Africa. However, this problem was overcome by a third party borrowing the specimens, measuring the required features and sending those measurements to me. Not an ideal situation but better than nothing! A total of 121 female specimens in this group were measured (see Appendix 1). Specimens were grouped, possibly intuitively, as follows: it was noted that by perusing the measurements of all the specimens that there was some correlation between labrum length, number of teeth to the apical section of the mandible and to a lesser degree antennal segment and mandible length. Specimens were assigned to groups as follows: if the mandibular toothed section had 249 teeth and the labrum was >0.27 mm the specimen was designated as *P. martini*; if the total number of teeth were 141 and 149 and the labrum was >0.23 and <0.27 mm it was assigned as *P. vansomerenae*; if a specimen had 140 teeth and a labrum of <0.23 it was assigned as *P. celiæ*. Deciding that *P. martini* had the longer measurements and *P. celiæ* the shortest was influenced by and correlated to measurements of the male material of all three species [Table 3]. It was also noted that the holotype of *P. vansomerenae* (♀) had similar measurements to 8 of the 10 female *P. celiæ* paratypes; the other two female *P. celiæ* paratypes having measurements similar to those of the three female *P. vansomerenae* paratypes available for
study. The recent acquisition of *P. martini* material from the United States Army Medical Research Unit colony in Kenya confirms the morphological separation of *P. martini* from the other two species [Fig. 14].

3.8 COMPUTER ANALYSIS.

Discriminant function analysis (DFA) was performed as a confirmatory measure. Data for this exercise were obtained by measuring 22 morphological features (see Appendix I) on each specimen. [The number of teeth on the mandible were not used in the analysis]. These data were then analysed using the programme BMDP-7M (Biomedical Discriminant Programs). The sample sizes were as follows:

- *P. martini* - 47 females
- *P. vagansmerage* - 38 females
- *P. geliae* - 23 females

Specimens were grouped as described in section 3.7. The data were analysed twice; firstly, including the measurements of all 22 variables; and, secondly, excluding the measurements of A3, A5, A4, Asc4 and labrum as it was considered that these may have biased the intuitive grouping of the three species.
3.9 RESULTS OF DFA OF THE EAST AFRICAN SYNPHLEBOTOMUS COMPLEX.

In the analysis of the first data set two specimens assigned as *P. yansomerena* were grouped as *P. martini*, one *P. yansomerena* as *P. celiae* and two *P. celiae* as *P. yansomerena*. The *P. yansomerena* holotype clearly groups with the *P. celiae* group and two of the *P. celiae* paratypes clearly group with *P. yansomerena*. The programme chose three variables namely wing length, ascoid 3 length and labrum length as giving the best discrimination between the three species. The F-test analysis of variance at p < 0.001 at 3 and 103 d.f. for *P. martini* and *P. celiae* was 285.10; for *P. martini* and *P. yansomerena* 118.91; and for *P. celiae* and *P. yansomerena* 16.08. The graphical plot (Fig. 1) clearly shows *P. martini* as distinct from the other two species.

The *P. martini* colony material has been plotted according to the following linear equations calculated by the programme.

**FEMALES.**

\[ CV_1 = 14.24120 + 0.04807 \text{ (wing length)} - 0.05649 \text{ (ascoid 3)} - 0.07754 \text{ (labrum)} \]

\[ CV_2 = 12.56319 - 0.05756 \text{ (wing length)} + 0.13312 \text{ (ascoid 3)} + 0.02894 \text{ (labrum)} \]
Fig. 14  Graphical plot [complete data set] showing
the separation of *P. martini* from *P. cellae*
and *P. vanamei*.

-53-
* Group centroids

### Fig. 14

- **M** - MARTINI
- **C** - CELIAE
- **V** - VANSONERENAE
- ○ - Paratypes
- □ - misidentified

- Group centroids
- Colony material
- Syntype
- Holotype
- Paratypes
Fig. 15  Graphical plot (reduced data set) showing the separation of *P. martini* from *P. cellae* and *P. vanamerei*. 

-54-
In the analysis of the second data set 93.6% of the 
*P. martini* group was classified correctly; those of 
*P. vansomerenae* 65.2% correct and *P. celiae* 78.9% 
correct. The programme chose the length of palps 2, 3 
and 4 as best splitting the three species. The 
graphical plot (Fig. 15) shows the separation of *P. 
martini* from *P. celiae* and *P. vansomerenae* - the 
grouping of the latter two being less distinct.

### 3.10 TAXONOMY OF THE *SYNPHLEBOTOMUS* GROUP.

The systematics of the *Synphlebotomus* group and the 
material examined are listed in Appendix 2 and 3.

### 3.11 DISCUSSION.

It is thought that in Kenya leishmaniasis caused by 
*L. aethiopica* in montane habitats and *L. major* in 
the Baringo district are zoonoses which are endemic. 
Man may occasionally become infected. Visceral 
leishmaniasis caused by *L. donovani* is believed to 
have been introduced into Kenya during the 2nd World 
War by troops from Ethiopia and the Sudan.

The sandfly *P. martini* is distributed from Ethiopia 
and Sudan to Central Kenya. The only species of the 
*Synphlebotomus* complex collected to the north of the
equator is *P. martini*. South of the equator all three species have been collected with the distribution of all three overlapping in the Kitui (Tseikuru) focus. Whether this is the case in Machakos (including the Masinga focus) is not known [see Fig. 3].

The graphical plots clearly show that it is possible to differentiate, on morphological features, *P. martini* from *P. celiæ* and *P. vansomerenæ*. The discrimination between *P. celiæ* and *P. vansomerenæ* is not distinct. The computer analysis suggests [Fig. 14] that the holotype of *P. vansomerenæ* is *P. celiæ*. It also places two of the *P. celiæ* paratype series as belonging to *P. vansomerenæ*. The fact that, when using this system of analysis, the holotype of *P. vansomerenæ* clearly groups with 8 of the paratypes of *P. celiæ* strongly suggests that the former is the holotype of the latter as its description predates *P. celiæ*. If accepted, this would necessitate the renaming of *P. vansomerenæ* and the designation of a new holotype. The linear equations [pp. 58] developed by the computer analysis will assist in differentiating borderline cases i.e. specimens where the measurements [as given on pg. 50], splitting the three species, overlap.
CHAPTER FOUR

SYSTEMATICS OF THE
SUBGENUS SERGENTOMYIA

4.1 INTRODUCTION

The taxon *Sergentomyia* is, today, generally accepted as a distinct genus. The species discussed in this chapter belong to the subgenus *Sergentomyia* of the genus *Sergentomyia*. In the past, species in this subgenus have been separated into a number of groups. Those recognised for the purpose of this revision are the "bedfordi group", the "fellax group" and the "schwetzi group" although the latter is excluded here. The females of this subgenus are characterised by having long, broad, tubular, smooth or slightly wrinkle-walled spermathecal sacs, usually doubled back on themselves or with the apical region bent at 90° [Fig. 17d]. In males the aedeagus is always a polymorphic finger-shape [Fig. 26e].
Abonnenc (1972), who at the time considered the taxon Sergentomyia as a subgenus of Phlebotomus, proposed renaming the "bedfordi group" the "bedfordi complex" which he suggested comprised the following species viz. Phlebotomus bedfordi and its varieties or subspecies, and 7 other species which he considered exhibited common characters. The varieties or subspecies of P. bedfordi were P. bedfordi congoensis, b. medius, b. distinctus, b. bereiri, and b. firmatus. The other 7 species were P. buxtoni, P. gracilis, P. impudica, P. pastoriana, P. richardi, P. schoutedeni and P. yusafi. I prefer to retain the term "bedfordi group", as "complex" implies cryptic species that are morphologically indistinguishable, and consider a number of additional species to belong to this group. I also consider P. buxtoni, because of the morphology of the female pharyngeal armature, to belong to the "fallax group". In addition, four of the varieties or subspecies previously synonymised with S. bedfordi have been resurrected to specific status.

Theodor (1948) proposed the "fallax group" and included in it many species which are now considered to belong to other distinct groups or even different subgenera. Those that I consider to belong to the "fallax group", in Africa south of the Sahara, are
S. antennata, buxtoni, cincta, dubius, fallax and two new species. In subsaharan Africa it would appear that S. fallax, itself, might only occur along the Red Sea coast.

Sergentomyia schwetzi may be composed of more than one species and the discrimination of species of what I shall call, the "schwetzi group", from the "bedfordi and fallax groups", is briefly explained in section 4.3.

4.2 REVIEW OF RELEVANT MORPHOLOGY AND TERMINOLOGY USED (unless otherwise stated refers to female specimens).

4.2.1 MOUTHPART MORPHOLOGY.

For information on the structure and functional morphology of phlebotomine sandflies and citation of previous works, see Lewis (1975). The nomenclature followed in the present text is derived from Lewis (1975) and Harbach & Knight (1980). It is explained as follows and illustrated in figures 16-19.
Figs 16-19. 9 mouthparts.

Fig. 16. pharynx  
  a) pharyngeal pump with armature;  
  b) lateral margins.

Fig. 17. mandible.

Fig. 18. hypopharynx  c) salivary gland; d) salivary duct; e) apical margin.

Fig. 19. labrocibarium  f) lateral flange; g) cibarium;  
  h) labrum; i) cibarial armature arch;  
  j) pigment plate; k) cibarial armature (teeth);  
  m) posterior margin of hard palate; n) hard palate; p) cibarial arch; q) clypeal margin; r) labral tip with sensillae and pits.  
  (scale lines 0.05mm).
4.2.1.1 The hypopharynx.

The apical margin (antero-lateral margin) of the hypopharynx [Fig. 1B] may be smooth, have weak (shallow) undulations, strong (deep) undulations or deep narrow indentations forming broad tooth-like structures [Figs 23-25]. The salivary pump is attached to the posterior end of this structure.

4.2.1.2 The mandibles.

The size, shape and number of teeth of the mandible [Fig. 17] discriminate certain species from others. The number of teeth per 0.01mm are counted, commencing approximately 0.01mm from the apex of the mandible unless otherwise stated [Fig. 17]. In a few species the length (or depth) of the individual teeth is given.

4.2.1.3 The cibarium.

In most works on sandflies, the "cibarium" implies that area which is armed with teeth, behind which lies the pigment plate. In this revision the cibarium is redefined and new terminology is suggested in order to introduce consistency in sandfly mouthpart terminology. The cibarium [Fig. 19g] extends from
the clypeolabral suture at its anterior end to the apex of the lateral flanges (at the posterior end).

The lateral flanges [Fig. 19f] border the hard palate and the cibarial armature and are often strongly pigmented mid-anteriorly to anteriorly. The hard palate [Fig. 19n] is that area immediately anterior to the cibarial armature, extending laterally to the lateral flanges [Fig. 19f] and anteriorly to the cibarial arch [Fig. 19p]; the hard palate is usually chitinised and often more pigmented than the remainder of the cibarium. The cibarial teeth [Fig. 19k] make up the cibarial armature at the posterior end of the cibarium. The pigment plate [Fig. 19j] is variable in shape and lies behind the cibarial armature.

4.2.1.4 The labrum.

In many works on sandflies the labrum [Fig. 19h] is referred to as the labrum-epipharynx or as 'E' (Lewis, 1975). Snodgrass (1944) makes no mention of an epipharynx and Harbach & Knight (1980) consider "labrum-epipharynx" to be synonymous with the "labrum". Therefore, as the mouthpart morphology of mosquitoes and phlebotomines is similar, the term labrum is used hereafter. The labrum extends from the clypeolabral suture to the tip of the apical sensilla,
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