Pujehun (Liv.). LIBERIA. Monrovia (Kumm, 1931*a*), Firestone Plantation (Du Group) (Barber *et al.*, 1932), Roberts Field (Briscoe, 1947). IVORY COAST. Bobo-Dioulasso (B.M.). GOLD COAST. Bole (Ingram, 1912), Cape Coast, Tamale (Simpson, 1914), Wa (Carter, 1916), Batiasan, Dogankade, Gambaga, Jefisi, Kulmasa, Lilixia, Mayoro, Nacon, Nandaw, Nandawli, Nangudi, Pinna, Sambolugu, Savelugu, Tanina, Tishi, Tumu, Ulu, Winduri, Yeji, Zouragu (Ingram, 1919), Sunyani (Edwards, 1941), Accra, Kintampo (Liv.). NIGERIA. Oshogbo (Mayer, 1911; Mattingly, 1947), Baro (Simpson, 1912*a*), Zungeru (Simpson, 1912*a*; Johnson, 1919), Lokoja (Connal, 1915), Kakuri (Johnston, 1916), Katagum (Johnson, 1919), Kaduna (Johnson, 1919, 1920), Gadau (Taylor, 1930), Abeokuta, Funtua, Ibi, Kano, Katsina, Shaki, Yola (Kumm, 1931*a*), Ibadan (Kumm, 1931*a*; Mattingly, 1947), Ikoyi (Kerr, 1933), Ogbomosho (Bugher *et al.*, in press). FR. CAMEROONS. Yaoundé (B.M.). BELGIAN CONGO. Kisui (as *sugens*, Newstead *et al.*, 1907), Leopoldville, Matadi (Newstead *et al.*, 1907; Duren, 1929), Elisabethville (Schwetz, 1927*a*), Stanleyville (Schwetz, 1927*b*, 1930*a*; Liégeois, 1944), Boma (Duren, 1929), Kinshasa (Bequaert, 1930), Lukula (Schwetz, 1938), Kaparata (Schwetz, 1944), Aba, Bondo, Buta, Libenge, Niangara, Titule (Liégeois, 1944), Coquilhatville* (as *sugens*, Wolfs, 1946). UGANDA. Entebbe (Theobald, 1907), unnamed locality (Neave, 1912), Sipi (Hancock & Soundy, 1929; Hargreaves, 1932), Kyere, Mukongoro (Hancock, 1930), Busi I., Fort Portal, Kitgum, Masindi Port, Soroti (Haddow in litt.), Ntotoro Valley (Lumsden in litt.), Buvuma I. (Gillett in litt.), Chagwe, Jinja, Metu, Rumogi (B.M.). SUDAN. Erkowit (Theobald 1910), Darfur Prov., Juba, Mongalla Prov. (Hewer, 1934), Nuba Mts. (Hewer, 1934; Lewis, 1943*a*), Malakal (Hewer, 1934; Lewis, 1945), Khartoum* (Bedford, 1938), Dar Shol, Delami, Kajo Kaji, Talodi (Edwards, 1941), Jebel Meidob (Edwards, 1941; Lewis, 1945), Jebelein (Edwards, 1941; Lewis, 1948), Wau (Edwards, 1941; Abbott in litt.), Damazin Cataract, Doka, El Obeid, Gedaref, Geneina, Jebel Gurein, Jebel Mandera, Kassala, Kosti*, Roseires, Sennar, Umm Ruaba (Lewis, 1945), El Fasher, Jebel Marra (Abbott, 1948), Rumbek, Yambio (Abbott in litt.), Loka (Liv.). ARABIA. Aden, Nobat (= Nobat Dakim), Sheikh Othaman, Ulub (Patton, 1905), Wadiyain (as Wadi Yain, Edwards, 1941), Jebel Jihaf (B.M.). SOKOTRA I. Hadibo, Kallansiya, Kathub (Leeson & Theodor, 1948). ABYSSINIA. Harrar (as *brumpti*, Neveu Lemaire, 1905), L. Metahara area* (as *Stegomyia* sp., Doreau, 1909), Meta Gafersa (La Face, 1939). ERITREA. Arisateb Valley, Tessenei, Ugaro (Lewis, 1943*b*), Ras Malalu, east slopes of central massif, western plains (Jannone *et al.*, 1946), Mt. Ramlu at 3,000–4,000 ft. (B.M.). BRITISH SOMALILAND. Buran (Edwards, 1941), Gedeis, Upper Sheikh (G. R. C. Van Someren, 1943), Las Anod (B.M.). KENYA. Shimoni (as *sugens*, Edwards, 1914), Digo, Kisumu, Meru (Symes, 1935), Mombasa (Symes, 1935; Wiseman *et al.*, 1939), Nairobi (Symes, 1935; H. I., *fide* Weyer, E. C. C. Van Someren in litt.), Fort Hall, Kakamega, Kilifi (Symes, 1935; E. C. C. Van Someren in litt.), Central Kavirondo (Symes & Roberts, 1938), 'Third Camp' (Edwards, 1941), Kaimosi Forest (Garnham *et al.*, 1946), Isiolo (Heisch, 1947), Kisumu (Grainger, 1947), Eldoret, Gotani, Kericho, Kiambu, Kisii, Kitale, Kitui, Langata, Makindu, Malindi, Mara R., Maragua, Maseno, Narok, Taveta, Thika, Turbo, Wesu (E. C. C. Van Someren in litt.), Malakisi (*fide* Leeson). TANGANYIKA. Lindi (Haworth, 1924), Morogoro (Scott, 1926; Harris, 1942), Mwanza (McHardy, 1932; Harris, 1942), 'Widely distributed from coast to Bukoba' (Harris, 1942), 'All along shores of Mwanza Gulf and on Ukara Island' (Smith in litt.), Dar-es-Salaam (B.M.). PEMBA I. Unnamed locality (Edwards, 1941). ZANZIBAR. Zanzibar Town (Aders, 1917*a*). MOZAMBIQUE. Unnamed localities (Howard, 1912), Mocuba, Quelimane (De Meillon & Rebelo, 1941), Namaacha (Rebelo & Pereira, 1943), Ressano Garcia (W. M., *fide* Stone). NYASALAND. Uplands (Lamborn, 1930), Fort Johnston (B.M.), 'Abundant above 3,000 ft.' (Lamborn, MS.). N. RHODESIA. Livingstone (Robinson, 1948). ANGOLA. Bihé (Theobald, 1910). S. RHODESIA. Mashonaland (Theobald, 1901), Gatooma, Salisbury, Shamva (Leeson, 1931), Bindura, Chibi, Mt. Darwin, Fort Victoria, Goromonzi, Gwelo, Maranka Reserve, Matopo Hills, Msoneddi, Ndanga, Triangle Estate, Umtali, Victoria Falls, Zaka (Meeser in litt.), Epworth (L.S.H.). TRANSVAAL. Onderstepoort (Theobald, 1911*b*; Bedford, 1928), Brits (Ingram & De Meillon, 1927), Yokeskei River (De Meillon, 1928), Komatipoort, Letaba, Louis Trichardt, Nelspruit, Skukuza, Tomango, Waterpoort, Waterval Boven (Ingram & De Meillon, 1929), Pietersburg (Liv.). ZULULAND, Begamuzi Drift (Ingram & De Meillon, 1927), Ntabanana (Bedford, 1928). NATAL. Weenen (Bedford, 1928), Margate (Muspratt in litt.). BECHUANALAND. Kasane (De Meillon, 1947*a*). S.W. AFRICA. Karabib, Okimbahe, Otjimbingwe, Outjo (Muspratt in litt.).

Aëdes aegypti

Apparently more or less throughout the region except at high altitudes and, perhaps, in the extreme south and south-west. The following records will be found to fill most of the gaps in the table given by Edwards (1941). CAPE PROVINCE. Grahamstown, Port St. Johns (Edwards, 1941), Kimberley (De Meillon, 1942), Upington (De Meillon, 1943). S.W. AFRICA. Tsumeb, Windhoek (De Meillon, 1943), Fransfontein, Karabib, Okimbahe (Muspratt in litt.). BECHUANALAND. Kasane, Nata (De Meillon, 1947*a*). N. RHODESIA. Balovale, Livingstone (Robinson, 1948), Ndola (Robinson, 1950). TANGANYIKA. 'Throughout' (Harris, 1942). SUDAN. Widespread in Darfur Province (Abbott, 1948).

DOUBTFUL RECORDS

Aëdes apicoargenteus

NIGERIA. Kaduna, Katagum, Zungeru. Johnson does not state from which of these localities his specimens came. Katagum seems much too dry. RUANDA-URUNDI. Kisenyi. No specimens are at present available for examination. In the distribution maps (Figs. 4 and 8) the record is ascribed to ssp. *denderensis*.

Aëdes africanus

GOLD COAST. Broomassie. The specimen in question is not marked with the locality but was contained in a box with other specimens similarly labelled and known to have come from Broomassie. There is nothing intrinsically unlikely about the record. TANGANYIKA. Ukara Island. This record is based on a single larva and requires confirmation. MOZAMBIQUE and NYASALAND. No specimens can now be found by means of which these interesting records could be confirmed or disproved. They are discussed below under zoogeography.

Aëdes simpsoni

SUDAN. Khartoum. This record is based on a single specimen found in an aeroplane and may be presumed to be the result of casual introduction. KENYA. Records given by Symes (1935) from localities above about 5,000 feet have not been confirmed and are thought to have been due to misidentification, although, in the absence of specimens, this cannot be proved.

Aëdes luteocephalus

BELGIAN CONGO. Kumba. In his type description Newstead states that a single specimen was taken at Kumba. This is clearly an error since the Liverpool School collection contains two cotypes both marked by Newstead on the actual mounts as taken at Kasongo. In his type description of *Aëdes* (*Dunnius*) *albomarginatus*, in the same paper, Newstead states that two specimens were taken at Kasongo, but the Liverpool collection contains only a single holotype marked as taken at Kumba. It is quite evident that Newstead confused the data relating to the two species in his published descriptions and that the type locality of *luteocephalus* is Kasongo. The point is of some importance since a record from Kumba would be entirely at variance with what is known of the distribution of this species, while Kasongo is perfectly acceptable. Edwards (1941) sought to equate Kumba with Tumba, but this appears to have been quite gratuitous. Kumba is, in fact, a small village whose position is clearly shown on Newstead's map (see also under misquoted localities *infra*). The reference by Theobald (1910) to a 'type ♂' of *luteocephalus* in the British Museum concerns a specimen of King's from the Sudan apparently chosen by Theobald as a lectallotype. SUDAN. Khartoum. This record is based on a single specimen found in a plane and may be taken to represent a casual introduction.

Aëdes unilineatus

GOLD COAST. Tamale. This record was based on larvae only and is queried by Ingram. He was, however, familiar with the larva of *unilineatus* which he helped to describe (Ingram and Macfie, 1917) and the record seems perfectly acceptable.

Aëdes vittatus

BELGIAN CONGO. Coquilhatville. Wolfs quotes this record from a report of the hygiene service at Coquilhatville for 1941. It is not supported by specimens and *vittatus* has not been found again in Coquilhatville. SUDAN. Khartoum and Kosti. Lewis (1945) considers that these were chance introductions. ABYSSINIA. Lake Metahara area. The species in question is stated to have been found breeding in large numbers in rock-holes and it appears very probable that it was *vittatus* although its identity cannot now be established.

RECORDS BASED ON MISIDENTIFICATIONS

The following records have been rejected.

Aëdes fraseri

SIERRA LEONE. Freetown (Edwards, 1917). = *dendrophilus* (see Edwards, 1921*a*). S. RHODESIA. Unnamed localities (Garnham *et al.*, 1946). = *langata.*

Aëdes africanus

N. RHODESIA. Unnamed locality (Edwards, 1912). = *chaussieri* from Lake Young area. S. RHODESIA. Mashonaland (Theobald, 1901). = *contiguus.*

UNIDENTIFIED AND DOUBTFUL LOCALITIES

SIERRA LEONE. Dunkiawallia, Kamasiki, Waliki. Records of *Aëdes vittatus* from these localities are not thought to be of sufficient interest to merit an intensive search. It is evident that this species is widely distributed throughout the territory. Kumm (1931*b*) takes Waliki to be the name of a place, but from Simpson's account it seems equally possible that it is the name of a river.

FR. CAMEROONS. Wuri (*A. apicoargenteus*). This is presumed to refer to some locality on the Wuri River, probably at or near Duala.

BELGIAN CONGO. Kimba (*A. luteocephalus*, Theobald, 1910*a*) and Tumba (*A. luteocephalus*, Schwetz, 1927*b*). These are clearly inaccurate renderings of the type locality, Kumba, as given by Newstead *et al.* (1907) (for a further discussion see above under doubtful records). Lualaba River (*A. africanus*, Edwards, 1941). In its present form this record is too vague to be of any value. No specimens are at present available.

KENYA. 'Third Camp' (*A. vittatus*). The significance of this record could only be ascertained by reference to relevant correspondence or records. These are not available to the author. The specimen was collected by Dr. Chell in about 1913.

? NYASALAND. Zoruta (*A. africanus*, Theobald, 1910). This is presumed to be a misspelling of Zomba from which Theobald (1901) has a previous record.

ARABIA. Wadi Yain (*A. vittatus*, Edwards, 1941). The correct rendering should be Wadiyain. Mr. Philby, who collected the specimens, kindly supplied this information together with the approximate map reference given below.

DISTRIBUTION OUTSIDE THE ETHIOPIAN REGION

Aëdes unilineatus. Punjab, Delhi Prov., Bombay area (Barraud, 1934).

Aëdes vittatus. Corsica (Bigot, 1861, not since found there); Spain (Gil Collado, 1935; Clavero, 1946); India, Ceylon (Barraud, 1934); Cochin China, Annam (Borel, 1930); Algeria (Senevet, 1936).

Aëdes aegypti. Throughout tropics and sub-tropics (Barraud, 1928; Kumm, 1931*b*; Farner *et al.*, 1946; Brug & Bonne-Wepster, 1947).

LIST OF LOCALITIES WITH TOPOGRAPHICAL DETAILS

The list is as accurate as it has been possible to make it from readily available sources. It could undoubtedly be improved, especially by persons with local knowledge. Figures enclosed in brackets have been read from maps or, in the case of rainfall figures, refer to an adjacent station. In the case of regions or provinces an average figure is given and such figures are also enclosed in brackets. Where more than one rainfall station is available for a particular locality an average figure is given. Published figures and figures sent in litt. are unenclosed. Altitudes are given in feet, where possible to the nearest 100 ft., otherwise to the nearest 500 ft. Rainfall is given as the mean annual total to the nearest 5 inches and all references in the text should be read in this sense. For many of the data included in the table the author is indebted to correspondents. Aside from this the main sources have been Gossweiler & Mendonça (1939), Grandidier (1934), Hurst & Black (1943), Nash (1948), Vandenplas (1943), *The Times Gazetteer*, the Atlas Général du Congo Belge, the Atlas do Portugal Ultramarino, the Gold Coast Atlas, the Atlas of the Tanganyika Territory, the East and South African Handbooks, the Boletim Mensal das Observaçoes Meteorologicas (Lourenço Marques), the annual rainfall summaries of the British East African Meteorological Department, the climatological summaries of the Rhodesia and Nyasaland Meteorological Service, the summary of rainfall normals issued by the South African Department of Irrigation, and the handbooks and reports of various government departments. Finally, where no published figures were available, reference was made to the excellent large-scale maps of nearly every part of Africa prepared during the last war for use by the forces and now available to the public. Among these the Rainfall Map of Eastern Africa prepared by the East African Survey Group (E. A. F. No. 1518 of 1943) deserves special mention.

LIST OF LOCALITIES

Locality	*Altitude*	*Latitude*	*Longitude*	*Rainfall*
Aba, Belgian Congo	(3,500)	3.50 N.	30.13 E.	(55)
Aba, Nigeria	< 500	5.07 N.	7.21 E.	85
Abeokuta, Nigeria	< 500	7.09 N.	3.21 E.	40
Aberdeen, Sierra Leone	< 500	8.30 N.	13.18 W.	< 100

LIST OF LOCALITIES—(*cont.*)

Locality	*Altitude*	*Latitude*	*Longitude*	*Rainfall*
Aburi, Gold Coast	1,400	5.51 N.	0.10 W.	40
Abu Usher, Sudan	(1,200)	(14.54 N.)	(33.14 E.)	(10)
Accra, Gold Coast	< 500	5.33 N.	0.13 W.	25
Aden, Aden Prot.	< 500	12.45 N.	45.04 E.	(5)
Adun, Nigeria	< 500	5.59 N.	8.09 E.	(80)
Afaka, Nigeria	(2,000)	(10.41 N.)	(7.23 E.)	(50)
Agbor, Nigeria	< 500	6.15 N.	6.14 E.	(80)
Aketi, Belgian Congo	(1,500)	2.42 N.	23.52 E.	(65)
Amagburugburu, Uganda	(3,000)	(0.45 N.)	(30.03 E.)	(55)
Amani, Tanganyika	3,000	5.05 S.	38.40 E.	75
Amanzimtoti, Natal	< 500	30.03 S.	30.53 E.	(40)
Anecho, Togoland	< 500	6.15 N.	1.39 E.	(30)
Ango, Belgian Congo	(2,500)	4.03 N.	25.53 E.	(75)
Apapa, Nigeria	< 500	(6.20 N.)	(3.19 E.)	(70)
Arisateb Valley, Eritrea	(2,000)	(15.13 N.)	(36.45 E.)	(15)
Asuboi, Gold Coast	< 500	(5.46 N.)	(0.22 W.)	(50)
Babango, Br. Cameroons	(5,000)	(6.20 N.)	(10.30 E.)	(70)
Badagry, Nigeria	< 500	6.23 N.	2.58 E.	(60)
Bahr el Ghazal, Sudan	(1,200)	(9.30 N.)	(30.00 E.)	(30)
Balovale, N. Rhodesia	3,400	(13.34 S.)	(23.07 E.)	40
Balumi, Belgian Congo	(2,000)	4.10 S.	15.50 E.	(55)
Lake Bangweulu, N. Rhodesia	3,800	11.20 S.	30.00 E.	(50)
Banningville, Belgian Congo	1,100	3.19 S.	17.21 E.	50
Baro, Nigeria	< 500	8.35 N.	6.18 E.	(55)
Basoko, Belgian Congo	(1,500)	1.11 N.	23.40 E.	(75)
Bathurst, Gambia	< 500	13.28 N.	16.40 W.	45
Batiasan, Gold Coast	(1,000)	(10.43 N.)	(1.44 W.)	(40)
Batkanu, Sierra Leone	(500)	(9.05 N.)	(12.27 W.)	110
Bayenga, Belgian Congo	(1,500)	2.19 N.	21.46 E.	(70)
Begamuzi Drift, Zululand	(3,000)	(28.10 S.)	(31.20 E.)	(25)
Bende, Nigeria	< 500	5.32 N.	7.36 E.	(90)
Benikoro, Sierra Leone	(1,500)	(9.43 N.)	(11.27 W.)	(80)
Bihé, Angola	(5,500)	12.18 S.	17.00 E.	(70)
Bindura, S. Rhodesia	3,700	(17.21 S.)	(31.21 E.)	(35)
Bismarckburg, Dahomey	2,300	8.12 N.	0.51 E.	55
Mt. Bizen, Eritrea	(5–8,000)	(15.18 N.)	(39.05 E.)	(15)
Black River, Belgian Congo	(1,500)	3.53 S.	15.55 E.	(55)
Bo, Sierra Leone	< 500	7.55 N.	11.44 W.	120
Boala Karafaia, Sierra Leone	(1,500)	(9.39 N.)	(11.04 W.)	(80)
Bobo-Dioulasso, Ivory Coast	1,400	11.12 N.	4.17 W.	40
Bole, Gold Coast	1,000	9.02 N.	2.29 W.	(40)
Boma, Belgian Congo	< 500	5.50 S.	13.09 E.	(35)
Bondo, Belgian Congo	(1,500)	3.55 N.	23.55 E.	(65)
Bonny, Nigeria	< 500	4.25 N.	7.13 E.	> 100
Bonthe, Sierra Leone	< 500	(7.33 N.)	(12.37 W.)	150
Bor, Sudan	1,700	6.12 N.	31.33 E.	35
Brass, Nigeria	< 500	4.19 N.	6.15 E.	> 100
Brazzaville, Fr. Eq. Africa	(1,000)	4.15 S.	15.20 E.	60
Brits, Transvaal	3,600	25.38 S.	27.47 E.	25
Broomassie, Gold Coast	(500)	8.21 N.	0.58 W.	(45)
Bubukwanga, Uganda	(3,000)	(0.45 N.)	(30.03 E.)	(55)
Budongo Forest, Uganda	(3,500)	(1.45 N.)	(31.34 E.)	(60)
Bugala I., Uganda	(3,800)	(0.24 S.)	(32.16 E.)	(80)
Bugoma Forest, Uganda	(4,000)	(1.20 N.)	(31.00 E.)	(55)
Bugomolo, Uganda	(3,500)	1.31 N.	31.27 E	(55)
Bujuko Forest, Uganda	(4,000)	0.25 N.	32.15 E	(45)

LIST OF LOCALITIES—(*cont.*)

Locality	*Altitude*	*Latitude*	*Longitude*	*Rainfall*
Bukakata, Uganda	(4,000)	0.15 S.	32.02 E.	55
Bukasa I., Uganda	(3,800)	(0.26 S.)	(32.30 E.)	(75)
Bukoba, Tanganyika	3,800	1.20 S.	31.48 E.	80
Bulawayo, S. Rhodesia	4,400	20.09 S.	28.37 E.	25
Bundibugiyo, Uganda	3,600	0.42 N.	30.04 E.	55
Bundinyama, Uganda	(3,000)	(0.47 N.)	(30.05 E.)	(55)
Buran, Br. Somaliland	3,000	10.13 N.	48.47 E.	10
Busia, Uganda	(4,000)	(0.28 N.)	(34.05 E.)	(60)
Busi I., Uganda	(3,800)	(0.03 N.)	(32.20 E.)	(60)
Busi R., Mozambique	< 500	(19.55 S.)	(34.20 E.)	(40)
Buta, Belgian Congo	(1,200)	2.48 N.	24.46 E.	60
Butere, Kenya	(4,500)	0.13 N.	34.30 E.	(70)
Buvuma I., Uganda	(3,800)	0.11 N.	33.18 E.	65
Bwigi I., Uganda	(3,800)	(0.28 S.)	(32.24 E.)	(75)
Calabar, Nigeria	< 500	4.57 N.	8.20 E.	125
Cape Coast, Gold Coast	< 500	5.06 N.	1.16 W.	25
Chagwe, Uganda	(4,000)	(0.25 N.)	(33.00 E.)	(55)
Chepalungu, Kenya	5,500	(1.00 S.)	(35.15 E.)	(35)
Chibi, S. Rhodesia	(4,000)	20.19 S.	30.25 E.	(30)
Chindio, Mozambique	< 500	17.39 S.	35.14 E.	(35)
Christiansborg, Gold Coast. *See* Accra.				
Coquilhatville, Belgian Congo . . .	1,200	0.04 N.	18.20 E.	(70)
Costermansville, Belgian Congo . .	5,300	2.30 S.	28.51 E.	(55)
Dagu, Sudan	(2,000)	(13.39 N.)	(30.08 E.)	(15)
Dakar, Senegal	< 500	14.40 N.	17.26 W.	20
Damazin Cataract, Sudan . . .	(1,000)	(11.44 N.)	(34.25 E.)	(30)
Danagla, Sudan	(1,300)	(14.25 N.)	(33.31 E.)	(15)
Dar-es-Salaam, Tanganyika . . .	< 500	6.50 S.	39.17 E.	45
Darfur Prov., Sudan	(2,500)	(13.00 N.)	(25.00 E.)	(15)
Dar Shol, Sudan	(2,500)	11.54 N.	30.28 E.	(30)
Daru, Sierra Leone	500	(7.59 N.)	(10.50 W.)	90
Mt. Darwin, S. Rhodesia	4,900	16.45 S.	31.38 E.	(35)
Delami, Sudan	(2,300)	(11.52 N.)	(30.20 E.)	(30)
Dendezi, Ruanda-Urundi . . .	(6,000)	(2.28 S.)	(29.03 E.)	(55)
Digio, Kenya	< 500	1.22 S.	40.56 E.	(35)
Diredawa, Abyssinia	(4,000)	9.40 N.	41.59 E.	(30)
Dodowa, Gold Coast	(500)	5.53 N.	0.05 W.	(40)
Dogankade, Gold Coast	(500)	(8.42 N.)	(0.29 W.)	(45)
Doka, Sudan	(1,500)	13.30 N.	34.45 E.	(25)
Dolo, Kenya	(1,000)	(4.08 N.)	(41.48 E.)	(10)
Du River, Liberia	(0–1,500)	(6.15 N.)	(10.25 W.)	> 100
Duala, Fr. Cameroons	< 500	4.03 N.	9.41 E.	160
Dubreka, Ivory Coast	< 500	9.48 N.	13.32 W.	(170)
Dueim, Sudan	1,500	13.59 N.	32.20 E.	10
Duke Town, Nigeria	< 500	(4.55 N.)	(8.19 E.)	> 100
Dumi-Mato, Belgian Congo . . .	(2,000)	4.30 S.	15.45 E.	(50)
Dunkiawallia, Sierra Leone. Not identified.				
Durban, Natal	< 500	29.52 S.	31.03 E.	45
Dwaji I., Uganda	(3,800)	(0.00)	(32.56 E.)	(80)
Eala, Belgian Congo	1,000	0.01 N.	18.30 E.	70
Edudu, Belgian Congo	(2,000)	(3.10 S.)	(16.30 E.)	(60)
Eldoret, Kenya	6,900	0.32 N.	35.16 E.	40
El Fasher, Sudan	2,800	13.38 N.	25.21 E.	10
Elisabethville, Belgian Congo . . .	4,000	11.40 S.	27.34 E.	50
El Obeid, Sudan	2,200	13.11 N.	30.14 E.	15
Embotyi, Cape Province . . .	< 500	(31.30 S.)	(29.50 E.)	(45)

LIST OF LOCALITIES—(*cont.*)

Locality	*Altitude*	*Latitude*	*Longitude*	*Rainfall*
Empangeni, Zululand	< 500	28.46 S.	31.55 E.	40
Entebbe, Uganda	3,900	0.05 N.	32.29 E.	60
Enugu, Nigeria	700	6.27 N.	7.29 E.	70
Epworth, S. Rhodesia	(5,000)	(17.56 S.)	(31.36 E.)	(35)
Erkowit, Sudan	4,300	18.46 N.	36.06 E.	(5)
Eshowe, Zululand	1,700	28.53 S.	31.28 E.	60
Firestone Plantation, Liberia . . .	< 500	(6.18 N.)	(10.25 W.)	> 100
Firiwa, Sierra Leone	(1,500)	(9.20 N.)	(11.18 W.)	(80)
Forcados, Nigeria	< 500	5.26 N.	5.26 E.	130
Fort Hall, Kenya	4,100	0.42 S.	37.10 E.	55
Fort Johnston, Nyasaland . . .	1,700	14.25 S.	35.16 E.	25
Fort Maguire, Nyasaland . . .	1,600	13.40 S.	34.57 E.	(30)
Fort Portal, Uganda	5,100	0.40 N.	30.17 E.	55
Fort Ternan, Kenya	7,000	0.12 S.	35.20 E.	50
Fort Victoria, S. Rhodesia . . .	3,700	20.04 S.	30.46 E.	25
Francistown, Bechuanaland . . .	3,300	21.13 S.	27.30 E.	20
Fransfontein, S.W. Africa . . .	(3,500)	(20.13 S.)	(15.01 E.)	(10)
Freetown, Sierra Leone	< 500	8.30 N.	13.10 W.	160
Funtua, Nigeria	(2,500)	(11.32 N.)	(7.15 E.)	(55)
Gadau, Nigeria	(1,000)	(11.50 N.)	(10.12 E.)	30
Gambaga, Gold Coast	1,300	10.33 N.	0.27 W.	(45)
Garissa, Kenya	(500)	0.27 S.	39.38 E.	10
Garsen, Kenya	< 500	2.16 S.	40.06 E.	(30)
Gatooma, S. Rhodesia	3,800	18.20 S.	29.51 E.	30
Gbohun-Gbohun, Nigeria. *See* Lagos.				
Gedaref, Sudan	2,400	14.02 N.	35.24 E.	25
Gede, Kenya	< 500	3.19 S.	40.01 E.	45
Gedeis, Br. Somaliland	(3,500)	(10.03 S.)	(45.30 E.)	(15)
Geneina, Sudan	3,100	13.29 N.	22.27 E.	25
Godia, Uganda	(4,000)	3.25 N.	30.58 E.	(60)
Goromonzi, S. Rhodesia	(4,800)	(17.51 S.)	(31.22 E.)	(35)
Gotani, Kenya	(1,000)	3.47 S.	39.32 E.	(45)
Grahamstown, Cape Province . . .	1,800	33.18 S.	26.32 E.	30
Grootfontein, S.W. Africa . . .	(4,000)	19.31 S.	18.06 E.	20
Guara Guara, Mozambique . . .	< 500	(25.00 S.)	(32.30 E.)	(25)
Gwelo, S. Rhodesia	4,700	19.28 S.	29.48 E.	25
Hadibo, Sokotra I.	< 500	(12.37 N.)	(54.05 E.)	(15)
Lake Hardin, Abyssinia	(3,000)	(8.52 N.)	(39.50 E.)	(40)
Harrar, Abyssinia	5,500	9.22 N.	42.02 E.	35
Heiban, Sudan	3,400	11.05 N.	30.05 E.	35
Ibadan, Nigeria	700	7.23 N.	3.50 E.	50
Ibi, Nigeria	< 500	8.11 N.	9.43 E.	(45)
Ikeja, Nigeria	< 500	(6.29 N.)	(3.14 E.)	(60)
Ikom, Nigeria	< 500	6.00 N.	8.40 E.	(90)
Ikoyi, Nigeria. *See* Lagos				
Ilado, Nigeria. *See* Lagos.				
Ilambi, Belgian Congo	(1,500)	0.34 N.	24.15 E.	80
Inongo, Belgian Congo	1,100	1.55 S.	18.30 E.	65
Irumu, Belgian Congo	(3,000)	1.25 N.	30.00 E.	50
Isangi, Belgian Congo	(1,000)	0.42 N.	24.15 E.	(80)
Isiolo, Kenya	(4,000)	0.22 N.	37.35 E.	20
Isipingo, Natal	< 500	30.00 S.	30.55 E.	(40)
Itowolo, Nigeria	< 500	(6.28 N.)	(3.17 E.)	(60)
Itwara Forest, Uganda	(5,000)	(0.45 N.)	(30.25 E.)	(55)
Iwonran, Nigeria. *See* Lagos.				
Jadotville, Belgian Congo . . .	(4,300)	11.00 S.	26.44 E.	(50)

LIST OF LOCALITIES—(*cont.*)

Locality	*Altitude*	*Latitude*	*Longitude*	*Rainfall*
Jano I., Uganda	(3,800)	(0.15 S.)	(32.36 E)	(75)
Jebelein, Sudan	1,500	12.37 N.	32.50 E.	(15)
Jebel Gurein, Sudan	(1,400)	(13.39 N.)	(34.41 E.)	(25)
Jebel Jihaf, Aden Prot.	7,100	(13.45 N.)	(44.40 E.)	(10)
Jebel Mandera, Sudan	(1,300)	(14.25 N.)	(33.31 E.)	(15)
Jebel Marra, Sudan	(5–12,000)	13.00 N.	24.20 E.	25
Jebel Meidob, Sudan	(2,500)	(15.18 N.)	(26.25 E.)	10
Jebel Moya, Sudan	(1,500)	(13.28 N.)	(33.22 E.)	(15)
Jefisi, Gold Coast	(1,000)	10.45 N.	2.16 W.	(40)
Jinja, Ugana	3,900	(0.26 N.)	(33.11 E.)	45
Juba, Sudan	1,800	4.51 N.	31.37 E.	35
Jubiya Forest, Uganda	(4,000)	(0.15 S.)	(31.59 E.)	(55)
Kaballa, Sierra Leone	(1,500)	9.39 N.	11.41 W.	80
Kabarole, Uganda. *See* Fort Portal.				
Kabinda, Belgian Congo	3,100	6.08 S.	24.30 E.	65
Kabwoch, Kenya	(4,000)	0.45 S.	34.27 E.	(65)
Kadugli, Sudan	2,000	11.00 N.	29.43 E.	30
Kaduna, Nigeria	1,900	10.30 N.	7.28 E.	45
Kailahun, Sierra Leone	(1,000)	(8.16 N.)	(10.36 W.)	120
Kaimosi, Kenya	5,500	0.05 N.	34.50 E.	70
Kajiado, Kenya	(6,000)	1.51 S.	36.47 E.	(20)
Kajo Kaji, Sudan	4,100	3.53 N.	31.40 E.	50
Kaka Town, Liberia	(1,000)	6.34 N.	10.20 W.	100
Kakamega, Kenya	5,100	(0.14 N.)	(34.44 E.)	70
Kakata, Liberia	(1,000)	(6.30 N.)	(10.25 W.)	100
Kakuri, Nigeria	(1,500)	(10.26 N.)	(7.26 E.)	(45)
Kalinzu Forest, Uganda	(4,000)	(0.25 S.)	(30.05 E.)	(55)
Kallansiya, Sokotra I.	< 500	(12.39 N.)	(53.38 E.)	(15)
Kalora, Sudan	(4,000)	(11.55 N.)	(31.18 E.)	(25)
Kalungu, Uganda	(4,000)	(0.20 S.)	(31.46 E.)	(45)
Kamabai, Sierra Leone	(1,500)	(9.20 N.)	(11.58 W.)	(100)
Kamasiki, Sierra Leone. Unidentified.				
Kampala, Uganda	3,900	0.19 N.	32.35 E.	45
Kano, Nigeria	1,500	12.02 N.	8.32 E.	35
Kaparata, Belgian Congo . . .	3,800	(0.25 N.)	(29.33 E.)	(60)
Karabib, S.W. Africa	3,800	(21.55 S.)	(15.40 E.)	5
Karimi, Belgian Congo	(4,500)	(0.07 N.)	(29.47 E.)	(55)
Kasane, Bechuanaland	(3,000)	17.49 S.	25.09 E.	20
Kasongo, Belgian Congo	(2,000)	4.27 S.	26.39 E.	(50)
Kasyoha Forest, Uganda. . . .	(4,000)	(0.20 S.)	(30.10 E.)	(55)
Kassala, Sudan	2,000	15.28 N.	36.24 E.	15
Katagum, Nigeria	(1,000)	12.18 N.	10.20 E.	20
Kateri, Nigeria	1,700	(9.37 N.)	(7.25 E.)	(60)
Kathub, Sokotra I.	< 500	(12.36 N.)	(54.00 E.)	(15)
Katompe, Belgian Congo . . .	(2,500)	6.06 S.	26.24 E.	(40)
Katsina, Nigeria	1,800	13.01 N.	7.30 E.	35
Kau, Sudan	(1,000)	(10.40 N.)	(31.30 E.)	(25)
Kauda, Sudan	(2,500)	(11.01 N.)	(30.33 E.)	(35)
Kayembe-Mukulu, Belgian Congo . .	(2,500)	(9.30 S.)	(25.36 E.)	(50)
Kericho, Kenya	6,400	0.23 S.	35.17 E.	65
Kerio, Kenya	(4,000)	0.38 N.	35.37 E.	(45)
Khartoum, Sudan	1,500	15.35 N.	32.35 E.	5
Kheiwok, Sudan	(2,000)	12.42 N.	29.09 E.	(15)
Khor Kobwa, Sudan	(2,500)	(4.02 N.)	(30.35 E.)	(55)
Kiambu, Kenya	6,300	1.13 S	36.52 E.	40
Kiansonzi, Uganda	(4,000)	(0.14 N.)	(31.45 E.)	(35)

List of Localities—(*cont.*)

Locality	*Altitude*	*Latitude*	*Longitude*	*Rainfall*
Kibale Forest, Uganda	(4,500)	(0.30 N.)	(30.26 E.)	(50)
Kibigori, Kenya	(4,000)	0.05 S.	35.03 E.	(65)
Kibokolo do Zómbo, Angola . . .	3,800	6.22 S.	15.17 E.	50
Kibos, Kenya	3,800	0.04 S.	34.51 E.	45
Kilembe, Uganda	4,500	(0.25 N.)	(29.59 E.)	(60)
Kilifi, Kenya	< 500	3.37 S.	39.52 E.	40
Kimbao, Belgian Congo	(3,500)	(5.30 S.)	(17.30 E.)	65
Kimberley, Cape Province . . .	4,000	28.42 S.	24.59 E.	15
Kimvula, Belgian Congo	(2,500)	(5.44 S.)	(16.04 E.)	(50)
Kindia, Fr. Guinea	1,400	10.03 N.	12.50 W.	80
Kingangati, Belgian Congo . . .	(2,500)	(4.22 S.)	(15.50 E.)	(50)
Kinshasa, Belgian Congo. *See* Leopoldville.				
Kintampo, Gold Coast	1,200	8.04 N.	1.42 W.	(55)
Kipini, Kenya	< 500	2.32 S.	40.32 E.	(45)
Kiryandongo, Uganda	4,000	1.53 N.	32.03 E.	50
Kisantu, Belgian Congo	1,900	5.07 S.	15.07 E.	(50)
Kisenyi, Ruanda-Urundi . . .	4,800	1.30 S.	29.10 E.	50
Kisii, Kenya	5,700	0.41 S.	34.47 E.	65
Kissy, Sierra Leone	< 500	(8.29 N.)	(13.12 W.)	> 100
Kisui, Belgian Congo	(1,500)	(0.22 S.)	(25.38 E.)	(70)
Kisumu, Kenya	3,800	0.06 S.	34.45 E.	45
Kitale, Kenya	6,200	1.02 N.	35.00 E.	45
Kitasa, Uganda. *See* Entebbe.				
Kitgum, Uganda	3,600	3.20 N.	32.53 E.	50
Kitinda, Uganda. *See* Entebbe.				
Kitui, Kenya	3,900	1.21 S.	38.01 E.	30
Kivanda-Kapepulu, Belgian Congo . .	(4,000)	(10.00 S.)	(24.00 E.)	(50)
Koinadugu, Sierra Leone . . .	(1,500)	(9.30 N.)	(11.25 W.)	(80)
Komatipoort, Transvaal	500	25.26 S.	31.57 E.	25
Kome I., Uganda	(3,800)	0.05 S.	32.45 E.	(80)
Koru, Kenya	5,900	0.11 S.	35.16 E.	60
Kosti, Sudan	1,500	13.10 N.	32.40 E.	15
Kribi, Fr. Cameroons	< 500	2.59 N.	9.56 E.	110
Kudemsa, Nigeria	(2,000)	(10.23 N.)	(7.33 E.)	(45)
Kudring, Sudan	(2,700)	(11.39 N.	(30.32 E.)	(35)
Kulmasa, Gold Coast	(1,000)	(9.42 N.)	(2.25 W.)	(40)
Kumasi, Gold Coast	(800)	6.43 N.	1.37 W.	70
Kumba, Belgian Congo	(1,500)	(1.50 S.)	(25.50 E.)	(70)
Kumba, Br. Cameroons	800	(4.40 N.)	(9.35 E.)	> 100
Kwamouth, Belgian Congo . . .	1,600	3.12 S.	16.15 E.	60
Kyarumba, Uganda	(5,500)	0.09 N.	29.58 E.	(50)
Kyenjojo, Uganda	4,800	0.36 N.	30.39 E.	45
Kyere, Uganda	3,500	1.29 N.	33.37 E.	50
Lado, Sudan	(1,500)	(5.01 N.)	(31.43 E.)	(35)
Lagos, Nigeria	< 500	6.20 N.	3.20 E.	70
Langata Forest, Kenya	(5,500)	1.20 S.	36.45 E.	(35)
Las Anod, Br. Somaliland . . .	(2,500)	(8.31 N.)	(47.26 E.)	(5)
Laufori, Uganda	(2,500)	3.36 N.	31.35 E.	(50)
Lela, Kenya	(4,500)	0.02 S.	34.36 E.	(65)
Lembwa River, Belgian Congo . .	(4,000)	6.01 S.	17.06 E.	(60)
Leopoldville, Belgian Congo . . .	1,100	4.20 S.	15.18 E.	55
Letaba, Transvaal	1,800	23.52 S.	30.18 E.	(25)
Leysdorp Road, Transvaal . . .	(2,000)	(24.00 S.)	(30.22 E.)	30
Libenge, Belgian Congo	1,300	3.40 N.	18.39 E.	55
Likoma I., Nyasaland	1,600	12.04 S.	34.44 E.	(75)
Lilixia, Gold Coast	(1,000)	10.46 N.	2.06 W.	(40)

LIST OF LOCALITIES—(*cont.*)

Locality	*Altitude*	*Latitude*	*Longitude*	*Rainfall*
Lindi, Tanganyika	< 500	10.00 S.	39.42 E.	35
Li Rangu, Sudan	(2,000)	(4.40 N.)	(28.21 E.)	(55)
Livingstone, N. Rhodesia . . .	3,200	17.50 S.	25.49 E.	25
Loka, Sudan	(1,000)	4.14 N.	31.01 E.	(50)
Lokoja, Nigeria	< 500	7.48 N.	6.44 E.	50
Londiani, Kenya	7,500	0.10 S.	35.36 E.	45
Lorha, Gold Coast	< 500	10.39 N.	2.52 W.	(45)
Louis Trichardt, Transvaal . . .	3,200	23.03 S.	29.54 E.	30
Lourenço Marques, Mozambique . .	< 500	25.58 S.	32.36 E.	25
Luanda, Kenya	(4,500)	0.02 N.	34.34 E.	65
Lukula, Belgian Congo	< 500	5.22 S.	12.59 E.	45
Luluabourg, Belgian Congo . . .	2,100	5.56 S.	22.18 E.	65
Lumbwa, Kenya	6,300	0.12 S.	35.29 E.	50
Mabang, Sierra Leone	< 500	(8.22 N.)	(12.52 W.)	(130)
Mabira Forest, Uganda	(4,000)	(0.28 N.)	(32.58 E.)	(55)
Maiduguri, Nigeria	1,200	11.49 N.	13.09 E.	20
Makeni, Sierra Leone	< 500	(8.55 N.)	(12.05 W.)	120
Makindu, Kenya	3,300	2.17 S.	37.49 E.	25
Malakal, Sudan	1,500	9.32 N.	31.39 E.	30
Malakisi, Kenya	(4,000)	(0.25 N.)	(34.20 E.)	(70)
Malindi, Kenya	< 500	3.17 S.	40.07 E.	40
Maluku, Belgian Congo	(1,000)	4.04 S.	15.33 E.	(55)
Mambone, Mozambique	< 500	20.58 S.	35.00 E.	(35)
Mambrui, Kenya	< 500	3.07 S.	40.09 E.	(40)
Mamirimiri, Uganda	(3,000)	(0.48 N.)	(30.09 E.)	(55)
Manjuguja North, Uganda . . .	(3,000)	(0.45 N.)	(30.03 E.)	(55)
Mara River, Kenya	(6,500)	1.07 S.	35.08 E.	(45)
Maragua, Kenya	(4,000)	0.47 S.	37.07 E.	(35)
Maranka Reserve, S. Rhodesia . .	(4,000)	(19.15 S.)	(32.15 E.)	(35)
Margate, Natal	< 500	(30.51 S.)	(30.22 E.)	(45)
Masaka, Uganda	4,300	0.20 S.	31.44 E.	45
Maseno, Kenya	6,000	0.01 S.	34.36 E.	50
Masindi Port, Uganda	3,400	1.42 N.	32.05 E.	40
Matadi, Belgian Congo	< 500	5.50 S.	13.31 E.	45
Matopo Hills, S. Rhodesia . . .	(4,000–5,000)	20.40 S.	28.30 E.	(25)
Maun, Bechuanaland	(3,000)	19.59 S.	23.25 E.	(15)
Mayoro, Gold Coast	(500)	(10.56 N.)	(1.04 W.)	(40)
Mayumba Forest, Gaboon . . .	< 500	3.24 S.	10.37 E.	(60)
Mbango, Uganda	(3,000)	(0.45 N.)	(30.03 E.)	(55)
Mbarara, Uganda	4,700	0.37 S.	30.39 E.	35
Meridi, Sudan	2,900	4.52 N.	29.28 E.	55
Meru, Kenya	6,200	0.03 N.	37.39 E.	60
Meta Gafersa, Abyssinia	(5,000)	(4.50 N.)	(38.45 E.)	(30)
Lake Metahara, Abyssinia . . .	(3,000)	8.52 N.	39.51 E.	(40)
Metu, Uganda	(3,000)	3.39 N.	31.47 E.	(50)
Mhlatuze Settlement, Zululand . .	(1,000)	(28.40 S.)	(31.45 E.)	55
Middle Point, Nigeria. *See* Lagos.				
Midia, Uganda	(4,000)	3.27 N.	31.01 E.	(50)
Misselele, Br. Cameroons . . .	< 500	(4.06 N.)	(9.25 E.)	85
Mityana, Uganda	(4,000)	(0.24 N.)	(32.05 E.)	(45)
Mnazi Moja, Zanzibar. *See* Zanzibar Town.				
Mocuba, Mozambique	(500)	(16.49 S.)	(37.01 E.)	40
Mombasa, Kenya	< 500	4.03 S.	39.40 E.	50
Mongalla Prov., Sudan	(1,500)	(5.00 N.)	(32.00 E.)	(35)
Mongbwalu, Belgian Congo . . .	4,000	(1.54 N.)	(30.04 E.)	(55)
Mongiro, Uganda	(3,000)	(0.49 N.)	(30.10 E.)	(55)

LIST OF LOCALITIES—(*cont.*)

Locality	*Altitude*	*Latitude*	*Longitude*	*Rainfall*
Monrovia, Liberia	< 500	6.18 N.	10.45 W.	> 100
Morogoro, Tanganyika	1,700	6.50 S.	37.47 E.	35
Moshi, Tanganyika	2,700	3.20 S.	37.32 E.	40
Moyale, Abyssinia	3,900	3.30 N.	39.02 E.	25
Moyamba, Sierra Leone	< 500	8.09 N.	12.22 W.	100
Mozambique, Mozambique	< 500	15.00 S.	40.42 E.	40
Mpumu Forest, Uganda	(4,000)	0.12 N.	32.51 E.	(55)
Msambweni, Kenya	< 500	4.27 S.	39.27 E.	60
Msoneddi, S. Rhodesia	(4,800)	(17.08 S.)	(30.53 E.)	(35)
Mtibwa Forest, Tanganyika	(2,000)	(6.00 S.)	(37.45 E.)	(35)
Mubende, Uganda	5,100	0.35 N.	31.22 E.	45
Mug, Sudan	(2,000)	(12.42 N.)	(29.09 E.)	(15)
Mugusi River, Kenya	(4,500)	(0.30 S.)	(34.42 E.)	(50)
Muhangi Forest, Uganda	(4,000)	0.50 N.	30.45 E.	(50)
Muhoroni, Kenya	4,300	0.09 S.	35.12 E.	60
Mukongoro, Uganda	3,300	1.20 N.	33.53 E.	55
Mukono, Uganda	3,900	0.21 N.	32.45 E.	55
Mumias, Kenya	(4,500)	0.21 N.	34.28 E.	70
Mushin, Nigeria. *See* Yaba.				
Mwanza, Tanganyika	3,700	2.32 S.	32.53 E.	40
Nacon, Gold Coast	(1,000)	(10.50 N.)	(1.25 W.)	(40)
Nahud, Sudan	2,100	12.42 N.	28.26 E.	15
Nairobi, Kenya	5,500	1.17 S.	36.50 E.	35
Naivasha, Kenya	6,200	0.43 S.	36.21 E.	30
Namaacha, Mozambique	(800)	25.58 S.	32.08 E.	40
Namanve, Uganda	3,700	0.21 N.	32.41 E.	50
Nampula, Mozambique	(2,000)	15.06 S.	39.17 E.	45
Nandaw, Gold Coast	(1,000)	(10.44 N.)	(2.18 W.)	(40)
Nandawli, Gold Coast	(1,000)	(10.19 N.)	(2.35 W.)	(45)
Nangudi, Gold Coast	(1,000)	(10.51 N.)	(0.40 W.)	(40)
Nanyuki, Kenya	6,400	0.01 N.	37.05 E.	30
Narok, Kenya	(6,500)	1.05 S.	35.51 E.	25
Nata, Bechuanaland	(4,000)	25.15 S.	25.15 E.	(15)
Navarro, Gold Coast	(1,000)	(10.41 N.)	(1.50 W.)	(40)
Ndanga, S. Rhodesia	(4,000)	20.11 S.	31.20 E.	(40)
Ndola, N. Rhodesia	4,100	12.59 S.	28.38 E.	50
Nefasit, Eritrea	(5,000)	(15.17 N.)	(39.03 E.)	(30)
Nelspruit, Transvaal	2,300	25.27 S.	30.58 E.	40
Nhemancone, Mozambique	(500)	(17.00 S.)	(37.00 E.)	(45)
Niangara, Belgian Congo	(2,500)	3.41 N.	27.55 E.	(65)
Njala, Sierra Leone	< 500	(8.05 N.)	(12.10 W.)	(110)
Nobat Dakim, Aden Prot.	1,100	(13.15 N.)	(44.40 E.)	(5)
Nova Lisboa, Angola	5,700	12.45 S.	15.48 E.	60
Nova Choupanga, Mozambique	(500)	(17.09 S.)	(34.40 E.)	(30)
Nsawam, Gold Coast	< 500	5.48 N.	0.20 W.	(45)
Nta, Belgian Congo	(2,500)	4.10 S.	15.45 E.	(55)
Ntabanana, Zululand	(1,000)	(28.35 S.)	(31.40 E.)	(30)
Ntotoro Valley, Uganda	(2,000–4,000)	(0.50 N.)	(30.00 E.)	(55)
Nuba Mts., Sudan	(2,000–4,000)	11.00 N.	30.30 E.	(35)
Nyamugasani Valley, Uganda	(3,000–12,000)	(0.01 S.)	(29.54 E.)	(50)
Obenge-benge, Belgian Congo	(1,500)	1.33 S.	25.05 E.	(75)
Oblogo, Gold Coast	< 500	(5.36 N.)	(0.17 W.)	(40)
Obuasi, Gold Coast	(700)	6.12 N.	1.40 W.	(60)
Odzi, S. Rhodesia	3,100	18.55 S.	32.25 E.	(35)
Ogbomosho, Nigeria	(1,100)	8.06 N.	4.12 E.	40
Okahandja, S.W. Africa	4,400	21.59 S.	16.56 E.	(15)

LIST OF LOCALITIES—(*cont.*)

Locality	*Altitude*	*Latitude*	*Longitude*	*Rainfall*
Okimbahe, S.W. Africa	(2,500)	(21.21 S.)	(15.23 E.)	(10)
Omatjette, S.W. Africa	(3,500)	21.03 S.	15.32 E.	(10)
Onderstepoort, Transvaal	4,200	(24.47 S.)	(31.15 E.)	30
Opobo, Nigeria	< 500	4.34 N.	7.35 E.	100
Oshogbo, Nigeria	1,000	7.47 N.	4.29 E.	45
Otjimbingwe, S.W. Africa	(2,500)	(22.21 S.)	(16.08 E.)	(10)
Outjo, S.W. Africa	4,000	(20.07 S.)	(16.09 E.)	15
Payida, Uganda	5,000	2.25 N.	30.59 E.	55
Pemba I.	< 500	5.00 S.	39.50 E.	80
Pietersburg, Transvaal	4,200	23.54 S.	29.25 E.	20
Pinna, Gold Coast	(1,000)	10.53 N.	1.45 W.	(40)
Pongwema, Belgian Congo	(2,000)	4.15 S.	16.00 E.	(55)
Ponthierville, Belgian Congo	1,600	0.22 S.	25.28 E.	(75)
Popokabaka, Belgian Congo	(1,500)	5.42 S.	16.40 E.	(55)
Port Harcourt, Nigeria	< 500	4.46 N.	7.11 E.	90
Port Herald, Nyasaland	< 500	17.02 S.	35.15 E.	35
Port Loko, Sierre Leone	< 500	8.46 N.	12.44 W.	105
Port St. Johns, Cape Province	< 500	31.38 S.	29.33 E.	50
Pretoria, Transvaal	4,400	25.45 S.	28.12 E.	30
Pujehun, Sierra Leone	< 500	7.35 N.	11.06 W.	> 100
Quelimane, Mozambique	500	(17.51 S.)	(36.54 E.)	55
Raga, Sudan	1,800	8.28 N.	25.41 E.	45
Mt. Ramlu, Eritrea	(1,000–6,000)	(13.15 N.)	(41.45 E.)	(20)
Ras Malalu, Eritrea	< 500	(15.12 N.)	(39.51 E.)	(10)
Ressano Garcia, Mozambique	< 500	25.26 S.	32.00 E.	(25)
Roberts Field, Liberia	< 500	(6.50 N.)	(11.22 W.)	100
Roberts Heights, Transvaal	(5,000)	25.47 S.	28.08 E.	25
Roseires, Sudan	1,800	11.51 N.	34.23 E.	30
Rumbak, Sudan	1,900	6.48 N.	29.42 E.	40
Rumogi, Uganda	(3,000)	3.34 N.	31.21 E.	(50)
Salisbury, S. Rhodesia	4,800	17.50 S.	31.01 E.	35
Saltpond, Gold Coast	< 500	5.12 N.	1.05 W.	(30)
Sambolugu, Gold Coast	(1,000)	(10.48 N.)	(0.53 W.)	(40)
Sango Bay Forests, Uganda	(4,000)	(0.50 S.)	(31.40 E.)	(45)
San Salvador, Angola	1,900	6.20 S.	14.47 E.	50
Santa Isabel, Fernando Po	< 500	3.46 N.	8.46 E.	> 100
Sapele, Nigeria	< 500	5.53 N.	5.46 E.	(100)
Savelugu, Gold Coast	(500)	9.38 N.	0.50 W.	(40)
Segbwema, Sierra Leone	< 500	(7.59 N.)	(10.58 W.)	(100)
Sennar, Sudan	1,700	13.34 N.	33.34 E.	20
Serakolia, Sierra Leone	(1,500)	(9.37 N.)	(11.08 W.)	(80)
Shaki, Nigeria	(1,500)	(8.34 N.)	(3.19 E.)	(40)
Shaloat, Sudan	(2,000)	(12.42 N.)	(29.09 E.)	(15)
Shamva, S. Rhodesia	3,200	17.20 S.	31.37 E.	(35)
Sheikh Gamal, Sudan	(2,000)	(12.42 N.)	(29.09 E.)	(15)
Sheikh Karim, Sudan	(2,000)	(11.01 N.)	(30.33 E.)	(35)
Sheik Othaman, Aden Prot.	< 500	(12.53 N.)	(45.03 E.)	(5)
Shimoni, Kenya	< 500	4.38 S.	39.23 E.	(55)
Sidamo Prov., Abyssinia	5,900	6.10 N.	38.45 E.	(40)
Singa, Sudan	(1,400)	13.10 N.	33.55 E.	25
Sinoia, S. Rhodesia	3,800	17.22 S.	30.11 E.	30
Sipi, Uganda	6,700	1.20 N.	34.22 E.	(70)
Skukuza, Transvaal	(1,000)	24.59 S.	31.36 E.	20
Sondu River, Kenya	(6,000)	0.31 S.	35.04 E.	(60)
Sonkonia, Sierra Leone	(1,500)	(9.45 N.)	(11.26 W.)	(80)
Sopo, Sudan	(2,000)	(8.06 N.)	(26.08 E.)	(45)

LIST OF LOCALITIES—(*cont.*)

Locality	*Altitude*	*Latitude*	*Longitude*	*Rainfall*
Soroti, Uganda	3,700	1.43 N.	33.37 E.	50
Stanleyville, Belgian Congo . . .	1,400	0.26 N.	25.14 E.	65
Sunyani, Gold Coast	1,200	7.22 N.	2.21 W.	60
Tagoi, Sudan	(3,500)	(11.53 N.)	(30.55 E.)	(25)
Takoradi, Gold Coast	< 500	4.53 N.	1.46 W.	40
Talodi, Sudan	2,000	10.37 N.	30.21 E.	30
Tamale, Gold Coast	600	9.28 N.	0.51 W.	45
Tanga, Tanganyika	< 500	5.05 S.	39.08 E.	55
Tanina, Gold Coast.	(1,000)	9.55 N.	2.28 W.	(45)
Taveta, Kenya	3,500	3.24 S.	37.40 E.	30
Tembura, Sudan	(2,000)	(5.36 N.)	(27.30 E.)	(55)
Tessenei, Eritrea	(2,000)	(15.08 N.)	(36.39 E.)	(15)
Thika, Kenya	4,900	1.03 S.	37.05 E.	35
'Third Camp', Kenya. Unidentified.				
Thysville, Belgian Congo . . .	2,000	5.16 S.	14.54 E.	(50)
Tirikoro, Sierra Leone	(1,500)	(9.05 N.)	(10.50 W.)	(90)
Tishi, Gold Coast	(1,000)	(11.02 N.)	(0.26 W.)	(35)
Titule, Belgian Congo	(1,500)	3.15 N.	25.35 E.	(75)
Tiwi, Kenya	< 500	4.15 S.	39.35 E.	65
Tomango, Transvaal	2,400	(25.27 S.)	(30.58 E.)	(30)
Torit, Sudan	2,500	(4.25 N.)	(32.33 E.)	40
Triangle Estate, S. Rhodesia . . .	(2,500)	(21.00 S.)	(31.30 E.)	(25)
Tshela, Belgian Congo	800	4.58 S.	12.56 E.	50
Tshumbiri, Belgian Congo . . .	(1,500)	(2.51 S.)	(16.15 E.)	(60)
Tsumeb, S.W. Africa	4,200	19.14 S.	17.42 E.	20
Tsunikitoko, Belgian Congo . . .	(2,000)	4.20 S.	16.20 E.	(55)
Tumu, Gold Coast	1,000	10.52 N.	1.59 W.	(40)
Turbo, Kenya	5,900	0.38 N.	35.03 E.	50
Tzaneen, Transvaal.	2,500	23.50 S.	30.10 E.	30
Ubassa, Nigeria	(1,500)	(10.35 N.)	(7.20 E.)	(45)
Ugaro, Eritrea	(2,000)	(14.46 N.)	(37.20 E.)	(20)
Ukara I., Tanganyika	3,900	1.51 S.	33.03 E.	60
Ulu, Gold Coast	(1,000)	(10.42 N.)	(2.47 W.)	(45)
Ulub, Aden Prot.	(3,000)	(13.30 N.)	(44.42 E.)	(5)
Umbeluzi, Mozambique	(500)	26.02 S.	32.20 E.	25
Umm Ruaba, Sudan	1,800	12.53 N.	31.13 E.	15
Umm Sunt, Sudan	(1,500)	(14.20 N.)	(33.35 E.)	(15)
Umtali, S. Rhodesia	3,700	18.58 S.	32.40 E.	30
Upington, Cape Province . . .	2,600	28.27 S.	21.15 E.	10
Upper Sheikh, Br. Somaliland . . .	4,700	(9.56 N.)	(45.12 E.)	20
Usakos, S.W. Africa	2,900	22.01 S.	15.35 E.	5
Usumbura, Ruanda-Urundi . . .	2,600	3.26 S.	29.15 E.	35
River Vakila, Belgian Congo . . .	5,100	(8.30 S.)	(27.15 E.)	(50)
Victoria Falls, S. Rhodesia . . .	3,000	17.52 S.	25.51 E.	20
Wa, Gold Coast	1,100	10.05 N.	2.27 W.	(45)
Wad Banda, Sudan	(2,000)	13.06 N.	27.55 E.	(15)
Wad el Magdub, Sudan	(1,300)	(14.23 N.)	(33.24 E.)	(15)
Wad Ganatir, Sudan	(2,000)	(12.35 N.)	(28.37 E.)	(15)
Wadiyain, Arabia	(1,000)	(15.30 N.)	(47.00 E.)	(5)
Wad Medani, Sudan	1,600	14.24 N.	33.31 E.	15
Waliki, Sierra Leone. Unidentified.				
Waterpoort, Transvaal	2,600	(22.53 S.)	(29.37 E.)	(15)
Waterval Boven, Transvaal . . .	4,800	25.38 S.	30.20 E.	30
Wathen, Belgian Congo	(2,000)	(5.08 S.)	(14.42 E.)	(50)
Wau, Sudan	1,700	7.42 N.	28.01 E.	45
Weenen, Natal	2,800	28.51 S.	30.05 E.	25

LIST OF LOCALITIES—(*cont.*)

Locality	*Altitude*	*Latitude*	*Longitude*	*Rainfall*
Wesu, Kenya	(5,000)	3.22 S.	38.20 E.	60
Windhoek, S.W. Africa	5,500	22.34 S.	17.05 E.	15
Winduri, Gold Coast	(1,000)	(10.43 N.)	(0.50 W.)	(40)
Witu, Kenya	< 500	2.22 S.	40.27 E.	45
Wuri, Fr. Cameroons. *See* Duala.				
Yaba, Nigeria	< 500	(6.24 N.)	(3.20 E.)	(70)
Yala, Kenya	(4,500)	0.06 N.	34.32 E.	65
Yambio, Sudan	2,900	4.34 N.	28.24 E.	55
Yangambi, Belgian Congo . . .	(1,000)	0.50 N.	24.15 E.	70
Yaoundé, Fr. Cameroons . . .	2,300	3.52 N.	11.31 E.	65
Yape, Gold Coast	(500)	9.08 N.	1.10 W.	(40)
Yatolema, Belgian Congo . . .	(1,500)	0.18 N.	24.32 E.	(80)
Yeji, Gold Coast	< 500	8.13 N.	0.39 W.	(50)
Yiraia, Sierra Leone	(1,500)	(9.27 N.)	(11.20 W.)	(80)
Yokeskei R., Transvaal	(5,000)	(26.05 S.)	(28.00 E.)	(30)
Yola, Nigeria	900	9.13 N.	12.29 E.	40
Lake Young, N. Rhodesia . . .	(4,500)	(11.14 S.)	(31.44 E.)	(40)
Zaka, S. Rhodesia	(3,000)	(20.21 S.)	(31.24 E.)	(40)
Zanzibar Town, Zanzibar . . .	< 500	6.10 S.	39.14 E.	65
Zika, Uganda. *See* Entebbe.				
Zomba, Nyasaland	3,100	15.21 S.	35.25 E.	55
Zouragu, Gold Coast	(1,000)	10.47 N.	0.47 W.	(40)
Zungeru, Nigeria	(600)	9.45 N.	6.05 E.	45

BIONOMICS IN RELATION TO DISTRIBUTION

The following notes are intended only to illustrate certain aspects of bionomics of particular importance to the study of distribution. The subjects discussed include breeding-places, seasonal distribution, and biting-habits (including vertical distribution). It will be seen that our knowledge of all these matters, with the possible exception of breeding-places, is still very rudimentary. It could have been much less so had collectors realized the importance of publishing full data wherever possible. Observations which may by themselves appear insignificant often acquire considerable significance when related to our knowledge as a whole.

BREEDING-PLACES

The fact that the majority of *Stegomyia* breed for the most part in tree-holes or plant axils has had an important bearing on the nature of the distribution records available. Much collecting has been carried out in Africa in the course of malaria surveys, but in work of this kind attention is commonly confined to such breeding-places as ground pools and swamp or stream edges. None of the Ethiopian *Anopheles* is known to breed in tree-holes. As against this, however, it is interesting to recall that two of the Ethiopian *Stegomyia*, *Aëdes africanus* and *Aëdes trinidad*, were first obtained from ground pools. Records of this kind are also available for some other species, e.g. *luteocephalus* (Briscoe, 1950) and *apicoargenteus* (Evans, 1925), but, except where they refer to rock-pools, they may be assumed to be due almost certainly to flushing of tree-holes by heavy rain. All the records quoted are from places with very heavy rainfall. The converse process, contamination of receptacles by ground-pool or stream breeding larvae, also occurs quite commonly. One calabash found by the author in a Ju-Ju shrine in Southern Nigeria contained a thriving population of *Anopheles gambiae*, *Megarhinus brevipalpis*, and *Aëdes aegypti*. Such cases serve to emphasize the point that, save for certain highly specialized forms, mosquito larvae are capable of a higher degree of tolerance than might be expected from the comparatively restricted range of breeding-places in which they are normally found. The restriction results, in fact, not from the preferences of the larva but from those of the ovipositing female, though no doubt the latter are adapted to providing the larva with optimum conditions for development (see Russell & Rao, 1942, and summary in Bates, 1949). It is probable that no Ethiopian *Stegomyia* breeds exclusively in one type of habitat, and cases in which only a single type of breeding-place is known are probably attributable to insufficient collecting. Nevertheless with the exception of certain highly plastic species (e.g. *aegypti*, *albopictus*) it is generally possible to distinguish a breeding-place of choice from others which are merely occasional or accidental. The whole question of the selection of breeding-places is a complex one and has never been systematically studied, at least in the present group. It would appear that the adoption of an unusual larval habitat may result from diametrically opposite conditions, namely the absence of suitable breeding-places or the existence of such ideal conditions that a teeming population is produced which 'overflows' into every usable niche.

The list of breeding-places which follows makes no pretence to completeness, but an effort has been made to include the preferred breeding-place of each species, where this is known, together with such records of occasional breeding-places as seem necessary to give an idea of the adaptability of the species in question. The ecology of the various classes of breeding-place is discussed briefly under seasonal distribution.

Aëdes apicoargenteus. *Preferred*. Tree-holes (Hopkins, 1936; Garnham *et al.*, 1946). *Occasional*. Rock-holes, utensils, bamboo stumps (Hopkins, 1936; Harris, 1942). *Aëdes fraseri*. *Preferred*. Tree-holes (Hopkins, 1936; Garnham *et al.*, 1946). *Occasional*. Rock-holes (Garnham *et al.*, 1946), rot-hole in mangrove (Holstein in litt.). *Aëdes dendrophilus*. *Preferred*. Tree-holes (Hopkins, 1936; Van Someren, 1946). *Occasional*. Banana axils, banana and bamboo stumps (Hopkins, 1936), rock-holes (Garnham *et al.*, 1946). *Aëdes africanus*. *Preferred*. Tree-holes (Hopkins, 1936, also mentions it as common in bamboo stumps). *Occasional*. Utensils (Hopkins, 1936), rock-holes (Garnham *et al.*, 1946), bamboo pots (Robinson, 1950). *Aëdes pseudoafricanus*. *Preferred*. Rot-holes in *Avicennia* mangrove (Chwatt, 1949). *Occasional*. No other breeding-places have been recorded. *Aëdes simpsoni*. *Preferred*. Plant axils, especially Colocasia, Gonja banana, and pineapple (Haddow, 1948). May be locally abundant in tree-holes (Hopkins, 1936) or in utensils (Lewis, 1943*a*). *Occasional*. Coco-nut shells, tubs (Hopkins, 1936), rock-pools (Lewis, 1943*a*), a concrete basin (Abbott, 1948), bamboo pots (Robinson, 1950), axils of *Dracaena* and *Strelitzia* (Muspratt, 1950 and in litt.). *Aëdes luteocephalus*. *Preferred*. Tree-holes (Hopkins, 1936; Lewis, 1943*a*). *Occasional*. Cut bamboos, utensils, crab-holes (? accidental) (Hopkins, 1936), rock-holes (Hopkins, 1936; Abbott, 1948), temporary pools (almost certainly accidental) (Briscoe, 1950). *Aëdes unilineatus*. *Preferred*. Tree-holes (Hopkins, 1936; Lewis, 1943*a*; Barraud, 1934). *Occasional*. Screw-palm axils (Ingram & De Meillon, 1929), rot-hole in paw-paw (Hopkins, 1936), bamboo pots (Robinson, 1950), bamboo stumps (author, unpublished). *Aëdes metallicus*. *Preferred*. Tree-holes (Hopkins, 1936). *Occasional*. Utensils, coco-nut shells (Hopkins, 1936), rock-pools (Lewis, 1943*a*), banana axils (Teesdale, 1941), a concrete basin (Abbott, 1948), bamboo pots (Robinson, 1950). *Aëdes vittatus*. *Preferred*. Rock-pools (including holes in coral, Wiseman *et al.*, 1939) (Hopkins, 1936). *Occasional*. Utensils, hoof-prints, boats, wells (Hopkins, 1936), tree-holes (Kerr, 1933; Rageau in litt.), bamboo pots (Harris, 1942). *Aëdes aegypti*. Common in all kinds of utensils, gutters, boats, water-tanks, &c. May be locally abundant in wells (Hopkins, 1936). Dalziel (1920) records it, surprisingly, as abundant in crab-holes and this has been confirmed by Dunn (1927, &c.) and by Riqueau (1929). Apart from this the dictum enunciated by Carter (1924), that the species is never found breeding right through from oviposition to adult in pools all the sides of which, at the waterline, are of mud, appears to hold good. Berner (1947) gives records from residual pools in earth drains and the author has had similar experiences, but it is extremely difficult in these cases to rule out contamination. Some interesting wild populations have been described, notably by Haddow (1945*a*, 1948) and Garnham *et al.* (1946). Haddow found larvae most commonly in tree-holes, less commonly in plant axils. Garnham and his fellow workers found them most commonly in rock-holes and in holes in recently felled trees, less commonly in true tree-holes (for a discussion of this point see below under seasonal distribution). Robinson (1950) found a high proportion of the tree-hole population to consist of this species. He also gives records from rock-pools which seem to constitute a dry season refuge. Adults of *Aëdes aegypti* recently received from Dr. Fain were bred out from holes in old weathered lava on the lava plain north of Lake Kivu near Sake. These holes were said to be about 10 km. from the nearest human settlement.

Seasonal Distribution

A number of scattered records are available, but their sum total is surprisingly small and little can be gained from attempting to correlate them. Most of our knowledge therefore rests on a few studies pursued continuously over a period in particular localities. There can be no question but that this is a most profitable field for study, and good figures, were they available, would throw much light both on bionomics and on distribution. As it is, so little is known regarding differences between individual species that the subject is best discussed in relation to breeding-places. For this purpose the latter are classified in accordance with common practice as tree-holes, bamboos, plant axils, rock-holes, and artificial containers. It must, however, be emphasized that this is not a natural classification and that even in the present state of our knowledge further subdivision is required.

Tree-holes. Two distinct types were recognized by Garnham *et al.* (1946), who found that the large horizontal tree-hole not uncommonly encountered in fallen tree-trunks was unattractive to most *Stegomyia* although apparently preferred to the smaller type of tree-hole by *Aëdes aegypti*. This is in accordance with the author's experience in Southern Nigeria except that such holes were not found to contain even *Aëdes aegypti*. The 'dominant species' appeared to be *Culex macfiei*. These observations appear to indicate that the attraction for the ovipositing female is not purely a chemical one depending on the nature of the walls of the breeding-place but is to some extent conditioned by the degree of exposure of the water surface to insolation. If this is so, then it might be expected that tree-holes with a more or less vertical opening and deeply shaded interior would be more attractive to certain species than those in the forks of trees with more or less horizontal opening. It is clear also that the situation of the breeding-place relative to shade trees will be of importance. Dunn (1928) made a quantitative study of the fauna of a tree-hole with a small opening *vis-à-vis* one with a large opening. His observations appear to indicate a general preference on the part of *Stegomyia* for the latter, but being based on only a single tree-hole of each type they must be regarded as inconclusive. A number of investigators (Dunn, 1927*a*; Harris, 1942; Garnham *et al.*, 1946; Hocking, 1947; Bailey, 1947) have employed 'artificial tree-holes', made by sawing off joints of bamboo, as traps, and Dunn showed these to be more attractive than containers made of metal. It would be interesting to compare the attractiveness of a container with deeply shaded interior, such as a narrow-necked calabash, with that of a bamboo pot, but this does not appear to have been done.

Larvae of *Aëdes unilineatus*, *metallicus*, *aegypti*, *simpsoni*, and *fraseri* have all been obtained by immersing dried material from tree-holes, and the larva of *Aëdes subargenteus* was first obtained in this way. It is presumed that these species survive through the dry season by means of drought-resistant eggs (Taylor, 1934; Hopkins, 1936; Garnham *et al.*, 1946; Gillett *et al.*, 1950), but it appears highly probable from the distribution studies discussed below that there is some variation in this respect between individual species. Robinson (1950) appears to regard survival in the adult state as more probable in Northern Rhodesia, and Taylor (1934) has an interesting negative record for *luteocephalus*. The possibility of obtaining larvae by immersion of tree-hole scrapings during dry-season surveys should be borne in mind by the collector particularly as such scrapings are much more easily transported than living adults or early stages.

Hatching does not usually take place immediately the first rain falls. Nor is it to be expected that all the eggs in a tree-hole will hatch on the first immersion. Ingram & Macfie (1916*b*) found larvae at Accra in March, i.e. right at the beginning of the rainy season, but Taylor, working at Gadau, noted that 'although a few showers fell during May and June no rainwater remained more than a few hours in any of the tree-holes until the beginning of July', and Muspratt (1945) notes that at Livingstone, where the rainy season lasts from October to May, larvae are usually found from the middle of November onwards. Robinson (1950) states that at Livingstone he found larvae in tree-holes from December to May inclusive and that 'one to one and a half inches of rain falling over a period of one to two weeks is sufficient to initiate breeding in tree-holes, although most holes do not get sufficient water before about three inches have fallen'. It is to be presumed that the last eggs laid in a large tree-hole during the previous year would be near the bottom and would therefore be flooded well before the tree-hole was full, but this point does not appear to have been investigated. In view of Robinson's findings in Northern Rhodesia it seems almost certain that a number of species of *Stegomyia* can survive the dry season as adults in wetter parts of the region. There can be no doubt, however, that the adult population is very drastically reduced even under quite favourable conditions. Thus in Bwamba County during a prolonged dry spell lasting from the end of December to the end of March 20 catches made between 2 February and 11 March yielded only 7 adults of *apicoargenteus* as compared with 198 from 20 catches made during the preceding wet season (Haddow *et al.*, 1947). At Itowolo 7 catches made between 21 November and 16 May yielded 24 *africanus* as compared with 501 from 15 catches between 12 June and 25 October. In this case the number of adults taken declined very sharply even during the short dry spell between the large and small rains and 2 catches made between 24 August and 7 September yielded only 7 *africanus* (Mattingly, 1949*a*). Adults do not, of course, appear in greatest numbers until some time after hatching takes place. At Itowolo greatest numbers of *africanus* were taken shortly before the period of maximum rainfall in July and a second peak occurred shortly after the heaviest rainfall during the small rains. In this case the seasonal distribution of *africanus* was closely paralleled by that of the two species of *Diceromyia* which were the only other tree-hole breeders taken, and it was considered that the type of breeding-place must be the governing factor rather than any intrinsic difference between the species. As against this the figures given by Kerr (1933) for *africanus* and *luteocephalus* in the Yaba area, although small, do suggest the possiblity of a specific difference. In this case *luteocephalus* showed a much smaller peak in relation to the small rains and a correspondingly larger concentration during the period May to July. In addition the average catch obtained during July was more than twice that obtained during June (slightly smaller during July than during June for *africanus* at both Yaba and Itowolo). In Bwamba the wet and dry season catches referred to in connexion with *apicoargenteus* yielded 429 and 34 *africanus* respectively.

Bamboos. Among the Ethiopian *Stegomyia* the only specialized bamboo breeders are confined to the East African Highlands and cannot therefore be discussed here. Most of the Guinean species appear to breed readily in bamboo pots and several of them are known from bamboo stumps, so that it is clear that this type of habitat closely resembles the small tree-hole. Bored bamboos clearly present a distinct type of habitat, but no information appears to be available regarding their utilization by Guinean species. In Southern Nigeria the most characteristic bamboo breeders appear to be *Dunnius* spp.

Plant axils. These are the subject of a most informative paper by Haddow (1948) devoted to the breeding-places and seasonal distribution of *Aëdes simpsoni* in Bwamba County. This author found that at Bundibugiyo with a rainfall of about 55 inches, local rainfall had little direct effect on the numbers of larvae obtained since a light shower was sufficient to fill the plant axils to capacity and heavy rain could not fill them further. Three or four showers a month appeared to be sufficient under normal circumstances to maintain the larval population. Increased rainfall favoured breeding indirectly, however, through its effect on the growth of the plants. A monthly survey of the axils of *Xanthosoma sagittifolium* showed that these only dried out completely for a short period at the beginning of February and the larval population was renewed within 10 days after the first light rain. During the dry season larvae appeared to be able to survive in the merest film of water. During the short period of drought they could be obtained by immersing scrapings from the dry axils, presumably from drought-resistant eggs. It seems that in localities with a higher or better distributed rainfall or in a wetter year larvae would occur all the year round and the necessity for a drought-resistant egg would not exist. At Mombasa, with a mean annual rainfall of only 45 inches, Wiseman *et al.* (1939) found that some banana axils held water throughout the dry season. They found adult *simpsoni* to be most numerous during the drier months and suggested that heavy rainfall might wash the larvae out of pineapple crowns and leaf axils.

Rock-holes. Garnham *et al.* (1946) showed that these are of two different kinds, each supporting an entirely different fauna. Well-shaded holes in boulders in the Kaimosi Forest were found to harbour typical tree-hole breeding species such as *fraseri*, *africanus*, and *dendrophilus*, but exposed pools outside the forest contained only *aegypti* and *vittatus*. Residual pools in stream beds must also be distinguished from those which are directly dependent for their water-supply on rain. Robinson (1950) notes that at Livingstone the occurrence of such pools in combination with tree-holes may serve to provide *Aëdes aegypti* and *vittatus* with natural breeding-places for nine months of the year, whereas tree-holes alone were available only for six months. In general it would seem that the latter species is likely to be most abundant during the dry season when the water level in stream beds is low (see also Gil Collado, 1935). A rain-filled rock-hole exposed to sunlight is in general more liable to rapid desiccation than a tree-hole, and species utilizing such breeding-places must be capable of very rapid larval development. Such a capacity is certainly possessed by *vittatus*, pupae of which have been found in rock holes only 3 days after the onset of rain (Lamborn, 1930). *Aëdes aegypti* is also capable of very rapid development, at least when adequate food is available. On a particularly rich diet this species was found to be capable of completing its development from the moment of hatching to the moment of emergence in 85 hours at normal laboratory temperature (author's unpublished experiments at Yaba).

Artificial containers. These do not form a natural group. Their attractiveness for particular species depends in part on their intrinsic nature and in part on their situation. Shade and proximity to dwellings are important extrinsic factors. Most species, other than *aegypti*, very seldom enter dwellings although some, e.g. *africanus*, *simpsoni*, *luteocephalus*, are occasionally recorded. Even *aegypti* has been shown to prefer natural breeding-places when these are available in sufficient numbers, e.g. in the case of villages situated near forests or shambas (Haddow, 1945*a*; Garnham *et al.*, 1946; Dunn, 1927 *a* and *c*). Receptacles made of natural organic matter, e.g. the bamboo pots used as traps or calabashes, to some extent mimic tree-holes and form a class by themselves. The only species regularly found in small containers made of metal, pottery, or other inorganic substances or in containers in or immediately about houses is *Aëdes aegypti*, and it is evident that its ability to utilize such breeding-places accounts in large measure for its very wide distribution. Nevertheless it cannot account entirely for this phenomenon. It may explain transportation, especially by sea, and occurrence in urban centres with piped or other permanent water-supplies, but it cannot explain occurrence in rural areas where the presence of water in small containers is as much a seasonal phenomenon as its presence in tree-holes. There can be no question that this is a highly adaptable species both with respect to temperature and to rainfall requirements, probably the most adaptable of all the Ethiopian *Stegomyia* with the possible exception of *vittatus*.

In a special class are those very large containers used for conservation, e.g. tanks, cisterns, concrete wells, hollow baobab trees, and these may perhaps be essential to the survival of certain species occurring in very arid parts of the region. Thus Patton (1905) records *Aëdes vittatus* only from such places in the neighbourhood of Aden. Even here, however, fig-trees and residual and other rock pools might be expected to provide natural breeding-places at least in some years.

Biting-habits

Under this heading are included three distinct aspects of mosquito behaviour, namely host preference, the biting-cycle, which is an expression of the concentrations of any particular species found biting at various times of day and night, and vertical distribution, which is an expression of the concentrations found at various heights above ground. All these, no doubt, are related reciprocally to distribution, but in the present state of our knowledge the nature and extent of this relationship can only be dimly apprehended. They are accordingly discussed very briefly.

Very little is known concerning host selection in this group. It seems reasonable to suppose that forest species may be, in general, more specific in their preferences than those inhabiting the savannah, and certain observations communicated privately by Dr. Chwatt suggest that *africanus* may be more exclusively addicted to primate hosts than *luteocephalus*. A detailed investigation of this point would be of considerable interest. On the whole the vast and confused literature relating to zoophily and anthropophily in mosquitoes suggests that the majority of species are plastic in the sense that host specificity occurs, if at all, at the level of the strain or biotype rather than that of the species (see, in particular, Galliard, 1936, and Wanson & Nicolay, 1937). In this connexion it may be noted that '*Culex molestus*', usually regarded as a highly anthropophilic form, besides showing a preference for birds over man when given the choice will, like *Culex pipiens* and *Culex fatigans*, produce many more eggs on a meal of bird blood than on one of mammal blood (Mattingly *et al.*, in press, and author's unpublished observations on Lagos *fatigans*). Woke (1937) studied the same question using *Aëdes aegypti* and found that of the various hosts employed man and monkey were the least satisfactory. The figures he obtained, expressed as eggs per mg. of ingested blood, were Monkey 28·2, Man 29·2, Canary 42·4, Turtle 46·3, Rabbit 48·9, Guinea-pig 52·4, and Frog 52·6. As against this Toumanoff (1949) obtained more numerous eggs and greater longevity with human blood than with that of two species of lizards (*Gecko* and *Calotes* spp.). There seems to be no reason to suppose that most mosquito species are any less plastic in this respect than in their host preferences. If this is so, then the species population may be expected to adapt itself to whatever selection of hosts is available in a given locality and we ought not to be surprised if a species which readily bites man in one part of its range refuses to do so in another. A number of inconsistencies of this kind are in fact to be found in the literature relating to the Ethiopian *Stegomyia*. Thus De Meillon (1947*a*) states that in South Africa *Aëdes vittatus* does not bite man, but Robinson notes (in litt.) that it bites in Northern Rhodesia. Garnham *et al.* (1946) noted that 'Adults have rarely been found, biting, in catches in the vicinity of breeding places' in the Kaimosi Forest, while, on the other hand, Leeson has an interesting unpublished record from Malakisi, not far from Kaimosi, where *vittatus* bit in abundance in a wooded ravine but were entirely absent from native huts at a similar distance from the breeding-places. Jannone *et al.* (1946) record it as biting in Eritrea, and Lewis (1943) considered that it was probably the most important vector of yellow fever in the Nuba Mountains because 'it existed in great numbers and bit people by day and in the evening near their homes'. Gil Collado (1935) records the Spanish form as biting man avidly. Similarly Haddow (1945*a*) and Garnham *et al.* (1946) note that adults of forest populations of *aegypti* are very rarely taken biting man. *Aëdes simpsoni* has proved equally elusive in Nigeria and the Gold Coast. Full length 24-hour catches at various heights above the ground failed to yield a single adult although larvae were taken abundantly in nearby banana groves (Bugher *et al.*, in press). Short-period catches at ground level in banana groves at Asuboi also failed to yield any adults although larvae were abundant (author's unpublished observation). On the other hand, it is understood from Dr. F. N. Macnamara that this species was quite often taken biting in the British Cameroons, while Haddow (1945*c*) was able to take 596 adults in the course of ten 24-hour catches in Bwamba County. Bostock & Simpson (1905) state that this is one of the commonest species in the Low Veld region of the Transvaal, suggesting by implication that here also it bites readily. *Aëdes unilineatus* appears very rarely to bite man. The only records of its biting or attempting to bite are two from the Sudan (Lewis, 1947). This author failed to observe it biting in the Nuba Mountains although larvae were common. *Aëdes metallicus* is recorded by Lewis (1943) as biting only very near its breeding-places in the Sudan. Bailey (1947) rarely took adults in Kenya; Wiseman *et al.* (1939) found it to bite freely at Mombasa. Robinson found it to the extent of 2 per cent. among just over 2,000 mosquitoes taken biting man at Livingstone. *Aëdes apicoargenteus* was taken by Haddow *et al.* (1947) in Bwamba and Garnham *et al.* (1946) found it to be 'the dominant species in many adult catches' in the Kaimosi Forest. In Nigeria only 7 specimens were taken during a year's catching (Mattingly, 1949*b*). Garnham *et al.* (1946) took adults of *fraseri* in abundance in deep forest, but Haddow *et al.* (1947) record only one specimen from a considerable number of catches in Bwamba. Haddow, Van Someren, *et al.*, however, record it as biting not uncommonly in this part of its range (in press). Garnham *et al.* (1946) took no adults of *dendrophilus* in Kaimosi, but Haddow, Van Someren, *et al.*, record it as 'quite common' in Bwamba. *Aëdes africanus* seems to bite man readily in all parts of its range, and the same is true of *pseudoafricanus* and *luteocephalus*.

Regarding the biting-cycle it will suffice for present purposes to point out that some species are markedly crepuscular with a strongly marked biting-peak shortly after sunset. These include *africanus* (Haddow *et al.*, 1947; Mattingly, 1949*a*; Kerr, 1933), *pseudoafricanus* (Mattingly, 1949*b*; Chwatt, 1949), *luteocephalus* (Kerr, 1933; Lewis, 1943*a*; Bugher *et al.*, in press), and *metallicus* (Lewis, 1947). Others feed quite readily during the daytime, e.g. *simpsoni* (Haddow, 1945*c*), *vittatus* (Lewis, 1943*a*), *apicoargenteus* (Garnham *et al.*, 1946; Haddow *et al.*, 1947), *dendrophilus* and *fraseri* (Haddow, Van Someren, *et al.*, in press), and possibly *unilineatus* (Lewis, 1947). Concerning hosts other than man little is known, but Haddow & Dick (1948) give an interesting account of *africanus* and *apicoargenteus* feeding on anaesthetized monkeys. De Meillon (1947*a*) took *luteocephalus* on a freshly killed baboon but failed to take any in a Magoon trap baited with a monkey either at 50 ft. or at ground level. Bedford (1928) gives records of *simpsoni* and *metallicus* from horses and cattle.

With respect to vertical distribution evidence is available only for a few species. Acrodendrophilic species, i.e. those biting in greatest numbers in the canopy, include *africanus* (Haddow *et al.*, 1947; Mattingly, 1949*a*; Garnham *et al.*, 1946), *luteocephalus* (Bugher *et al.*, in press; Haddow, Van Someren, *et al.*, in press; De Meillon, 1947), *apicoargenteus* (Garnham *et al.*, 1946; Haddow *et al.*, 1947), and *fraseri* (Garnham *et al.*, 1946). It is very dangerous to base any estimate of the size of the population of such species as *africanus* on ground-level catches. It must be emphasized that such catches can give little or no idea of the relative abundance of a canopy species. Thus in a series of catches in Bwamba Haddow *et al.* (1947) took only 22 out of 502 *africanus* at ground level, while the author (1949*a*) took only 39 at ground level out of a total of 525 at Itowolo. It is true that Kerr (1933) obtained considerable numbers of '*africanus*' on the ground, but this was almost certainly due to the presence of *pseudoafricanus* as a contaminant. The presence of small numbers of the latter species, which is less addicted to the canopy than *africanus*, may also have been responsible for the rather higher percentage taken on the ground at Itowolo than in Bwamba (7·4 per cent. as compared with 4·4 per cent.). It is also essential that catches should be made during the peak biting-time. Species biting mainly on the ground include *dendrophilus* (Haddow, Van Someren, *et al.*, in press), *simpsoni* (Haddow, 1945*c*), *aegypti*, and *metallicus* (Bailey, 1947). Still less is known regarding the vertical distribution of breeding-places. Bailey (1947) obtained *simpsoni* in bamboo pots at ground, level only, and Garnham *et al.* (1946) give a similar observation on forest-dwelling *aegypti*. Teesdale (1945), however, obtained the latter in bamboo pots placed on the tops of coco-nut palms. Garnham *et al.* (1946) obtained *fraseri* and *dendrophilus* at all heights up to 60 ft. (the greatest height investigated), but note that *africanus*, while breeding at heights up to 50 ft., was five times commoner at ground level than higher up.

ZOOGEOGRAPHY

The existence of two major elements in the Ethiopian fauna, a West African on the one hand and an East and South African on the other, has long been recognized. Chapin (1932), basing his conclusions mainly on the birds, has mapped out an approximate boundary for the West African sub-region and Edwards (1941) attempted to fit this to the distribution of the mosquitoes. The latter author gives a list of species supposed to be confined to the forested part of this area or to spread only into the adjacent savannah. Among the *Stegomyia* he includes *Aëdes apicoargenteus*, *fraseri*, *luteocephalus*, and *dendrophilus*. Of these, however, only *apicoargenteus* occurs within the area of more or less continuous closed canopy forest where it is accompanied by *Aëdes africanus*, a species which Edwards does not include and which is certainly found well outside the sub-region. *Aëdes luteocephalus* is not a forest species at all. It is a savannah species which does not enter closed forest. It extends far beyond the boundaries of the sub-region. Of the four species listed by

Edwards only *fraseri* and *apicoargenteus* are even approximately confined to the West African sub-region and even these are found in certain isolated forest areas around the Kavirondo Gulf which lie in Chapin's East African Highland District. *Aëdes dendrophilus* resembles *fraseri* in possessing a restricted forest-fringe type of distribution but, like some birds and Lepidoptera, this species also occurs in the forested parts of Natal, an interesting distribution suggesting that it is a more ancient species than the others, probably a relict from some past pluvial period when the southern forests were more nearly continuous with those of central Africa (see Chapin, 1932: 376, and Moreau, 1933). For general notes on mosquito distribution in the region see Haddow (1945*a*), De Meillon (1947*b*), Lewis (1947), and Abbott (1948).

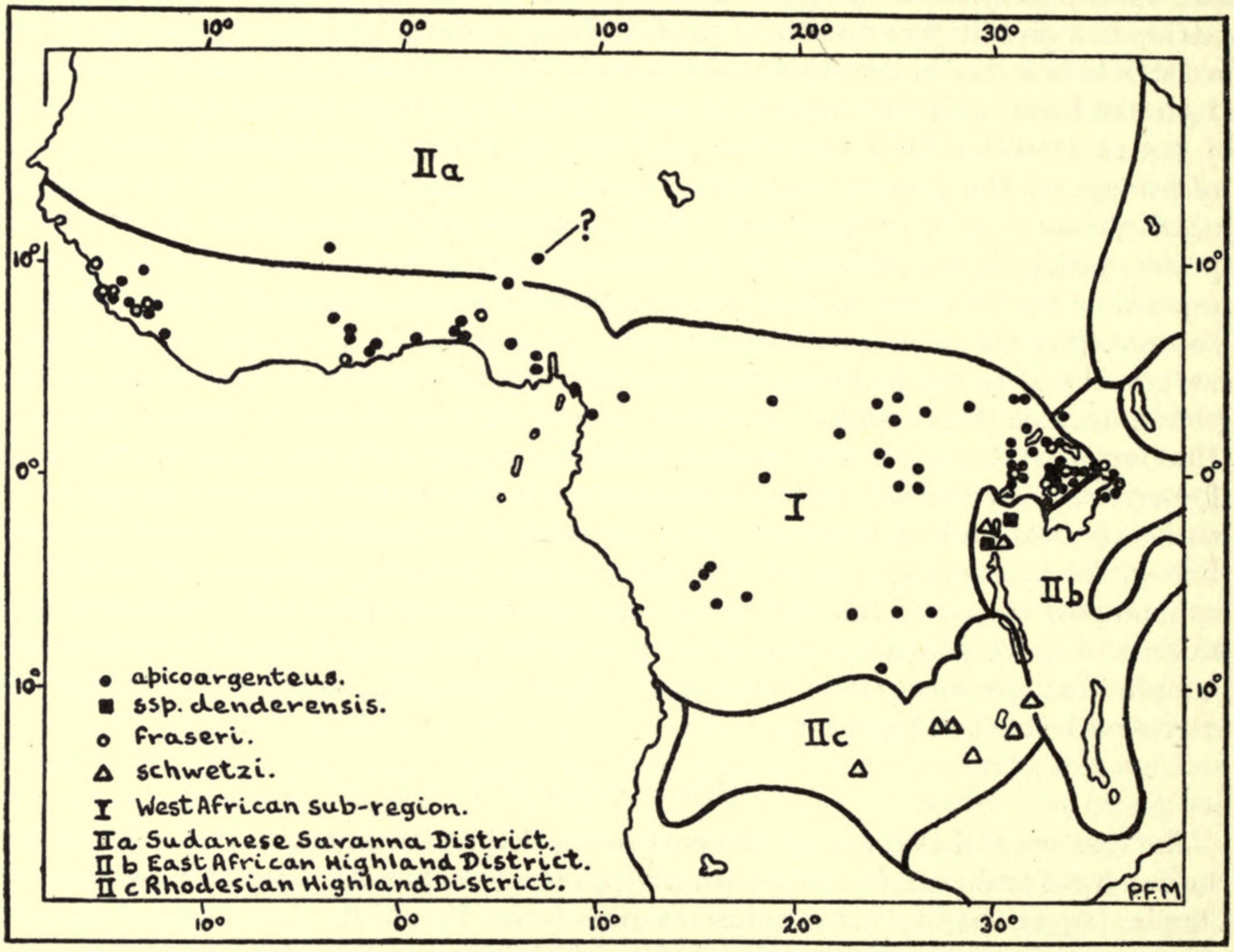

FIG. 4. Distribution of the *Aëdes apicoargenteus* group.

Of all the West African species only *apicoargenteus* can be said to be typical of the sub-region in the sense that it occupies the whole or a large part of it and extends for only short distances beyond its boundaries (Fig. 4). This species is therefore discussed first.

Aëdes apicoargenteus. In so far as our knowledge goes, the distribution of this species fits Chapin's boundaries very well. The only certain records outside them are from Kitgum and a few localities round the Kavirondo Gulf, all in the East African Highland District, and Lorha in the Sudanese Savanna District. There is also a probable record from Kaduna in this district. All these localities have mean annual rainfalls of at least 45 in., but if the 45-in. isohyet is taken as the limit of distribution, further exceptions must be made, since Accra, Anecho, and Masindi Port certainly, and Katompe and Kiansonzi probably, have a lower rainfall than this. The explanation appears to be that, within limits, the monthly distribution of rain is as important in determining distribution as its total amount. Accra and Anecho lie in the curious dry belt extending approximately from Cotonou to Cape Three Points, where the coast runs parallel to the path of the south-west monsoon instead of cutting sharply across it as it does farther east and west. Although the rainfall in this area is low the

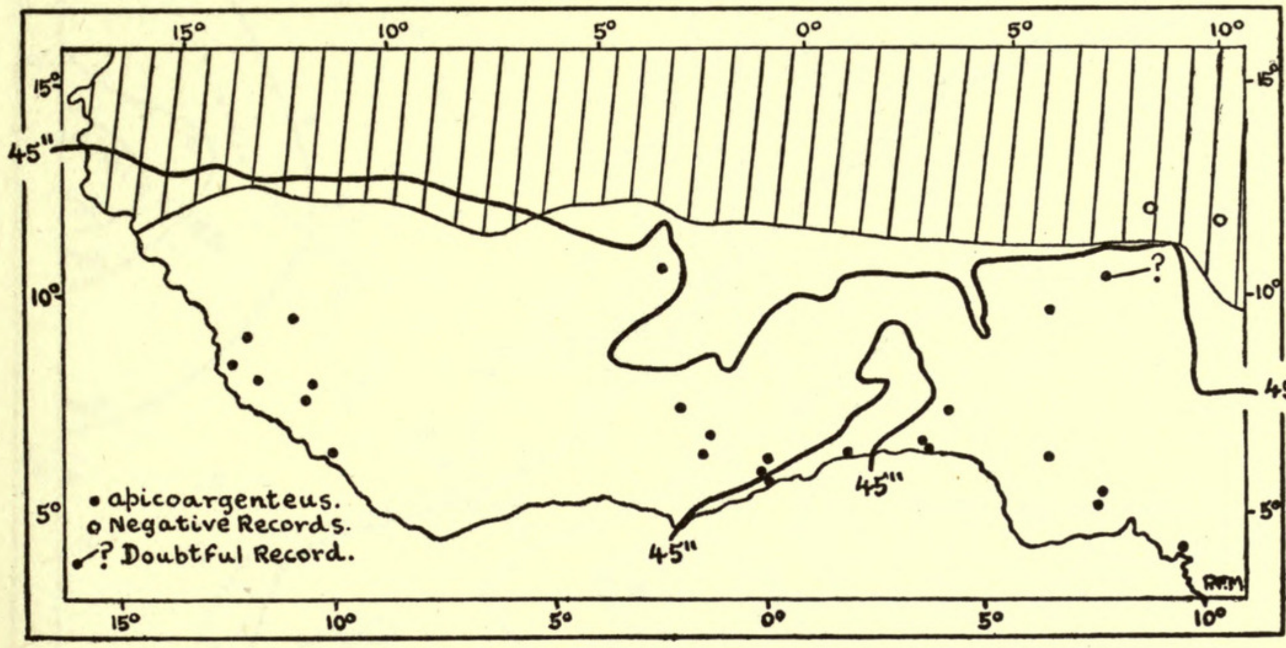

FIG. 5. Distribution of *Aëdes apicoargenteus* in West Africa. The shaded area receives less than 1 in. of rain during each of six or more months in the year. Rainfall contours after Nash (1948).

proximity of the sea maintains a high atmospheric humidity and the seasonal distribution of rain is very equable, there being, on an average, only 4 dry months (i.e. months with less than 1 in. of rain) at Anecho and 3 at Accra. Even so, however, it is unlikely that *apicoargenteus* occurs permanently within the area since in some years the rainfall is almost certainly too low (e.g. 10·84 in. at Accra in 1926). It is noteworthy that the record from Accra (Macfie & Ingram, 1923*b*) was for December 1918, i.e. the end of a 3-year period of exceptionally heavy rain (41·05 in. in 1916, 44·20 in. in 1917, and 32·37 in. in 1918). Deducing empirical limits from the data available it may be said that *apicoargenteus* is not known to occur anywhere with less than 25 in. and 3 dry months, 30 in. and 4 dry months, or 45 in. and 5 dry months. On this basis we might expect to find the species everywhere in the western part of its range with 5 dry months or less, and such a distribution is in good accordance with the data available. Reliable negative records are few and, in general, no use is made of these in the present paper. Those shown in Fig. 5 (Gadau and Kano) seem to be the only ones of much value in the present instance.

In the eastern and southern parts of its range the distributional limits of *apicoargenteus* are probably mainly altitudinal. Over almost the whole of Uganda rainfall is high and extremely equable in its annual distribution (Masindi Port and the Kiansonzi area have only one dry month), but there is some reason to suppose that the species may be absent from the extreme northern part of the territory. Thus Lumsden in a recent survey failed to find it beyond Payida in the West Nile Province although other localities visited (Godia, Laufori, Metu, Midia, Rumogi) would seem, to judge from nearby rainfall stations, to have plenty of rain (3 dry months in each case). It cannot, however, be said that reliable negative records have been established

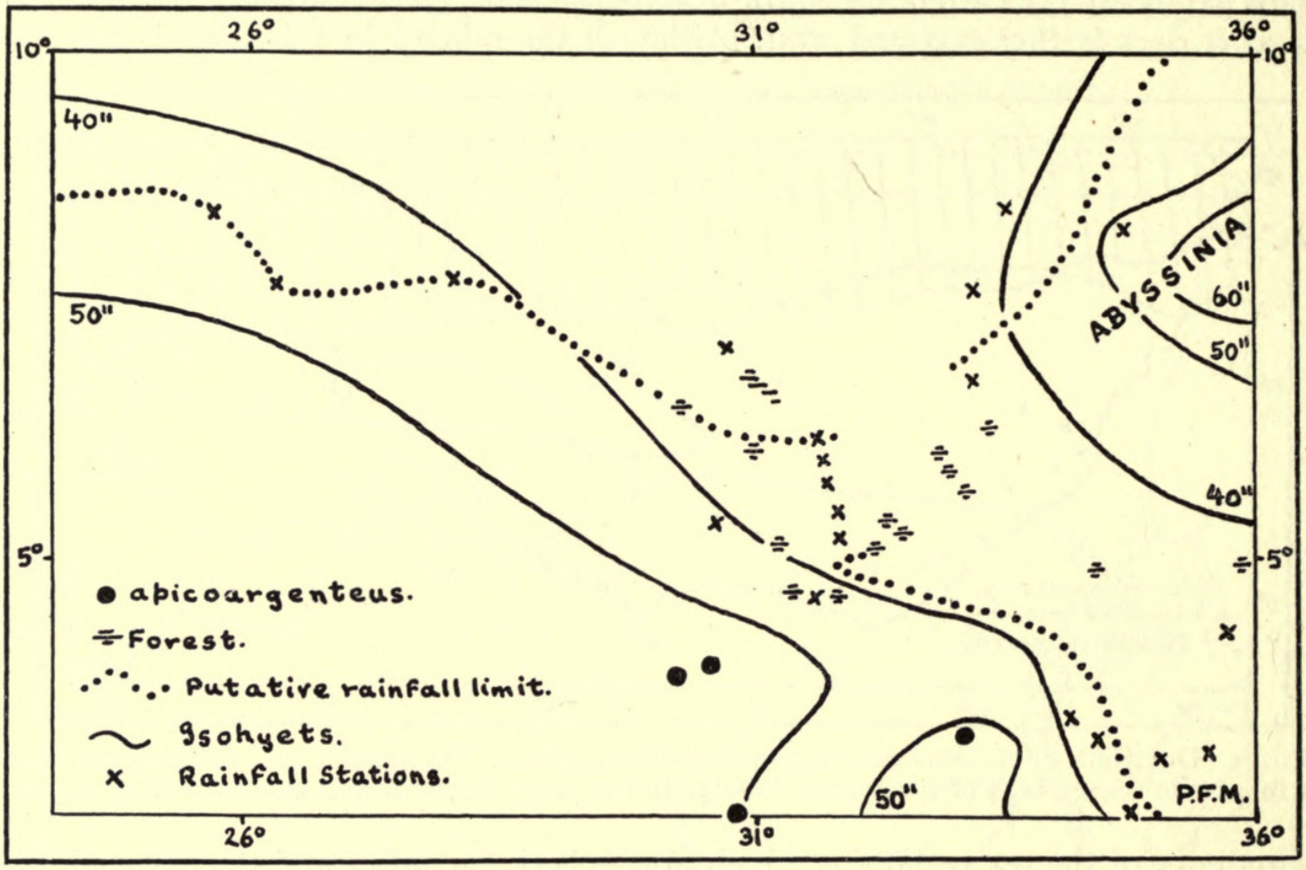

FIG. 6. Distribution of *Aëdes apicoargenteus* in north-east Uganda and the Sudan. Only those rainfall stations are shown which are in the critical area.

for this area, since the survey was a very short one. When the empirical limits deduced for the western part of the range are applied here an exceedingly interesting picture is obtained (Fig. 6). The boundary turns east in the neighbourhood of Juba and again farther north in the neighbourhood of Bor. How far east it runs is unknown since no figures are available from this comparatively little-known part of the Sudan, but it is tempting to suppose that it may join with a similar boundary delimiting the wetter parts of Abyssinia. The similarity of the Abyssinian and West African faunas has often been a matter for comment (see, e.g., Carpenter, 1935), and whether a bridge still exists in this region or not, it seems reasonable to suppose that a relatively slight change of climate would suffice to recreate one. *Aëdes apicoargenteus* is not known from Abyssinia, but so little collecting has been done there that negative records are quite valueless. *Aëdes africanus* is known from the Sidamo Province so that the existence of a fairly recent link between the Abyssinian and Guinean *Stegomyia* may be safely inferred. The more northerly part of the Bor–Pibor region is largely swampy and is stated by Lewis (1947) to possess very few trees, but the map (NB 36 of the International Series) shows small isolated patches of forest having the appearance of relicts of a continuous belt running north-east from Mongalla to the Abyssinian border. Collections from these patches of forest as well as from others in the Bor, Mongalla, and Juba areas would be of great interest.

From Mt. Elgon southwards the distribution of *apicoargenteus* is limited well to the

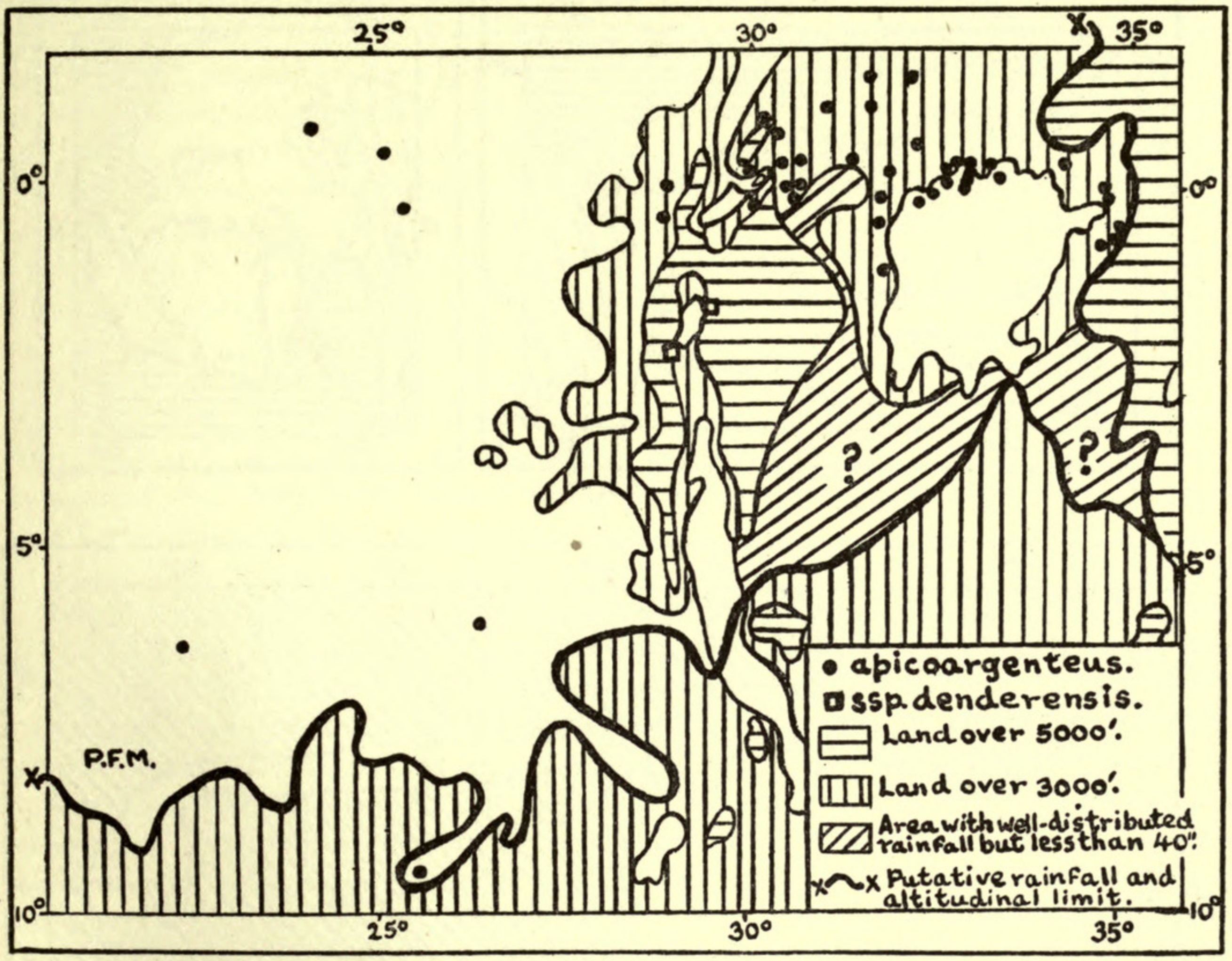

FIG. 7. Distribution of *Aëdes apicoargenteus* in the southern and eastern parts of its range.

west of the 45-in. isohyet by altitudinal factors (Fig. 7). Haddow, Van Someren, *et al.* (in press), report that it does not occur above about 5,500 ft. on the western slopes of Ruwenzori, and Garnham *et al.* (1946) record it up to approximately the same altitude in Kavirondo. This is a critical level for many plants and animals at this latitude (see Chapin, 1932). Considerable areas of northern Tanganyika, while having less than 45 in. of rain in the year, have a sufficiently well-distributed rainfall to support the species, at least on the basis calculated for West Africa. No collecting has, however, been done except at and near Mwanza, from which there is a negative record.[1] Once again surveys of isolated patches of forest would be of considerable interest. In the Kivu Highlands *apicoargenteus* appears to extend up to at most 5,000 ft. Above this it is replaced by *schwetzi* (very rare as far north as this) or more

[1] See Appendix.

commonly by ssp. *denderensis*. Farther south still, as noted by Chapin for the birds, the altitudinal limit is much lower and it is not known to occur above 2,500 ft. or possibly 3,000 ft. (Kayembe-Mukulu). In the Katanga and the Rhodesian Highlands it certainly does not reach 4,000 ft. (Elisabethville, Ndola), and it is replaced at these altitudes and, farther south still, at 3,500 ft. (Balovale) by *schwetzi*. It seems im-

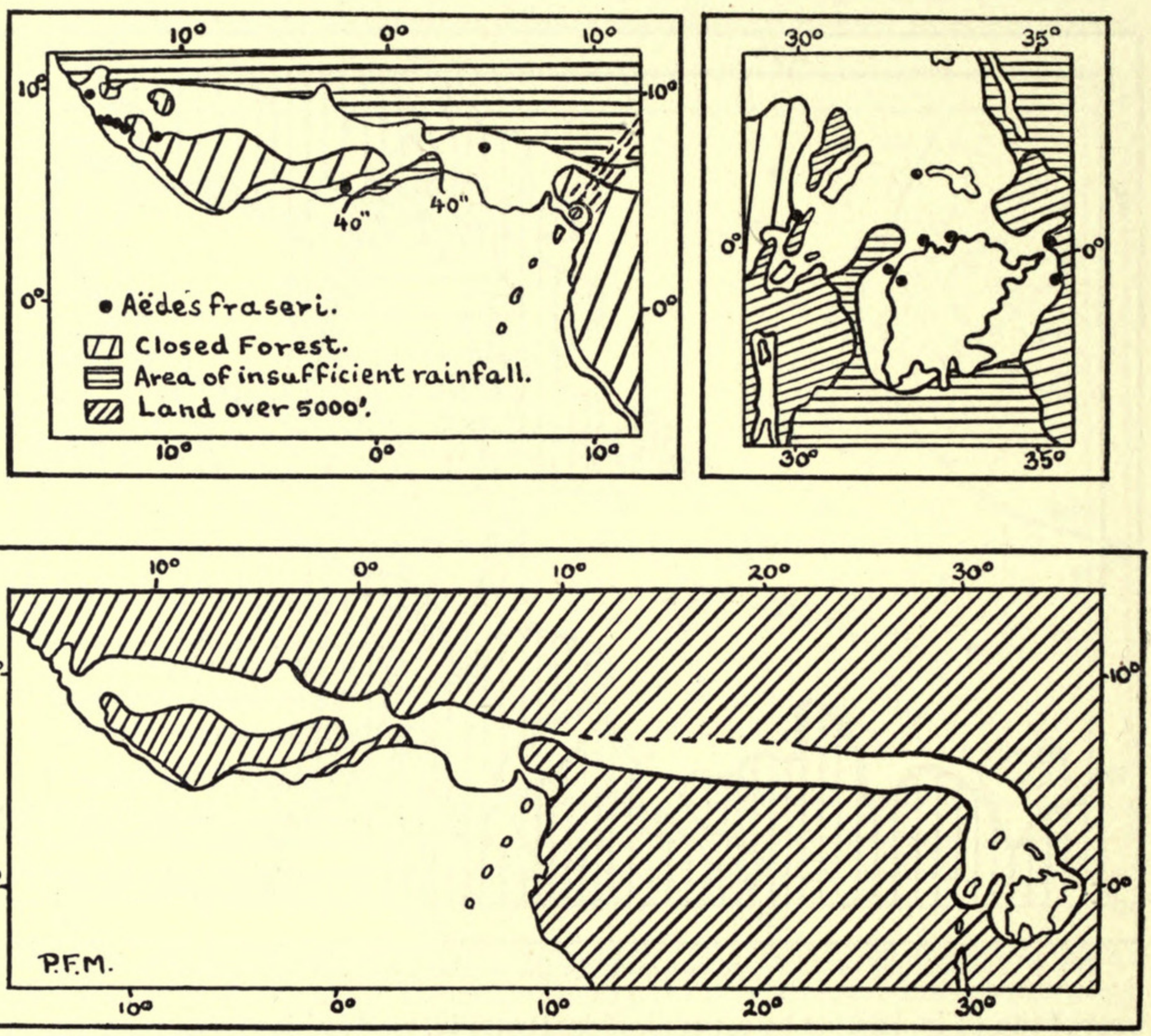

FIG. 8. Distribution of *Aëdes fraseri* in the western and eastern parts of its range and putative range as a whole.

probable that this species would be found anywhere in the southern Congo above about 3,000 ft.

Summarizing the distribution of *apicoargenteus* it may be said that it shows a much less clear-cut relationship to rainfall and altitude than do a number of other species. The explanation may be that it requires for permanent survival in an area a more purely equatorial type of forest than the dry or mixed forests which suffice for, for example, *africanus*. This matter is, however, beyond the scope of the present paper and must be left for discussion in a later one.

Aëdes fraseri. As already noted this species has a peripheral or fringing distribution relative to the main Guinean forests (Fig. 8). Haddow states (in litt.) that, unlike *apicoargenteus* and *africanus*, it is never taken more than a short distance inside the Semliki Crown Forest. Garnham *et al.* (1946) found it in the depths of the Kaimosi Forest, but it would appear that this is a comparatively poor type of relict forest. Chapin (1932: 232) discusses the distribution of birds having a similar habit and states that they follow the northern border of the Congo forests in a narrow band and sometimes extend southwards along the eastern edge of the forests or occur in places along its southern margin. Except at Dubreka *fraseri* is not known to occur anywhere with a rainfall of less than 40 in. or more than 3 dry months. Dubreka has 4 dry months with a rainfall of over 150 in., and here the species is at present known only from mangrove. Applying the limits of 40 in. with 3 dry months or 100 in. with 4 dry months a putative distribution is obtained which is in very good agreement with the known distribution of *fraseri* and the type of distribution described by Chapin (Fig. 8). An extensive area with comparable rainfall also exists in the southern Congo, and it is possible that *fraseri* may be found there although at present there are no records. Similar altitudinal limits appear to apply to this species in Uganda and Kenya to those given for *apicoargenteus* (Garnham *et al.*, 1946; Haddow, Van Someren, *et al.*, in press). It is to be noted that the dry area in the Gold Coast and Togoland and, farther east, the Adamawa Highlands both constitute serious interruptions to the distribution and it would seem that the Upper and Lower Guinean populations may at times be discontinuous.

Aëdes dendrophilus. In the northern part of its range this species appears to have a fringing distribution very similar to that of *fraseri* (Fig. 9), but its putative rainfall limits are even more restricted since it is not known from anywhere with more than 2 dry months in the year.[1] In addition it is also known from an area in Natal with the same type of rainfall and from Fernando Po which suggests that it is a rather ancient species with, at one time, a much wider distribution. This view is also supported by its morphological characters. Its altitudinal limits appear to be much the same as those cited for *fraseri* (Garnham *et al.*, and Haddow, Van Someren, *et al.*, loc. cit.). Various small, isolated areas in the southern part of the continent appear to possess an adequate rainfall for the species and not all of them are at impossible altitudes. Among the more promising are the Haenertsberg–Magoebaskloof area of the Transvaal, the Mbabane region of Swaziland, parts of Mozambique (Vila Paiva d'Andrada and Chinde–Pebane areas), the Inyanga, Morgenster, Bikita, Mt. Silinda, and Umtali regions of Southern Rhodesia, and certain localities in southern Tanganyika at the northern end of Lake Nyasa (Makete, Musekera, Mwitika, Kyela).

Aëdes africanus. Like *apicoargenteus* but unlike *fraseri* and *dendrophilus* this species is found in the depths of closed canopy forest which does not therefore constitute a barrier to its distribution. Among mosquitoes, as noted by Chapin for the birds, this capacity to penetrate thick closed canopy forest is the exception rather than the rule. Unlike *apicoargenteus*, *africanus* has not been found in the dry part of the Gold Coast. It is, however, able to surmount the Rhodesian Plateau and in consequence its distribution is very closely and completely defined by the 40-in. isohyet except to the east of Lake Victoria where there is a complete altitudinal

[1] See Appendix.

barrier and south of Lake Nyasa where the rainfall is sufficient but its distribution is unsuitable (Fig. 10). The only records from outside the distributional area so defined are those from Zomba (Theobald, 1901) and Mozambique (Howard, 1912), of which the former certainly and the latter very probably fall within an isolated area of adequate rainfall which may well support a relict population (Fig. 11). It is

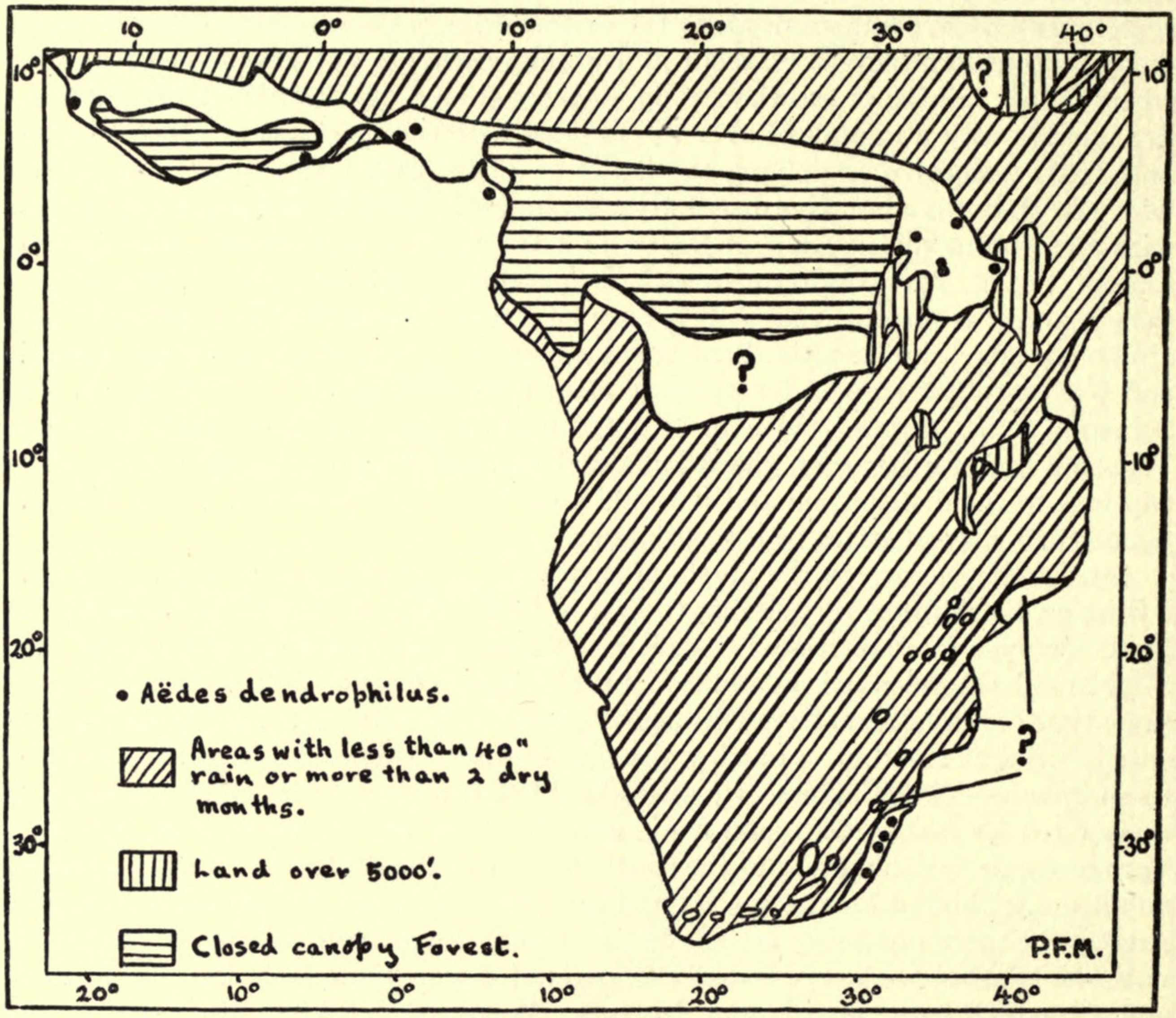

FIG. 9. Distribution of *Aëdes dendrophilus*.

unfortunate that these records can no longer be checked. The putative distributional limits of 40 in. with 4 dry months, 45 in. with 5 dry months, or 50 in. with 6 dry months, deduced empirically from the known distribution, fit this distribution so well that it can scarcely be doubted that they are significant. As to whether their effect on the species is direct or indirect, through the effect on vegetation, is not at present known.[1] The existence of a relict population of this species in Abyssinia has already been referred to. Altitudinal limits appear to be similar to those of *apicoargenteus*, but with a decidedly greater tolerance of high altitude especially in the southern part of the range. Known limits include 5,500 ft. on Ruwenzori (Haddow & Van Someren,

[1] See Appendix.

1950), about 6,000 ft. in the Kavirondo region (Garnham *et al.*, 1946), about 6,000 ft. in the Kivu Highlands (Costermansville) and in Ruanda (Dendezi), about 5,500 ft. on the Kibara Massif (R. Vakila) and on the Bihé Plateau (Bihé), and about 4,000 ft. on the Rhodesian Plateau (Elisabethville, Ndola). The record from the Sidamo Province of Abyssinia (Bevan, 1937) is associated with an altitude of 5,900 ft.

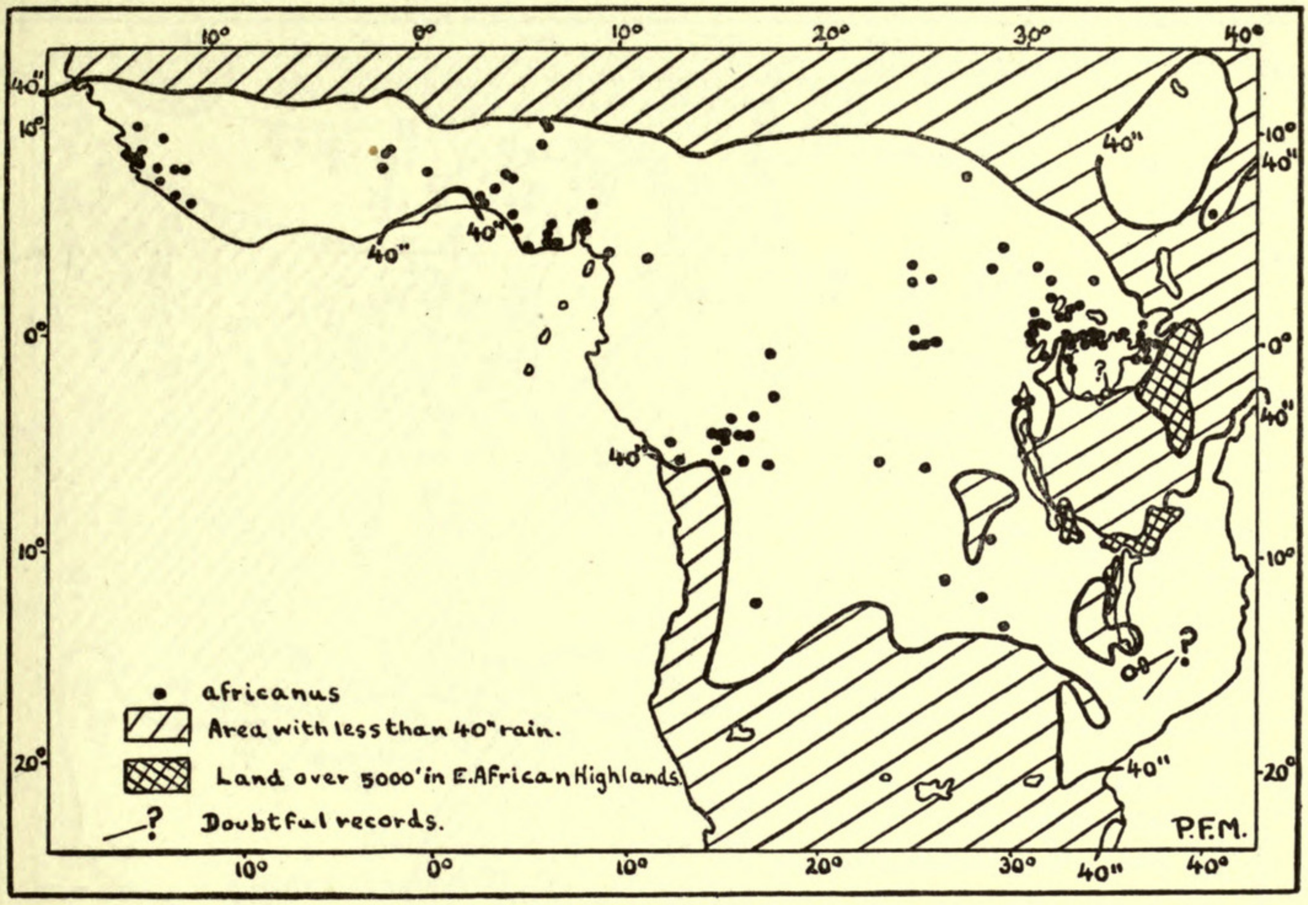

FIG. 10. Distribution of *Aëdes africanus*.

Aëdes simpsoni. This is the only species, in addition to those already discussed, which occurs in the area of continuous closed canopy forest. Its presence here is almost certainly the result of introduction by man, since Haddow (1945*c*, 1950, &c.) has clearly shown that it is a mosquito of the forest edges and especially of plantations and shambas, and its occurrence in the forest proper is confined to stray individuals and is so rare as to be without significance. Haddow has pointed out, in conversation, that very much traffic takes place in young pineapple and banana plants which frequently contain larvae. As a plant-axil breeder it flourishes in areas of very much lower rainfall than can be tolerated by the species so far discussed. The minimum average rainfall tolerated is, as far as present records go, 20 in. with 8 dry months (Sennar), and the 20-in. isohyet fits the known distribution very well (Fig. 12). These rainfall requirements appear to exclude it entirely from Chapin's Sudanese and Somali Arid Districts and from his South-West Arid District (except in the Bulawayo area). Otherwise it occurs in all the main faunal districts. Its altitudinal limits appear to be much the same as those of *africanus* and it is known from up to about

5,500 ft. on Ruwenzori, 5,000 ft. in the Cameroons and in Eritrea, 6,000 ft. in the Kivu Highlands, 5,500 ft. on the Bihé Plateau, 4,000 ft. on the Rhodesian Plateau, and 4,500–5,000 ft. in the Transvaal (Roberts Heights) and Southern Rhodesia (Salisbury, Bulawayo). It is rare on the Rhodesian Plateau, but Robinson (1950) considers this to be due to the absence of banana plantations. Garnham *et al.* (1946) appear to have found it up to about 6,000 ft. in Kavirondo but, unfortunately,

FIG. 11. Distribution of *Aëdes africanus* in the south-eastern part of its range showing rainfall and number of dry months.

its distribution in other parts of the Kenya Highlands is not known with certainty since no records from altitudes above about 4,500 ft. can now be confirmed. The virtual isolation of the Transvaal and Natal population by a dry belt in Southern Rhodesia and Mozambique has been noted above.

Aëdes luteocephalus (Fig. 13). This species appears, if anything, to be even more reluctant to enter closed forest than *simpsoni*. Haddow has stated, in conversation, that it will not enter the edges of the Semliki Forest even though it may be biting freely in the open. As a corollary to this it appears to be entirely absent from the Upper and Lower Guinean Forests even though it has succeeded in establishing itself in coastal areas where the former has been cleared (e.g. Roberts Field). It has also been recorded from two localities (Adun, Bende) in the western extension of the

Lower Guinean Forest beyond the Cross River. These records cannot now be confirmed from specimens and may have referred to *africanus*. It is in any case probable that the forest in this area has by now been so broken up as to constitute only a partial barrier. It appears to be even more resistant to drought than *simpsoni*, the

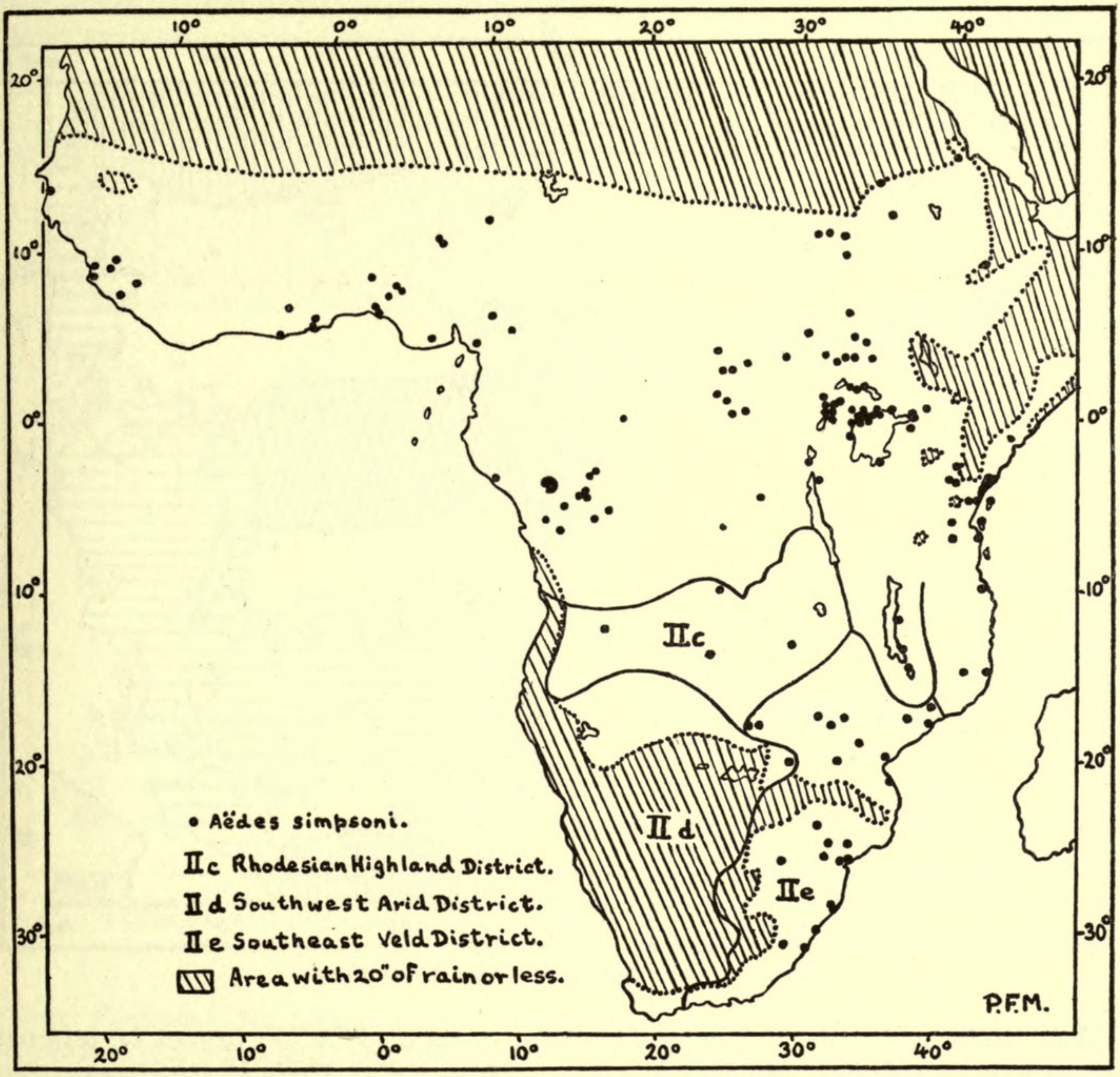

FIG. 12. Distribution of *Aëdes simpsoni*.

lowest rainfall recorded anywhere in the northern part of its range being 15 in. with 8 dry months (Danagla and Wad el Magdub in the Wad Medani area). In the southern part of its range it is also known from Maun, which has only 15 in. The record from Nefasit shows that in this part of its range it can occur up to about 5,000 ft., but elsewhere it is rare above about 3,500 ft. In western Kenya it has been recorded from two localities at about 4,000 ft. (Kerio, Fort Hall), but on the Uganda Plateau it is very rare and the only records which can be confirmed are from about 3,000 ft. in the Semliki Valley and from between 3,000 ft. and 4,000 ft. in the West Nile

Province. The record from Mpumu cannot now be confirmed and may have referred to *africanus*. As against this it seems possible that *luteocephalus* occurring in this region may occasionally have been misidentified as *africanus*. On the Rhodesian Plateau it has been recorded from Balovale (3,400 ft.) and Ndola (4,100 ft.). At Ndola it varies in abundance from year to year and in one year only a single specimen was

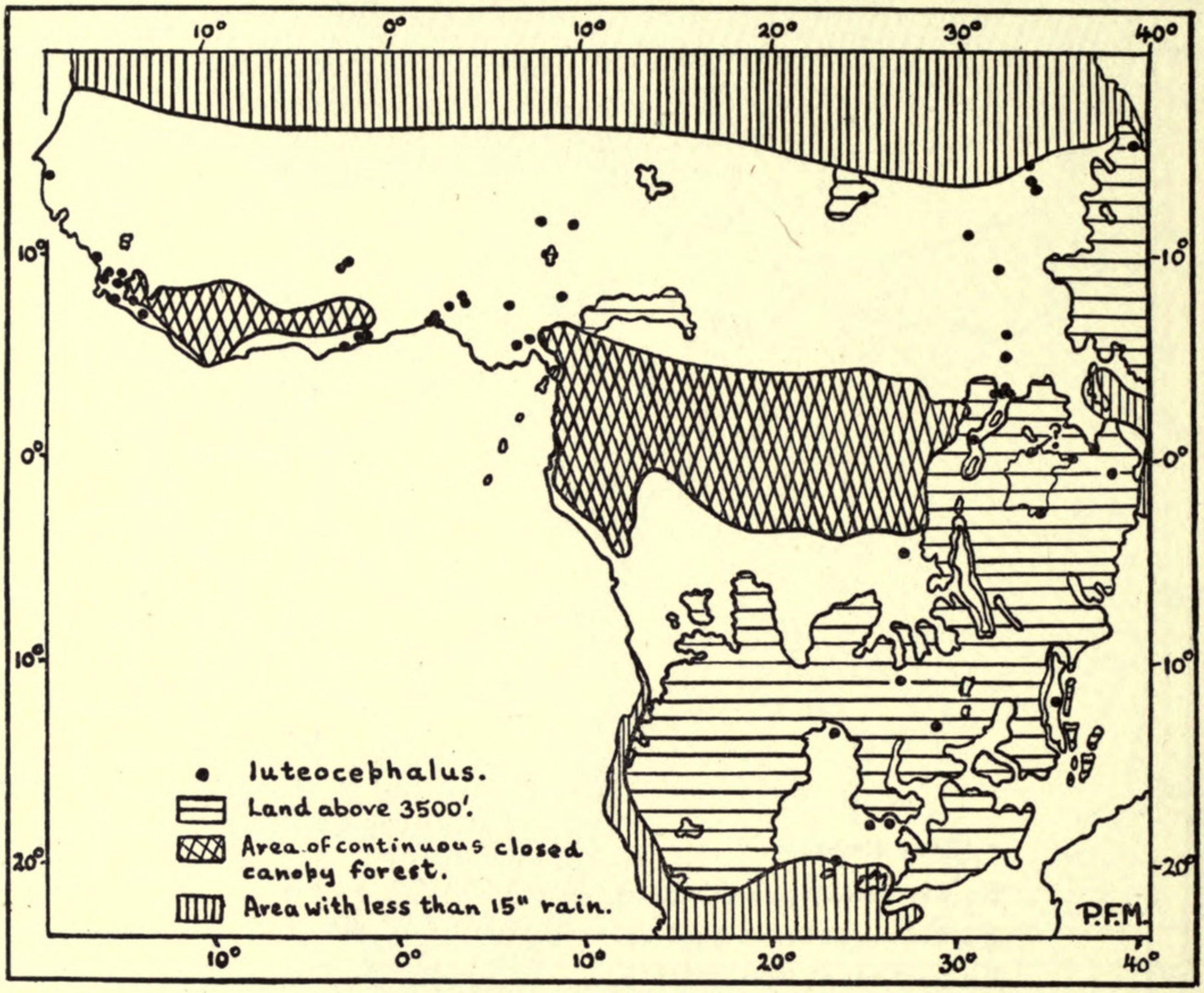

FIG. 13. Distribution of *Aëdes luteocephalus*.

taken (Robinson in litt.). The eastern limit of its distribution cannot be inferred since no collecting has been done in western Tanganyika. There is a single specimen from Likoma Island off the eastern shore of Lake Nyasa in the London School of Hygiene collection. Nor is it known whether it occurs in Mozambique, but it may be taken as virtually certain that it does not extend nearly as far south as *simpsoni*.

Aëdes unilineatus. This species is of interest as being one of the few Ethiopian *Stegomyia* which also occurs in the Oriental Region. Like *luteocephalus* it is purely a savannah mosquito, but its resistance to drought appears to be even higher and it is on record from several places with rainfalls of about 10 in. (Dolo, El Fasher, Erkowit). Unlike *luteocephalus* it does not occur in deforested areas with high rainfall such as Freetown and it is not, in fact, known from anywhere in Africa with more than 55 in. per annum (Tembura). It is not known whether it occurs in those parts of Arabia with adequate rainfall and there are no acceptable negative records even from the Aden region since it is not clear that anybody has searched in tree-holes. It is stated by persons with local knowledge that the latter are by no means rare in the wetter parts of Arabia, especially in fig-trees growing in the wadis. It is not known from anywhere above 4,000 ft. except Erkowit, which is in the hottest part of its

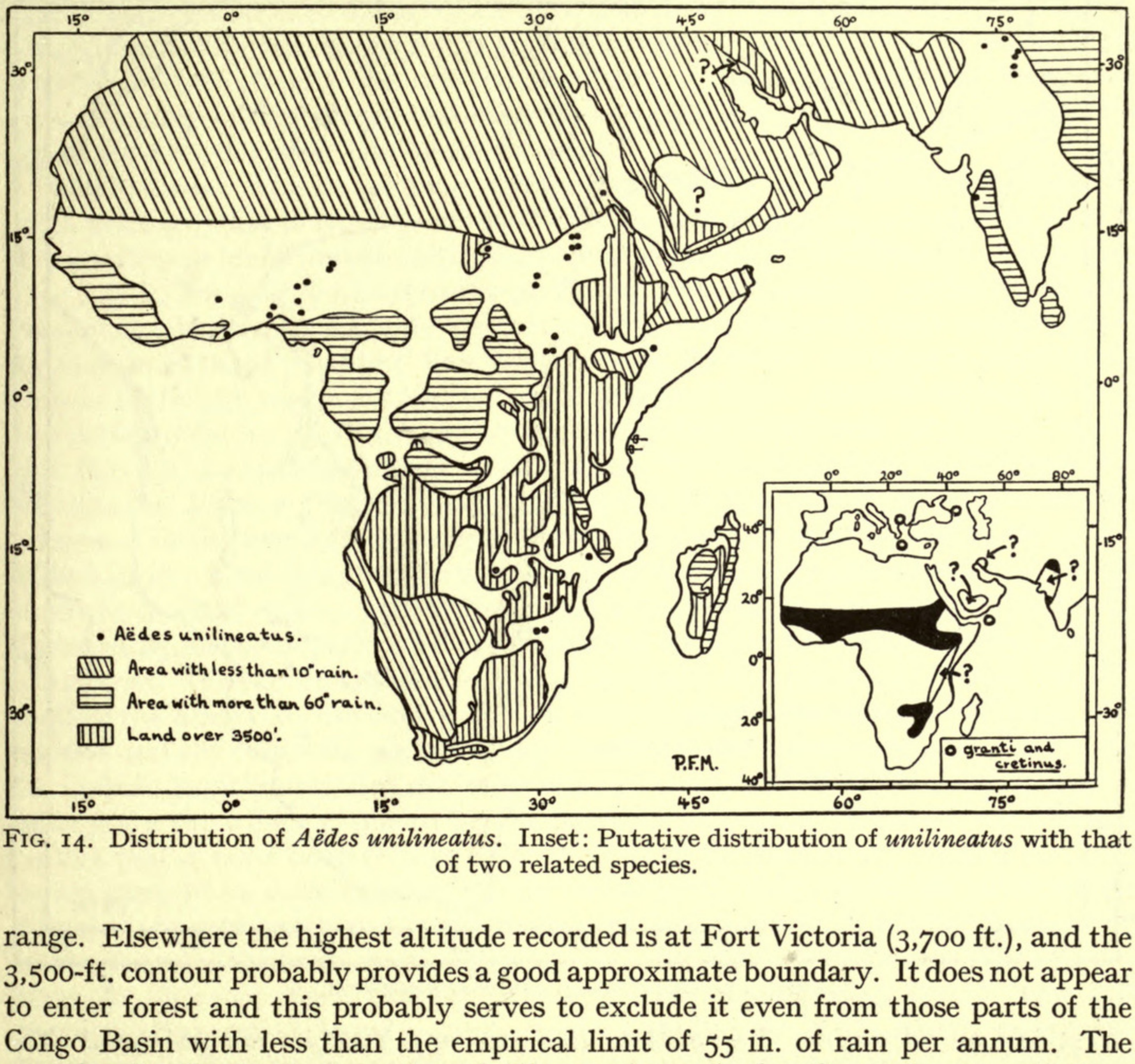

FIG. 14. Distribution of *Aëdes unilineatus*. Inset: Putative distribution of *unilineatus* with that of two related species.

range. Elsewhere the highest altitude recorded is at Fort Victoria (3,700 ft.), and the 3,500-ft. contour probably provides a good approximate boundary. It does not appear to enter forest and this probably serves to exclude it even from those parts of the Congo Basin with less than the empirical limit of 55 in. of rain per annum. The putative distribution is shown inset in Fig. 14. As to whether the southern populations of the Zambesi and Limpopo valleys are linked with the northern population of the Sudanese and Guinean savannahs is not known, but, in view of the fact that it occurs as far east as Dolo, it seems possible that it may extend southward along the edges of the central plateau. The Indian records seem to indicate similar climatic limits with the exception of that from the Bombay area. The rainfall here is about 70 in. per annum. It appears that *unilineatus* is a relict of a fauna which was at one time widespread over much of Asia Minor. Related species still occurring in this area include *granti*, which is known only from Sokotra, and *cretinus*, which has been recorded from Crete (Edwards, 1921*b*), Macedonia (as *delta*, Séguy, 1924), and Transcaucasia (as *albopictus*, Rhoudkhadzé, 1926; as *lindtropi*, Schingarew, 1927, and see Stackelberg, 1937).

Aëdes metallicus. This species has been recorded from only four localities in the

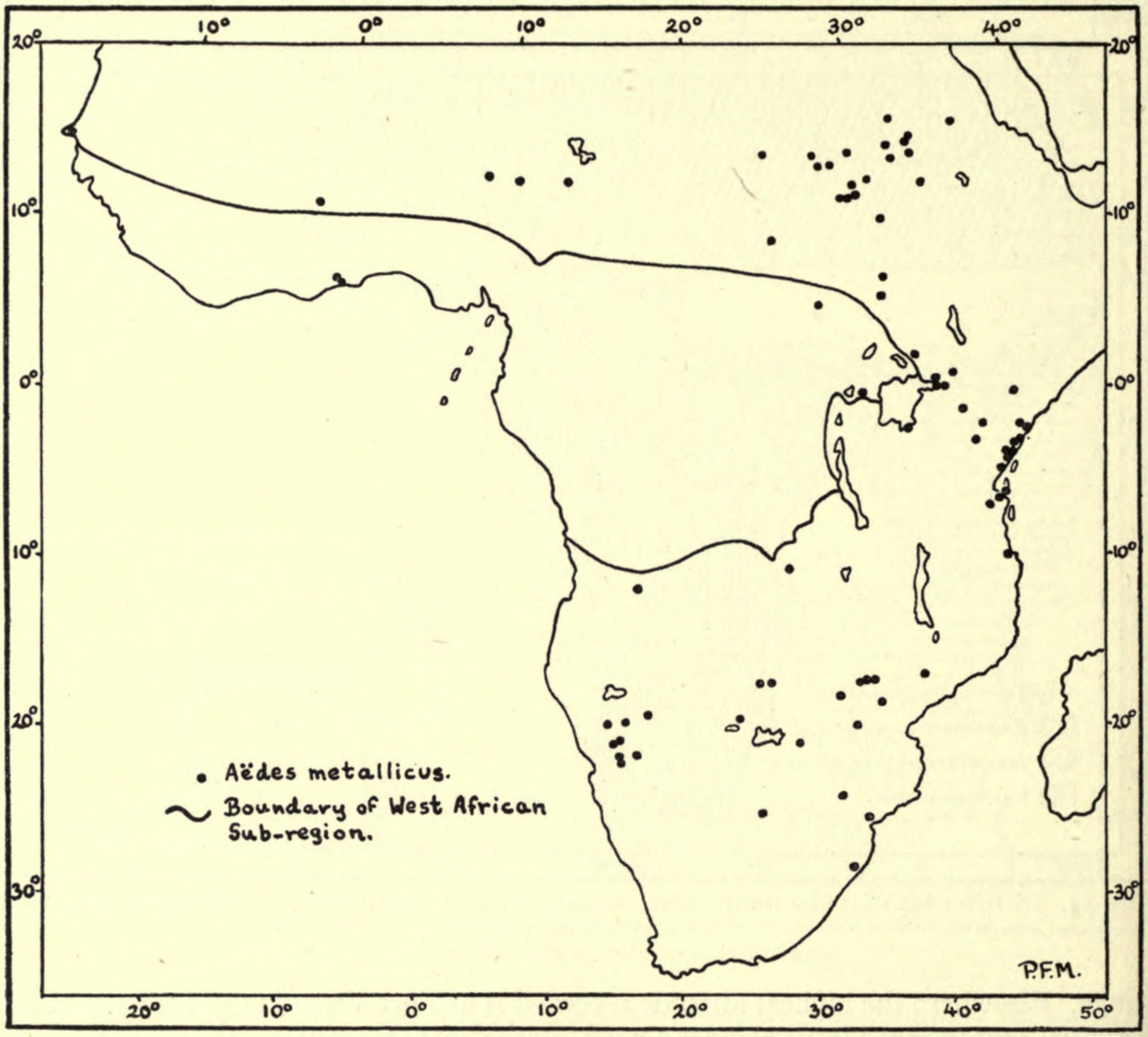

FIG. 15. Distribution of *Aëdes metallicus*.

West African sub-region. Two of these (Mbarara and Yambio) are peripheral. The other two (Accra, Asuboi) are in the dry area of the Gold Coast and Togoland (Fig. 15). Its resistance to drought appears to be greater even than that of *unilineatus* and it is the only species so far discussed which occurs widely in Chapin's South-West Arid District. It is not, however, known from Arabia. Despite its almost complete absence from the West African sub-region it is known from several localities in East Africa with quite high rainfall, e.g. Kakamega with 70 in. and Tanga with 60 in. It seems probable that temperature plays a greater part in controlling the distribution of this species than in the case of those previously discussed. Its altitudinal limits vary in different parts of the range. In Kenya it has been recorded from an indefinite altitude in the Fort Ternan area (Garnham *et al.*, 1946), apparently about 6,000 ft., and from 5,500 ft. in the Nairobi area. There are no records from the Kivu Highlands and only one from the Rhodesian Plateau (Jadotville, 4,300 ft.). On the Bihé Plateau it apparently occurs at about 5,500 ft. and in South-West Africa it occurs up to about 4,500 ft. (Okahandja). It appears to be absent from the higher parts of the Transvaal where it has not been recorded above about 2,000 ft. (Letaba), but in Southern Rhodesia it occurs up to 4,800 ft. (Salisbury). Morphologically it is unique among the Ethiopian *Stegomyia* in lacking a ventral process from the paraprocts, a feature which recalls the oriental members of the sub-genus. Its mesonotal ornamentation is also unique and suggests a comparison with the *Aëdes longipalpis* group *vis-à-vis* the other Ethiopian *Finlaya*.

Aëdes vittatus. This is the most widely distributed of the species here discussed (with the exception of *aegypti*). It combines drought resistance, due at least in part to its ability to breed in rock-pools, with a marked ability to withstand low temperatures. It is, however, by no means equally common everywhere. In the Lagos area it is extremely rare, having only been recorded once. In Bwamba only a single specimen has been taken (Haddow, Van Someren, *et al.*, in press). It appears to be absent from or extremely rare in a large area of the Belgian Congo, a fact which may perhaps be related to the nature of the surface rocks (Lubilash sandstones, see Chapin, 1932: 30). It is not clear to what extent it enters forest, but Garnham *et al.* (1946) specifically mention its absence from shaded forest rock-holes and there are many indirect references in the literature to suggest that it is largely or entirely a mosquito of the open country. That this does not preclude it, as it apparently precludes *luteocephalus*, from the forested eastern part of the Congo is readily understood from the fact that its breeding-places of preference are commonly found in the exposed beds or edges of streams. The occurrence of this species in Spain is of particular interest since it implies the ability to contend with two sets of adverse conditions, the long, cold winters and the torrential nature of the breeding-places during spring and summer. Gil Collado (1935) notes that it is most abundant in the autumn. It is not known in what stage the winter is passed in this part of the range, although it seems almost certain that it must be in the egg. On the basis of the Ethiopian records alone, this would seem to be more resistant to low temperature than any of the other species discussed, except perhaps *aegypti*, if only because it occurs in a number of places in the Kenya Highlands well above 6,000 ft. (Eldoret, Kericho, Kiambu, Kitale, Mara R., Maseno, Meru, Narok). There is also an interesting record from Sipi (6,700 ft., Hancock & Soundy, 1929), on the Uganda side of Mt. Elgon. As against this there are some rather striking negative records. Patton (1905) notes that it has not been found on the Jebel Jihaf above Ulub. Mara (1945) failed to find it on Mt. Bizen. (This may have been a coincidence, but it seems to be a very common mosquito at lower levels.) It appears to be very rare on the Rhodesian Plateau, where the only records are from Elisabethville and Livingstone, and there is no record from the Kivu Highlands. The likeliest explanation seems to be that the egg is highly resistant to low temperatures as well as to desiccation but the adults and larvae are not. In this case survival would depend on the coincidence between suitable temperature conditions and a low water level in the streams. Records from over 4,000 ft. in the southern part of the range include Bihé, Salisbury, Goromonzi, Gwelo, Msonneddi, Onderstepoort, Yokeskei River, Waterval Boven, and Pietersburg. It is interesting to note that it has not been found as high up as *metallicus* in South-West Africa or as *simpsoni* in Eritrea.

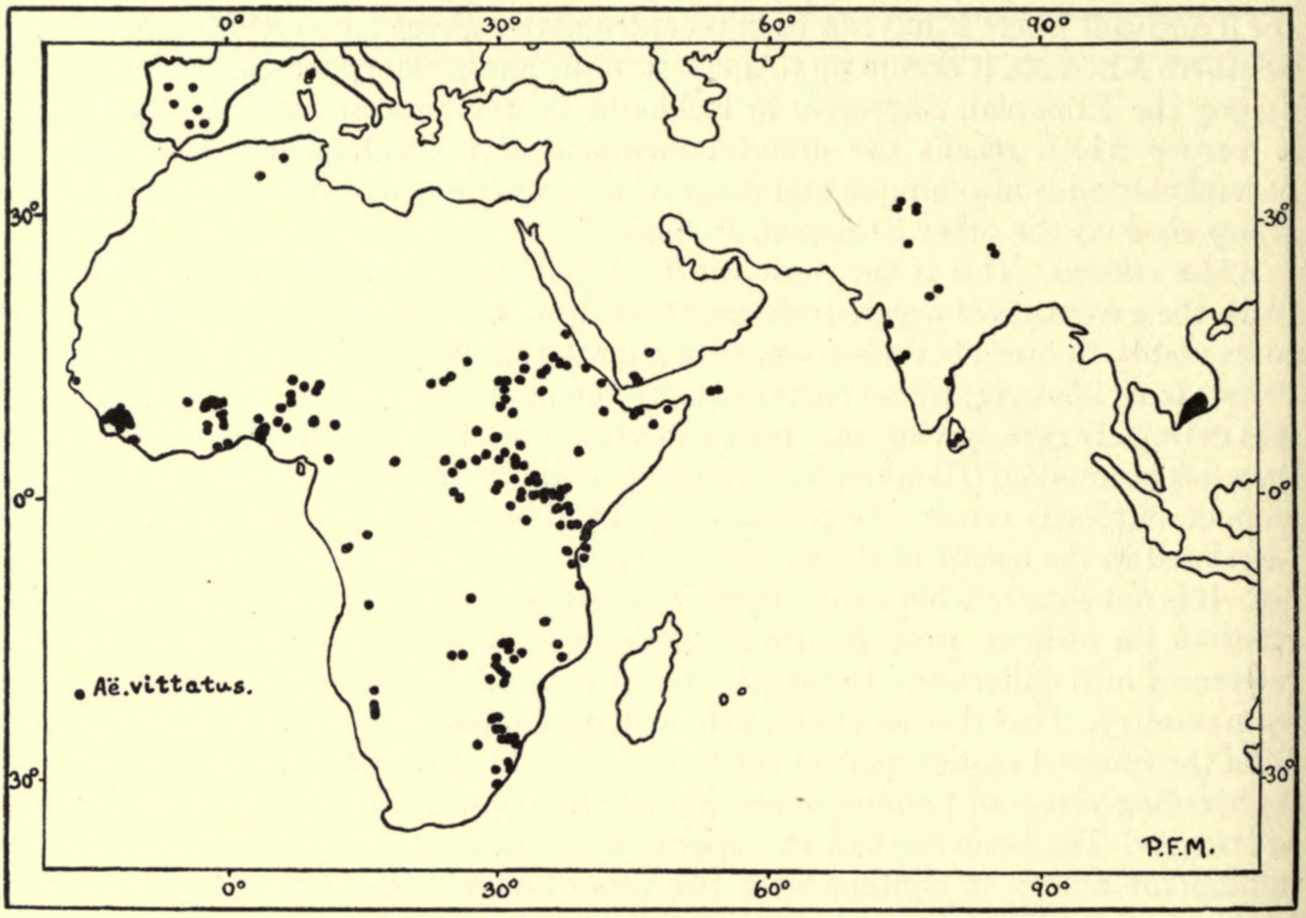

FIG. 16. Distribution of *Aëdes vittatus*.

Aëdes aegypti. For reasons already given it is not proposed to discuss the distribution of this species in detail. Some notes on its altitudinal limits may, however, be of interest as bearing on the general problem of *Stegomyia* distribution and the relationship between the Ethiopian and Palearctic elements in the sub-genus. The most remarkable record of *aegypti* from the Ethiopian region is perhaps that of Mara (1945), who found it at nearly 8,000 ft. on top of Mt. Bizen, and this during by no means the warmest part of the year. That this was a temporary introduction is highly probable, but it seems that larvae at any rate can survive for short periods at temperatures well below those which broadly limit the distribution of the species. Some unpublished records from comparatively high altitudes in Kenya, kindly sent by Mrs. Van Someren, include the following: Eldoret (6,900 ft.), Fort Ternan (7,000 ft.), Kajiado (about 6,000 ft.), Kiambu (6,300 ft.), Londiani (7,500 ft.), Lumbwa (6,300 ft.), Maseno (6,000 ft.), Naivasha (6,200 ft.), Nanyuki (6,400 ft.), Narok (6,500 ft.). Symes (1935) notes that it is particularly abundant at Meru (6,200 ft.). Southerly records from comparatively high altitudes include Salisbury (4,800 ft., Theobald, 1910), Pretoria (4,400 ft., Theobald, 1910), and Windhoek (5,500 ft., De Meillon, 1943). MacGregor (1927) makes the curious observation that in Mauritius *aegypti* seems to be restricted to the coastal belt and is very local while on Rodriguez it is much commoner and is found up to 'at least 800 feet'.

SUMMARY

The present paper deals with the distribution of those species of *Stegomyia* which have been found in the West African sub-region. No species is entirely confined to the sub-region as defined by Chapin. On the basis of this sub-genus it would be reasonable to extend the limits of the sub-region to include all land below 6,000 ft. around the Kavirondo Gulf and, farther north, to a point somewhere east of Kitgum. All published records are listed together with such unpublished records as are at present available. It has been possible to verify, and where necessary amend, the majority of doubtful records by reference to preserved specimens. Records for which this has not been possible are discussed individually. Full distributional records of *Aëdes aegypti* are not given since the data available for this species are so numerous as to require separate treatment. Records of the species discussed in this paper are available from rather more than 500 different localities and these are listed with their altitude, longitude, latitude, and rainfall as nearly as these can be ascertained. Some notes on taxonomy are given, including corrections to published descriptions and some reassignment of specimens and new synonymy. The keys to the sub-genus at present available are extremely misleading and new keys to adults and larvae have therefore been prepared. Full taxonomic treatment is reserved for a later paper. Bionomics are discussed in relation to distribution with particular emphasis on seasonal distribution, the study of which is regarded as crucial for our understanding of every aspect of the group. Zoogeography is discussed principally in relation to rainfall. Temperature will be discussed in a later paper. It is here considered only in so far as its influence is manifested in altitudinal distribution. By far the most serious hindrance to our understanding of the distribution of the group is the absence of records from almost the whole of Tanganyika and Nyasaland. Some points of general interest which have emerged in the course of the work include the existence of a climatic 'bridge' between the Ubangi–Uelle and Abyssinian Highland districts, across the south-eastern extremity of the Sudan, the existence of which may help to explain the strong Guinean element in the Abyssinian fauna. The existence of an isolated population of *Aëdes dendrophilus* in Natal and Pondoland supports the hypothesis of a much wider extension of the African forests in the past already inferred from the distribution of other groups. It is shown that large parts of the Guinean region have the same type of annual rainfall distribution as the part of South Africa in question. Old records, which unfortunately can no longer be checked from specimens, indicate the presence of an isolated population of *Aëdes africanus* in southern Nyasaland and a part of Mozambique. It is shown that the area in question possesses a type of rainfall suited to *africanus* but is separated from that part of Northern Rhodesia in which this species is known to occur by a broad belt in which the annual rainfall distribution is unsuitable. The Upper Guinean Forest, although by no means continuous, appears to be sufficiently so to constitute a

complete barrier to all but five species, and two of these, *aegypti* and *simpsoni*, may have been introduced into its interior by man. *Aëdes vittatus* occurs only in the higher northern and eastern parts of the forest area. Its exclusion from the remainder may be the result of geological factors. It is probable that penetration of those areas in which it does occur has been along stream and river beds since it does not appear normally to enter forest. *Aëdes africanus* and *apicoargenteus* are the only species normally found in the heart of the high, closed canopy, equatorial forest, and both of these extend far into the park savannah; *africanus* also occurs in the Rhodesian dry forest; *fraseri* and *dendrophilus* appear to be restricted to fringing and relict forests of an undefined type. The remainder are savannah species. The relationship of the various species to their characteristic plant associations is almost wholly obscure and will not be understood until much careful work has been done on both the entomological and the botanical side. This subject will be discussed in a later paper.

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APPENDIX

SINCE going to press, a number of specimens have been received which are of so much interest from the point of view of distribution that they are felt to warrant special mention. The new records are as follows:

Aëdes apicoargenteus. TANGANYIKA. Ukara Island (B.M.).

Aëdes africanus. KENYA. Taveta (B.M.).

Aëdes dendrophilus and *Aëdes simpsoni*. B. CONGO. Elisabethville area (B.M.).

The records of *apicoargenteus* and *dendrophilus* are each based on a single incomplete female and are therefore subject to confirmation. Both specimens are, however, in quite good condition and agree so closely with the types that little doubt is felt as to their identity. Of the three records the most startling is that of *Aëdes africanus* of which several good specimens have been sent by Dr. Lumsden. Taveta has a mean annual rainfall of only 26 inches with five dry months and is thus far outside the limits so far recorded for *africanus*. The explanation, suggested to me by Dr. Haddow, appears to be the presence in this locality of 'dense, humid, evergreen forest' depending, not on rainfall, but on 'innumerable springs rising through the volcanic ash'. From this it is clear that the presence of *africanus* in this locality is dependent, not on the local rainfall, but on a subsoil water content conditioned by the rainfall some considerable distance away. It is tempting to infer from this that the 40 inches or so which are normally required are necessary rather for the maintenance of a suitable type of forest than for the provision of adequate supplies of water in the breeding-places. It must, however, be remembered that under the conditions described humidity will be high and temperature low, and evaporation from tree-holes within the forest will be correspondingly reduced. Accordingly the *effective* rainfall will be higher than in other localities where the actual rainfall is similar. Nevertheless it would seem that this most interesting discovery lends strong support to the belief, elsewhere expressed, that rainfall is primarily of importance for its indirect effect on vegetation. The Taveta population is quite clearly an isolated relict one comparing in this respect with those in the Sidamo Province of Abyssinia and, perhaps, in the Zomba area and adjacent parts of Mozambique.

The record of *apicoargenteus* from Ukara Island, for which I am indebted to Mr. Smith, extends the known distribution of the species in this area very much to the south. It does not in any way affect the empirical rainfall limits deduced from existing data, but it suggests the possibility of an interesting comparative study on seasonal distribution here and in the neighbouring border-line area around Mwanza.

The record of *dendrophilus* from Elisabethville, sent by Monsieur Lips, comes from far outside the known rainfall limits of the species. It seems that it may well be explained by the presence of extensive gallery forest in this region, in which case the record would be comparable with that of *africanus* from Taveta. Further details on this point are awaited from the collector, but it is known that *Aëdes chaussieri* and *masseyi* have recently been found in gallery forest in this area (Lips in litt. and specimen of *chaussieri* now in the British Museum). This record, if confirmed, would seem to render almost certain the presence of *dendrophilus* in the South Congo savannah as suggested above.

The record of *simpsoni* from the Elisabethville area does not appear to call for special comment.