

ABERRATIONS AND VARIATIONS IN ANOPHELINE LARVAE OF THE SOUTHEASTERN UNITED STATES (Diptera, Culicidae)

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Since 1942 thousands of mosquito larvae have been submitted to the Fourth Service Command Medical Laboratory for identification or confirmation. This has afforded an excellent opportunity to obtain specimens which have departed widely from the usual types. Unfortunately only a small number of the aberrations seen prior to 1944 were retained or recorded and therefore few of these can be presented in this paper. Beginning in June 1944 a careful examination was made of a large number of our common southeastern anophelines and variations were noted. Between June and August, roughly 10,074 anopheline larvae (exclusive of *A. barberi* and those anophelines not identified to species) were examined by various members of the laboratory, and most of these were checked by the writer. Some aberrations were noted after the month of August and these, too, have been recorded. The species, and roughly the number of each examined between June and August were: *A. atropos* D. and K.—26; *A. bradleyi* King—14; *A. crucians* Wied.—3,678; *A. georgianus* King—407; *A. punctipennis* (Say)—4,941; *A. quadrimaculatus* Say—1,008.

Since some of the aberrations were recorded before June and after August 1944, and since an exact count was not kept of the number of specimens actually seen by the author himself, the percentage of aberrations or variations cannot be determined. It is the purpose of this paper to describe and illustrate the variety of forms which certain taxonomic characters may assume.

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Taxonomically, the inner and outer anterior clypeal hairs of the head of anopheline larvae are very important structures. *Anopheles crucians*, *A. quadrimaculatus*, and *A. punctipennis* normally have two simple inner clypeals and two thickly, dichotomously, branched outer clypeals. Any major variation of these hairs would make it difficult to determine the species with the aid of our present larval keys. Most of the anomalies which will be presented pertain to the inner and outer clypeals of the head. This is due to the fact that a careful check was made particularly of these conspicuous hairs. However other aberrations (i.e. palmates, frontals, etc.) were noted and described. For diagrams of anopheline larvae showing positions of the various head and abdominal hairs, the reader is referred to Ross and Roberts (1943; Part 1, pp. 1.3, 1.4), Russell et al. (1943; pp. 14-16), or King et al. (1944; p. 78).

The aberrations for each species are grouped together. The date and place of collection² of the specimens is listed under the explanations of the figures. Collection data for similar aberrations are listed under each figure. Each date represents one specimen unless otherwise indicated. Where anomalies are described and not figured, collection data is given in the text. The drawings were first outlined with the aid of a camera lucida and then corrected for symmetry.

ABERRATIONS IN ANOPHELES QUADRIMACULATUS SAY

Inner Clypeal Hairs:—The anomalies are listed in Table 1. Either one (Figs. 2,3) or both (Figs. 4,5) clypeals may be weakly or strongly branched. Simple branching (Figs. 2-5) occurred more frequently than multiple (Figs. 6-11) branching. Russell (1925) recorded 18 specimens with one of the two inner clypeals forked and 1 specimen with both forked. Root (1922) noted the forked condition of a normally simple hair as a rare abnormality. Buren (1944) described an anomalous larva in which the inner clypeals were densely plumose, actually almost resembling outer clypeals.³

Ten specimens were found with only a single, medial, inner clypeal (Figs. 1, 12)⁴. One specimen had three normally shaped inner clypeals with their basal tubercles wide apart

² All the specimens were collected on or near army installations but only the town or county in which the post is located has been listed.

³ The adult reared from this unusual larva was a typical female *Anopheles quadrimaculatus*.

⁴ When the inner clypeals are broken off their basal tubercles generally remain on the clypeus. When the outer clypeals break off the tubercles may remain or more often the point of insertion is indicated by a scar. When a clypeal is missing and there is no indication of a basal tubercle or scar, it is assumed that the clypeal was never present.

TABLE I.—Types of inner clypeal aberrations and the number of specimens of each type found in three species of *Anopheles*. dichot. br. = dichotomously branched.

Type of Aberration		Species and Number of Specimens Recorded					
Left Inner Clypeal	Right Inner Clypeal	<i>Anopheles crucians</i>	Figures	<i>Anopheles punctipennis</i>	Figures	<i>Anopheles quadrimaculatus</i>	Figures
simple or 2-branched	2-branched or simple	67	15,16,17	28	41, 48	107	3
simple or 3-branched	3-branched or simple	11	20, 21	1	50	12	6
simple	small with 3 apical branches			1	47		
simple or 4-branched	4-branched or simple			1	51	1	9
simple	5-branched	1	25				
6 or more branches	simple			3	54		
thickly and dichot. br.	simple	1	27				
smaller than normal	2-branched					1	2
2-branched	2-branched	11	18, 19	3	49	18	4, 5
3-branched or 2-br.	2-branched or 3-branched	2	22	1	52	6	7
3-branched	3-branched					1	8
4-branched or 2-br.	2-branched or 4-branched	1	23			2	10
4-branched or 3-br.	3-branched or 4-branched	1	24			1	11
5-branched	3-branched			1	53		
4-branched	5-branched	1	26				

Only one inner clypeal atypical.

Both inner clypeals atypical

and evenly spaced (Fig. 13). One specimen (FLORIDA—Tampa, X-5-44) had one inner clypeal slightly to the right of the middle, the other inserted in about the middle of the pre-clypeus. The distance between the basal tubercles is a highly constant and valid character. However one specimen (GEORGIA—Atlanta, VIII-18-44) had the bases of the inner clypeals so close together that another basal tubercle could not be inserted between them.

Outer Clypeal Hairs:—Three specimens had three outer clypeals and all of these had only a single medial inner clypeal (Fig. 1) (See Footnote 4).

Frontal Head Hairs:—One specimen (MISSISSIPPI—Grenada, VII-3-44) had hair 6 on the left side (left middle frontal hair) inserted directly in front of hair 7 (left outer frontal hair). Normally hair 6 lies between hairs 5 and 7.

Occipital Head Hairs:—The specimen with the densely plumose inner clypeal hairs described by Buren (1944) was also unusual in that an additional occipital hair was inserted behind left occipital hair nine (See Footnote 3).

Palmate Hairs:—One specimen was found having two palmate hairs on the right side of the fifth segment and one (normal) on the left side (Fig. 65).⁵ One specimen (MISSISSIPPI—Greenwood, VII-5-44) had two palmate hairs on the right side of segment four and one palmate on the left. The duplicated palmate was well developed but had fewer leaflets than the normal. The normal palmate on the right was similar to the left palmate.

Antepalmate Hairs:—The antepalmates on segments IV and V are usually single and occasionally double. Root (1924) and Russell (1925) noted that in some specimens this hair is double on some segments and single or triple on others, with the branching occurring at the base, or at various distances along the hair. In the present study one specimen (MISSISSIPPI—Greenwood, VII-22-44) had one of its antepalmates four branched, two others single, and one double.

ABERRATIONS IN ANOPHELES CRUCIANS WIED.

Inner Clypeal Hairs:—The anomalies are tabulated in Table 1 with the number of specimens of each type found. Figures 16-27 show how the normally simple inner clypeals may vary from simple forking to multiple branching. Either one (Figs. 15-17, 20, 21, 25, 27) or both (Figs. 18, 19, 22-

⁵ All larvae possessing an additional palmate (including those later described for *A. punctipennis*) were checked, before the specimens were mounted, by gently prodding the palmates with a needle, thus proving that the additional hair was actually inserted and had not broken off from another segment and floated to its present position. Under high magnification the tubercular insertion of both palmates could be plainly seen.

24, 26) of the hairs may be affected. The branching may be strong (Figs. 17, 19) or weak (Figs. 16, 18) and may occur at various distances along the hair. Russell (1925) recorded one larva with both inner clypeals forked.

The left inner clypeal shown in Figure 27 may possibly represent a thickly and dichotomously branched outer clypeal which has assumed an inner clypeal position. Seven specimens were found with only a single, medial inner clypeal (Fig. 28) and one specimen had a single forked inner clypeal (Fig. 29). (See Footnote 4). One specimen had three inner clypeals whose basal tubercles were close together (Fig. 30), and another had four inner clypeals, one of these hairs itself being branched at the base (Fig. 31).

Outer Clypeal Hairs:—One specimen had three normally branched outer clypeals, two of them inserted on the left side (Fig. 14). One specimen had the right outer clypeal sparsely branched (Fig. 15). One specimen (SOUTH CAROLINA—Horry Co., VII-10-44) had a normally branched but unsclerotized and unpigmented right outer clypeal; the left outer clypeal was normal.

Post Clypeal Hairs:—Anophelines normally have two post clypeals. The specimen having three inner clypeals (Fig. 30) also had an additional post clypeal on the right side.

ABERRATIONS IN ANOPHELES PUNCTIPENNIS (SAY)

Inner Clypeal Hairs:—The inner clypeals of *A. punctipennis* are often smaller, more slender and more lightly pigmented than those of *A. crucians* or *A. quadrimaculatus*. For this reason weak branching is difficult to detect under a binocular dissecting microscope (the instrument used in almost all of our identification work). However any variations in these hairs are easily seen under a compound microscope and all specimens suspected of having branched inner clypeals were examined under high power. A careful check revealed that variations and aberrations in these hairs are not too uncommon.

The anomalies are listed in Table I and these are very similar to those found in the preceding two species. Two specimens had one of the inner clypeals distinctly smaller in size than the other (Figs. 46, 47). Again simple forking or branching occurred more frequently than multiple branching; either one (Figs. 47, 48, 50, 51, 54) or both (Figs. 49, 52, 53) of the hairs may be affected and the branching may be weak or strong and occur at various levels. Root (1922) noted the forking of the inner clypeal as a rare abnormality. Eight specimens were recorded with only a single, medial inner clypeal (Figs. 55, 58) (See Footnote 4). Three specimens had three inner clypeals. One of these had all three normal in shape and close

together (Fig. 56). The others had the accessory hair slightly smaller and separated for some distance to the right of the two normal, medial inner clypeals (Fig. 57).

Outer Clypeal Hairs:—The outer clypeals of some specimens showed considerable variation not only in the branching but also in their position along the front margin of the clypeus. Practically all of these aberrations were restricted to one side of the head only, the other clypeal being normal or broken off.

Three specimens had three outer clypeals, all normally branched. In two of these, two clypeals arose close together on the left side (Fig. 32); in the third they were a little more separated. The outer clypeal may vary from the normal thickly and dichotomously branched hair (Fig. 32) to a sparsely feathered or branched shaft (Figs. 33-39, 43, 44) to a simple hair (Figs. 40-42). Its insertion may also be moved centrally (Figs. 35, 37-44). One specimen with normally branched hairs had the right outer clypeal moved somewhat centrally toward the inner clypeals. Its left outer clypeal was in a normal position (TENNESSEE—Paris, VII-17-44).

The specimens shown in Figures 43 and 44 may be interpreted in two ways. The medial position of the hair might make one consider it an accessory inner clypeal. However the left outer clypeal is absent (See Footnote 4). For this reason the accessory clypeal in these two cases is probably an outer clypeal moved medially, and one whose branching has been greatly reduced. The fact that it is shorter and stouter than the normal inner clypeals may be further evidence for this conclusion. However it will be seen that the inner clypeals may sometimes almost assume the branching of an outer clypeal (Figs. 53, 54) and therefore this additional hair may possibly be an additional inner clypeal. The simple hair to the left of the inner clypeals in Figure 41 is very similar to the additional hair shown in Figure 57 (an inner clypeal), though actually not in line with the inner clypeals. The left thickly branched outer clypeal was absent and since the present series of aberrations shows that an outer clypeal may become simple, this hair probably represents an outer clypeal which has become simple and moved medially towards the inner clypeals. The specimen in Figure 42 can be interpreted in the same manner and probably also represents an outer clypeal (c.f. Fig. 40). One specimen had both outer clypeals weakly branched (Fig. 45).

Frontal Head Hairs:—Anophelines normally have 6 (three pairs) of frontal head hairs. One specimen (GEORGIA—Augusta, V-24-44) had a total of seven frontal hairs, the additional one being inserted between hairs 5 and 6 on the left side. One specimen having a single inner clypeal had only 4 frontal head hairs in the normal position. However one frontal hair was inserted between the inner preclypeals (Fig. 58). Russell

(1925) observed that *punctipennis* larvae caught in a syrup kettle invariably had stunted frontal head hairs. The hairs were shorter, the branches few, as well as shorter, and frequently from 1 to 3 of the frontal hairs were entirely missing. Russell further states that it was not determined whether or not the unusual character of these hairs was inherent or due to the habit these larvae have of browsing upon each other. In the present specimen, noted above, there is no question but that there were never more than 4 frontal head hairs in the normal position since only 4 hairs are present and there is no indication (by basal tubercle or round opening in the sclerite) of any others.

Palmate Hairs:—One specimen was found with 2 palmates on the left side and one on the other (Fig. 66) on the second abdominal segment (GEORGIA—Columbus, VI-12-44). The larger and more darkly pigmented palmate is the additional hair since the palmate on the right side is similar to the palmate having the more slender and more lightly pigmented leaflets (See Footnote 5). Another specimen (NORTH CAROLINA—Durham, VII-11-44) had 3 palmate hairs on segment IV, 2 of these inserted close together on the right side.

Antepalmate Hairs (Hair 2):—Root (1924) and Russell (1925) have shown that the number of branches on the antepalmate hairs of *punctipennis* are highly variable. The 103 specimens examined by Russell came from four counties in Georgia and one county in Alabama. The 37 larvae studied by Root were collected near a single locality near Baltimore, Maryland. Root (1924) states that until the differences (between *A. quadrimaculatus* and *A. punctipennis*) which he found are confirmed in larvae taken from other localities they should not be regarded as definitely established. In their key to the anophelines of the southeastern states, King et al. (1944) state that in *A. punctipennis* the antepalmates on segments four and five are usually double, except in specimens from central Florida, in which they are usually single.

A study of 1,821 specimens from six southeastern states (a total of 31 localities) tends to confirm the observations of Root and Russell. The number of branches of the antepalmates may be highly variable in certain individuals (Table 2). Not only do they vary on segments four and five but they often differ on the right and left side of the same segment. The antepalmates are usually all double (47.39%) but may rarely be all single (1.26%) or triple (3.57%) and sometimes one or more may be four or five branched (See Table 2 for the other possible combinations). The types of branching which may occur in hair 2 are shown in Figure 64.

Russell (1925) reared four *A. punctipennis* adults of the variety sometimes called "*A. perplexens*". The wings of this form show a repression or complete absence of the large pale patch of scales usually found at the outer third of the costa.

TABLE 2.—Showing the number of branches of hair 2 on abdominal segments four and five in 1,821 larvae of *A. puricarpus*. The number of branches on the left and right side of the fourth and fifth segments are indicated by a fraction. For example, under 4 (fourth segment) 1/1 means that both the left and right antepalpmates are simple and 3/4 indicates that these hairs are three and four branched respectively.

Abd. Seg.—Abdominal segment; No. of Spcms.—Number of specimens

LOCALITY	No.	Abd. Seg.																
		4	5	4	5	4	5	4	5	4	5							
ALABAMA:—Aliceville; Anniston; Gadsden; Opelika; Selma; Tuskegee. (17 Collections: V-18-44 to VIII-24-44)	Hair 2	1/1	1/1	1/1	1/2	1/1	2/2	1/1	2/2	2/3	2/1	2/2	3/2	2/2				
		1/1	1/1	1/1	1/2	2/1	2/1	2/1	1/1	2/3	2/2	1/2	2/1	1/1	1/2			
GEORGIA:—Augusta; Bibb Co.; Cochran; Columbus; Macon; Moultrie; Rome; Savannah. (20 Collections: V-28-44 to VII-2-44)	2	2/1	1/1	1/2	1/2	1/1	2/2	3	1/1	2/2	2/1	2/2	2/2	2/3				
		1/2	1/1	1/1	2	2/1	2/1	3	1/2	1	2/1	2/2	2/2	2/3				
MISSISSIPPI:—Centerville; Grenada; Jackson (11 Collections: VI-1-44 to VII-17-44)	2	2/1	1/1	1/2	1/2	1/1	2/2	3	1/1	2/2	2/1	2/2	2/2	2/3				
		1/2	1/1	1/1	2	2/1	2/1	3	1/2	1	2/1	2/2	2/2	2/3				
NORTH CAROLINA:—Durham; Maxton; Monroe; Rockingham; Swannanoa (11 Collections: V-3-44 to VII-25-44)	3	1/1	1/1	1/2	1/2	1/1	2/2	3	1/1	2/2	2/1	2/2	2/2	2/3				
		1/2	1/1	1/1	2	2/1	2/1	3	1/2	1	2/1	2/2	2/2	2/3				
SOUTH CAROLINA:—Columbia; Greenwood; Greenville; Horry Co.; Spartanburg (15 Collections: V-25-44 to VII-28-44)	8	1/1	1/1	1/2	1/2	1/1	2/2	3	1/1	2/2	2/1	2/2	2/2	2/3				
		1/2	1/1	1/1	2	2/1	2/1	3	1/2	1	2/1	2/2	2/2	2/3				
TENNESSEE:—Dyersburg; Memphis; Nashville; Paris (13 Collections: V-17-44 to VII-13-44)	6	1/1	1/1	1/2	1/2	1/1	2/2	3	1/1	2/2	2/1	2/2	2/2	2/3				
		1/2	1/1	1/1	2	2/1	2/1	3	1/2	1	2/1	2/2	2/2	2/3				
TOTAL	23	43	75	5	165	863	12	1	293	1.26%	2.36%	4.12%	.28%	9.06%	47.39%	.66%	.05%	16.09%

Russell goes on to state that the larvae of two reared adults with a totally repressed costal spot had all four of their antepalpal hairs on segments four and five unbranched. However one of the other two larvae (which gave rise to adults with partial repressed costal markings) had the usual two branched antepalpal hairs. The last larva had two forked and two simple antepalpal hairs. King et al. (1944) write that specimens of *punctipennis* from central Florida may have the size of the costal spot considerably reduced and in some individuals the wing may be almost entirely dark scaled. These writers further say that this variation has also been observed occasionally in other areas and is possibly the form described as *A. perplexens* (Mount Gretna, Pa.).

In the present study every state yielded one or more larvae with simple antepalpal hairs. Four reared females, received from Paris, Tennessee, had the costal spot at the outer third completely repressed. The six larvae recorded from Tennessee with simple antepalpal hairs all came from the same locality but whether the reared adults, mentioned, came from larvae with simple antepalpal hairs is not known. One female *punctipennis* taken in a resting station (NORTH CAROLINA—Swannanoa, IV-24-44) showed complete recession of the costal spot. Two larvae having three simple and one double antepalpal hair came from the same locality. H. R. Dodge collected one male and one female *punctipennis* with the melanistic wings (GEORGIA—Baker Co., VIII-44).

Anopheles punctipennis larvae with simple antepalpal hairs are not restricted to Florida and adults with repressed costal markings have been noted from several widely separated areas. Certainly further rearings of this species should be carried out to determine whether any relationship exists between larvae with simple antepalpal hairs and adults with repressed costal markings.

ABERRATIONS IN ANOPHELES BRADLEYI KING

Inner Clypeal Hairs.—Only two aberrant larvae were noted. One of these had a single medial inner clypeal (Fig. 62) and the other had three inner clypeals (Fig. 63).⁶

VARIATIONS IN ANOPHELES ATROPOS D. AND K.

Inner and Outer Clypeal Hairs.—King et al. (1944) in their key to the southeastern anophelines state that the outer clypeals of *atropos* are sparsely feathered or branched (5 to 10 short branches) on the apical half and the inner clypeals are forked or sparsely feathered at the tip (Fig. 59).

In a study of 16-specimens (FLORIDA—Tampa, VI-15;

⁶ The adult female reared by Capt. A. H. Halff, from this larva, had the petiole of vein five all dark scaled.

29-44, 15 specimens: Tarpon Springs, VIII-5-43, 1 specimen), only 5 possessed normal clypeals. Of the 11 others, 4 had one, and 1 had both inner clypeal hairs simple (Fig. 61). Two specimens had both, and 1 had only one, of the outer clypeals 4 branched. One specimen had the outer clypeals 3 and 4 branched respectively. Three specimens had one outer clypeal three branched, the other normal. Two specimens had both outer clypeals three branched (Fig. 61) and two branched (Fig. 60).

SUMMARY

A study of a large number of our common anopheline larvae shows that aberrations will occur in hairs that are taxonomically important. The various types of anomalies and the species in which they were found are summarized in Table 3. In general the different anomalies are common to several species of *Anopheles*. It is probable that if a larger number of specimens are examined all of the species would be found to have more or less similar aberrations and other types of anomalies would also be noted. The cause of these abnormalities is not known, but it is probable that the more unusual ones are not genetically transmitted.

Variations which differ only slightly from the normal (i.e. forking or branching of an inner clypeal, Figs. 2-5, 16-19, 48, 49) are comparatively numerous and from the collection data of the specimens will be seen to occur at regular intervals, in many regions. The more unusual aberrations (i.e. three inner or outer clypeals, etc., Figs. 1, 13, 14, 30, 32, 56) which depart strikingly from the normal type, occur either singly, or rarely at irregular intervals.

Larval keys are usually written to determine average specimens and rarely include possible variations. It should always be remembered that not all specimens collected will fit every character described in a key. The descriptions and illustrations in the present paper should tend to emphasize that fact. Almost all of the aberrations have been deposited in the United States National Museum, Washington, D. C.

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TABLE 3.—Various types of aberrations and the number of specimens of each type found in four species of *Anopheles*.

Type of Aberration	Species and Number of Specimens Recorded							
	<i>Anopheles quadrimaculatus</i>	Figures	<i>Anopheles crucians</i>	Figures	<i>Anopheles punctipennis</i>	Figures	<i>Anopheles bradleyi</i>	Figures
One inner clypeal 2-branched; the other simple	108	2, 3	67	15, 16, 17	28	41, 48		
One inner clypeal 3- or more branched; the other simple	13	6, 9	13	20, 21, 25, 27	6	47, 50, 51, 54		
Both inner clypeals 2-branched	18	4, 5	11	18, 19	3	49		
One inner clypeal 3- or more branched; the other 2- or more branched	10	7, 8, 10, 11	5	22, 23, 24, 26	2	52, 53		
Only one inner clypeal	10	1, 12	8	28, 29	8	55, 58	1	62
Three inner clypeals	1	13	1	30	3	56, 57	1	63
Four inner clypeals			1	31				
One outer clypeal sparsely branched or simple			1	15	17	33-44		
Both outer clypeals sparsely branched					1	45		
Three outer clypeals	3	1	1	14	3	32		
Three post clypeals			1					
Aberrant frontal head hairs	1				2	58		
One abdominal segment with three palmates (other segments normal)	2	65			2	66		

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EXPLANATION OF FIGURES 1-13

Aberrations in *Anopheles quadrimaculatus* Say

Fig. 1, Three outer clypeals (the right outer clypeal has been broken off but its basal tubercle remains). Two normally branched outer clypeals are inserted close together on the left side. There is only one medial inner clypeal (GEORGIA—Valdosta, VII-21-44). Two similar specimens with all three outer clypeals attached were collected in MISSISSIPPI—Biloxi, IX-22-44 (two outer clypeals on the right side; the inner clypeal was broken off but only one basal tubercle was present indicating that this specimen, too, had only a single medial inner clypeal): Hattiesburg, X-6-44 (two outer clypeals on the left side; only one medial inner clypeal present).

In Figures 2-12, the outer clypeals are normal or were broken off and are not indicated.

Fig. 2, Left inner clypeal smaller and more slender than the right one. Right inner clypeal with a weak branch (FLORIDA—West Palm Beach, VI-6-44).

Fig. 3, Left inner clypeal strongly branched (SOUTH CAROLINA—Debidue Beach, VI-1-44). One hundred six somewhat similar specimens (58 with the left and 48 with the right inner clypeal strongly or weakly forked at various levels) were taken from the following regions: ALABAMA—Mobile, VI-20-44; VI-29-44 (7 specimens): Opelika, VI-27-44. FLORIDA—Boca Raton, V-23-44; V-31-44 (2 specimens); VI-16-44 (3 specimens); VI-21-44 (3 specimens); VII-6-44 (3 specimens); VII-10-44; VIII-30-44 (6 specimens); IX-14-44 (4 specimens); IX-26-44 (3 specimens); Fort Myers, VIII-11-44 (2 specimens); VIII-24-44 (2 specimens); VIII-28-44: Homestead, VII-14-44 (3 specimens): Marianna, VIII-9-44; X-25-44 (2 specimens): Pensacola, VI-19-44; X-9-44: Tampa, VIII-7-44 (2 specimens); VIII-16-44 (4 specimens); VIII-24-44; VIII-28-44. GEORGIA—Atlanta, VIII-18-44 (4 specimens); Bibb Co., VI-13-44; Chatham Co., VI-13-44 (2 specimens); VII-7-44; IX-28-44: Columbus, VII-18-44: Valdosta, VIII-30-44 (2 specimens). LOUISIANA—Harahan, II-1-45 (6 specimens). MISSISSIPPI—Greenwood, VI-5-44; VI-15-44 (3 specimens); VII-8-44; VII-19-44: Grenada, VI-15-44; VI-29-44: Hattiesburg, VII-4-44 (2 specimens): Centerville, VI-27-44; VII-25-44: Jackson, VI-29-44. NORTH CAROLINA—Goldsboro VII-6-44 Monroe, VI-13-44; VI-17-44 (2 specimens): Rockingham, VIII-22-44: (4 specimens). SOUTH CAROLINA—Columbia, VII-18-44: Myrtle Beach, V-31-44; VI-2-44 (2 specimens); VII-10-44. TENNESSEE—Paris, VI-26-44: Dyersburg, VI-13-44; VII-4-44: Tullahoma, VIII-1-43. Two specimens with no collection data.

Fig. 4, Both inner clypeals . . .

LOUISIANA—Harahan, II-1-45 (3 specimens). MISSISSIPPI—Grenada, VII-6-44. NORTH CAROLINA—Monroe, VI-17-44 (2 specimens).

Fig. 5, Both inner clypeals forked, the right weakly from the tip (FLORIDA—Boca Raton, V-31-44). Two similar specimens (branches at various levels) taken from: FLORIDA—Pensacola, VI-19-44. MISSISSIPPI—Jackson, VI-9-44.

Fig. 6, Right inner clypeal three branched, left simple (FLORIDA—Boca Raton, V-31-44). Eleven somewhat similar specimens with the branches strong or smaller and weaker, and at different levels; or with the left three branched and the right simple, taken from the following: FLORIDA—Boca Raton, VI-16-44; VII-6-44; VII-10-44; IX-14-44 (2 specimens): Fort Myers, VIII-11-44; Marianna, X-25-44; Tampa, VIII-16-44. LOUISIANA—Harahan, II-1-45. TENNESSEE—Dyersburg, VII-12-44 (2 specimens).

Fig. 7, Inner clypeals three and two branched respectively (FLORIDA—Boca Raton, V-31-44). Five similar specimens (branching at different levels, or two and three branched respectively) taken from: FLORIDA—Boca Raton, VII-10-44. GEORGIA—Atlanta, VIII-18-44; Chatham Co., VI-13-44. MISSISSIPPI—Grenada, VII-6-44. NORTH CAROLINA—Monroe, VI-17-44.

Fig. 8, Both inner clypeals three branched (FLORIDA—Boca Raton, VIII-30-44).

Fig. 9, Left inner clypeal four branched, right simple (FLORIDA—Fort Myers, VIII-11-44).

Fig. 10, Inner clypeals four and two branched respectively (GEORGIA—Atlanta, XI-2-43). One similar specimen with the left two and the right inner clypeal four branched taken from GEORGIA—Columbus, VIII-18-44.

Fig. 11, Inner clypeals four and three branched respectively (FLORIDA—Avon Park, IV-8-44).

Fig. 12, Single medial inner clypeal (FLORIDA—Pincastle, V-8-43). Six similar specimens taken from: FLORIDA—Tampa, X-5-44. GEORGIA—Atlanta, VIII-18-44; Bibb Co., VI-13-44. MISSISSIPPI—Jackson, IX-28-44; Greenwood, VII-5-44. SOUTH CAROLINA—Myrtle Beach, V-31-44.

Fig. 13, Three evenly and widely spaced inner clypeals. The outer clypeals are normal and only their bases are drawn to indicate position (MISSISSIPPI—Greenwood, VI-26-44).

EXPLANATION OF FIGURES 14-31

Aberations in *Anopheles crucians* Wied.

Fig. 14, Three outer clypeals, the additional hair inserted on the left side and slightly smaller than the normal. The left inner clypeal is broken off near the base (GEORGIA—Chatham Co., VII-3-44).

Fig. 15, Right outer clypeal five branched. The left outer clypeal was missing and the head was too darkly pigmented to determine whether or not a basal tubercle or scar was present. The left inner clypeal is branched. (GEORGIA—Valdosta, I-11-43).

Fig. 16, Weak apical branching of the right inner clypeal, left simple (GEORGIA—Valdosta, I-26-43). Twelve somewhat similar specimens (weak branching of either clypeal) taken from: FLORIDA—Starke, VII-12-44; Tampa, VIII-2-44. GEORGIA—Chatham Co., VIII-3-44 (4 specimens); Valdosta, XII-42 (2 specimens); I-3-43; IV-21-44; VII-28-44; VIII-16-44.

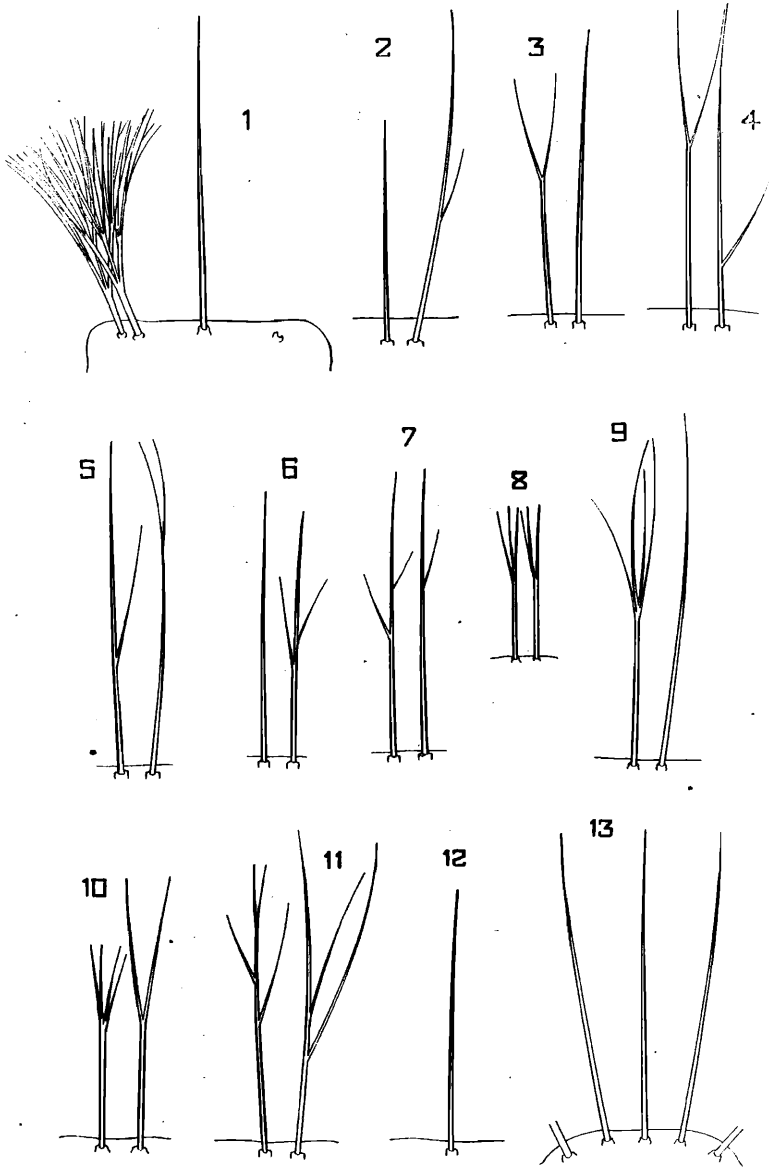


Fig. 17, Right inner clypeal strongly branched, left simple (SOUTH CAROLINA—Columbia, IV-21-44). Fifty-two somewhat similar specimens (branching of either clypeal at various levels) have been recorded from the following localities: FLORIDA—Avon Park, IV-19-44; Pensacola, III-29-43; Starke, VI-20-44; Tampa, VI-8-44; VIII-16-44; Sebring, VII-14-44; West Palm Beach, VIII-19-44. GEORGIA—Columbus, VII-26-44; Augusta, VII-26-44; Chatham Co., VII-7-44; VII-26-44 VIII-3-44; (4 specimens): Valdosta, XII-42 (2 specimens); I-11-43; I-26-43 (3 specimens); III-31-43; IV-5-44 (2 specimens); IV-15-44; IV-16-44; IV-20-44; IV-29-44; V-3-44; V-23-44; VI-17-44; VIII-16-44; Bibb Co., VI-15-44; VII-18-44; Moultrie, VI-26-44; Liberty Co., VII-17-44; IX-15-44 (2 specimens); IX-22-44 (2 specimens); X-14-44 (2 specimens). MISSISSIPPI—Hattiesburg, VIII-5-44; X-19-44. NORTH CAROLINA—Fayetteville, V-22-44; Rockingham, VI-10-44; VI-26-44; VII-27-44; VIII-17-44; Maxton, VI-22-44; VIII-30-44. SOUTH CAROLINA—Myrtle Beach, VI-27-44.

Fig. 18, Weak branching of both inner clypeals (GEORGIA—Valdosta, I-3-43).

Two similar specimens but with the branches slightly stronger, and arising farther below the apex were taken at Valdosta, IV-21-44; VI-17-44.

Fig. 19, Both inner clypeals strongly branched (NORTH CAROLINA—Rockingham, VI-26-44). Seven somewhat similar specimens were taken from the following regions: FLORIDA—Starke, VII-31-44; Orlando, VII-22-44. GEORGIA—Chatham Co., VII-3-44; VIII-16-44; Columbus, VII-26-44; Valdosta, XII-42. SOUTH CAROLINA—Myrtle Beach, VII-27-44.

Fig. 20, Right inner clypeal with three apical branches, left simple (NORTH CAROLINA—Rockingham, VI-5-44). Five somewhat similar specimens taken from: FLORIDA—Tampa, VIII-16-44 (left three branched, right simple). GEORGIA—Chatham Co., VIII-3-44 (3 specimens); Valdosta, VII-10-44.

Fig. 21, Right inner clypeal with three branches, left simple (GEORGIA—Valdosta, III-17-43). Four somewhat similar specimens (either hair branching at different levels) taken from: GEORGIA—Chatham Co., VI-13-44; Augusta, VIII-26-44; Valdosta, IX-22-44 (2 specimens).

Fig. 22, Inner clypeals with three and two branches respectively (SOUTH CAROLINA—Columbia, IV-21-44). One similar specimen recorded from GEORGIA—Valdosta, VII-28-44.

Fig. 23, Inner clypeals four and two branched respectively (GEORGIA—Valdosta, I-26-43).

Fig. 24, Inner clypeals three and four branched respectively (GEORGIA—Valdosta, I-26-42).

Fig. 25, Right inner clypeal five branched, left simple (GEORGIA—Valdosta, IV-26-43).

Fig. 26, Inner clypeals four and five branched respectively (GEORGIA—Valdosta, VI-17-44).

Fig. 27, Left inner clypeal thickly and dichotomously branched, right simple (GEORGIA—Valdosta, IV-16-44).

Fig. 28, Single medial inner clypeal (GEORGIA—Valdosta, VI-20-44). Six similar specimens were taken from: FLORIDA—Starke, VII-17-44; GEORGIA—Chatham Co., VI-27-44; Augusta, VII-26-44; Savannah, VII-10-44; Valdosta, VII-28-44. NORTH CAROLINA—Rockingham, IX-1-44.

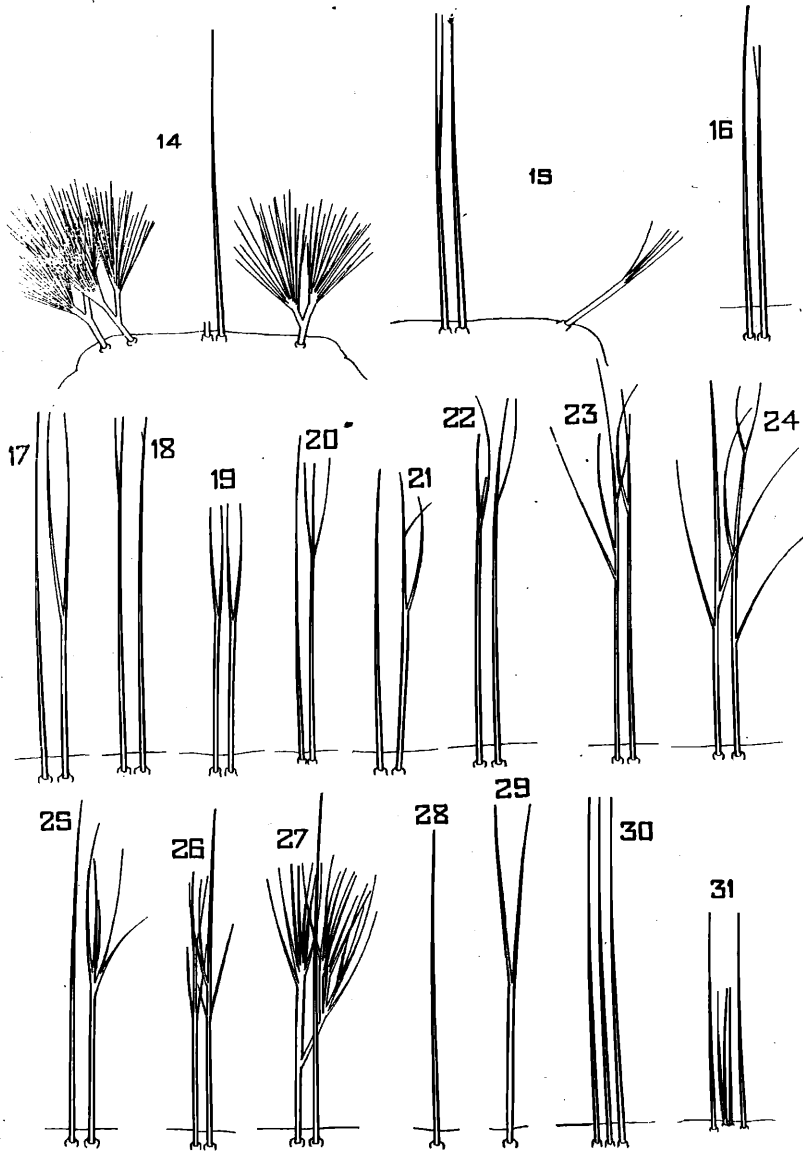


Fig. 29, Single medial forked inner clypeal. The right outer clypeal normal, the left outer clypeal was broken off (FLORIDA—Starke, VI-20-44).

Fig. 30, Three inner clypeals (this specimen also had three postclypeals) (GEORGIA—Valdosta, I-26-43).

Fig. 31, Four inner clypeals. One of these inner clypeals is branched from the base (MISSISSIPPI—Flora, IV-6-44). (The outer clypeals in Figures 16 to 31 are either normal or were broken off on one or both sides, and are not included in the drawings.)

EXPLANATION OF FIGURES 32-58.

Aberrations in *Anopheles punctipennis* (Say)

Fig. 32, Three normal outer clypeals, two of them closely inserted on the left side (NORTH CAROLINA—Maxton, VI-14-44). Two similar specimens have been taken from: TENNESSEE—Paris, VII-17-44: Nashville, VII-10-44 (in this specimen the additional outer clypeal was separated for some distance to the right of the normal one).

Figs. 33-44, One outer clypeal sparsely branched or simple. The other outer clypeal was normal or sometimes broken off and, in the drawing, is either not shown or is indicated by its base.

Fig. 33, Left outer clypeal with seven branches (MISSISSIPPI—Centerville, VI-5-44). Three somewhat similar specimens had the right outer clypeal sparsely branched (a few more branches) and were taken from: ALABAMA—Tuskegee, VIII-11-44. NORTH CAROLINA—Monroe, VIII-21-44. TENNESSEE—Paris, VI-20-44.

Fig. 34, Left outer clypeal five branched (NORTH CAROLINA—Swannanoa, VI-5-44). Extreme tips of inner clypeals not indicated.

Fig. 35, Right outer clypeal with five branches and moved toward the inner clypeals (GEORGIA—Augusta, V-24-44).

Fig. 36, Left outer clypeal four branched (TENNESSEE—Paris, VI-5-44.)

Fig. 37, Right outer clypeal three branched (TENNESSEE—Nashville, VI-28-44). Two somewhat similar specimens (one with the left, the other with the right outer clypeal three branched, the branches on different levels) taken from: ALABAMA—Anniston, VII-25-44: GEORGIA—Augusta, VIII-17-44.

Fig. 38, Right outer clypeal two branched (MISSISSIPPI—Jackson, V-26-44).

Fig. 39, Right outer clypeal moved medially and with only one abnormally formed branch (TENNESSEE—Paris, VI-20-44).

Fig. 40, Right outer clypeal simple (NORTH CAROLINA—Swannanoa, VI-20-44).

Fig. 41, Left outer clypeal a long slender simple hair, slightly shorter, and a little to the left of the inner clypeals. The right inner clypeal is forked (ALABAMA—Tuskegee, VIII-11-44).

Fig. 42, Left outer clypeal simple and moved close to the inner clypeals (MISSISSIPPI—Jackson, VI-9-44).

Fig. 43, Left outer clypeal sparsely feathered and moved close to the inner clypeals (GEORGIA—Rome, VIII-22-44).

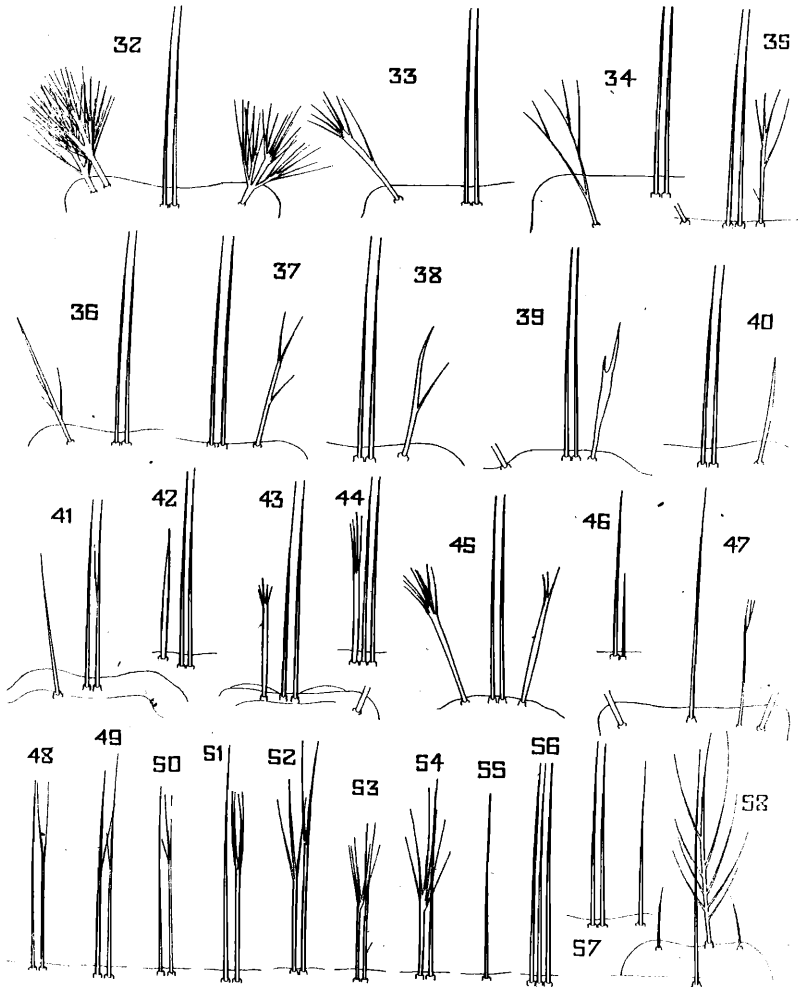


Fig. 44, Left outer clypeal moved next to the inner clypeals and bearing only four apical branches (NORTH CAROLINA—Maxton, VI-14-44). (See text for further explanation of Figures 41-44).

Fig. 45, Both outer clypeals sparsely branched and moved toward the inner clypeals (TENNESSEE—Paris, VI-26-44).

(Figs. 46, 48-58, The outer clypeals are either normal or broken off and are not included in the drawings.)

Fig. 46, Right inner clypeal smaller and more slender than the normal left, (TENNESSEE—Paris, V-30-44).

Fig. 47, Right inner clypeal, small, slender, with three apical branches and moved toward the base of the right outer clypeal. Only the bases of the normal outer clypeals are shown (ALABAMA—Anniston, VII-17-44).

Fig. 48, Right inner clypeal strongly forked (GEORGIA—Bibb Co., V-25-44, 2 specimens), Twenty-five somewhat similar specimens (nine with the right and sixteen with the left inner clypeal forked at various levels) were taken from the following regions: ALABAMA—Anniston, VI-20-44: Opelika, V-26-44. GEORGIA—Atlanta, V-44: Augusta, VI-9-44: Bibb Co., VI-15-44. MISSISSIPPI—Grenada, IX-2-43; VI-22-44: Hattiesburg, II-21-44: Jackson, VI-15-44. NORTH CAROLINA—Maxton, V-29-44. SOUTH CAROLINA—Greenville, III-19-44 (2 specimens); VI-10-44: Spartanburg, VI-13-44. TENNESSEE—Dyersburg, VI-3-44; VI-13-44: Nashville, VII-10-44 (5 specimens): Paris, V-30-44 (2 specimens); VI-6-44; VII-13-44.

Fig. 49, Both inner clypeals branched (TENNESSEE—Nashville, VI-2-44). Two similar specimens (branching at different levels) were taken from TENNESSEE—Paris, VI-20-44.

Fig. 50, Right inner clypeal with three branches, left simple (GEORGIA—Bibb Co., V-25-44).

Fig. 51, Right inner clypeal four branched, left simple (SOUTH CAROLINA—Spartanburg, VII-5-44).

Fig. 52, Inner clypeals three and two branched respectively (NORTH CAROLINA—Swannanoa, VI-26-44).

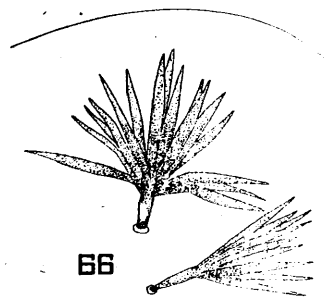
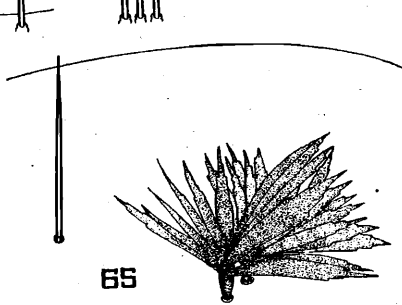
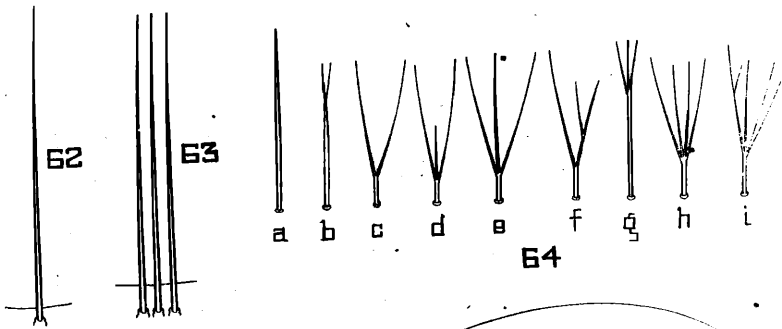
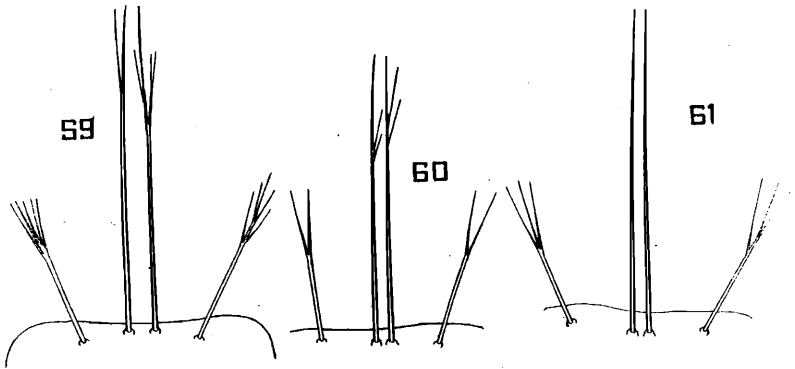
Fig. 53, Left inner clypeal with five branches, right strongly forked near the middle and with a small weak branch from near the base (ALABAMA—Opelika, V-29-44.)

Fig. 54, Left inner clypeal with six branches, the right one simple (GEORGIA—Rome, VI-3-44). Two specimens, one with the left inner clypeal thickly branched apically (about 8 or more branches) taken from ALABAMA—Anniston, VI-13-44; the other specimen with the left inner clypeal apically feathered with weak branches (more than six) and smaller in length than the normal right inner clypeal was taken from SOUTH CAROLINA—Greenville, III-19-44.

Fig. 55, Single medial inner clypeal (ALABAMA—Opelika, V-29-44). Six similar specimens were taken from: GEORGIA—Macon, VIII-2-44. MISSISSIPPI—Grenada, IX-2-43: Jackson, VI-1-44 (2 specimens): TENNESSEE—Paris, V-30-44; VII-26-44.

Fig. 56, Three normally shaped inner clypeals (TENNESSEE—Paris, VI-20-44).

Fig. 57, Three inner clypeals, the additional one being separated for some dis-



tance to the right of the two normal medial inner clypeals. Left outer clypeal normal, right one broken off (GEORGIA—Atlanta, VI-22-44). One similar specimen taken from ALABAMA—Opelika, VIII-12-44, had both normal outer clypeals attached.

Fig. 58, Frontal head hair lying between the inner preclypeals. Only a single medial inner clypeal is present (GEORGIA—Columbus, VI-12-44).

EXPLANATION OF FIGURES 59-66.

Figs. 59-61, Inner and outer clypeals of *Anopheles atropos* D and K.

Fig. 59, Normal inner and outer clypeals (FLORIDA—Tampa, VI-15-44).

Fig. 60, Outer clypeals forked, inner clypeals normal (FLORIDA—Tampa, VI-15-44).

Fig. 61, Outer clypeals three branched, inner clypeals simple (FLORIDA—Tampa, VI-15-44).

Figs. 62, 63, Inner clypeals of *Anopheles bradleyi* King.

Fig. 62, Single medial inner clypeal (MISSISSIPPI—Gulfport, V-19-44).

Fig. 63, Three inner clypeals (SOUTH CAROLINA—Myrtle Beach, VII-3-44; see footnote 6).

Fig. 64, Antepalpmate hairs (hair 2) of *Anopheles punctipennis* showing the varied branching which that hair may assume; a, simple; b, c, two branched; d-g, three branched; h, four branched; i, five branched.

Fig. 65, Right half of the fifth segment of *Anopheles quadrimaculatus* (MISSISSIPPI—Greenwood, IV-19-44) showing the additional palpmate. The simple antepalpmate is also shown.

Fig. 66, Left side of the second segment of *Anopheles punctipennis* (GEORGIA—Columbus, VI-12-44) showing an additional palpmate.