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THE MOSQUITOES OF OKLAHOMA

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PREFACE

During 1938-39, a project was set up by the Oklahoma Agricultural Experiment Station for a study of Oklahoma mosquitoes. This was not considered as a major project; collections and identifications were made incidental to other work. In the fall of 1939 the author resigned from the staff of the Oklahoma Agricultural and Mechanical College, but during the summer of 1940 he returned to the State to continue the mosquito survey. The 1940 work was made possible by the Oklahoma State Health Department and the U. S. Indian Service, as these organizations desired more information on the *Anopheles* species in the southeastern counties.

Without the aid of several people, this survey would not have been possible, and the writer is indebted to Dr. F. A. Fenton, Head of the Department of Entomology, Oklahoma A. and M. College, for his interest and support of the work; to Dr. G. F. Mathews, State Health Commissioner, Mr. H. J. Darcey, Chief of the Bureau of Sanitation, Oklahoma State Health Department, and Dr. D. W. Gillick, District Medical Director of the Indian Service, who made possible the investigation in the southeastern counties during the summer of 1940. Acknowledgments are due others, who helped the writer in many collections; these are Mr. K. C. Emerson, formerly a student at the College, Mr. Milo Simmonds, malaria control engineer of the State Health Department, and especially Mr. Gaines Eddy, formerly a student, who accompanied the writer on many of the collecting trips, and helped in the identifications of larvae and adults.

Introduction

Although counted among our most annoying pests, mosquitoes are considered by most people living in temperate zones to be little more than a necessary evil. The discoveries of Ross and Reed on the transmission of malaria and yellow fever by these insects, followed by the brilliant successes of Gorgas, Watson, and others in controlling the diseases by attacking the vectors, have resulted in a general appreciation among the more educated population of tropical and subtropical regions as to the importance of mosquitoes to human welfare.

No one has attempted to estimate the cost of mosquitoes to Oklahoma, but it must be considerable, although even an approximation of this figure would be difficult. The most serious offense of this family of insects is the role some of the species play as carriers of disease. Fortunately the list of mosquito-borne diseases in Oklahoma is short; of these malaria ranks first. Canavan (1935) has shown that most of the malaria in the State occurs southeast of a line running diagonally from the northeast to the southwest, and that the disease is a serious public health problem in several of the counties in the extreme southeast.

In spite of its tremendous oil industry, essentially Oklahoma is an agricultural state. Laboratory experiments indicate that mosquitoes may serve as carriers of the virus of equine encephalomyelitis, which, in the late summer outbreak of 1937, killed many thousands of horses in Oklahoma. The economic loss resulting from irritation and blood loss, in live stock, cannot be estimated, but it must be considerable, not in deaths, but in loss of condition. That mosquitoes can be extremely irritating to live stock is demonstrated by deaths resulting from attack by huge swarms of the insects; Bishopp (1933) observed this to occur in Florida, where domestic animals and poultry were killed during an outbreak of *Psorophora confinnis*. Another way in which mosquitoes are an economic liability is their rendering of resort areas less attractive to the vacationer. With large tracts of land in Oklahoma being set aside for recreational purposes, and with the construction of impoundments, ranging in size from small ponds to huge artificial lakes, the mosquito problem promises to become more acute, not only as regards disease control, but also in the elimination of annoyance. Newer farming practices in Oklahoma, involving ponding and terracing, will increase mosquito abundance. The need is for an increase in standing water, and for a checking of the run-off after rains. How terracing especially favors certain groups of mosquitoes will be shown below. Not the least of their objectionable qualities is the ability of these insects to make impossible the enjoyment of the cool summer evenings on one's yard or porch. MacCreary (1938), who was unable to demonstrate that these pests caused a reduction in milk production in Delaware, says: "Mosquito control needs no justification other than the increased comfort it offers to the people who are directly affected. The more ardent protagonists would do well to confine themselves to this point rather than by nebulous reasoning and insufficient evidence seek to justify control on the basis of increased milk production and similar claims."

Oklahoma: Physiography, Climate, Farming

Lane (1926) described Oklahoma as a plain, sloping gently southeast. The Black Mesa, in the extreme northwest, is "a bed of volcanic lava, now standing high above the level of surrounding elevations and giving to the landscape a characteristic appearance not found elsewhere in the State" (Lane); it has an elevation of 5,050 feet and is the highest point in the State, while the southeastern border, 300 to 400 feet above sea level, is the lowest area. Redfield (1927) divides the State into eleven "fairly distinct regions," some of which are sharply demarcated from neighboring regions, while others gradually merge into the adjoining types of land.

The Ozark uplift, which includes several northeastern counties, is a sparsely settled area timbered chiefly with blackjack and post oak. The average height of the hills is 250 feet above their bases. The soil is very rocky, with a preponderance of flint, but where thick enough, it is fertile and is especially favorable for fruit farming. Much of the drainage is underground.

The Ouachita Mountains in the southeast are the most sparsely settled and rugged area in Oklahoma, with thin, poor soils. The loftiest mountain is 3,000 feet above sea level, and is almost 2,000 feet above its base. The mountain slopes are thickly wooded, and lumbering is the chief industry; pine and cedar are the predominant trees. The streams are clear and rapid.

The south-central Arbuckle Mountains consist of a core of granite surrounded by sedimentary rock. These hills are about 400 feet above their bases. The soils are thin, and the hills are mostly grassland, while the valleys are timbered.

The Wichita Mountains in the southwest have rock similar to those of the Arbuckles. The granite hills have been washed free of soil, and are either bare, or support a scanty growth of timber. The hill tops are 700 to 900 feet above their bases.

The Red River region lies between the Ouachita and Arbuckle mountains, and is bounded on the south by the Red River. The deep black soils are among the most fertile in Oklahoma. The population, mostly rural, is fairly dense.

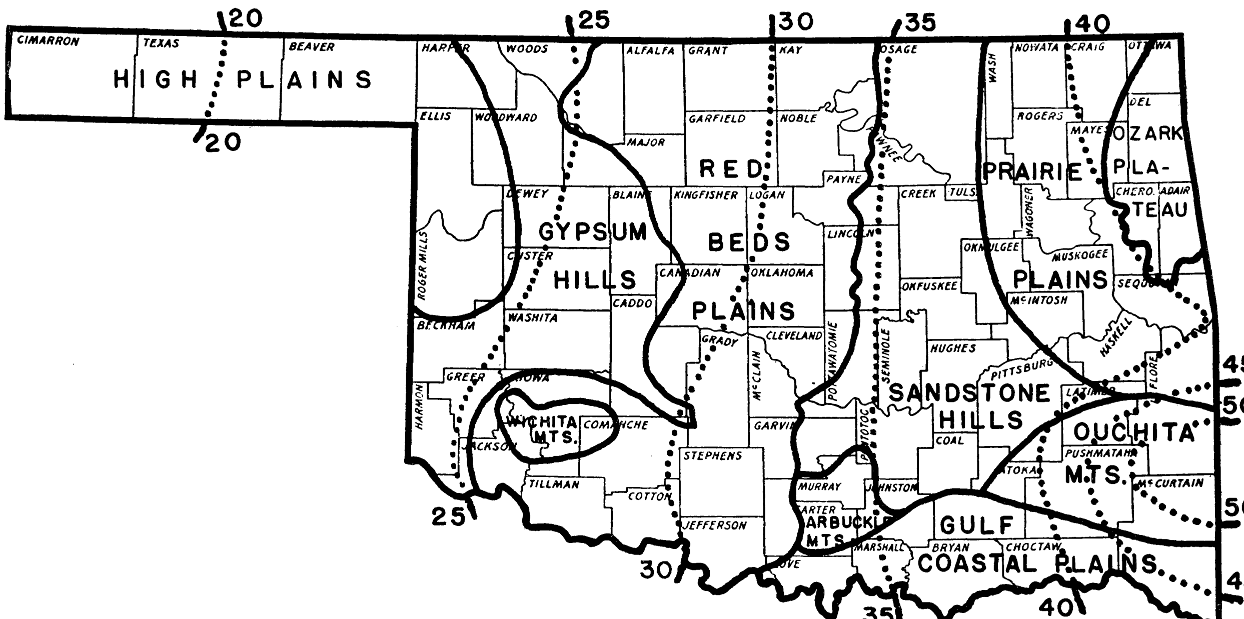
The Sandstone Hills region does not have definite boundaries, but comprises a number of counties in the east-central section, including Osage on the north, Payne and Garvin on the west, and Coal, Pittsburg, and Latimer on the south. The rocks are principally sandstone and shale, and as the soil is quite fertile, agriculture and grazing are important industries. It is in this region that some of the great oil fields are found. Coal mining is another important industry.

The Prairie Plains region lies in the northeastern section, between the sandstone hills and the Ozarks. The rocks are mostly shales and limestones; the soils are deep, fairly fertile, and farming is the chief industry.

The Red Beds Plains region extends all the way across Oklahoma from the north to south; it is bounded on the east by the sandstone hills and on the west by the Gypsum hills. In the south this area entirely surrounds the Wichita Mountains and extends westward almost to the Texas line. The rocks are soft red shale and sandstone. The soil is deep, and varies in fertility. Farming and stockraising are predominant industries.

The Gypsum Hills region, comprising roughly a tier of counties just west of the Red Beds Plains, is similar to the latter area, but is separated from it because of ledges of gypsum. The chief industries are agriculture and grazing. Many salt springs and plains are scattered through this area and the western edge of the Red Beds Plains, of which the largest is the Cherokee Salt Plains in Alfalfa County.

The Panhandle Counties, and the extreme northwest corner of the state proper, are called the High Plains region. This area is sparsely settled, for although the soils are fertile, rainfall is too meager to permit much agricultural development.



Oklahoma, showing physiographic regions and annual precipitation in inches. (From Burrill, 1936).

Two great river systems drain Oklahoma. The Arkansas River enters near Ponca City, and flowing southeastward, leaves the State at Fort Smith. Its chief tributaries are the Salt Fork, Cimarron, and Canadian Rivers. All of these streams are similar in character, with sand-choked beds and waters heavily charged with sediment. During dry weather they become almost or even entirely dry, but, originating in the Rocky Mountains, they are subject to sudden rises, and during floods large quantities of sand are carried downstream and are deposited in the form of extensive sand bars and islands. Redfield states that the depth of sand in the Arkansas probably averages 30 feet, and that ordinarily much of the water drained by the river moves through the sand. The Illinois, Grand, and Virdigris Rivers, which enter the Arkansas from the north and run through the northeastern portion of Oklahoma, flow through a different type of country and have waters that are clear rather than muddy. Their beds are not choked with sand. The Arkansas and its tributaries drain the northern three-fourths of the State.

The Red River is also typically a plains river, with a sandchoked bed, and carries a comparatively small amount of water during dry weather. Its tributaries are the North Fork, similar in character to the other plains rivers; the Washita, which runs through the Arbuckles and which carries less sand; and the Kiamichi and Little Rivers in the southeast, which, flowing through the rocky Ouachita mountains, have clear waters well stocked with gamefish.

Oklahoma's climate is temperate, but the temperature varies between extremes of below zero in winter to above 100 degrees F. in summer. Strong winds sweep over the vast plains. From east to west there is a steady diminution in the amount of precipitation; in the southeast the annual rainfall averages 45 inches, but in the northwest it is only 15 inches. Most of the rain falls between April through September, with May the high and January the low months.

Because of these varied conditions, farm practises must be adapted to the physiographic type of country and to the climate. The two chief crops are wheat and cotton; the former occupies the northwestern quarter of the State, while the cotton belt includes the southern half. Other principal crops are corn, in the east, grain sorghums, especially important in the arid western areas, and livestock. Osage County, several counties in the south-central region, and some of the northwestern counties are especially adapted to range livestock; dairy cattle and poultry are concentrated near the large markets, while hogs are more abundant in the eastern counties.

Object

Little work has been done on the mosquitoes of Oklahoma. Because of the geographical position of the State and its variety of physiographic regions, it was thought that a survey of the mosquito population would yield interesting information. Such a survey is essential in planning control work.

The object of the mosquito survey was as follows: To determine which species of these insects are present in Oklahoma, estimate their relative abundance, map their distribution, and study their breeding places.

A considerable portion of the bulletin is devoted to a taxonomic treatise of the local species. With several splendid monographs on the American Culicidae already in existence, it would seem that little new could be added. Unfortunately most of these publications are unavailable except to persons having access to certain libraries, and as it is hoped that this bulletin will be of use to local students, health officials, and others who may be interested in identification, biology, and control of mosquitoes, the inclusion of aids to identification is necessary for completeness. No apologies are offered for unavoidable repetitions in the keys of information published by others; certain morphological structures must be emphasized for specific identifications, and these characters have been stressed in many published keys.

Methods

Most of the time spent in collecting mosquitoes was utilized in larval collections; larvae and pupae were taken by dipping. Dippers of approximately the same size were used throughout the survey, and a record was kept of the number of dips taken in each breeding place. All types of water were examined. The dipping might be called random sampling of the breeding waters, but naturally larvae were sought for in what seemed to be the most favorable situations, where drift, floatage, and vegetation furnished suitable shelter and food for the larvae, while open, unprotected waters, or those that obviously contained no larvae, were avoided. Each collection was placed in a separate bottle, and taken to the laboratory, where identifications were made. Adults were bred from pupae, and from many of the larvae, but usually the identifications were made on larval characters. Most of the larvae were examined individually with a low power binocular microscope; in a few cases, where great numbers of larvae were taken and a fair sample showed that only one species was present, every tenth or twentieth specimen was identified with the microscope. Even so, those not placed under the microscope were examined carefully; a collector who becomes familiar with a group of species in a circumscribed area learns a number of specific characteristics that are apparent to the naked eye, so that after a time he becomes certain of his macroscopic identifications. A record was kept of the number of larvae of each stage, as well as pupae, of each species. The numbers of larvae and pupae represent actual counts, except for a very few collections, where larval density was so great that only an estimate was possible.

Adult collections were made with the aid of light traps, animal or human bait, or the adults were taken in their natural resting places. Because the survey was not a major project, light trap collections could not be made every night, so that, although the traps were set out as often as possible, often there were periods of a week or more when the collections could not be made or examined. Only a few mosquitoes were taken from a horse as bait, but a fairly large number was captured while feeding on the author or his companions. Natural resting places included bushes and grass, overhanging creek banks, hollow trees, bridges and culverts, and sheds, barns, and occasionally houses.

At the time the writer began this survey, the entomology museum of the Oklahoma Agricultural and Mechanical College already contained a splendid collection of adult Oklahoma mosquitoes, most of them having been taken by J. Standish and R. Kaiser during their insect survey of the State in 1937. The Standish-Kaiser collection was supplemented by student collections, made over a period of several years. These specimens were identified by Dr. R. Matheson of Cornell University. During June, 1938, Kaiser and W. T. Nailon made a number of adult collections in various parts of the State. Finally, a few specimens were sent to the author by Dr. W. M. Wood and Mr. Milo Simmonds, of the State Health Department, for identifications. The Entomology Department's records are included because they give additional information on localities, and because two species are represented that the author did not find. These records are not included in the analysis that attempt to show relative abundance, as their method of capture is uncertain, and it is feared that the specimens in the museum do not represent a true picture of abundance. A few of the Wood-Simmonds records of adult captures are included in the tables.

Although the writer wished to survey the entire State impartially, this was not possible. Naturally most of the work was done in the vicinity of Stillwater, with the four southeastern counties, Bryan, Choctaw, Pushmataha, and McCurtain, coming second in the number of collections. Observations in other parts of the State are somewhat scattered, and most were made on trips that were taken in connection with other work. The adult surveys of Standish, Kaiser, and Nailon give many records from localities that were not visited by the author. Unfortunately, the northeastern corner, the interesting Gypsum Hills region, with its salt springs and flats, and the south-central area have been largely neglected. Special mosquito collecting trips were made to the Panhandle, Woods County, Harmon County, the Wichita Mountains, and the Ouachita Mountains.

The Breeding Places of Oklahoma Mosquitoes

An interesting and as yet unsolved problem is the reason for the selection by certain species of mosquitoes of definite types of water for larval development. *Psorophora* and many *Aedes* species deposit their eggs in depressions in the ground, where the eggs remain dormant sometimes for years before rains flood them and permit hatching. Females of other species lay their eggs directly on the surface of the water; these eggs must hatch in a relatively short time. Females do not seem to oviposit in any kind of water; the concentration of larvae in definite water types cannot be explained only on the basis of a survival of larvae in favorable water, for laboratory experiments have shown a rather delicate selectivity in oviposition on the part of females offered several dishes of water differing only in their organic or inorganic content.

The situations in which Oklahoma mosquitoes were found breeding (Table 1) were classified as follows:

Running streams. Most species are not able to develop in running water, and the larvae taken in this type of water were found along the edges of streams where the current was slight and small eddies and backwashes had formed behind rocks and other obstructions. Water partially pooled behind sticks and leaves dammed back of rocks in shallow rapids often contains large numbers of larvae. This type of breeding water is clear and cool, and *Anopheles punctipennis* was the species most frequently encountered.

Pooled streams. During the long dry summers the water in most of the creeks and smaller rivers diminishes until the stream beds contain a series of pools, which eventually may dry up completely. A creek pool must not be confused with a temporary rain pool that happened to form in a dry creek bed. Perhaps these stream pools are the most available type of water for oviposition. The water may be clear, but usually it is quite turbid. Most of the larvae and pupae taken were those of *A. punctipennis*. The relative abundance of the species is somewhat misleading, because of the collection of large numbers of *Culex restuans, salinarius,* and *tarsalis* in two pools in a creek bed into which sewage from an institution was discharged; breeding in these pools was so heavy that only an estimate could be made of the number of *Culex* taken per dip.

Natural lakes. Only nine collections were made in natural lakes and ponds; here *A. quadrimaculatus* and *C. tarsalis* were most frequently encountered, in accumulations of drift, floatage, and emergent or surface vegetation. Unprotected water, subject to wave action, does not support mosquito breeding.

Swamps, marshes, bayous, and similar quiet waters, with much vegetation and floatage furnished suitable breeding places for *A. quadrimaculatus* and *A. punctipennis;* in 38 collections, *quadrimaculatus* outnumbered all the other species. Densely shaded areas were not so suitable as those in which the vegetation was open enough to permit a considerable amount of sunlight to strike the water.

Impoundments contained the same species as did natural lakes and swamps, and are important because they are especially favorable for *A. quadrimaculatus*. This species was seldom found in stock ponds, which usually contained little vegetation and had muddy, trampled margins. Impoundments become ideal breeding places when they have not been cleared of trees and other vegetation, or when they are stocked with Characeae or other types of vegetation that furnish protection for the larvae. The writer knows of at least one death due to subtertain malaria, which occurred in one of the northern towns of the State. The patient had not been away from this locality, and he, and a companion, apparently were infected with the same strain of parasite during an evening spent in a city park; in this park was an ornamental impounded stream in which *quadrimaculatus* breeding was heavy. As subtertain malaria is practically unknown in this region, it seems likely that one or more mosquitoes were infected by feeding on a transient who had visited the park or the neighborhood. Although fortunately of rare occurrence, this case illustrates the possibility of similar tragedies in other localities.

Springs and seepages, with clear, cool water, were especially favorable to *A. punctipennis* and *C. tarsalis*. Relatively few collections were made in this type of water, and more observations are necessary to determine whether the seepages below earth-filled dams are similar ecologically to natural seepages and springs. Only one *A. quadrimaculatus* larva was taken in seepages.

TABLE 1—NUMBERS OF LARVAE IN TYPES OF BREEDING WATER

SPECIES	Streams Running	Streams Pooled	Natural lakes	Swps. etc.	Impoundments	Sprgs. Seepages etc.	Flood or Rain Pools Temp.	Flood or Rain Pools Semi-perm.	Salt pools	Artificial Contnrs.	Tree holes	Rock pool	Total
Aedes aegypti										109			109
A. alleni											1		1
A. atlanticus		1					28	1					30
A. atropalpus												2	2
A. dorsalis									2				2
A. nigromaculis		4				17	454	9					484
A. sollicitans									80				80
A. triseriatus											91		91
A. trivittatus				1			112						113
A. vexans		110		45		6	818	33					1012
An. barberi											17		17
A. crucians					12			3					15
A. pseudopunctipennis		1004											1004
A. punctipennis	616	2034	12	195	126	265	179	89		141			3657
A. quadrimaculatus	25	388	43	241	386	1	56	92		30			1262
Culex apicalis	99	497		87	41	18	83						825
C. erraticus	95	241	19	123	695			35					1208
C. peccator				6									6
C. quinquefasciatus		93				70	226	28		285			702
C. restuans	11	1479		1		35	532	71		190			2319
C. salinarius	1	1443			1	29	144	13		177			1808
C. tarsalis	11	1470	155	17	88	632	358	132		283			3146
M. septentrionalis											14		14
O. signifera											70		70
P. ciliata		1					429	36					466
P. confinnis		20					1720	53		3			1796
P. cyanescens		3					535	12					550
P. discolor		41					299	11					351
. ferox		2		2			114	12					130
P. horrida							46	56					102
P. howardii							8						8
P. signipennis	5	113					1935	10		13			2076
T. inornata		833	3	69		196	611	1		11			1724
U. sapphirina	4	18		72	21			7					122
Totals	867	9795	232	859	1370	1269	8687	704	82	1242	193	2	25302
Number of collections	57	206	9	38	58	32	153	35	1	28	12	1	630
Number of dips	1339	3332	275	1174	2858	402	2375	781	80	214		1	
Average number of dips per collection	24	16	31	31	49	13	16	22	80	8		1	
Average number larvae per collection	15	48	26	23	24	40	57	20	82	44	16	2	

Temporary and semi-permanent flood and rain pools are the chief source of Oklahoma's pest mosquitoes. In them are found the species of *Psorophora* and *Aedes* that lay their eggs in depressions in the ground, where the eggs remain dormant until submerged by rains or rising waters. Temporary rain pools form in open prairies, dry creek beds, roadside ditches, and many other situations, including poorly drained areas in cities and towns, where the adult mosquitoes often cause great annoyance. The prairie rain pools, with their grassy bottoms, contain clear water entirely exposed to sun; pools in roadside ditches may be heavily shaded and so turbid that the larvae cannot be seen in the water. Unquestionably the practice of terracing is increasing the abundance of these pest mosquitoes, for water dammed behind terraces usually contains great numbers of larvae.

Salt water pools, which form at the edges of the great Salt Plains near Cherokee, are inhabited by *Aedes sollicitans* and *A. dorsalis.* Completion of the dam across the Salt Fork near Cherokee, which will flood the Great Salt Plains, should bring about interesting ecological changes. Only one collection was made in salt water pools, but there are many salt plains and springs in the northwestern area of Oklahoma, and these two species should be quite widespread.

Water caught in rot holes of trees contains a characteristic fauna, including five species of mosquitoes, of which *A. triseriatus* is the most important.

Rock pools are collections of water in crevices in rocks in stream beds. In the Wichita National forest, Kaiser and Nailon discovered two larvae of *Aedes atropalpus* in such a pool.

"Artificial" containers of water included watering troughs, rain barrels, cans, buckets, and a section of tile sewer pipe standing on end. *Aedes aegypti, A. punctipennis,* and several species of *Culex* are most frequently encountered in these containers.

The Relative Abundance of Oklahoma Mosquitoes

Forty species of mosquitoes have been found in Oklahoma. Two of them, *Aedes canadensis* and *Theobaldia melanura,* were not collected by the author, but were represented in the Entomology Department's museum. *A. bimaculatus, A. sticticus,* and *Psorophora varipes* were taken only as adult females, captured while feeding, while *Anopheles barberi, A. pseudopunctipennis, A. crucians,* and *Orthopodomyia signifera* were found only in the larval stage. A single female *Mansonia perturbans* was captured in a light trap.

The percentage totals* given in Table 2 do not represent a true picture of the relative abundance of the species, because equal effort could not be made in each method of collection, and because the entire State was not surveyed with equal thoroughness. For example, if more time had been spent in capturing adult females while they were feeding on man or animals in the southeastern counties, the number of *Aedes sticticus* taken would have been much higher. *P. varipes* appeared to be very abundant in the extreme southeastern corner of McCurtain county, but only one trip was made into this region. Again, had a thorough search been made of the salt springs and pools of the Gypsum Hills region, large numbers of *A. sollicitans* and *A. dorsalis* would have been identified. Furthermore, certain species are readily captured by some methods but not by others; it will be noted that few *A. quadrimaculatus* and *A. punctipennis* were attracted to light traps, while these species, particularly the former, far outnumbered the others in natural resting places. The number of *A. quadrimaculatus* from natural resting places represents the individuals actually caught and identified; if the resting adults simply had been counted, their numbers would have been in the thousands. It is interesting to note that of the *Culex* species only *C. salinarius* and *C. erraticus* were observed attacking man. *P. cyanescens* seemed to be the most common species feeding on man, followed by *A. trivittatus. Aedes sticticus, P. ciliata, P. horrida,* and *P. varipes* are greater pests than the adult records indicate. Of the species taken in light traps, *P. signipennis* far outnumbered the others, although few individuals were seen attacking man. *A. nigromaculis* was also common in light traps.

*The sum of the percentages does not equal 100 because there seemed to be no point in carrying the percentages beyond the first decimal, and the percentage totals of the rare species were not included.

TABLE 2—RELATIVE ABUNDANCE

SPECIES	Adult Collections: Biting: Horse	Biting: Man	Light Trap	Natural Resting Places	A&M	Total except A&M	Percentage totals	Larvae: Totals	Larvae: Percentage totals	Adults & Larvae: Totals	Adults & Larvae: Percentage totals
Aedes aegypti		1		2	+	3		1u9	0.4	112	0.4
A. alleni		6	1	1		8		1		9	
A. atlanticus		3				3		30		33	
A. atropalpus				7		7		2		9	
A. bimaculatus		1				1				1	
A. canadensis					+						
A. dorsalis				3	+	3		2		5	
A. nigromaculis	1	2	616		+	619	10.9	484	1.9	1103	3.6
A. sollicitans				39		39	0.7	80	0.3	119	0.4
A. sticticus		51	10	4	+	65	1.1			65	
A. triseriatus	1	19	1	7	+	28	0.5	91	0.4	119	0.4
A. trivittatus		101	13	23	+	137	2.4	113	0.4	250	0.8
A. vexans	1	34	45	41	+	121	2.1	1012	4.0	1133	3.6
An. barberi								17		17	
A. crucians					+			15		15	
A. pseudopunctipennis					+			1004	4.0	1004	3.2
A. punctipennis	6	19	23	284	+	332	5.8	3657	14.4	3989	12.9
A. quadrimaculatus	3	4	1	873	+	881	15.5	1262	5.0	2143	6.9
Culex apicalis			6	13		19		825	3.3	844	2.7
C. erraticus	1	6	31	7	+	45	0.8	1208	4.8	1253	4.0
C. peccator				2	+	2		6		8	
C. quinquefasciatus				1	+	1		702	2.8	703	2.3
C. restuans			19	3	+	22		2319	9.2	2341	7.6
C. salinarius	3	28	16	22	+	69	1.2	1808	7.1	1877	6.1
C. tarsalis	2		132	39	+	173	3.0	3146	12.4	3319	10.7
Mansonia perturbans			1			1				1	
Meg. septentrionalis				1	+	1		14		15	
O. signifera					+			70		70	
Psorophora ciliata		16	30	2	+	48	0.8	466	1.8	514	1.7
P. confinnis		13	135		+	148	2.6	1796	7.1	1944	6.3
P. cyanescens		347	183	5	+	535	9.4	550	2.2	1085	3.5
P. discolor	1	25	57		+	83	1.5	351	1.4	434	1.4
P. ferox		51	3	13	+	67	1.2	130	0.5	197	0.6
P. horrida		51	3	38	+	92	1.6	102	0.4	194	0.6
P. howardii				3		3		8		11	
P. signipennis		6	1923	27	+	1956	34.4	2076	8.2	4032	13.0
P. varipes		51				51	0.9			51	
Theobaldia inornata	41		1	10	+	52	0.9	1724	6.8	1776	5.7
T. melanura					+						
U. sapphirina	2	2		61	+	65	1.1	122	0.5	187	0.6
Totals	62	837	3250	1531		5680		25302		30982	

In spite of the obvious inadequacies of the records, certain correlations may be noted in comparing percentage totals of both larval and adult collections. Unquestionably the most abundant Oklahoma mosquito is *Anopheles punctipennis;* although it represented only 5.8 per cent of the adults, 14.4 per cent of the larvae were this species. Adult resting places contained many more *A. quadrimaculatus* than any other species (15.5 per cent of the adults); perhaps because of its more limited distribution and more restricted breeding habits, larvae of *A. quadrimaculatus* were much less numerous than those of *punctipennis,* so that the combined percentage totals of larvae and adults amounted to only 6.9 per cent. *A. pseudopunctipennis* larvae and pupae breed in great numbers in alga-filled, sunny seepage pools in the sandy beds of the western plains streams. The percentage total of this species would have been much higher if more collections had been possible in the northwestern area of the State during late summer. Nevertheless, the species cannot be considered a common Oklahoma mosquito; of 630 larval collections, 263 of which were made in running or pooled streams, *A. pseudopunctipennis* was taken only twice. *A. barberi* and *A. crucians* are rare.

Of the thirteen species of *Aedes, A. vexans* and *A. nigromaculis* were the most abundant; the former because of the frequency with which the larvae were encountered in rain or flood pools, and the latter because of its attraction to light traps, although its larvae were also common. There was no evidence of the tremendous numerical superiority of *A. vexans* over other mosquitoes in Oklahoma, such as Riley and Chalgren (1939) observed in the Minneapolis-St. Paul Metropolitan area of Minnesota; relatively few were collected in light traps. *A. aegypti* may be abundant locally towards the close of the summer. *A. alleni, atlanticus, atropalpus,* and *canadensis* are rare, while only a single female of *A. bimaculatus* was found; it was caught biting during one of the last collections the author made in Oklahoma. *A. dorsalis* and *sollicitans* should be common in the Gypsum Hills region but certainly are not abundant elsewhere. *A. sticticus* is a serious pest in the early summer in wooded areas of the southeastern counties, while *A. trivittatus* may be somewhat of a pest in certain localities, especially wooded ones. *A. triseriatus,* limited to breeding in tree holes, is uncommon.

Culex tarsalis is one of the most prevalent Oklahoma mosquitoes; although not many adults were taken, 12.4 per cent of all the larvae belonged to this species. *Culex apicalis, erraticus, quinquefasciatus, restuans,* and *salinarius* are common, while *C. peccator* is rare.

Mansonia perturbans was taken only once. The few searches made for the larvae were all negative. *Megarhinus septentrionalis* and *Orthopodomyia signifera,* which breed in tree holes, are not numerous.

With the exception of *P. howardii,* which was taken only occasionally, all of the *Psorophora* species are abundant, and, with *A. vexans, A. nigromaculis,* and *A. sticticus,* constitute Oklahoma's serious pest mosquitoes. *P. signipennis* was the predominant *Psorophora,* although it was taken chiefly in light traps and as larvae. *P. cyanescens* was observed attacking man more often than any other species. Both *P. horrida* and *ferox* may be abundant locally, and cause considerable annoyance. The writer, while walking through shaded bushes and weeds at the edge of a large overflow near Shawnee, disturbed hundreds of adult mosquitoes resting in the damp underbrush. A sample of these insects, taken by sweeping, revealed that almost all were *P. horrida.* It should be noted that *P. discolor* is not uncommon. Dippings on successive days in the same rain pools showed that this species develops more slowly than the other *Psorophora;* hatching of the eggs seemed to be delayed, and mature larvae and pupae usually appeared after the other species had emerged. The habit of *P. discolor* larvae of remaining motionless at the bottom of the pool, where they apparently attach themselves to grass or debris, may be another reason for the supposed scarcity of the species.

Theobaldia inornata larvae and pupae were numerous during the colder months of the year. Most of the few adults taken were captured from horses used as bait. *T. melanura* is rare.

Uranotaenia sapphirina is fairly numerous. Large numbers of adults were often seen resting in underbrush, in wet hoof prints, and similar situations.

Larval Associations

Some of the mosquitoes show little selectivity in their breeding habits, and so are associated with any of the other species. Others, more or less restricted in the types of water selected for larval development, are members of rather clear-cut associations. Table 3 shows the number of times the larvae and pupae of the various species were collected with each of the other species. The table is similar to that published by Owen (1937).

Aedes aegypti, Culex quinquefasciatus, C. restuans, C. salinarius, C. tarsalis, and *Anopheles punctipennis* are found together in various "artifical" water receptacles. *Psorophora columbiae* and *P. signipennis* were each taken once in artificial containers, but their occurrence there is unusual.

Species living together in rot holes in trees are *Anopheles barberi, Aedes alleni, A. triseriatus, Orthopodomyia signifera* and *Megarhinus septentrionalis.*

Only one collection was made from a rock pool, where *A. atropalpus* was the only species encountered.

Aedes sollicitans and *A. dorsalis* are found together in salt water pools. A number of *Culex tarsalis* adults were swept from grass at the margin of the salt water pools, with *A. sollicitans* and *A. dorsalis* adults, but no larvae of *tarsalis* were taken in the pools. Nevertheless, their breeding places must have been very near.

A large group of mosquitoes are adapted to the semi-arid climate of Oklahoma, breeding in tremendous numbers in the pools that form after rains. These are *Aedes atlanticus, A. nigromaculis, A. sticticus* (not taken in the larval stage in this survey), *A. trivittatus, A. vexans,* and all the eight species of *Psorphora.*

The characteristic associations in the quiet, uncontaminated waters of natural lakes, swamps, and impoundments are *A. quadrimaculatus, Culex erraticus, C. tarsalis,* and *Uranotaenia sapphirina. A. punctipennis* was not particularly abundant in this type of water, but was associated with *quadrimaculatus* principally in pooled streams. *A. punctipennis* larvae were collected 342 times, and those of *quadrimaculatus* 174 times; the two species were taken together 93 times. Because of its wide selection of breeding places, *A. punctipennis* is taken more frequently with *quadrimaculatus* in proportion to the total number of collections of the latter, than vice versa. *A. punctipennis* was associated with 23 of the 33 other species found as larvae.

Theobaldia inornata, which appears in the fall and disappears in the spring, was somewhat limited in its associations because of its seasonal abundance. *C. tarsalis* was most frequently encountered with it.

Seasonal Abundance

The numbers of larvae, pupae, and adults collected are arranged according to months in tables 4 and 5. The monthly totals are much greater in June, July, and August, which is due not only to the greater abundance of mosquitoes during the summer, but of course also to the many collections made during these months when other duties were lighter. Nevertheless the table gives some indication of seasonal prevalence. Unfortunately, only the positive collections are recorded; a much larger percentage of searches for larvae made in the cold months was discarded because they were unfruitful.

The majority of the species are most numerous in the summer, and continue to breed through October and into November, when cold weather sets in. Larvae of *A. punctipennis* were taken in every month but January and February; in table 4 the 25 specimens taken in February were actually eggs, which hatched soon after they were taken to the laboratory. For convenience, these were incorporated in the table as larvae. Adults were obtained from these eggs. *A. quadrimaculatus* increased in numbers later in the summer, and were far more numerous in October than the table

TABLE 3—LARVAL ASSOCIATIONS

	Total times collected	*A. aegypti*	*A. alleni*	*A. atlant.*	*A. atrop.*	*A. dors.*	*A. nigro.*	*A. sollic.*	*A. triser.*	*A. trivit.*	*A. vexans*	*An. barberi*	*A. crucians*	*A. pseudopunct.*	*A. punct.*	*A. quad.*	*C. apical*	*C. errat.*	*C. peccat.*	*C. quinque*	*C. restuans*	*C. salin.*	*C. tarsalis*	*M. sept.*	*O. signifera*	*P. ciliata*	*P. confinnis*	*P. cyan.*	*P. discolor*	*P. ferox*	*P. horrida*	*P. howardii*	*P. signipennis*	*T. inornata*	*U. sapphirina*
A. aegypti	7														3					4	3	3	2				1						1		
A. alleni	1								1																										
A. atlanticus	4										1		1		3		1									1	1		1	2	1		1		
A. atropalpus	1																																		
A. dorsalis	1							1																											
A. nigromac.	29									1	17				2						1	1	2			10	13	12	2	1	1		23	2	
A. sollicitans	1					1																													
A. triseriatus	8		1									3												1	3										
A. trivittatus	8						1				7				2		1				1		2			4	3	3		5	3		6		
A. vexans	56			1			17			7			1		18	1	7				6	7	13			16	14	15	2	8	5	1	41	2	
An. barberi	5								3															3	5										
A. crucians	8			1							1				3	5	2	5					1			1	1			1					2
A. pseudopunct.	2																						2												
A. punctipennis	342	3		3			2			2	18		3			93	77	52		8	26	28	51			8	19	4	8	9	2	3	21	11	11
A. quadrimac.	174										1		5		93		27	89	2	3	2	3	14			2	5		2	1	1	1	1		21
Culex apicalis	95			1						1	7		2		77	27		15		1	9	10	13			3	4	2	2	3	1	1	7	2	7
C. erraticus	113												5		52	89	15		2	2	1	2	11			1	1		2						24
C. peccator	2															2		2																	
C. quinquefasc.	22	4													8	3	1	2			6	8	8				1						2	3	1
C. restuans	48	3					1			1	6				26	2	9	1		6		24	30							1			5	6	
C. salinarius	42	3					1				7				28	3	10	2		8	24		23			2	2	3					7	2	1
C. tarsalis	97	2					2			2	13		1	2	51	14	13	11		8	30	23				5	2	2	2	1			12	14	1
M. septent.	5								1			3													5										
O. signifera	7								3			5												5											
P. ciliata	51			1			10			4	16		1		8	2	3	1				2	5				35	26	12	6	6	2	33	1	1
P. confiinnis	85	1		1			13			3	14		1		19	5	4	1		1		2	2			35		24	16	5	4	3	37		
P. cyanescens	37						12			3	15				4		2					3	2			26	24		4	4	5		28		
P. discolor	29			1			2				2				8	2	2	2					2			12	16	4		1	1		12		
P. ferox	14			2			1			5	8		1		9	1	3				1		1			6	5	4	1		5	2	6		
P. horrida	8			1			1			3	5				2	1	1									6	4	5	1	5		1	5		
P. howardii	4										1				3	1	1									2	3			2	1		1		
P. signipennis	89	1		1			23			6	41				21	1	7			2	5	7	12			33	37	28	12	6	5	1		2	
T. inornata	40						2				2				11		2			3	6	2	14			1							2		
U. sapphirina	26												2		11	21	7	24		1		1	1			1									

TABLE 4—LARVAL DISTRIBUTION BY MONTHS

SPECIES	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Totals
Aedes aegypti					5	5	15	84					109
A. alleni				1									1
A. atlanticus						1	1	28					30
A. atropalpus						2							2
A. dorsalis							2						2
A. nigromaculis				18	59	85	168	89		65			484
A. sollicitans							80						80
A. triseriatus				10	18	7	56						91
A. trivittatus				14	1	5	63	30					113
A. vexans				57	313	467	83	35	12	40	5		1012
Anopheles barberi						12	5						17
A. crucians						3	5	7					15
A. pseudopunctipennis										1004			1004
A. punctipennis		25	16	58	149	1056	981	1065	102	169	33	3	3657
A. quadrimaculatus						179	497	501	25	60			1262
Culex apicalis				21	51	376	108	242	16	8	3		825
C. erraticus						37	508	586	52	25			1208
C. peccator								6					6
C. quinquefasciatus						1	27	436		135	96	7	702
C. restuans				237	250	1742	81	9					2319
C. salinarius					48	1490	176	91			3		1808
C. tarsalis				95	1077	1573	87	72	6	235	1		3146
Meg. septentrionalis						9	3	2					14
Orth. signifera						49	9	12					70
Psorophora ciliata					53	38	162	194	2	17			466
P. confinnis					57	78	966	661	34				1796
P. cyanescens					106	17	238	185	1	3			550
P. discolor					22	51	94	184					351
P. ferox					2	34	11	78	5				130
P. horrida						1	65	31	5				102
P. howardii						2		2	4				8
P. signipennis				11	299	734	238	459	25	310			2076
Th. inornata	227	376	97	193	93					420	250	68	1724
U. sapphirina						13	61	43		5			122
Totals	227	401	113	715	2603	8067	4790	5132	289	2496	391	78	25302

TABLE 5—ADULT DISTRIBUTION BY MONTHS

SPECIES	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Totals
Aedes aegypti					1	2							3
A. alleni						4	4						8
A. atlanticus						2	1						3
A atropalpus						7							7
A. bimaculatus								1					1
A. dorsalis							3						3
A. nigromaculis				1	2	305	112	188	10	1			619
A. sollicitans							39						39
A. sticticus						65							65
A. triseriatus					2	17	6	2		1			28
A. trivittatus						106	29	2					137
A. vexans					1	95	17	4	3	1			121
A. punctipennis			1		37	58	104	87		45			332
A. quadrimaculatus					4	304	230	251		92			881
Culex apicalis						18			1				19
C. erraticus						9	3	5	28				45
C. peccator						1	1						2
C. quinquefasciatus								1					1
C. restuans					1	18	3						22
C. salinarius						41	22	3		3			69
C. tarsalis			1	1	36	76	46	10	1	2			173
Man. pertubans						1							1
Meg. septentrionalis						1							1
Psorophora ciliata						22	11	15					48
P. confinnis						26	9	97	16				148
P. cyanescens					8	151	192	167	17				535
P. discolor					2	46	12	22		1			83
P. ferox						46	21						67
P. horrida					3	36	51	2					92
P. howardii							3						3
P. signipennis					11	854	346	735	10				1956
P. varipes						3	48						51
Th. inornata			2							50			52
U. sapphirina						7				58			65
Totals			4	2	108	2321	1313	1592	86	254			5680

indicates. *A. pseudopunctipennis* was taken only in October by the author, who was unable to find it earlier in the summer, although special searches were made for it in stream bed pools where the species was known to breed. *Aedes aegypti* becomes more abundant in late summer. Other species are prevalent in the cooler months; the writer took adults of *Aedes sticticus* only in June (no collections in the southeastern counties were possible earlier than June); by this time the larvae had apparently all disappeared, although enough females remained to be quite annoying. Most of the *A. vexans* appeared in early summer, although its larvae were taken as late as November. *Theobaldia inornata* is primarily a winter-breeding species; from late fall to early spring the larvae and pupae were observed in tremendous numbers in stream pools and other types of water, but during the summer both adults and immature stages disappeared.

Identification of Oklahoma Mosquitoes

THE ADULT FEMALES. No attempt will be made to discuss thoroughly the general morphology of mosquitoes; students who are unfamiliar with the structures used for identification of mosquitoes will find excellent summaries in almost any textbook of medical entomology and in special publications dealing with this family of insects. Matheson's (1929) handbook is especially recommended, as well as the recent revision of the mosquitoes of the southeastern United States by King, Bradley, and McNeal (1939). In order to recognize genera, it is essential to understand the distribution of the bristles on the thoracic pleurae of the adults, the important ones being the spiracular bristles, situated in the membrane just before the anterior spiracle; the post-spiraculars immediately behind the anterior spiracle; and the lower mesepimerals, on the lower part of the mesepimeron. Other bristles are not essential because only nine genera are known from Oklahoma, and in the key the larger, more easily seen characteristics have been used wherever possible. Thus, instead of relying entirely on the pleural bristles, *Orthopodomyia* is keyed out by the colorational pattern of the mesonotum.

1. Proboscis rigid, distal half strongly curved downwards; large mosquitoes clothed with brilliantly colored, iridescent scales....*Megarhinus septentrionalis*
   Proboscis not rigid and curved downward; body without a thick clothing of iridescent scales 2
2. Scutellum evenly rounded .... (*Anopheles*) 36
   Scutellum trilobed 3
3. Small species, with lines and patches of brilliant, blue iridescent scales on wings, mesonotum, and pleurae; vein 6 (2nd A) ending in wing margin near the forking of the 5th vein (Cu) ....*Uranotaenia sapphirina*
   Usually larger, without blue iridescent scales; vein 6 ending in wing margin beyond the forking of the fifth vein. 4
4. Spiracular bristles absent 5
   Spiracular bristles present 8
5. Post spiracular bristles absent 6
   Post spiracular bristles present .... (*Aedes*) 9
6. Integument dark brown; 6 narrow but conspicuous lines of white scales on the mesonotum ....*Orthopodomyia signifera*
   Dull grey or brown mosquitoes; if marked with white, mesonotum without six conspicuous narrow white lines on a dark brown background.......... 7
7. Wing scales broad, black and white mixed; several lower mesepimeral bristles ....*Mansonia perturbans*
   Wing scales narrow, dark; usually only one lower mesepimeral bristle (*Culex*) 21
8. Post spiracular bristles present; tarsal segments with conspicuous white markings; if these markings are absent, the general color is shiny black or purplish .... (*Psorophora*) 27
   Post spiracular bristles absent; dull brown species with tarsal segments entirely dark .... (*Theobaldia*) 35

AEDES

9. Integument bright yellow .... *A. bimaculatus*
Integument brown or grey 10

10. Tarsi entirely dark, without white rings 11
Tarsal segments with white bands 14

11. Mesonotum brown, with a broad longitudinal white stripe along median line .... *A. atlanticus*
Mesonotum without a broad central white stripe 12

12. Mesonotum with two narrow yellowish-white longitudinal stripes, one on each side of the middorsal line .... *A. trivittatus*
Mesonotum without two longitudinal yellowish-white stripes 13

13. Mesonotum dark centrally, sides broadly silver-scaled; the posterior pronotum densely clothed with broad, flat, silvery scales; abdominal tergites without white bands .... *A. triseriatus*
Mesonotum with a central stripe of bronzy-brown scales, the sides broadly whitish or yellowish; posterior pronotal lobes clothed with brown scales, and not with a dense clothing of flat silvery scales; abdominal tergites with narrow basal white bands or at least with a few white scales at the base of some of the tergites .... *A. sticticus*

14. Tarsi with white rings only at the bases of the segments 15
The white bands of the tarsal segments involving both sides of the joint; i.e., on both ends of the segment 19

15. First vein (R) from base of the wing to the humeral cross vein with a conspicuous line of white scales .... *A. alleni*
First vein without this marking 16

16. Proboscis broadly white in the middle 17
Proboscis entirely dark 18

17. Lateral light spots of the abdominal segments of the same color as the basal bands of the tergites and the longitudinal dorsal stripe *A. nigromaculis*
Lateral light spots of the abdominal segments white, contrasting strongly with the yellowish color of the basal bands and longitudinal stripe on the dorsum of the abdomen .... *A. sollicitans*

18. Mesonotum dark, with conspicuous white lines forming a lyre-shaped pattern; tarsal rings broad .... *A. aegypti*
Mesonotum uniformly brown; tarsal rings very narrow .... *A. vexans*

19. The second, fourth and sixth veins white scaled, dark and light scales mixed on the other veins. .... *A. dorsalis*
Wings entirely dark (a few light scales may be present at the base of the costa) 20

20. Mesonotum dark centrally, whitish or yellowish anteriorly and along the sides; a few light scales on the costa at the base of the wing .... *A. atropalpus*
Mesonotum uniformly golden brown; wing scales all dark........ *A. canadensis*

CULEX

21. Tarsi with conspicuous white rings; proboscis with a white ring at the middle .... *C. tarsalis*
Tarsi and proboscis dark 22

22. Abdominal bands on the apical margin of each tergite........ *C. apicalis*
Abdominal bands on the basal margin of the tergites, or tergites without white bands 23

23. Occiput with at least some broad, flat scales in addition to the erect forked scales and the narrow curved recumbent scales 24
Occiput with only the erect forked scales and the narrow, curved recumbent scales 25

24. Almost all of the occiput clothed with broad flat scales .... *C. peccator*
Occiput with relatively few broad flat scales; these chiefly along the margin of the eye .... *C. erraticus*
25. Abdominal tergites without conspicuous transverse bands of white scales .... *C. salinarius*
Abdominal tergites with transverse white bands 26
26. Basal white bands of abdominal tergites, especially on the second segment, triangular, being broader in the middle than at the sides .... *C. quinquefasciatus*
These bands of about the same width over the entire segment........ *C. restuans*

Psorophora

27. Large species; mesonotum with rather narrow lines of scales, leaving exposed areas of the shiny black integument 28
Smaller species; the mesonotum uniformly scaled 29
28. A narrow longitudinal stripe of yellow on the mid dorsal line of the mesonotum; tarsi with conspicuous light rings .... *P. ciliata*
Mesonotum without the yellow stripe; tarsi mostly dark, not conspicuously banded .... *P. howardii*
29. Dark black and purplish species; integument of thorax shiny black or dark brown; abdomen and legs with purple scales; wings unspotted, the scales uniformly dark 30
Brownish or greyish species; scales of body and legs not purple; wings with a mixture of light and dark scales or with light and dark spots........ 33
30. Fourth and fifth hind tarsal segments entirely dark .... *P. cyanescens*
Fourth, or fourth and fifth hind tarsal segments white 31
31. Fourth hind tarsal segment white, the fifth dark .... *P. varipes*
Both fourth and fifth hind tarsal segments white 32
32. Mesonotum rather sparsely but uniformly clothed with yellowish scales *P. ferox*
Mesonotum with a broad central stripe of black scales, the sides pure white .... *P. horrida*
33. Wings scales black and white mixed, but wings without definite white spots .... *P. confinnis*
Wings with some of the white scales grouped to form definite white spots........ 34
34. Costa with a single prominent white spot on the apical half of the wing .... *P. discolor*
Costal with two conspicuous white and black spots on the apical half of the wing .... *P. signipennis*

Theobaldia

35. Costa subcosta, and first vein with dark and white scales mixed........ *T. inornata*
Wing scales entirely dark .... *T. melanura*

Anopheles

36. Wing scales entirely dark 37
Wings with dark and light spots 39
37. Scales at the forks of the second and fourth veins, the base of the second and base of the third vein clumped together to form dark spots on the wing 38
Wings without spots; small species .... *A. barberi*
38. Palpi with narrow white rings .... *A. walkeri*
Palpi entirely dark .... *A. quadrimaculatus*
39. Vein 6 with three dark spots .... *A. crucians*
Vein 6 with one or two dark spots 40
40. Vein 6 white basally, dark apically; vein 3 white at the middle, dark at each end .... *A. pseudopunctipennis*
Vein 6 white in the middle, a large dark spot near each end; vein 3 dark .... *A. punctipennis*

THE LARVAE. In the larvae, the characters used for distinguishing genera are found chiefly in the structure of the spiracular apparatus and the anal segment. For identification of species, one must study the arrangement of certain hairs and hair tufts on various parts of the body. Other characters are given in the key.

Key to Oklahoma Mosquito Larvae

1. Air tube absent .... (*Anopheles*) 26
   Air tube present 2
2. Air tube ending in a sharp point, adapted for piercing the tissues of aquatic plants .... *Mansonia perturbans*
   Air tube normal, not ending in a sharp point 3
3. Dorsal head hairs represented by four large spines .... *Uranotaenia sapphirina*
   Dorsal head hairs slender and hair-like 4
4. Air tube with a single pair of ventral hairs or hair tufts (sometimes very small tufts) 5
   Air tube with several pairs ventral tufts or hairs .... (*Culex*) 9
5. Ventral tuft close to the base of the air tube 6
   Ventral tuft at or beyond the middle of the air tube 7
6. Large predaceous larvae, mouth brushes forming a strong, curved grasping organ; anal gills very short, pecten absent .... *Megarhinus septentrionalis*
   Smaller larvae, with fan-like mouth brushes; anal gills longer; pecten present .... (*Theobaldia*) 14
7. Air tube without pecten, most of the eighth abdominal segment covered by a large sclerotized plate .... *Orthopodomyia signifera*
   Air tube with a row of small spines or teeth on each side (pecten), eighth abdominal segment not covered by a large plate 8
8. Ventral brush of anal segment extending forwards to the base of the segment; the hairs forming the anterior portion of the ventral brush inserted in perforations of the plate, which rings the anal segment .... (*Psorophora*) 31
   Ventral brush usually posterior to the plate of the anal segment; if the brush does extend forwards to the base of the segment, the anal plate does not ring the segment, so that the hairs do not pierce the plate .... (*Aedes*) 15

Culex

9. Upper and lower head hairs single .... *C. apicalis*
   Upper head hairs double, lower single .... *C. peccator*
   Upper head hairs multiple 10
10. Upper head hairs smaller and multiple, lower long and single; skin of body very pilose .... *C. erraticus*
    Both upper and lower head hairs large and multiple; skin of body not densely covered with short hairs 11
11. Ventral tufts of air tube represented by several scattered single hairs *C. restuans*
    Ventral tufts of air tube normal 12
12. Air tube very long and tapering, with four pairs of rather small ventral tufts .... *C. salinarius*
    Air tube shorter, thicker, the tufts larger 13
13. Air tube longer and not expanded at the middle, with five pairs of ventral tufts in line .... *C. tarsalis*
    Air tube shorter, somewhat expanded medially, with four pairs of ventral tufts, the third not in line with other three .... *C. quinquefasciatus*

Theobaldia

14. Air tube with a line of small tufts along outer half .... *T. melanura*
    Air tube with only the basal pair of ventral tufts .... *T. inornata*

Aedes

15. Anal segment ringed by the plate 16
    Dorsal plate of anal segment saddle-like or interrupted ventrally 20

16. Pecten with one or more of the outer teeth separated from the basal teeth (detached teeth outwardly) 17
All of the pecten teeth close together, with no detached outer teeth 18

17. Upper and lower head hairs single, air tube 1 by 3; pecten not extending beyond the ventral tuft .... *A. nigromaculis*
Upper head hairs long and single, lower double; air tube short, about 1 by 2, pecten teeth extending almost to the apex, far beyond the ventral tuft .... *A. bimaculatus*

18. Comb scales few (about 6), in a single row .... *A. atlanticus*
Comb scales more numerous, in a triangular patch or irregular double row 19

19. From salt water pools; anal gills very short .... *A. sollicitans*
From fresh water pools; anal gills long and tapering .... *A. trivittatus*

20. Head hairs single 21
At least one pair of head hairs double or multiple 23

21. Pecten of air tube with detached teeth outwardly .... *A. atropalpus*
Pecten teeth all close together 22

22. About 25 comb scales in an irregular double row .... *A. dorsalis*
About 8 comb scales in a single row; base of scales shaped like the sole of a foot, scales with a long central tooth and several smaller lateral ones .... *A. aegypti*

23. Pecten of air tube with detached teeth outwardly .... *A. vexans*
Pecten teeth all close together 24

24. Comb scales in a row; from tree holes .... *A. triseriatus, A. alleni*
Comb scales in a patch; from ground pools 25

25. Plate of anal segment smaller, not almost reaching the mid-ventral line; head hairs large, multiple .... *A. canadensis*
Plate of anal segment reaching almost all around the segment, and interrupted near the mid-ventral line; upper head hairs triple, lower double or single .... *A. sticticus*

ANOPHELES

26. Frontal head hairs short, not feathered; lateral abdominal hairs of segments four, five, and six plumose; from tree holes .... *A. barberi*
Frontal head hairs long and feathered; lateral abdominal hairs of segments four, five, and six single, or split at the base into two or more branches, but not plumose; not from tree holes 27

27. Long lateral abdominal hairs of segments four and five with a single main stem and a few small lateral branchlets from this main stem; each inner angle of posterior spiracular flap produced into a long, upward-pointing tail-like process .... *A. pseudopunctipennis*
Long lateral abdominal hairs not as above; inner angles of posterior spiracular flap not produced into "tails" 28

28. Inner clypeal hairs finely branched at the tip .... *A. walkeri*
Inner clypeal hairs without branchlets 29

29. The hair just anterior to the palmate hairs on the fourth and fifth abdominal segments conspicuous, forming a tuft of several branches .... *A. crucians*
The ante-palmate hair of these segments with three or less branches 30

30. Inner clypeal hairs very close together; the ante-palmate hairs of fourth and fifth abdominal segments double or triple .... *A. punctipennis*
Inner clypeal hairs widely separated; ante-palmate hairs of fourth and fifth abdominal segments usually single, sometimes double .... *A. quadrimaculatus*

PSOROPHORA

31. Large species; mouth brushes stout, adapted for grasping prey .... *P. howardii, P. ciliata*
Smaller species, mouth brushes normal, fan-like 32

32. Antennae very long and swollen; air tube short, cylindrical, with a pair of long multiple ventral tufts .... *P. discolor*
    Antennae normal, slender; air tube inflated at the middle; hair tufts on the tube inconspicuous 33
33. Antennae very long, longer than the head 34
    Antennae short, about as long as or much shorter than the head 35
34. Lateral hairs of 4th and 5th abdominal segments long and single........ *P. ferox*
    The hairs shorter and multiple .... *P. horrida*
35. Head hairs single, sometimes double 36
    Head hairs multiple .... *P. confinnis*
36. Air tube with two long hairs at apex .... *P. cyanescens*
    Air tube with these hairs very short .... *P. signipennis*

THE MALE TERMINALIA. The student who wishes to become familiar with mosquitoes must study the male terminalia and should consult papers by Edwards (1920), Root (1923, 1924), and Freeborn (1924); descriptions of the general morphology of the terminalia may be found in Matheson (1929), and in textbooks of medical entomology. Unfortunately the names applied to the parts of the terminalia have changed from time to time, and those employed in this paper are being discarded by some entomologists, but are used here because they were used by Matheson (1929) and Dyar (1928). A useful table of the various names is given in Herms (1939).

The terminalia must be mounted on a microscope slide properly before many of the parts can be seen clearly. The more generalized terminalia need only to be cleared in potassium hydroxide, washed in water, dehydrated in alcohol, cleared in clove oil, and mounted in balsam on a slide, care being taken to spread the sidepieces as widely apart as possible in order to insure a better view of the mesosome, anal segment, and claspette lobes. But this procedure is not sufficient for species with more complicated terminalia; these must be stained and dissected. Mr. W. H. W. Komp, of the U. S. Public Health Service, has argued for years that careful dissections are essential, and the author's technique, outlined below, has been based on methods developed by Komp. The terminalia, with one or two of the abdominal segments, are snipped off the specimen and dropped into a dish containing a ten or twenty per cent solution of potassium hydroxide. If the specimen is dry, it may be desirable to drop it first into alcohol; this seems to hasten the soaking of the specimen by the heavier potassium hydroxide solution. It is kept in this solution until the nonchitinous structures have been dissolved out, but is removed before the integument begins to bleach. This process may be hastened by heating. The terminalia are then washed in acidulated water, and transferred to an acid fuchsin stain, which is made up by dissolving 0.8 gram acid fuchsin in 25 cc. of a 25 per cent solution of hydrochloric acid. The specimen is kept in this stain for several hours; it can be left in the stain for a day or longer without harm. It is then placed for fifteen minutes or longer in 70 and 95 per cent alcohols, to each of which a drop of acetic acid has been added, and is cleared in clove oil. A drop of the oil, with the specimen, is placed in a hollow-ground slide, and the dissection is made under a low power binocular microscope. Minuten nadeln, set in narrow glass tubing, are excellent dissecting needles. After dissection the parts of the terminalia are transferred to a thin sheet of balsam on a slide and arranged to show their characteristic structures. This balsam is allowed to dry for a day or longer before a coverslip, with a small drop of balsam on its lower surface, is placed over the specimen.

The male terminalia are especially valuable for identifying species. In several genera, the terminalia are quite primitive, without an unusual development of any of the parts. In Oklahoma *Orthopodomyia, Theobaldia, Mansonia, Megarhinus,* and *Uranotaenia* the sidepiece is simple, usually coincal, and at its base has a more or less mound-like lobe which bears one or several spines or hairs at its apex. The clasper is unmodified, claspette lobes are absent, and the mesosome and tenth sternites are relatively undeveloped. With the exception of *Theobaldia* only one species of each of these genera is present in Oklahoma, and the student can readily identify the males by characters given in the key to females.

In *Anopheles,* the sidepiece possesses no lobes, but does have a pair of long spines at the base. Claspette lobes are present; they are small and bear spines and hairs on the upper surfaces. There are two lobes on each side; the lobe nearest the sidepiece may be called the outer lobe, and that nearest the median line the inner lobe. The mesosome is long, tubular, and usually bears several pairs of leaflets at the tip. The ninth tergite lobes or processess vary in shape, and may be useful in identifications. The anal segment is a membranous, hood-like structure which obscures the view of the mesosome and claspette lobes if it is not removed. It may be desirable to dissect out the mesosome and the claspette lobes, but usually they can be seen quite clearly in undissected material. In the key below, *A. walkeri* and *A. maculipennis* are included, for both of these species may be found in or near Oklahoma some day, although neither was taken by the author.

Key to Male Anopheles

1. Mesosome without leaflets .... *A. barberi*
   Mesosome with leaflets 2
2. Inner and outer claspette lobes of each side fused into a single, pointed lobe .... *A. crucians.*
   Inner and outter claspette lobes distinct, not forming a single pointed lobe 3
3. Mesosome strongly bent forward, with two or more pairs of short, delicate, serrated leaflets; the inner claspette lobes with a pair of long, slender, curved spines .... *A. pseudopunctipennis.*
   Mesosome upright, with several pairs of long, unserrated leaflets; spines on inner claspette lobes shorter and thicker 4
4. Lobes of ninth tergite long, slender, and more or less pointed 5
   Lobes of ninth tergite shorter, clubbed or rounded at the tip 6
5. Spines of outer claspette lobes sharply pointed .... *A. maculipennis*
   These spines rounded; slightly clubbed at the tip .... *A. walkeri.*
6. Spines of outer claspette lobe sharply or bluntly pointed; ninth tergite lobes rounded or sometimes pointed, not very broad at the apex .... *A. punctipennis*
   Spines of outer claspette lobes rounded; ninth tergite lobes clubbed or expanded at apex, the tip round or truncate .... *A. quadrimaculatus*

The terminalia of *Psorophora* species are characterized chiefly by the development of the claspettes, which are usually long and columnar, with various spines, hairs, and filaments at the apex. The clasper also may be modified, being greatly swollen in some species, and bearing a long, flattened appendage in another.

Key to Male Psorophora

1. Claspette very small, fused for its entire length to the base of the sidepiece; a few hairs and spines at the tip .... *P. signipennis*
   Claspette longer, columnar, more or less separated from the sidepiece 2
2. Sidepiece short, globular; claspette divided apically into two divergent, slender arms, each bearing a long spine .... *P. horrida*
   Sidepiece longer and more slender; claspette not divided apically 3
3. Clasper sharply bent in a right angle at the middle, the basal half with a broad, thick appendage; claspette with a thick stem and broadly expanded at the tip; the surface of this expansion densely covered with short, curved hairs, and a twisted filament at the inner edge .... *P. howardii*
   Clasper and claspette not as above 4
4. Clasper slender; the expanded tip of the claspette with a broad, hooked filament on the inner edge, the apical border with many short, thick setae .... *P. ciliata*
   Clasper swollen; claspette without the hooked filament 5
5. Clasper swollen to the tip; claspette straight, the apex not expanded, with two small filaments bent down against the stem .... *P. varipes*
   Clasper swollen in the middle, tapering to the tip; claspette curved or bent, the apex expanded and with several or many spines or filaments 6

6. Claspette bearing four to seven long, straight spines .... *P. confinnis, P. discolor*
   Claspette with some of the many filaments or spines twisted or bent 7
7. Claspette strongly curved at the tip, with two broad, twisted filaments on the upper point and many long spines along the margin .... *P. ferox*
   Claspette with the tip not bent; the apex expanded, concave, with two large curved spines on the inner point, and many broad short spines on the upper surface .... *P. cyanescens*

In *Culex* the most interesting structure is the inner plate of the mesosome, which has a different shape in each species. Below the apex of the sidepiece there is a prominent lobe, which bears spines, filaments, and a leaf. The lobe itself is split into two parts in some species, and bears a complicated group of appendages. It is essential to stain and dissect *Culex* terminalia in order to obtain a lateral view of the inner plate of the mesosome.

Key to Culex Males

1. Mesosome simple, the halves united by a band below the apex; the tip with a few small denticles; apical lobe of the sidepiece with two long curved rods and several shorter spines; the leaf absent .... *C. apicalis*
   Inner plate of mesosome of various shapes, with teeth or processes, the apical lobe with a leaf 2
2. Apical lobe of sidepiece divided into two parts; the tenth sternites with a single row of short spines 3
   Apical lobe of sidepiece not divided, with three rods, a leaf, and several small setae; tenth sternites with a dense group of spines at the tip 4
3. Inner plate of mesosome narrow, curved, the tip shallowly furcate; lower part of apical lobe a thick arm with a rod at the tip, a slender rod arising from the middle, sidepiece very short and globular .... *C. peccator*
   Inner plate of mesosome broad, with two short divertent spines anteriorly, a short curved spine posteriorly; lower part of apical lobe with two arms, each bearing a thick rod; sidepiece not globular .... *C. erraticus*
4. Ninth tergites prominent, mound-like, separated by a deep cleft; inner plate of mesosome quadrate, with a short spine on the upper and lower anterior corners, and some small denticles between the spines .... *C. restuans*
   Ninth tergites undeveloped, a narrow ribbon with a row of long hairs; inner plate of mesosome not as above 5
5. Mesosome with a long, broad, curved, pointed process anteriorly and a shorter process posteriorly .... *C. quinquefasciatus*
   Inner plate of mesosome with a curved, broad, short process on the upper anterior corner, a sharply bent, pointed process on the lower anterior corner, a group of smaller teeth between them, and a long, broad arm arising from the base of the plate .... *C. salinarius*
   Inner plate of mesosome with two long, curved processes, one arising at the base of the plate; and a shorter process ending in two short, thick, divergent spines .... *C. tarsalis*

In *Aedes,* the sidepiece usually bears a basal lobe, and often an apical lobe as well. If the basal lobe is absent, it is at least indicated by a group of long hairs. The claspettes are absent in some species, but usually they are present, with a long columnar steam and a filament of various shapes. The lobes of the ninth tergites of many of the Oklahoma species are similar to those of *A. sollicitans* (plate 2 figure 18). The mesosome is a simple tube.

Key to Male Aedes

1. Columnar claspettes absent 2
   Columnar claspettes present 3
2. Clasper broad, flat, ending bluntly with the spine inserted laterally; basal lobe pointed, with a small dense tuft of spines .... *A. vexans*
   Clasper slender, the spine subterminal; basal lobe absent, but the sidepiece with a ventral plaque densely covered with long, thick hairs and spines .... *A. aegypti*

3. Sidepiece without distinct lobes, a group of long hairs at the base representing the basal lobe 4
Sidepiece with at least a distinct basal lobe, which may be small, rounded, but nevertheless raised from the surface of the sidepiece........ 6
4. Sidepiece with a small tuft of hairs on the inner surface at about the middle .... *A. triseriatus*
Sidepiece without the median tuft of hairs 5
5. Stem of claspette strongly curved, twice as long as the filament....*A. atropalpus*
Stem of claspette short, straight; the filament curved, as long as the stem .... *A. alleni*
6. Apical lobe absent; basal lobe small, rounded.....*A. sollicitans; A. nigromaculis*
Apical lobe present; basal lobe large 7
7. Basal lobe with a flat, squarish outer surface evenly covered with long, fine hairs arising from prominent tubercles, and without a large spine among the hairs .... *A. canadensis*
Basal lobe with one or more large spines among or near the smaller hairs........ 8
8. Basal lobe with two or three large spines on the margin of the patch of hairs; claspette stem broad, abruptly narrowed before the insertion of the filament, which is sharply angled, broad at the base and tapering to a sharp, beak-like point .... *A. dorsalis*
Basal lobe with a single large differentiated spine; claspette not as above........ 9
9. Claspette with a thick, sinuous stem; the filament small; apical lobe long, narrow, somewhat pointed .... *A. atlanticus*
Claspette stem slender 10
10. Upper surface of claspette filament with one or two sharp, retrose points .... *A. trivittatus*
Filament of claspette without backward pointing process 11
11. Spine of basal lobe curved, pointed, and arising in the dense patch of setae; the filament of the claspette evenly rounded above........*A. sticticus*
Spine of basal lobe long, straight, with a small knob at the tip, and inserted below the fine, sparse setae of the basal lobe; the filament of the claspette broad and angled at the base, from which it tapers to a hooked point .... *A. bimaculatus*

Notes on The Species

AEDES AEGYPTI (Linnaeus)

RECOGNITION CHARACTERS. Adult female: Proboscis and palpi dark. white scales apically. Mesonotum with a silvery lyre-shaped marking. Tarsi with conspicuous, broad, basal, white bands. Wing scales dark. Abdominal tergites with broad basal white bands.

Male terminalia (plate 1, figure 1): Sidepiece short, conical, without apical or basal lobes, but the inner surface with a broad plaque densely clothed with long, thick hairs.

Larva: Head hairs small, unbranched. About 8 comb scales in a single row; base of these scales shaped like the sole of a foot, each scale with a large central spine and smaller lateral ones. Dorsal plate of anal segment interrupted ventrally, so that it does not ring the segment; ventral tuft beyond the pecten. Air tube short, about twice as long as wide.

DISTRIBUTION. This species is probably much more widely distributed in the State than the records indicate. Collections have been made at Checotah, Millerton, Stillwater, and Shannon Springs.

HABITS. The larvae breed in various artificial water containers. Towards the end of the summer the adults may be abundant enough to cause annoyance in some places. In the latitude of Stillwater the eggs can survive the winter (Rozeboom, 1940).

AEDES ALLENI Turner

RECOGNITION CHARACTERS. Adult female: Proboscis and palpi dark. Mesonotum broadly silver-scaled laterally and back of the head, a central stripe of golden brown scales anteriorly, four indistinct brown lines before the scutellum; scutellum with a patch of white scales on the middle lobe. Tarsal segments with broad white basal rings. Wing scales mostly black. The most distinctive character of this species is the white scaling of the first vein from the base of the wing to the humeral cross vein. Costa with some white scales at the base of the wing. Abdominal segments with broad basal white bands.

Male terminalia (plate 1, figures 2 and 3): Sidepiece long; basal lobe represented by a patch of long hairs; apical lobe absent. Claspette columnar, filament curved, simple, as long as the stem.

Larva: The author has no specimens of *A. alleni* larvae. It was only after re-examining a group of adults bred from larvae and pupae taken in a tree hole at Craterville Park that he realized he actually had possessed at least the pupa of this rare species, for a single male was discovered among specimens of *A. triseriatus*. According to Dyar, the upper head hairs are long and single, the lower short and multiple; the comb has seven scales in a row, the air tube is two and a half times as long as wide, with the pecten on the basal half, and inside of a two-haired ventral tuft. The anal segment is not ringed by the plate. The larva must be practically identical to that of *A. triseriatus*.

Dyar (1928) states that this species is known only from the Rio Grande Valley, where *A. triseriatus* does not occur. Matheson (1929) believed it was probably only a variety of *A. triseriatus*. The species is valid, for in spite of the similarities of the larvae, there are differences in the male terminalia, while the females, with their board white tarsal bands and white-scaled first vein at the base of the wing, can not be confused with *triseriatus*.

DISTRIBUTION. The records reported here extend the range of this species considerably. It seems to occur throughout Oklahoma, but it is very rare. Locality records are Alva, Calera, Craterville Park, Hugo, Lake Blackwell, Taloga, Talihina, and Wichita National Forest. With the exception of the single larva or pupa taken at Craterville Park, all the specimens were taken as adult females.

HABITS. The larvae breed in rot holes of trees, with those of *A. triseriatus*. The adult females attack man readily; were it not for this habit, the existence of this species in Oklahoma probably would not have been suspected.

AEDES ATLANTICUS Dyar and Knab

RECOGNITION CHARACTERS. Adult female: Proboscis and palpi dark. Mesonotum with a broad central stripe of silvery scales, the sides brown. Tarsi dark, not banded. Wing scales dark. Abdominal segments dark, unbanded dorsally, but with small basal white spots laterally; the venter white.

Male terminalia (plate 1, figures 4, 5, and 6): Sidepiece long, with a prominent, long, pointed apical lobe and a large, expanded basal lobe. Outer surface of basal lobe with many long, strong hairs, and a single large differentiated spine, set apart from the hairs. Claspette long, the base curved and expanded medially, the filament broad, much shorter than the stem.

Larva: Upper and lower head hairs long and single, comb scales few, in a single row; air tube short, stout, about twice as long as wide, with the pecten on the basal half, within the ventral tuft; anal segment ringed by the plate.

A. atlanticus and *A. tormentor* cannot be separated as adult females. Carpenter (1939) reports both species from Arkansas, and as the latter may well occur in Oklahoma, the identity of the females taken by the author must remain in doubt. However, several larvae were taken, and these keyed out to *atlanticus* rather than *tormentor*. Only one adult was obtained from the larvae, and this was a female. A male from Root's collection was dissected in order to obtain material for the photomicrographs.

DISTRIBUTION. Larvae and adult females were taken in wooded areas in the southeastern part of Oklahoma, near the following communities: Eagletown, Idabel, Smithville, Valliant, and Wright City. It must have a fairly wide distribution in the mountains of southeastern Oklahoma, and as no collections were made in this region earlier than June, it is probable that the species is more abundant than the records indicate.

HABITS. The larvae were taken in temporary and semi-permanent rain pools, particularly those in woods. Adult females were captured attacking man. Howard, Dyar, and Knab (1917) state that the larvae may be found "at intervals during the season, and the eggs undoubtedly hibernate."

AEDES ATROPALPUS (Coquillett)

RECOGNITION CHARACTERS. Adult female: Proboscis and palpi dark. Mesonotum dark centrally, whitish or yellowish anteriorly and along the sides, the white marking curving mediad before the wing base; a patch of light scales centrally before the scutellum. Wing scales dark; costa with a few white scales at the base of the wing. Tarsi with broad white rings on both sides of the joints. Abdominal tergites with basal white bands.

Male (plate 1, figures 7 and 8): Sidepiece long; basal lobe small, inconspicuous, being simply a thick patch of long hairs; apical lobe absent. Claspette long columnar; the stem bent, twice as long as the simple filament, and with a long hair from a prominent tubercle two-thirds of the distance from the base.

Larva: Head hairs single. Comb scales in a large patch; dorsal plate of anal segment saddle-like; air tube short, about twice as long as wide; pecten extending about three-fourths of the length of the tube, beyond the ventral tuft, and with the last few teeth more widely separated than the basal ones ("detached teeth outwardly").

In the small series of somewhat battered Oklahoma specimens at the author's disposal, the light mesonotal markings are whitish rather than yellowish, and are much narrower than the broad, lateral, yellow areas on the mesonotum of *atropalpus* from Maryland. In Oklahoma specimens the white stripe curves towards the middle of the mesonotum before the wing base, leaving the lateral portion of the mesonotum from the wing base to the scutellum dark. This marking is reminiscent of that of *A. aegypti,* but the species can be readily separated from *aegypti* by the white rings on both ends of the tarsal segments. Dyar recognizes two races, *atropalpus atropalpus* from the Atlantic states, and *atropalpus epactius* from Arizona and Mexico, which has white rather than yellow markings on the mesonotum.

DISTRIBUTION. This species was collected at Hinton and in the Wichita National Forest. It seems to be rare in Oklahoma.

HABITS. The larvae breed in crevices and holes in rocks along streams.

AEDES BIMACULATUS (Coquillett)

RECOGNITION CHARACTERS. Adult female: Readily recognized by the bright yellow coloration of the integument.

Male terminalia (plate 2, figures 15 and 16): A male specimen in the U. S. National Museum, taken by Thibault at Scott, Pulaski Co., Arkansas, on September 23, 1909, has a small, finger-shaped apical lobe clothed with small hairs; a narrow, somewhat rounded basal lobe on a short stem, with a long spine arising at the base of the lobe; and the claspette with a long filament, the upper margin of which is angled basally.

Larva: Upper head hairs long and single, lower double. Comb scales in a triangular patch. Anal segment ringed by the plate. Air tube short, about twice as long as wide; pecten scales extending almost to the apex, far beyond the basally situated ventral tuft, and with one or two teeth widely detached apically. (From a specimen in Root's collection, taken at Leesburg, Georgia).

DISTRIBUTION. Only a single female was taken; it was captured while attempting to bite while the writer was collecting larvae in a low, wooded area just south of Shawnee. The species must be very rare in Oklahoma.

HABITS. Dyar (1928) says that the larvae breed in muddy rain pools. The females will attack man.

Coquillett (1902) described *A. bimaculatus* from a female collected at Brownsville, Texas. Howard, Dyar, and Knab (1917) give the following distribution for this species: Texas, New Orleans, Louisiana, Mississippi, Arkansas, and San Blas, Mexico. These authors state that the range for *A. fulvus* is Central America to Brazil, and mention the similarities in coloration of the two species. Dyar (1928) considered *bimaculatus* to be a synonym of *A. fulvus* (Wiedemann), while Bequaert (1933) said, "This species is known from North Carolina to Brazil. In the southeastern United States it generally goes under the name *Aedes bimaculatus* (Coquillett), which does not seem to be even subspecifically distinct from the more tropical form." However, Edwards (1932) lists both species as valid, and gives U. S. A. for the distribution of *bimaculatus,* and C. and S. America for that of *fulvus.*

As the author had no males of *bimaculatus,* the single male in the U. S. National Museum was examined; this specimen was collected by Thibault in September, 1909, at Scott, Pulaski County, Arkansas. Figure 15 of plate 2 was redrawn from a sketch made of the terminalia. The basal lobe has a short, thick stem, on which the long straight spine is inserted, and broadens apically, being somewhat rounded. The apical lobe in this specimen looks like a short, thumb-shaped projection. Another specimen in the Museum, labelled *A. fulvus,* was taken at Colon, C. Z., by Chidester, on June 6, 1920. The apical lobe of the sidepiece is much different from that of the Arkansas male; it is a broad ridge extending all the way to the base of the sidepiece (plate 2, figure 13). Dyar (1928) describes the apical lobe of *fulvus* as a ridge running to the base of the sidepiece, while Howard, Dyar, and Knab (1917) say that in *bimaculatus* it is "small narrow, lappett-shaped . . . "

When one compares the two slides in the Museum, the difference between the apical lobes is so striking that there would seem to be no question about *fulvus* and *bimaculatus* being good species. But a careful examination of the Arkansas male will reveal a thin membrane extending between the apical lobe and the base of the sidepiece, which makes one suspect that the body of the lobe is collapsed, leaving a thumb-shaped portion at the apex. Two males of *bimaculatus* were obtained from A. A. Weathersbee, of the South Carolina State Health Department, who collected them in Orlando County, Florida. Both of these males have a small, thumb-like apical lobe, with an irregular membrane extending to the base of the sidepiece. It seems strange that every one of the specimens from the United States should have collapsed apical lobes as a possible result of methods of mounting. A male that the writer captured at El Real, Panama, is identical with that taken by Chidester; it has a broad, ridge-like lobe (plate 2, figure 14). Vargas (1940) described another member of the *fulvus* group from the State of Campeche, Mexico, which he identified as *A. bimaculatus*, but later (1941) named *A. rozeboomi.* The excellent microphotographs published by Vargas show that this mosquito is distinctly unlike *fulvus* and *bimaculatus*. Dr. Vargas very kindly sent his specimen to the author, and figure 17 of plate 2 is a microphotograph of the sidepiece.

AEDES CANADENSIS (Theobald)

RECOGNITION CHARACTERS. Adult female: Proboscis and palpi dark; a few white scales on the palps. Mesonotum uniformly golden brown, scales on the sides somewhat lighter. Wing scales dark. Tarsi with broad white rings on both sides of the joints. Abdominal tergites with pale narrow basal bands.

Male terminalia (plate 1, figures 11 and 12): Sidepiece with a large, flat apical lobe clothed with broad, scale-like setae arising from prominent tubercles. Basal lobe large, square, the outer surface flat, and covered with many long fine hairs inserted in tubercles. Claspette long, columnar; the stem longer than the filament, which is narrow, hair-like.

Larva: Head hairs multiple; comb scales in a patch; air tube three times as long as wide; pecten on the basal third without detached teeth, and within the ventral tuft; dorsal plate of anal segment saddle-like.

DISTRIBUTION. Specimens in the A. & M. collection were taken at Atoka and Broken Bow. The writer did not find this species.

HABITS. Dyar (1928) says that the larvae breed in shaded temporary rain pools.

AEDES DORSALIS (Meigen)

RECOGNITION CHARACTERS. Adult female: Proboscis and palps dark. Mesonotum with a central area of golden scales, yellowish white laterally. Scales of costa, first, third, and fifth veins mixed dark and light, broader; those of second, fourth, and sixth veins white, narrow. Tarsi with broad white bands involving both ends of the segments. Abdomen with broad, dorsal, basal white bands and a central longitudinal white stripe.

Male terminalia (plate 1, figures 9 and 10): Sidepiece long, cylindrical, apical lobe broad, distinct, rounded; basal lobe prominent, with the outer surface densely covered with long, strong hairs; two or three stout spines on the margin of the patch of hairs; these spines not greatly different from the hairs. Claspette long, columnar, the stem twice as long as the filament; stem stout, abruptly narrowed before the apex. The filament strongly bent, broadly expanded basally and tapering to a beak-like point.

Larva: Dyar states that the larva has single head hairs; approximately 25 comb scales in an irregular double row; air tube three and a half times as long as wide, with pecten not quite reaching the middle, within the multiple ventral tuft; dorsal plate saddle-like.

DISTRIBUTION. Larvae and adults were taken at the edge of the Great Salt Plains near Cherokee. This species should be widespread in the Gypsum Hills region of Oklahoma.

HABITS. The larvae breed in salt water pools.

AEDES NIGROMACULIS (Ludlow)

RECOGNITION CHARACTERS. Female: Palpi dark; proboscis with a broad white ring at the middle. Mesonotum clothed with golden-brown scales, an indistinct lighter stripe on each side of the median line. Wing scales black and white mixed, the black predominating. Tarsal segments with broad basal white bands. Abdominal segments with a dorsal longitudinal white stripe and broad basal white bands, widening laterally; the lateral spots the same color as the basal bands.

Male terminalia (plate 3, figures 21 and 22): Sidepiece long; apical lobe absent; basal lobe small, but distinct, with a thick patch of hairs. Claspette columnar, a stout stem with a prominent tubercle at the tip, and a broad filament about as long as the stem.

Larva: Head hairs single. Comb scales few, scattered, in a triangular patch. Anal segment ringed by the plate. Air tube over three times as long as wide, pecten extending three-fourths its length, within the small ventral tuft, and with two or three detached teeth outwardly.

DISTRIBUTION. This is a common species in Oklahoma, and may be found anywhere in the State, although the writer's records are mostly from the eastern half.

HABITS. The larvae breed in temporary pools of fresh water. The adults are attracted to light traps.

AEDES SOLLICITANS (Walker)

RECOGNITION CHARACTERS. Adult female: The female closely resembles that of *A. nigromaculis*, but the longitudinal dorsal stripe and the basal bands of the abdomen of *sollicitans* are yellowish in color, while the lateral spots are white.

Male terminalia (plate 2, figure 18; plate 3, figures 23 and 24): The terminalia are so similar to those of *A. nigromaculis* that no attempt has been made to distinguish between them in the key.

Larva: Head hairs single. About 15 to 20 comb scales in a triangular patch or irregular double row. Anal segment ringed by the plate. Air tube two and a half times as long as wide; pecten teeth along the basal half, without detached teeth outwardly, and within the small ventral tuft. Anal gills very small, much shorter than the anal segment.

DISTRIBUTION. Larvae and adults were collected at the edge of the Great Salt Plains near Cherokee. Howard, Dyar, and Knab (1917) state that the range of *sollicitans* includes the Atlantic and Gulf coasts of North America, but that

Theobald's records from North Dakota and interior points in North America probably refer to *A. nigromaculis*. *A. sollicitans* occurs inland as far as the Great Salt Plains of Oklahoma, and in the Gypsum Hills region it should be quite widespread.

HABITS. The larvae breed in salt water pools. The adults are vicious biters, and in the early morning they flew up from the grass and weeds near the salt pools and attacked the author, even following him for some distance to where the automobile was parked.

AEDES STICTICUS (Meigen) (= *hirsuteron*)

RECOGNITION CHARACTERS. Adult female: Proboscis and palps dark. Mesonotum with a central stripe of bronzy-brown scales, the sides broadly whitish or yellowish, a light spot before the scutellum. Wing scales and tarsal segments dark. Abdomen with narrow basal white bands, sometimes represented by only a few scales.

Male terminalia (plate 3, figure 25): Sidepiece long, apical lobe large, rounded, with short, curved setae; basal lobe large, expanded outwardly, its outer surface densely clothed with long thick setae, and a large, thick, pointed spine among the setae. Claspette long, columnar, the stem much longer than the filament, which is short, broad, and tapering to a sharp, hooked point.

Larva: According to Dyar, the upper head hairs are triple, the lower double; the comb scales are in a patch; the air tube is three times as long as wide, with pecten on the basal half, within the ventral tuft; the anal segment is not ringed by the plate, which almost reaches the mid-ventral line.

DISTRIBUTION. The species seems to have a wide distribution in the southeastern areas of Oklahoma, particularly in the mountains.

HABITS. No larvae were found. Howard, Dyar, and Knab point out that there is only one brood a year, and that the larvae appear in early spring pools. As the author was unable to collect in the eastern wooded areas of Oklahoma before June, only adults were taken, but during June there were enough of them left to be extremely annoying in certain wooded areas. Males were taken resting on underbrush. The females are vicious biters, and this species is no doubt a much more serious pest in eastern Oklahoma than the collection records indicate.

AEDES TRISERIATUS (Say)

RECOGNITION CHARACTERS. Adult female: Proboscis and palps dark. Mesonotum black centrally, the sides broadly silver-scaled, a white patch before the scutellum; the posterior pronotum densely clothed with broad, flat, silvery scales. Wing scales dark, tarsal segments dark. Abdominal segments unbanded dorsally, but with basal white spots laterally.

Male terminalia (plate 3, figure 26): Sidepiece long, without basal or apical lobes, but with a fairly dense group of long hairs at the base and another group situated at about the middle on the ventral surface. Claspette long, the stem a little shorter than the filament, which is curved and narrow.

Larva: Upper head hairs single, lower multiple. Dorsal plate of anal segment saddle-like. Comb scales few, in an irregular double row, each scale with a single large tooth. Air tube about three times as long as wide; pecten teeth along the basal third, within the tuft.

DISTRIBUTION. The species may be taken throughout Oklahoma, but of course locally it is limited to wooded areas where breeding places can exist. In such places the adults may be fairly abundant.

HABITS. Larvae breed only in rot holes in trees, but sometimes a suitable breeding place may be found practically on the ground between the roots of a tree, provided the water contains a heavy infusion of leaves and rotting wood. The adults will bite man, but because of the restricted breeding habits, they cause little annoyance.

AEDES TRIVITTATUS (Coquillett)

RECOGNITION CHARACTERS. Adult female: Palpi and proboscis dark. Mesonotum dark, with two longitudinal, narrow stripes of yellowish-white scales. Wing scales and tarsal segments dark. Abdominal tergites dark or with a few light scales basally, especially at the sides. This species is readily separated from the other dark-legged Oklahoma *Aedes* by the two light stripes on the mesonotum.

Male terminalia (plate 3, figure 27): Sidepiece long, apical lobe small, indistinct; basal lobe distinct, with a dense patch of long hairs and a single long, stout spine arising with the hairs. Claspette stem curved, about as long as the filament, which has one or two characteristic backward-pointing sharp processes at the broad middle, from which it tapers to a sharp, hooked point

Larva: Head hairs single. Comb scales in a patch. Air tube short, about two and a half times as long as wide, the pecten on the basal half, within the ventral tuft. Anal segment ringed by the plate.

DISTRIBUTION. The species seems to be widely distributed through most of Oklahoma, but most of the records are from the eastern half. It is probably much less abundant in the drier western areas.

HABITS. The larvae live in temporary rain pools, especially in shady places. The adults are often encountered with the other species of *Aedes* and *Psorophora* that attack during the day when one invades their resting places in woods.

AEDES VEXANS (Meigen)

RECOGNITION CHARACTERS. Adult female: Proboscis dark, sometimes with a few scattered light scales; palpi dark, with a few light scales at the tip. Mesonotum uniformly golden-brown. Wing scales dark. Tarsal segments with narrow basal white rings. Abdominal tergites with basal white bands.

Male terminalia (plate 3, figure 28): Sidepiece long, without an apical lobe but with a prominent angle near the base which has a dense tuft of long setae. Clasper broad, blunt at the apex, with a lateral spine near the apex.

Larva: Upper head hairs multiple, lower double. Comb scales few, in a patch. Anal segment not ringed by the plate, which almost reaches the mid-ventral line. Air tube about three times as long as wide; pecten along the basal half, with one or more teeth detached from the others towards the apex; pecten within the ventral tuft.

DISTRIBUTION. The species may be taken throughout Oklahoma.

HABITS. The larvae breed in temporary rain and flood pools. Matheson (1929) believes there are two annual broods in central New York; Carpenter (1939) says there is a single brood in Arkansas. The larvae can be collected throughout the breeding season, but as has been observed in other regions, they are particularly abundant in the spring. These hatch from eggs that have overwintered, and the larvae taken later in the year are probably from eggs that also overwintered, but remained dormant in spite of repeated inundations. This is one of the common Oklahoma species. The adults are attracted to light traps. The females often cause a great deal of annoyance.

ANOPHELES BARBERI Coquillett

RECOGNITION CHARACTERS. Adult female: A small dark mosquito, the wings without spots caused by a clumping of the scales near bases and forks of the veins.

Male terminalia (plate 5, figure 50): Distinguished from the other Oklahoma *Anopheles* by the absence of leaflets on the mesosome. The sidepieces are short and thick, and the spines of the outer claspette lobes are broad and flattened.

Larva: Frontal head hairs small, simple, not feathered; long lateral abdominal hairs of fourth, fifth, and sixth segments, as well as those on the first three segments, long and feathered.

DISTRIBUTION. The species was taken near Idabel and Stillwater, and probably exists in most of the wooded areas of the State. It is a rare mosquito.

HABITS. The larvae breed in tree holes.

ANOPHELES CRUCIANS Wiedemann

RECOGNITION CHARACTERS. Adult female: The wings have dark and light spots, and the most characteristic feature of this species is the three dark spots along the sixth vein.

Male terminalia (plate 5, figures 51, 52, and 53): The male is distinguished from the other *Anopheles* by the fusion of the inner and outer claspette lobes on each side into a single, pointed lobe, bearing two stout pointed spines at the tip and another below the apex.

Larva: Separated from *A. punctipennis* and *quadrimaculatus* by the prominent tuft just before the palmate hairs on the fourth and fifth abdominal segments: this hair is single, double, or triple in *punctipennis* or *quadrimaculatus*.

DISTRIBUTION. This species has been taken at Antlers, Coalgate, Stillwater, Talihina, Valliant, and Muse. For some reason, it is particularly abundant in the artificial reservoirs around Coalgate, but even here it is not numerous.

HABITS. The larvae were found among various types of vegetation and floatage in impoundments, and in grassy, semipermanent rain pools.

ANOPHELES PUNCTIPENNIS (Say)

RECOGNITION CHARACTERS. Adult female: Wings with dark and light spots; the third vein dark, the sixth vein with two large dark spots.

Male terminalia (plate 5, figures 59, 60, and 61): Mesosome erect, with several pairs of long slender leaflets at the tip; spines of outer claspette lobe more or less pointed, sometimes rather bluntly so; lobes of ninth tergite short and rounded or truncate apically, although in some specimens they may be fairly long and somewhat pointed. The best character for separating this species from *quadrimaculatus* seems to be the spines on the outer claspette lobes, which are pointed in *punctipennis* but rounded in *quadrimaculatus*. There is some variation in this structure; often the spines in *punctipennis* are quite blunt, and may be confused with those of *quadrimaculatus*. The lobes of the ninth tergite vary so much in *punctipennis* that they appear to be of little value. In figure 61 the spines on the outer lobe are actually obscured by the heavy spine on the inner lobe; on both lobes they are pointed.

Larva: The antepalmate hair on the fourth and fifth abdominal segments double or triple; inner clypeal hairs are very close together.

DISTRIBUTION. This is the predominant Oklahoma mosquito, and is found all over the State. The writer has 91 locality records; however, he was unable to find this species in the Panhandle counties, where none of the water examined seemed to be favorable for mosquito breeding, except for a marshy overflow near Guymon where only *Theobaldia inornata* and *Culex tarsalis* were collected.

HABITS. The larvae breed in almost any kind of water, but favor streams The adults were taken biting man only occasionally. The females hibernate; larvae were not found during the colder months of winter, but during a warm spell in February eggs were collected in a stream pool. The eggs hatched and adults were bred from the larvae. In spite of its abundance, there is no reason to believe that the species acts as a malaria vector in southeastern Oklahoma, as is suggested by Canavan (1935); it is just as abundant outside the malarious areas as within.

ANOPHELES PSEUDOPUNCTIPENNIS Theobald

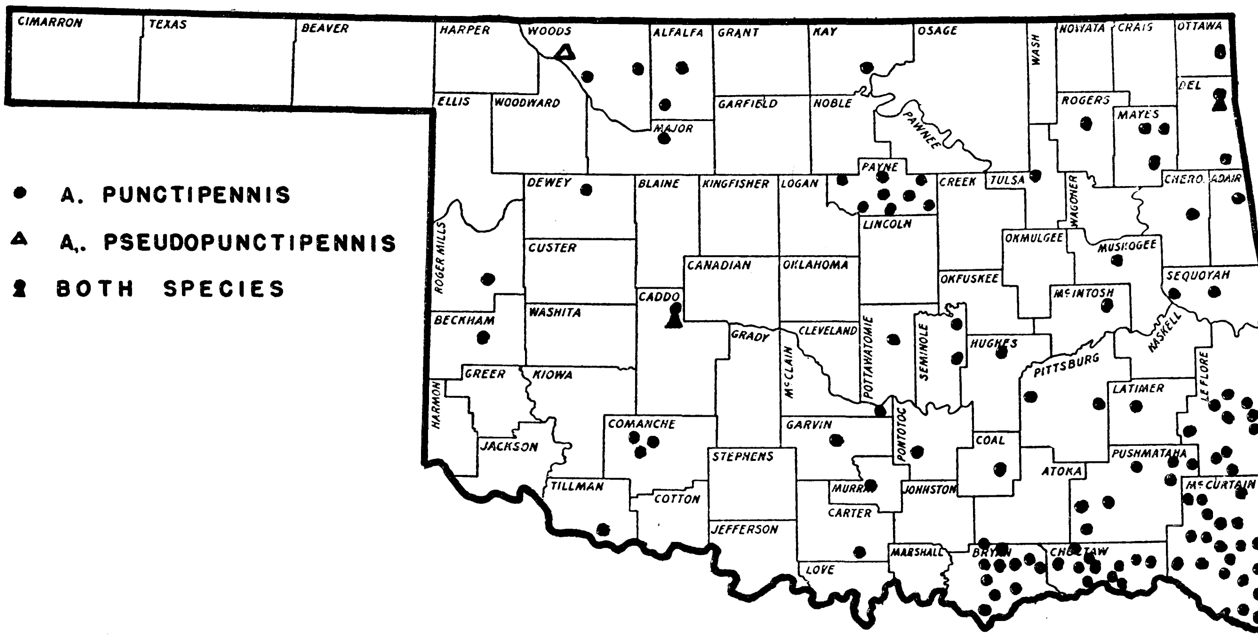
RECOGNITION CHARACTERS. Female: Wing with light and dark spots; the third vein mostly white; the sixth vein white basally and dark outwardly.

Male terminalia (plate 5, figures 54 and 55): Mesosome strongly bent forward, with two or more pairs of small, serrated leaflets at the tip; spines of inner claspette lobes long and curved.

Larva: Easily recognized by the long lateral abdominal hairs on the fourth and fifth segments; they are single, and have along their length small, scattered, lateral branchlets. Komp (1937) has described the value of the long, upward-pointing processes from the inner angles of the posterior spiracular flap.

DISTRIBUTION. The writer has been able to collect this species only in the western part of the State, north of Freedom, but the A. & M. collection contains specimens from Grove and Hinton. It probably has a fairly wide distribution in the sand-choked river beds of the western plains. The species must be considered to be rare, however; at least throughout most of Oklahoma.

HABITS. The larvae were found in a seepage pool in a sandy river bed, where there was a thick growth of green algae. Here the larvae were so numerous that the number taken could only be estimated. Nothing is known concerning the habits of the adults in Oklahoma.



Distribution of *Anopheles punctipennis* and *A. pseudopunctipennis* in Oklahoma.

The distribution and biology of *A. pseudopunctipennis* has caused a great deal of speculation, for there is some evidence that the species is divided into races or subspecies, as is *A. maculipennis*. It has a very wide distribution, ranging from the southwestern United States through Central America and South America into Argentina. In parts of this range it bites man and is involved in the transmission of malaria; in other parts, although it appears to be abundant, it is considered to be of little if any importance as a malaria vector. It has been found that the subspecies of *A. maculipennis* can be recognized only by the structure of the eggs, and so it is interesting to note that in California, Herms and Frost (1932), and Herms and Freeborn (1920) described two kinds of *pseudopunctipennis* eggs, both of which differ from those of the species in Panama (Rozeboom, 1937), and Costa Rica (Kumm, 1941). Vargas (1939) believed that the form with the egg described by Herms and Frost was distinct enough to merit specific rank, and called it *A. boydi*. Barber (1939) says that in New Mexico the eggs resemble those described by Herms and Freeborn. A number of eggs were collected from a breeding pool north of Freedom; they were taken to the laboratory and examined under the microscope. Detailed float ridge counts and measurements were not made, but the eggs looked exactly like those that are found in Panama and Costa Rica. The floats were large, each one meeting the other along the mid-dorsal line, and made up of many float ridges, and on the posterior end of the egg was the characteristic collar-like frill. If egg structure has any significance, there must be three kinds of *pseudopunctipennis* in North America, the Oklahoma form being similar to that found in Central America. It should be pointed out that Oklahoma specimens will not run out in Dyar's and Matheson's keys to males, for the mesosome is as apt to have three or more pairs of leaflets as two. Vargas found considerable variation in the mesosomal leaflets of Mexican specimens, and Barber says that although the number of leaflets varied from two to eight in his material from New Mexico, most specimens had eight.

ANOPHELES QUADRIMACULATUS Say

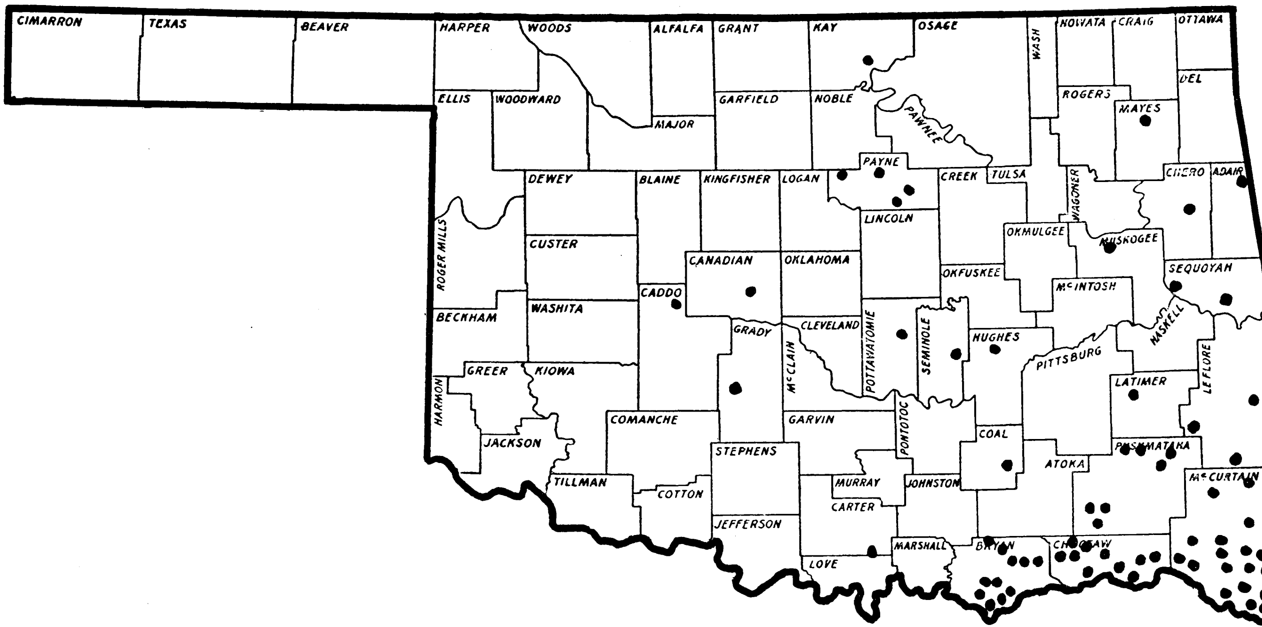
RECOGNITION CHARACTERS. Adult female: Wing scales dark, but the scales are clumped to form four darker spots on the wing. Palpi entirely dark.

Male terminalia (plate 5, figures 62, 63, and 64): Mesosome erect, with several pairs of long, slender leaflets; spines of outer claspette lobes rounded, not pointed; lobes of ninth tergite short, rounded or truncate, and more or less expanded at the tip.

Larva: Separated from *A. crucians* by the hair just before the palmate hairs on the fourth and fifth abdominal segments, which is single and rarely double instead of being a large tuft; and from *A. punctipennis* by the inner clypeal hairs, which are very close together in that species but widely separated in *quadrimaculatus*.

DISTRIBUTION. *A. quadrimaculatus* is abundant in the southeastern counties, where the adults often may be seen resting under bridges and culverts or in hollow trees in great numbers. According to the writer's locality records, this mosquito disappears at about the middle of the State; the most westerly records are Ponca City on the north and Chickasha on the south; Hassler (1941) has found it at El Reno. As few collections were made in the western half of Oklahoma, more observations are necessary. If the species does occur in the west, it must exist in small areas rather sporadically, but even under these conditions its presence near communities should be known. The apparent reason for the scarcity or absence of the species in the western half of Oklahoma is the lack of suitable breeding places, which become more and more abundant as one approaches the south and east boundaries of the State. Many communities are impounding waters for recreational and other purposes, and it is recognized that every farm should have at least one suitable stock pond. *A. quadrimaculatus* has a predilection for the quiet waters of impoundments, particularly when it can find protection in drift, floatage, and various types of aquatic vegetation. The practice of ponding may cause its spread into the western part of Oklahoma.

HABITS. The larvae breed in lakes, ponds, marshes, bayous, stream pools, and similar collections of quiet water. Protection and food are found in floatage, drift, and acquatic vegetation. The water may be either shaded or sunny, but deep shade is not so favorable as intermittent shade and sun. The adults attack man, although



Distribution of *Anopheles quadrimaculatus* in Oklahoma.

this is not shown in the author's records, as few collections were made in houses. The females enter houses in the evening to feed on man; they are crepuscular and do not attack out of doors during the day, as do certain *Psorophora* and *Aedes* species. It is the malaria transmitter of the southeastern United States, and its distribution in Oklahoma shows that it is the species concerned in this State also. The adult females hibernate, and the species becomes more abundant later in the summer, provided, of course, that unusually long periods of drought do not cause most of its breeding places to dry up. This may occur even in McCurtain county.

Neither *A. walkeri* nor *maculipennis* has been found in Oklahoma. It seems doubtful that the latter will be taken in the State, but there seems to be no reason why the former should not be discovered some day; Vargas (1940) reports it as far west and south as Imuris, Sonora, Mexico.

If these species are taken in the State, their presence, particularly that of *maculipennis*, will have to be confirmed by the male terminalia, and so the essential parts are illustrated in plate 5. The character used to separate these species from those already found in Oklahoma are given in the keys to male *Anopheles*.

CULEX APICALIS Adams

RECOGNITION CHARACTERS. Adult female: Proboscis, palpi, wings, and tarsal segments dark. Abdominal tergites with narrow apical white bands.

Male terminalia (plate 3, figures 29 and 30): Apical lobe of sidepiece with two stout curved rods and several shorter setae. Mesosome simple, each half with a group of small denticles at the apex; the halves joined near the apex by a transverse bar. Tenth sternites with a single row of spines. Lobes of ninth tergite small, widely separated, with a few small hairs.

Larva: Upper and lower head hairs long and single; comb scales in a large patch. Air tube very long and slender, eight or nine times as long as wide, and with a slight apical flare; five or six pairs of short ventral tufts.

DISTRIBUTION. This species, which is common, was taken throughout the eastern half of the State, and should occur all over Oklahoma.

HABITS. The larvae breed in various types of water, but have a predilection for running and pooled streams, where they are usually found with *A. punctipennis*. The adults are said to feed on frogs and other cold blooded animals.

CULEX ERRATICUS Dyar and Knab

RECOGNITION CHARACTERS. Adult female: Proboscis, palpi, wings, and tarsi dark. Occiput with flat, broad scales among the narrow, curved recumbent ones, especially along the orbit and on the sides. Abdominal tergites with or without basal white bands.

Male terminalia (plate 3, figures 31, 32, and 33; plate 4, figure 49): Apical lobe of sidepiece divided, the lower part with two arms each bearing a long, curved rod; the upper part with a long hooked filament, a broad leaf, and several smaller filaments. Inner plate of mesosome somewhat rectangular; the upper corner furcate, with two stout points; another short point on the lower corner; the basal hook long and curved. Tenth sternites with a comb-like row of spines. Lobes of ninth tergites large, roughly ovoid or elliptical, and covered with long hairs.

Larva: Upper head hairs quite short and multiple, lower ones long and single. Comb scales in a patch. Air tube long and slender, six times as long as wide, with five pairs of ventral tufts, the first fairly long and the others progressively shorter. Skin very pilose.

DISTRIBUTION. *C. erraticus* is very common in the eastern half of Oklahoma, and probably can be taken anywhere in the State where suitable breeding water exists.

HABITS. The larvae are especially abundant in impoundments, where they are associated with *A. quadrimaculatus* and *U. sapphirina*. Few adults were captured, but occasionally they were observed biting man.

CULEX PECCATOR Dyar and Knab

RECOGNITION CHARACTERS. Adult female: Proboscis, palpi, wings, and tarsi dark. All of the occiput is clothed with broad, black, flat scales, except for a small central area of curved narrow scales. Abdominal tergites without basal white bands. Females of *C. peccator* can be separated from those of *C. erraticus* by the greater amount of flat, broad, scales on the occiput; there are more narrow, curved scales on the occiput of *erraticus*.

Male terminalia (plates 3 and 4, figures 34, 35, and 36): Apical lobe of sidepiece divided; the lower part a thick stem with a curved, stout rod, a shorter rod arising from about the middle of the stem; upper portion with a long filament expanded outwardly, a large expanded leaf on a short, stout stem, two smaller spines and a hair. Clasper broad, flattened. Sidepiece short, globular. Inner plate of mesosome narrow, bent; the tip furcate, with two short, blunt points; basal hook long, curved. Tenth sternites with a comb-like row of spines closely fused together. Lobes of ninth tergite small but distinct, upright, with long hairs from prominent tubercles.

Larva: Upper head hairs small, double; lower long and single. Comb scales in a large patch. Air tube long and slender, five or six times as long as wide, with five or six pairs of large ventral tufts, the basal ones large, the others successively smaller. Skin of thorax pilose.

DISTRIBUTION. *C. peccator* is rare in Oklahoma, and was taken by the writer only in the southeastern counties near Broken Bow, Valliant, Tom, and Kenefick; a record in the A. and M. collection is based on identification of females.

HABITS. The larvae were taken in a large, swampy backwash south of Broken Bow. Males were taken resting in a hollow tree and underbrush.

CULEX QUINQUEFASCIATUS Say (= *fatigans*)

RECOGNITION CHARACTERS. Adult female: Proboscis, palpi, wings, and tarsi dark. Abdominal tergites with broad white basal bands. Females of *C. quinquefasciatus* and *C. pipiens* cannot be separated satisfactorily.

Male terminalia (plate 4, figures 37, 38, and 39): Sidepiece with undivided apical lobe bearing three rods, a leaf, a hooked filament, and several smaller setae. Inner plate of mesosome with a long, curved, pointed process in front and a shorter posterior one. Tenth sternites tufted with a dense patch of spines. Lobes of ninth tergite undeveloped, represented by a row of long hairs. *C. pipiens* can be distinguished from *C. quinquefasciatus* only by the mesosome; instead of having the long, curved, pointed spine, *C. pipiens* has a shorter, blunt spine (plate 4, figure 40).

Larva: Upper and lower head hairs multiple. Air tube five times as long as wide, with four pairs of ventral hair tufts; the first, second, and fourth on each side in line, the third out of line.

DISTRIBUTION. This species should be found anywhere in Oklahoma.

HABITS. The larvae breed in artificial containers, but they were also found in stream pools, springs and seepages, and rain pools. Only one adult was captured, and it should be noted that this mosquito was never taken while biting man.

CULEX RESTUANS Theobald (= *territans*)

RECOGNITION CHARACTERS. Female: Similar to the female of *C. quinquefasciatus,* from which it can not be distinguished satisfactorily. Dyar attempts to separate them by the scales of the mesonotum, which in *restuans* are "fine hair-like", but in *quinquefasciatus* are "narrow curved." Matheson uses the basal white band on the second abdominal segment, which is narrowed laterally in *quinquefasciatus* but only slightly so in *restuans*.

Male terminalia (plate 4, figures 41 and 42): Apical lobe undivided, with three stout rods, a leaf, and some smaller setae. Inner plate of mesosome with a stout spine on each of the anterior corners, and some small denticles between the spines. Tenth sternites tufted with a dense patch of spines. Ninth tergite lobes prominent, separated by a deep cleft; each lobe with fine hairs.

Larva: Head hairs long and multiple. Air tube four times as long as wide; ventral tufts represented by several scattered hairs.

DISTRIBUTION. This mosquito is common, and should be found throughout Oklahoma.

HABITS. The larvae are found in artificial water containers, rain pools, springs and seepages, and stream pools. No adults were observed biting man.

CULEX SALINARIUS Coquillett

RECOGNITION CHARACTERS. Adult female: Proboscis, palpi, wings, and tarsi dark. Abdominal tergites without basal white bands, or with narrow, rather indistinct bands of brownish-yellow scales.

Male terminalia (plate 4, figures 43, 44, and 45): Apical lobe of sidepiece undivided, with three stout rods, a curved filament, a leaf, and a seta. Inner plate of mesosome with a curved, broad spine on one upper corner; a sharply bent, pointed spine on the other upper corner; a group of smaller teeth between these processes; and a long, broad process arising from the base of the plate. Ninth tergite lobes represented by a row of long hairs. Tenth sternites tufted with strong spines.

Larva: Head hairs multiple. Air tube very long and slender, seven or eight times as long as wide, and tapering. Four fairly small ventral tufts, each usually with two to four hairs.

DISTRIBUTION. The species should be found throughout Oklahoma.

HABITS. Artificial containers, stream pools, springs and seepages, and rain pools are all favorable breeding places. This mosquito was taken while feeding on man more often than any other *Culex*.

CULEX TARSALIS Coquillett

RECOGNITION CHARACTERS. Adult female: Readily identified by the broad white ring at the middle of the proboscis and the broad white rings on the tarsi, involving both ends of the joints.

Male terminalia (plate 4, figures 46, 47, and 48): Apical lobe of sidepiece with three rods, a leaf, and several smaller setae. Inner plate of mesosome with two long curved processes, one arising at the base of the plate; a shorter appendage ending in two short points. Tenth sternites tufted with a dense group of spines; lobes of ninth tergite represented by a row of long hairs.

Larva: Head hairs long and multiple. Air tube about six times as long as wide, with five pairs of ventral tufts of moderate size.

DISTRIBUTION. This is one of the most abundant mosquitoes in Oklahoma, and it was taken throughout the eastern half of the State, and as far west as Guymon and Hollis.

HABITS. Larvae were found sometimes in gently flowing water in streams, but they are much more numerous in stream pools. Other breeding places were lakes, swamps, impoundments, artificial containers, and especially springs, seepages, and rain pools. It is most often associated with *A. punctipennis*. Apparently the adults do not bite man, but two females were captured on a horse. They are attracted to light traps.

MANSONIA PERTURBANS (Walker)

RECOGNITION CHARACTERS. Adult female: Proboscis white-ringed at the middle; tarsal segments broadly white-banded basally; wing scales broad, dark and light mixed, without forming dark and light spots.

Male terminalia: The sidepiece has a pointed basal lobe with a stout spine at the apex.

Larva: The air tube is pointed at the tip and adapted for piercing the tissues of aquatic plants.

DISTRIBUTION. Only one female has been taken in Oklahoma; this was taken in a light trap at Stillwater.

HABITS. The larvae attach themselves by their air tubes to various aquatic plants below the surface of the water. Where they are abundant, the adults cause much annoyance, but the species must be too rare in Oklahoma to have any importance.

MEGARHINUS SEPTENTRIONALIS Dyar and Knab

RECOGNITION CHARACTERS. Adult female: Proboscis rigid, curving downwards distally. These large, brilliantly colored mosquitoes have the body densely clothed with flat, iridescent scales.

Male terminalia: Sidepiece with a mound-like basal lobe with three stout spines at the apex.

Larva: The mouth brushes of these large, predaceous larvae are adapted for grasping the prey. The air tube is short, without pecten, and with a single pair of ventral tufts at the base. The anal gills are very short.

DISTRIBUTION. The species was taken at Stillwater and several localities in the wooded southeastern areas of the State.

HABITS. The chief breeding places are rot holes in trees, but often the larvae are found in artificial containers. They feed on other mosquito larvae. The adults do not suck blood.

ORTHOPODOMYIA SIGNIFERA (Coquillett)

RECOGNITION CHARACTERS. Adult female: Palpi and proboscis dark with conspicuous lines of white scales. Mesonotum with six narrow longtitudinal lines of white scales. Legs mottled with white; hind tarsi with broad white rings involving both ends of the joints. Wing scales broad, black and white mixed.

Male terminalia (plate 5, figure 65): Sidepiece with a mound-like basal lobe with three stout spines at the apex.

Larva: Head hairs multiple. Eighth abdominal segment with a large plate, covering most of the segment. Air tube without pecten and with a single pair of ventral tufts before the middle.

DISTRIBUTION. This mosquito was taken at Stillwater and Idabel.

HABITS. The larvae breed in tree holes. No adults were captured.

PSOROPHORA CILIATA (Fabricius)

RECOGNITION CHARACTERS. Adult female: Large species, with a longitudinal stripe of golden scales on the mid dorsal line of the mesonotum. Hind legs with erect scales; hind tarsal segments banded basally. *P. ciliata* may be confused with *P. howardii*, another large species, but the latter does not have the yellow stripe on the mesonotum, and the tarsi are mostly unbanded.

Male terminalia (plate 6, figure 68): Claspette long, columnar, expanded apically; the tip with a broad, curved filament, and many short, thick setae. Clasper curved, not swollen medially, and ending in a sort of shallow fork.

Larva: Large predaceous larvae with a square head and mouth brushes strong and adapted for grasping the prey. Air tube long, cylindrical, a pair of long ventral hairs beyond the pecten. One spine of each pecten tooth prolonged into a long hair.

DISTRIBUTION. This species was taken throughout Oklahoma except in the extreme western areas, where few collections were made. Because of the small amount of rainfall, there is little standing water in this part of Oklahoma, and naturally those species that are dependent upon temporary ground pools for their existence must be quite scarce. The author did not have an opportunity to collect in the arid western plains a short time after a heavy rain.

HABITS. The larvae devour the larvae of *Psorophora* and *Aedes* that also breed in temporary rain or flood pools. The species is common, and the adults are severe biters.

PSOROPHORA CONFINNIS (Lynch Arribalzaga) (= *columbiae*)

RECOGNITION CHARACTERS. Female: Proboscis with a broad white area in the middle; wing scales mostly dark, with white ones mixed with the dark; no white spots on the wing. Tarsal segments broadly banded with white basally.

Male terminalia (plate 6, figures 69 and 70): Claspette slender, broadly expanded apically; the tip with four to seven, usualy five or six, long, broad setae. Clasper swollen medially. By examining the terminalia of this species, Martini (1935) and Aitken (1941) proved that *P. columbiae* is the same as *P. confinnis*.

Larva: Head hairs multiple. Antennae about as long as the head. Air tube inflated, a small ventral tuft outwardly.

DISTRIBUTION. This mosquito is found throughout most of Oklahoma, and has been taken as far west as Cheyenne (A. & M. record). It is one of the common species.

HABITS. The larvae breed in temporary rain and flood pools, but rarely they are taken from artificial containers, where the females probably deposit their eggs above the water line. The adults will attack man, but not many were taken from human bait. Bishopp (1933) has described the ferocity with which this mosquito may attack domestic animals.

PSOROPHORA CYANESCENS (Coquillett)

RECOGNITION CHARACTERS. Adult female: Thorax brownish-black; abdomen and legs with shiny purple scales. Mesonotum with a rather sparse covering of yellow scales. Wings dark; tarsi dark. This species is separated from the other purplish *Psorophora* (*ferox, horrida, varipes*) by the absence of white on the last hind tarsal segments.

Male terminalia (plate 6, figure 71): Clasper broad in the middle but not greatly swollen. Claspette long, columnar, narrow at the base and widely expanded at the tip; the apical border concave; two large curved spines on the inner point, and many broad, flattened spines along the apical border.

Larva: Antennae about as long as the head. Head hairs single. Air tube inflated, a pair of very long hairs at the tip.

DISTRIBUTION. *P. cyanescens* can be found throughout Oklahoma; it has been taken as far west as Beaver, and occurs throughout the eastern two-thirds of the State.

HABITS. The larvae breed in temporary ground pools, and seem to develop more rapidly than any of the other species with which they are associated. The species is very abundant, and the adults are severe biters; the adult records indicate that this is the worst of Oklahoma's pest mosquitoes. The females bite during the day when one invades their haunts in wooded areas, but they come out in even greater numbers at dusk and will fly into inhabited areas to attack people spending the evening hours out of doors. After a rainfall they may be abundant enough to drive people indoors or to a different locality.

PSOROPHORA DISCOLOR (Coquillett)

RECOGNITION CHARACTERS. Adult female: Proboscis ringed with white at the middle. Wings with dark and light spots; costa largely dark, except at the base, and with a single white spot near the apex of the wing. Tarsal segments with broad white basal rings.

Male terminalia (plate 6, figure 72): The terminalia are similar to those of *P. confinnis*. Dyar (1928) separates *confinnis* from *discolor* by the number of spines on the tip of the claspette; the former is supposed to have six and the latter five. This character cannot be used, as there is considerable variation in the number of these spines in each species.

Larva: Antennae strongly curved, swollen at the middle, and much longer than the head. Head hairs long and single. Air tube short, cylindrical, with a pair of long multiple ventral tufts at the middle.

DISTRIBUTION. Dyar (1928) says that the larvae occur rarely in transient rain pools, and according to King, Bradley, and McNeel (1939) the species occurs sparingly throughout the South. Carpenter's (1939) observations indicate that it is not abundant in Arkansas. Although it cannot be included with the common Oklahoma species, it certainly is not rare, and it seems desirable to list the localities in which it was taken. These are as follows: Atoka, Ardmore, Alva, Boswell, Bennington, Finley, Golden, Grant, Henryetta (A. & M. record), Hugo, Idabel, Lake Blackwell, Muse (A. & M.), Moyers, Nashoba, Oswalt (A. & M.), Perkins, Summerfield, Stillwater, Strong, Shawnee, Tuskahoma, Watts, Wright City, Talihina (Winding Stair Mountain), Wyandotte.

HABITS. The larvae breed in temporary ground pools, and are considerably slower in their development than the other *Psorophora* and *Aedes* with which they are associated. The larvae are very wary, attaching themselves to grass or debris at the bottom of the pool when disturbed, and must be taken by scraping the dipper through the debris and mud at the bottom of the pool. The muddy water in the dipper must be poured out very slowly or many of the specimens will be overlooked. The adults have been captured while feeding on man, and a number were taken in light traps.

PSOROPHORA FEROX (Humbolt)

RECOGNITION CHARACTERS. Adult female: Proboscis dark. Mesonotum black with rather sparse yellow scales. Legs and abdomen shiny purple; fourth and fifth hind tarsal segments entirely white. Wing scales dark; wing without spots.

Male terminalia (plate 6, figure 73): Clasper greatly swollen in the middle. Claspette long, columnar, the apex bent at right angles to the stem; the tip broad, with two flat, twisted filaments on the upper point and many long setae along the apical border.

Larva: Antennae longer than the head, slightly swollen basally. Head hairs double. Lateral abdominal hairs of fourth, fifth, and sixth segments long and single, rarely double. Air tube inflated, and inconspicuous ventral tuft outwardly.

DISTRIBUTION. This species has been taken in wooded localities throughout the eastern half of the State.

HABITS. The larvae breed in temporary rain pools, especially shaded ones. This mosquito is not very abundant in Oklahoma, but locally it may be prevalent enough to cause annoyance. The females attack during the day when one passes through their wooded haunts, and in the extreme southeastern corner of McCurtain county, this species, with *P. varipes,* made collecting very uncomfortable in some localities.

PSOROPHORA HORRIDA (Dyar and Knab)

RECOGNITION CHARACTERS. Adult female: Similar to *P. ferox,* with shiny purple legs and abdomen, and with the fourth and fifth hind tarsal segments entirely white, but the mesonotum differs from that of *P. ferox* in that it has a central longitudinal stripe of black scales, while the sides are clothed with pure white scales.

Male terminalia (plate 6, figures 74 and 75): Sidepiece short and globular; the clasper is short, broad, and widest just before the apex. Claspette columnar, the apex broad, and split into two divergent arms, each ending in a long spine.

Larva: Similar to that of *P. ferox,* but abdominal segments four, five, and six with short lateral hair tufts, each with three to five, rarely two, branches.

DISTRIBUTION. King, Bradley, and McNeel (1939) call this a rare species, recorded from Arkansas, Tennessee, and Mississippi. Carpenter (1939) says he has a single adult specimen, captured in woods in Union County. The Oklahoma records are as follows: Antlers, Alva, Byars, Blue, Checotah, Durant, Eagletown, Goodland School, Grant, Golden, Gore (A. & M. record), Henryetta (A. & M.), Hugo, Moon, Nelson, Perkins, Ripley Bluffs, Shawnee, Stillwater, Summerfield, Sawyer, Sherwood (A. & M.), Tulsa, Valliant, Westville.

HABITS. The larvae breed in shaded temporary rain pools. The adults attack man readily, and are usually taken with biting *P. ferox* females in woods. This species represents 0.6 per cent of the total number of mosquitoes collected, but this figure could have been raised by a half hour's diligent collection of the tremendous numbers of adults that were seen resting in shaded underbrush on the edge of a large overflow near Shawnee on July 11, 1940. Even in their resting places the males could be identified by the bulbous terminalia. The species is not rare in Oklahoma, and as the locality records indicate, it can be found almost anywhere in the State.

PSOROPHORA HOWARDII Coquillett

RECOGNITION CHARACTERS. Adult female: A large, dark mosquito, similar to *P. ciliata,* but without the longitudinal yellow stripe on the mesonotum, with fewer erect scales on the legs, and with only indistinct, narrow pale rings at the base of the first and second tarsal segments.

Male terminalia (plate 6, figure 76): Clasper thick, the outer half more slender and tapering to a plunt point, sharply bent at right angles to the basal half. Claspette with a short, thick stem and a broadly expanded tip; the surface of the tip densely covered with short, curved hairs, a twisted filament at the inner edge.

Larva: Similar to that of *P. ciliata,* from which, according to Dyar, it may be separated by the elongated spine on each of the pecten teeth, which, in *P. ciliata,* is very much longer than the rest of the tooth, but in *P. howardii* is only three times as long as the basal part of the tooth.

DISTRIBUTION. This mosquito is rare in Oklahoma. It was taken at Bennington, Coalgate, Ft. Towson, Perkins, and Shawnee.

HABITS. The larvae breed in temporary rain pools, and devour the larvae of other rain pool species. No adults were observed feeding.

PSOROPHORA SIGNIPENNIS (Coquillett)

RECOGNITION CHARACTERS. Adult female: Proboscis broadly white in the middle; tarsal segments with broad white basal bands; wing scales black and white mixed, the costa with two conspicuous light and dark spots on the apical half of the wing. *P. signipennis* can be distinguished from *P. discolor* by these costal spots; in the latter there is a single prominent white costal spot on the apical half of the wing.

Male terminalia (plate 6, figures 77 and 78); Clasper slightly swollen in the middle. Claspette small, closely fused to the sidepiece, with a few setae at the tip.

Larva: Antennae about as long as the head. Head hairs single or double. Air tube inflated, with an inconspicuous pair of ventral tufts. The air tube does not have the long hairs at the tip, which serves to distinguish *P. signipennis* from *P. cyanescens.*

DISTRIBUTION. This mosquito is one of the commonest Oklahoma species, and can be taken anywhere in the State.

HABITS. The larvae breed in temporary ground pools, but a few were found in artificial containers. Any of the temporary pool breeders may be encountered occasionally in creek pools; their presence here may be the result of a recent rise in the level of the water, a recent origin of the pools, or a washing of the eggs or larvae from adjacent areas in the creek bed. A creek pool is considered to have been formed by the drying of a running stream, and not by rainfall, and as it is more or less permanent, ordinarily such bodies of water are not breeding places for *P. signipennis* and its associated species.

P. signipennis outnumbered by far the species taken in light traps. But in spite of the abundance of the larvae and of the adults in light traps, the females were rarely observed biting.

PSOROPHORA VARIPES (Coquillett)

RECOGNITION CHARACTERS. Adult female: Shiny black and purple mosquitoes with unspotted wings. Similar in appearance to *P. horrida* and *P. ferox,* but readily separated from them by the last two hind tarsal segments, both of which are white in those species, while in *varipes* the fourth hind tarsal segment is white and the fifth dark. *P. cyanescens,* another black and purple mosquito, has no white markings on the tarsi.

Male terminalia: The writer has no males of *P. varipes;* only attacking females were taken. Dyar (1928) pictures a long, straight claspette, with a few hairs on the upper part of the stem, and two short filaments at the tip, bent down against the stem.

Larva: According to published descriptions, the larva must be very similar to those of *P. ferox* and *P. horrida.* Howard, Dyar, and Knab (1917) state that the abdominal segments of the larvae of "*P. discrucians*" (actually *varipes*) have "lateral hairs multiple on first segment, double on second, single on third to sixth," in which case the larva would key out with *P. ferox.* As no larvae were examined, the species is not included in the key to larvae.

DISTRIBUTION. The adults were abundant on July 17, 1940, in a low wooded area along "Harris Bayou" southeast of Tom, in the extreme southeastern corner of McCurtain County. Other localities are Idabel, Mintubbe Lake, and Nelson.

HABITS. The larvae breed in temporary ground pools. The adults are severe biters, and when abundant they are extremely annoying, attacking when their haunts are invaded.

THEOBALDIA INORNATA (Williston)

RECOGNITION CHARACTERS. Adult female: Individuals are usually large. Proboscis and legs unbanded, but somewhat mottled with white scales. Wing scales mostly dark; no spots on the wing, but the costa, subcosta, and first veins have white scales mixed with the dark ones. The general color is a dull brown.

Male terminalia (plate 2, figures 19 and 20): The sidepiece has a mound-like basal lobe with two or three spines at the apex. The mesosome is long and slender with a thin creast at the tip.

Larva: Air tube with a pair of multiple ventral tufts at the base, within the pecten.

DISTRIBUTION. This species becomes very abundant during the winter months, and the most widely separated localities in which it was taken are Guymon, Tulsa, Hugo, and Craterville Park. It should be found anywhere in Oklahoma.

HABITS. The larvae breed in clear, cool waters of stream pools, seepages, and temporary rain pools. Although present in great numbers in stream pools during the winter, the larvae do not seem to be able to withstand freezing. Adults placed in freezing temperatures in a refrigerator for several days revived in a few minutes when subjected to laboratory temperatures. Adults could be induced to bite man occasionally in the laboratory, and a number were taken from horses late in the fall, when the weather was cold enough to be distinctly uncomfortable. The species disappears in the summer.

THEOBALDIA MELANURA (Coquillett)

RECOGNITION CHARACTERS. Adult female: Similar to *T. inornata,* but the wing scales are entirely dark; there is no mixture of dark and light scales along the costal border of the wing.

Male terminalia: Instead of being long, narrow, and crested, as in *inornata,* according to Dyar (1928) the mesosome is conical and truncate in *T. melanura.*

Larva: Dyar says that the larva has, in addition to the basal ventral tuft on the air tube, a row of small tufts on the outer half of the tube.

DISTRIBUTION. The species is rare; it was not taken by the writer, but specimens in the A. & M. collection are labeled Eagletown and Tulsa.

URANOTAENIA SAPPHIRINA (Osten-Sacken)

RECOGNITION CHARACTERS. Adult female: A small dark species with brilliant iridescent blue scales arranged in short lines or small patches on the occiput, mesonotum, thoracic pleurae, and base of the first and fifth veins of the wing.

Male terminalia (plate 5, figures 66 and 67): The sidepiece is very short and stout; the clasper short; and the mesosome short, divided, with three small hooks on each half.

Larva: Readily distinguished from all the other Oklahoma species by the four heavy spines on the head instead of the usual slender single or multiple head hairs.

DISTRIBUTION. This species was taken throughout the eastern half of the State.

HABITS. The larvae are found in permanent collections of water, and are usually associated with *A. quadrimaculatus* and *C. erraticus.* Many adults were seen resting in wet hoof prints and similar depressions in creek beds, and on damp underbrush and logs in swamps. Rarely they were observed biting a horse or man.

PLATE 1

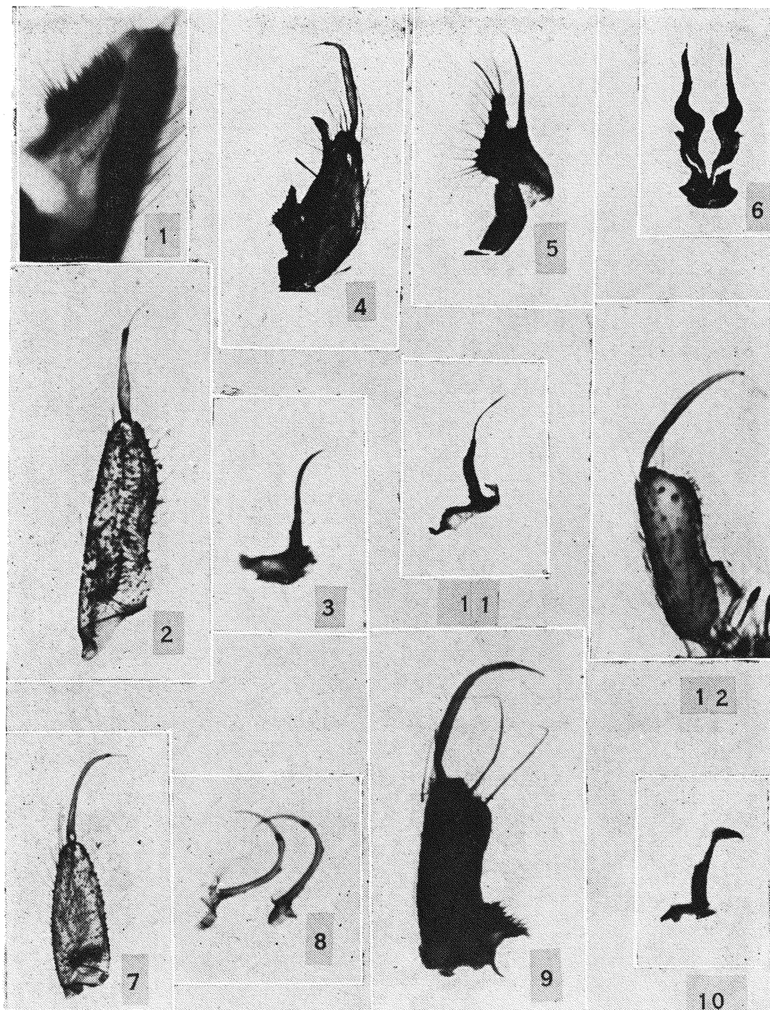


Figure 1—*A. aegypti*, sidepiece, showing hairy basal plaque.
Figure 2—*A. alleni*, sidepiece.
Figure 3—*A. alleni*, claspette.
Figure 4—*A. atlanticus*, sidepiece.
Figure 5—*A. atlanticus*, basal lobe.
Figure 6—*A. atlanticus*, claspette.
Figure 7—*A. atropalpus*, sidepiece.
Figure 8—*A. atropalpus*, claspettes.
Figure 9—*A. dorsalis*, sidepiece.
Figure 10—*A. dorsalis*, claspette lobe.
Figure 11—*A. canadensis*, claspette.
Figure 12—*A. canadensis*, sidepiece.

PLATE 2

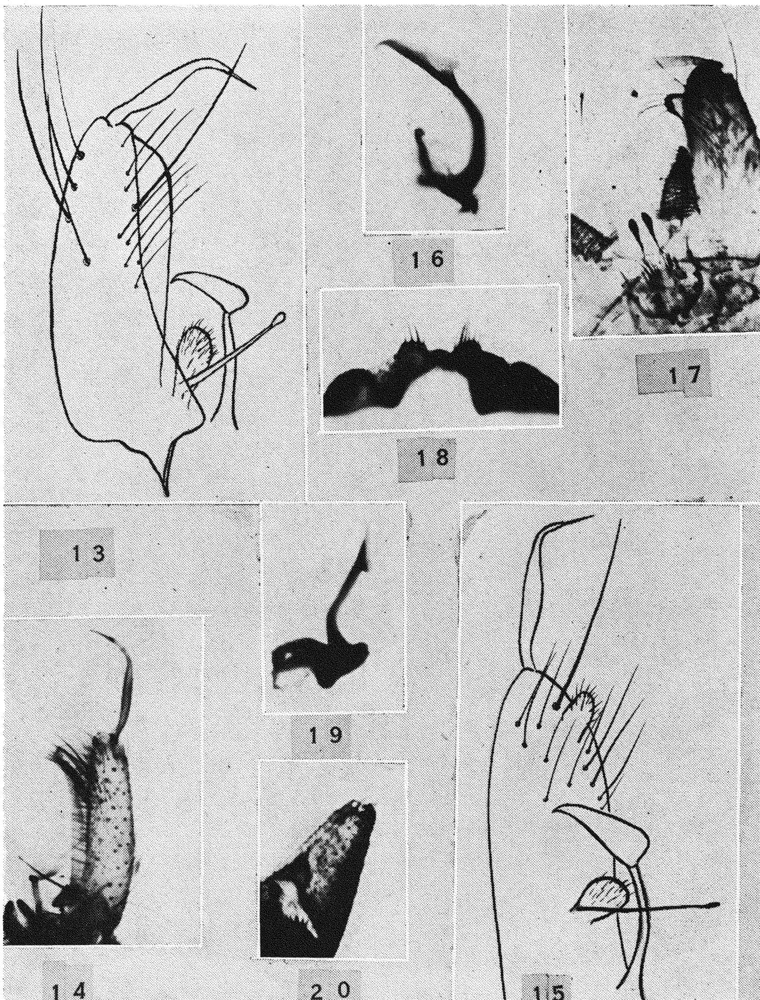


Figure 13—*A. fulvus*, sidepiece and claspette. Redrawn from sketch of U. S. National Museum specimen No. 1302, collected at Colon, Canal Zone, by Chidester on June 6, 1920.

Figure 14—*A. fulvus*, sidepiece. Specimen collected by the author at El Real, R. de Panama, on May 25, 1936.

Figure 15—*A. bimaculatus*, sidepiece and claspette. Redrawn from sketch of U. S. National Museum specimen No. 533, labelled, "Scott, Pulaski Co.," Ark. Thibault. Sept. 23, '09.

Figure 16—*A. bimaculatus*, claspette. Florida. From collection of Mr. A. Weathersbee.

Figure 17—*A. rozeboomi* from Mexico, described by Vargas (1940) as *A. bimaculatus*. Original photograph of specimen loaned to the author by Vargas.

Figure 18—*A. sollicitans*, lobes of ninth tergite.

Figure 19—*Theobaldia inornata*, mesosome (lateral view).

Figure 20—*T. inornata*, sidepiece.

PLATE 3

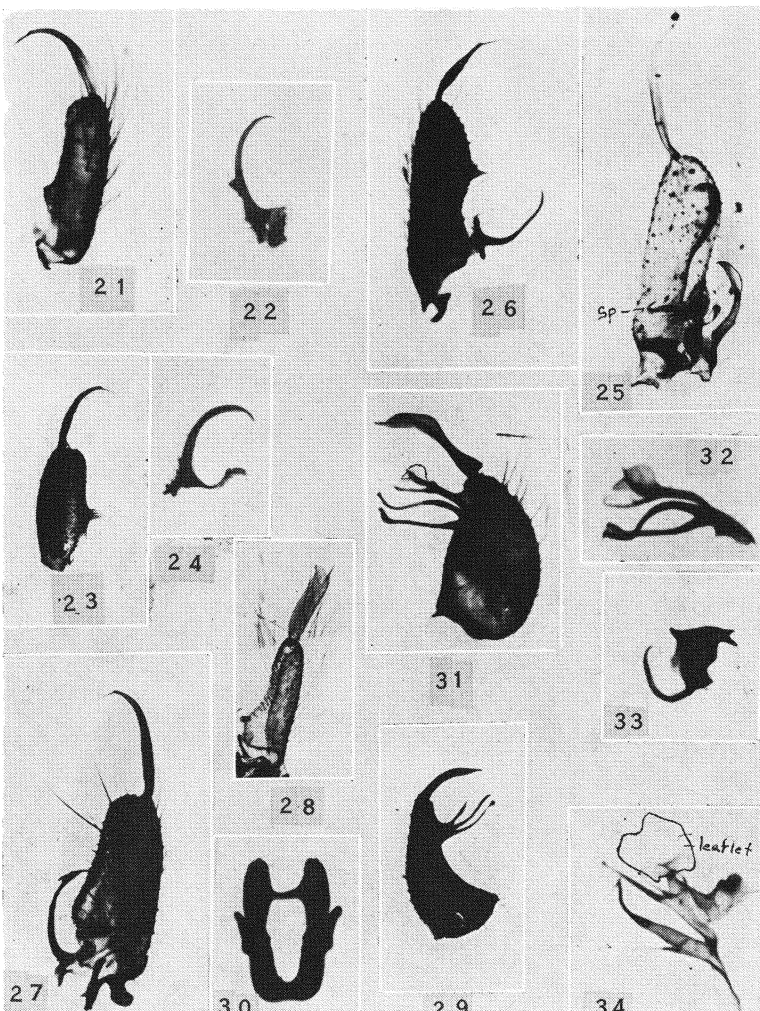


Figure 21—*A. nigromaculis*, sidepiece.
Figure 22—*A. nigromaculis*, claspette.
Figure 23—*A. sollicitans*, sidepiece.
Figure 24—*A. sollicitans*, claspette.
Figure 25—*A. sticticus*, sidepiece and claspette.
Figure 26—*A. triseriatus*, sidepiece and claspette.
Figure 27—*A. trivittatus*, sidepiece and claspette.
Figure 28—*A. vexans*, sidepiece.
Figure 29—*Culex apicalis*, sidepiece.
Figure 30—*C. apicalis*, mesosome (front view).
Figure 31—*C. erraticus*, sidepiece.
Figure 32—*C. erraticus*, Apical lobe of sidepiece.
Figure 33—*C. erraticus*, inner plate of mesosome (lateral view).
Figure 34—*C. peccator*, Apical lobe of sidepiece.

PLATE 4

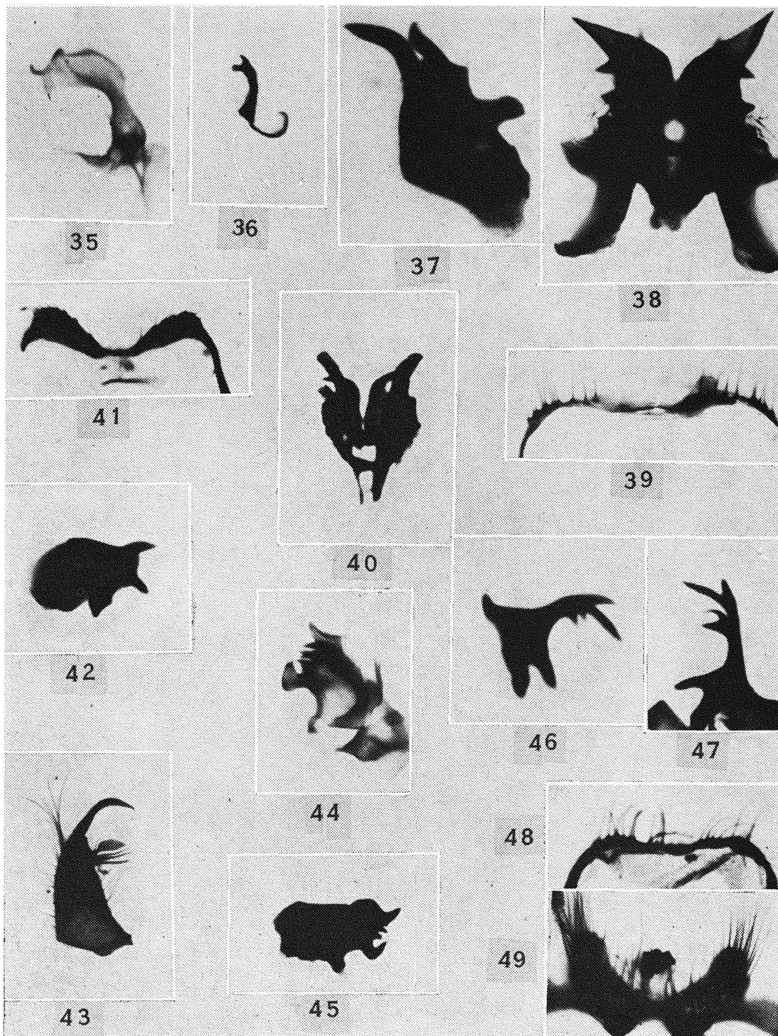


Figure 35—*C. peccator*, clasper.

Figure 36—*C. peccator*, inner plate of mesosome (lateral view).

Figure 37—*C. quinquefasciatus*, inner plate of mesosome (lateral view).

Figure 38—*C. quinquefasciatus*, mesosome (front view).

Figure 39—*C. quinquefasciatus*, ninth tergite.

Figure 40—*C. pipiens*, mesosome (front view).

Figure 41—*C. restuans*, ninth tergite.

Figure 42—*C. restuans*, inner plate of mesosome (lateral view).

Figure 43—*C. salinarius*, sidepiece.

Figures 44 and 45—*C. salinarius*, inner plate of mesosome (lateral view).

Figure 46—*C. tarsalis*, inner plate of mesosome (lateral view).

Figure 47—*C. tarsalis*, inner plate of mesosome (front view).

Figure 48—*C. tarsalis*, ninth tergite.

Figure 49—*C. erraticus*, lobes of ninth tergite.

PLATE 5

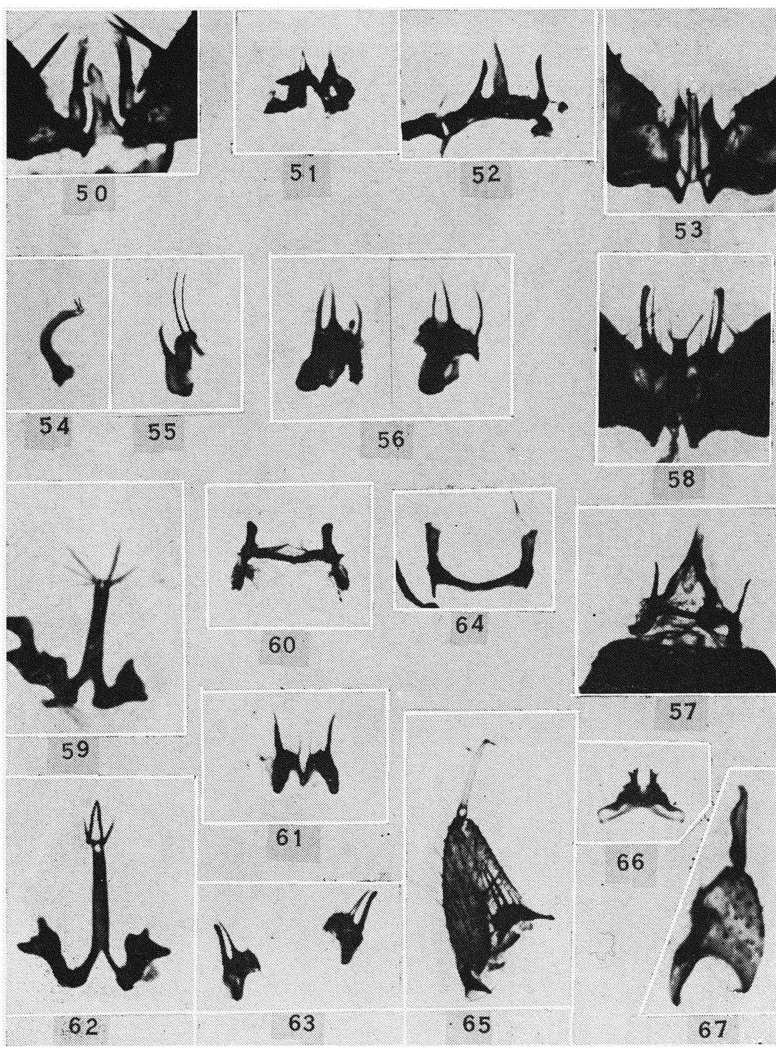


Figure 50—*A. barberi*, mesosome and outer claspette lobes.

Figure 51—*A. crucians*, claspette lobes.

Figure 52—*A. crucians*, ninth tergite.

Figure 53—*A. crucians*, mesosome and claspette lobes.

Figure 54—*A. pseudopunctipennis*, mesosome (lateral view).

Figure 55—*A. pseudopunctipennis*, claspette lobes.

Figure 56—*A. maculipennis*, claspette lobes.

Figure 57—*A. maculipennis*, ninth tergite.

Figure 58—*A. walkeri*, showing the rounded, slightly clubbed spines on the outer claspette lobes.

Figure 59—*A. punctipennis*, mesosome.

Figure 60—*A. punctipennis*, ninth tergite.

Figure 61—*A. punctipennis*, claspette lobes.

Figure 62—*A. quadrimaculatus*, mesosome.

Figure 63—*A. quadrimaculatus*, claspette lobes.

Figure 64—*A. quadrimaculatus*, ninth tergite.

Figure 65—*O. signifera*, sidepiece.

Figure 66—*U. sapphirina*, mesosome (front view).

Figure 67—*U. sapphirina*, sidepiece.

PLATE 6

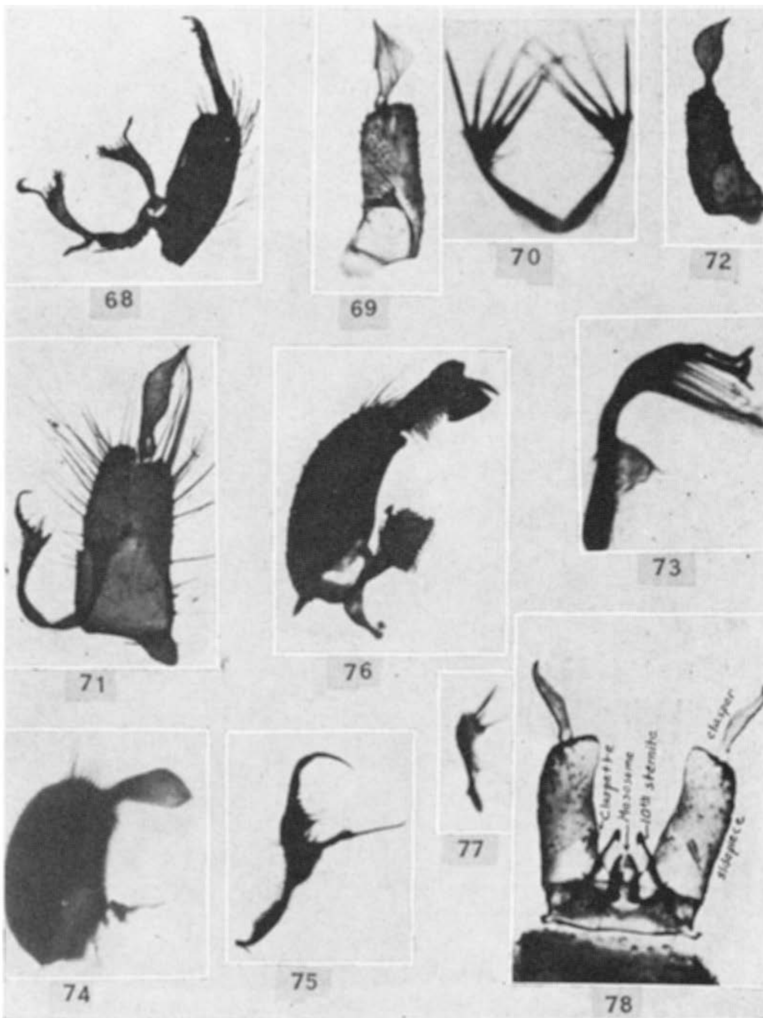


Figure 68—*P. ciliata*, sidepiece and claspettes.

Figure 69—*P. confinnis*, sidepiece and claspette.

Figure 70—*P. confinnis*, claspettes.

Figure 71—*P. cyanescens*, sidepiece and claspettes.

Figure 72—*P. discolor*, sidepiece.

Figure 73—*P. ferox*, claspette.

Figure 74—*P. horrida*, sidepiece.

Figure 75—*P. horrida*, claspette.

Figure 76—*P. howardii*, sidepiece and claspette.

Figure 77—*P. signipennis*, claspette.

Figure 78—*P. signipennis*, terminalia (undissected).

Mosquito Control

From time to time requests are received by the College for information regarding mosquito abatement. The ordinary procedure for the control of malaria-carrying *Anopheles* is to destroy the breeding places by draining or filling swamps, lakes, and similar bodies of water, or to kill the larvae with oil or Paris green. No doubt drainage is practicable in many localities in Oklahoma, particularly in the southeastern counties, but the need in this State is for an increase, not a decrease, in the amount of water surface. Many impoundments are being constructed throughout the State for urban water supply, recreational purposes, and for watering stock. Most of the stock ponds seem to be of little importance as breeding places for *A. quadrimaculatus*, as they contain little vegetation or floatage, and the margins are trampled and muddy. However, there is no denying that other impoundments may cause serious, if sporadic, cases of malaria, outside of what is now considered to be the malaria zone. Such impoundments near communities or camps should be watched for the presence of *A. quadrimaculatus*, and if the mosquitoes are found to be abundant, the breeding should be stopped. This can be accomplished without drainage or oiling; weekly applications during the summer and fall of Paris green dust, diluted one part to ninety-nine parts of an inert dust, will kill the larvae without destroying the recreational or aesthetic value of the impoundment, for the quantity necessary to kill *Anopheles* larvae is so small that it has no effect on vegetation or fish. A half pound to a pound of the poison to an acre of water surface is sufficient. People interested in malaria control must not lose sight of the requirements of duck and fish ponds, but, on the other hand, conservation protagonists should not ignore the problems of the health officer, and if the construction of impoundments for wild life are contemplated, some thought should be given to the location of such ponds and the possible effects on malaria rates. Sincere efforts at cooperation between malariologists and conservationists are desirable.

There seems to be a general lack of appreciation of the importance of temporary rain pools as sources of pest mosquitoes. Most people refer to tin cans and rain barrels when they express a desire to be rid of mosquito annoyance. Surprisingly few of the so-called domestic mosquitoes were captured in the act of biting; species of *Psorophora* and *Aedes* are the real pest mosquitoes in Oklahoma. Every community has many poorly-drained ditches and other water-holding excavations in the ground, both artificial and natural, which produce hordes of these vicious biters. If the pools cannot be drained or filled, Paris green again seems to be the most effective remedy, but for these mosquitoes it must be used as a spray rather than as a dust. King and McNeel (1938) showed that such a spray, applied at the rate of one to ten pounds of Paris green to an acre of water one foot deep, caused a high mortality among *Aedes* and *Psorophora*. The writer's observations in Oklahoma showed that the rain pool breeding *Psorophora* and *Aedes* were killed within 24 hours after the pools were sprayed with Paris green at the rate of one pound to an acre of water one foot deep. Some of the predaceous *P. ciliata* larvae took a little more time to die, but they too soon succumbed. King and McNeel point out that at the rate of two pounds of poison to the acre, two gallons of water containing one ounce of Paris green will cover about 1,250 square feet. The spray can be applied very easily with either a knapsack sprayer or an ordinary sprinkling can, and many rain pools can be treated in a few hours time.

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