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South Dakota Mosquitoes and Their Control

R. W. Gerhardt

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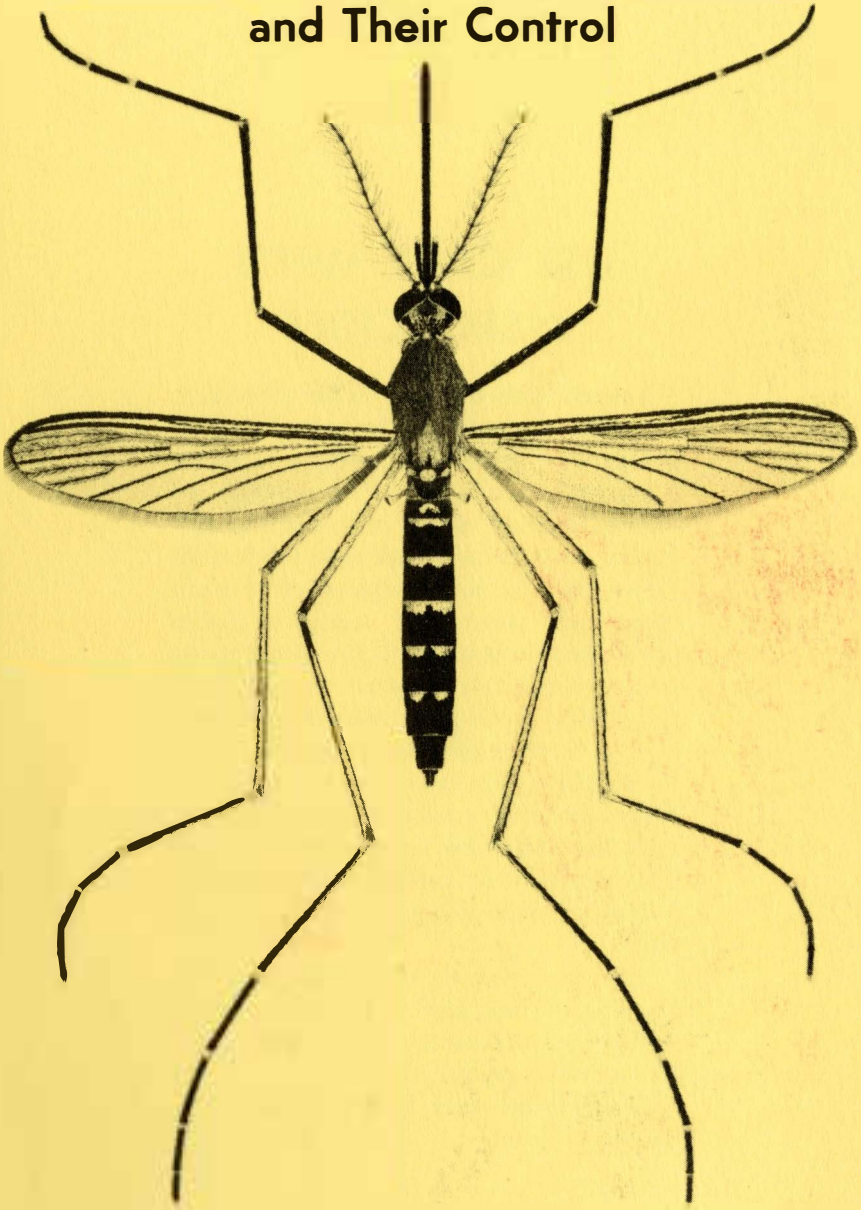
South Dakota
MOSQUITOES
and Their Control



Entomology-Zoology Department Agricultural Experiment Station

SOUTH DAKOTA STATE UNIVERSITY, BROOKINGS

FRONT COVER *Aedes vexans*, a native of the Great Plains Region and the most common mosquito in South Dakota. Actual size: about one-quarter inch in length. (From Carpenter and LaCasse, 1955).

USE CARE WITH INSECTICIDES

Insecticides have variable effects on humans as well as insects. Furthermore, any given insecticide may be prepared and sold in a variety of forms, each of which may present different dangers to those who work with them. Federal law requires that each insecticide container carry a label which provides explicit directions for its use, precautions against misuse, and first aid procedures to counteract intoxication from accidental exposure. Since these directions may be markedly different for each product, it is necessary that the label be carefully read and fully understood before the insecticide is used in any phase of mosquito control.

All insecticides are poisons. All should be handled with precautions that insure the safety of mosquito control workers and the public.

Stop! Read and UNDERSTAND the label!

South Dakota

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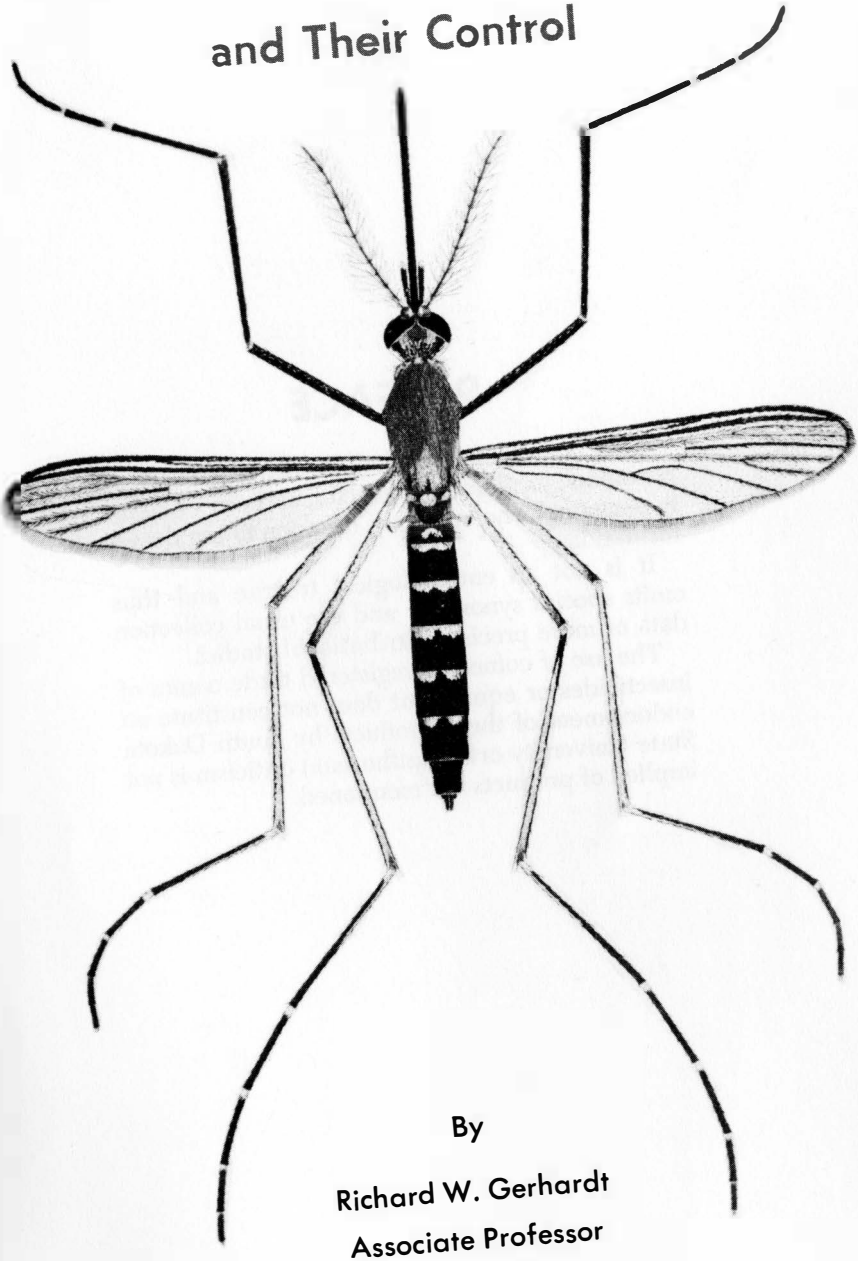


By

Richard W. Gerhardt

Associate Professor

PREFACE

This bulletin is intended for extension service personnel, local health agencies, and city or county personnel who may have occasion to use the information.

It is not an entomological treatise and thus omits species synonomy and the usual collection data of more precise distributional studies.

The use of coined or registered trade names of insecticides or equipment does not constitute an endorsement of these products by South Dakota State University or the author and criticism is not implied of products not mentioned.

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

INTRODUCTION

Mosquitoes have always been an annoyance to humans and domestic animals in South Dakota. References to their pestiferous and sometimes almost unendurable attacks are included in the journals and accounts of early-day explorers and settlers of Dakota Territory.

During those times, mosquitoes were most abundant in the river valleys and in the East River portion of the state where glacial scoured pot holes provided breeding places. Mosquitoes from these natural water accumulations were more or less seasonal, being associated with the high water period of spring and early summer.

The eastern half of South Dakota was quickly settled following the Homestead Act of 1865, with most of the arable land occupied by 1880. Western South Dakota was mostly settled by 1890, although more sparsely than the eastern part.

Following the settlement of South Dakota, the production of pest and disease carrying mosquitoes became increasingly associated with water accumulations resulting from use of land for agriculture. The native mosquito species are biologically flexible and undoubtedly utilized the newly located breeding places immediately. The result was, and still is, the more intimate association of these pests with man and his domestic animals.

Much of eastern South Dakota lacks effective drainage. The land is relatively flat, is underlaid with heavy clay deposits which reduce water percolation into the soil, and the land slope has been interrupted by roadways and other necessary surface alterations.

Most land owners and farm operators have little specific knowledge regarding mosquito production and, it often seems, no foresight in planning agricultural operations which might reduce problem sources of these pests. This general unawareness is especially unfortunate in the western half of the state where irrigated agriculture is practiced. In particular, outmoded water-rights laws promote the promiscuous application of available irrigation water to croplands which often have not been carefuly prepared or provided with suitable

drainage facilities. Oddly, if an assigned quantity of water is not used, the user may lose access to it.

Irrigation, as a means of insuring crop production, is now being employed in eastern South Dakota where rainfall has often been unreliable. This practice will lead to increased mosquito annoyance unless provisions are made for efficient water application and removal.

If it is possible to extrapolate from known circumstances of the past and present, it seems certain that the problems of annoyance by pest mosquitoes and disease transmission by vector species will increase.

South Dakota Communities and Their Important Mosquito Species

No South Dakota community is free of mosquitoes. Most, in fact, experience severe mosquito problems during the summer season. Data on the species of mosquitoes, and their relative abundance were gathered as a part of the mosquito species survey which is the main subject of this publication.

Thirty communities responded to a questionnaire directed to the city clerk or health department. Of these, 22 reported serious mosquito problems, 17 had some sort of control program, and only 9 reported that the program was reasonably effective. Most of these control efforts rely on killing adult mosquitoes (adulticiding) by fogging as the only means of control.

During the course of this study, mosquito collections were made from each county and most communities of 1,000 or more population. These collections included larval surveys, hand captures of adults and light trap catches. Based on this limited data and data recorded by other authors (U.S.P.H.S., 1951), the following list of communities and their most abundant mosquito species was prepared:

Community	Most Prevalent Species
Aberdeen	*Aedes vexans, A. nigromaculis, A. dorsalis, Culex tarsalis.*
Belle Fourche	*Aedes vexans, A. nigromaculis, A. dorsalis, A. triseriatus*
Britton	*Aedes vexans, Culex tarsalis*
Brookings	*Aedes vexans, Culex tarsalis*
Chamberlain	*Aedes vexans, A. nigromaculis, A. dorsalis*
DeSmet	*Aedes vexans, Culex tarsalis*
Edgemont	*Aedes vexans*
Elk Point	*Aedes vexans, Culex tarsalis*
Eureka	*Aedes vexans, Culex tarsalis*
Gettysburg	*Culex tarsalis*
Herreid	*Aedes vexans, A. nigromaculis*
Highmore	*Aedes vexans, Culex tarsalis*
Hot Springs	*Aedes nigromaculis*
Huron	*Aedes vexans*
Kadoka	*Aedes dorsalis*
Lake Andes	*Aedes vexans, A. dorsalis*

Lemmon	*Aedes dorsalis, A. nigromaculis, A. vexans*
Leola	*Aedes spencerii*
Madison	*Aedes nigromaculis*
McIntosh	*Aedes nigromaculis, A. vexans*
Milbank	*Aedes vexans, A. dorsalis*
Mitchell	*Aedes nigromaculis*
Mobridge	*Culex tarsalis, Aedes vexans*
Parker	*Aedes vexans*
Pierre	*Aedes vexans*
Rapid City	*Culex tarsalis, Aedes triseriatus*
Redfield	*Aedes vexans*
Salem	*Aedes vexans*
Sioux Falls	*Culex tarsalis*
Sisseton	*Aedes vexans, Culex tarsalis*
Spearfish	*Culex tarsalis, Aedes dorsalis*
Tyndall	*Aedes vexans*
Vermillion	*Aedes vexans, Culex tarsalis*
Vivian	*Aedes vexans, A. dorsalis*
Watertown	*Aedes vexans, Culex tarsalis*
Webster	*Aedes vexans*
Wessington Springs	*Aedes vexans*
Winner	*Aedes vexans*

Even the most cursory inspection of the list shows that *Aedes vexans*, a typical prairie species, is the most frequently encountered mosquito in the state. Indeed, the land area between the Missouri and Mississippi Rivers is dominated by this species.

CHARACTERISTICS AND HABITS OF MOSQUITOES

Mosquitoes belong to the order Diptera of the insects, the true flies which have only two wings. The body of the mosquito is divided into three parts—head, thorax, and abdomen. The head is almost entirely composed of large compound eyes. It also bears the feelers or antennae, two appendages at the base of the feelers known as the palpi, and a long prominent proboscis or beak. The thorax bears two wings, six legs, and two small, short knobbed stalks near the base of the wings known as halteres. The abdomen, composed of ten segments, has no appendages except the inconspicuous sexual apparatus at the tip.

Mosquitoes may be distinguished from all other two-winged insects by the possession of scales along the wing veins and a fringe of scales along the hind margin of the wings, together with the prominent proboscis or beak which projects from the head. Male mosquitoes have bushy or feathery antennae, or feelers, while the antennae of the female are thread-like. Some gnats or midges have feathery feelers but none has the long beak of the male mosquito. Some crane-flies resemble female mosquitoes, but they lack the piercing beak and their wings are bare, not scaled along the veins as in mosquitoes. The insect most commonly mistaken for a mosquito is the gnat or midge which sometimes appears in dancing swarms or clouds in daylight. Mosquitoes never appear in such dancing swarms in broad daylight. Also, the tail or abdomen of gnats is longer than the wings when these are folded down over the back. Mosquito wings usually extend to the tip of the tail or beyond when the wings are folded.

Life History of Mosquitoes

During its development the mosquito passes through four stages, three of which are passed in water: (1) the egg; (2) the larvae, or wiggletail; (3) the pupa, or tumbler; and (4) the winged adult. The eggs are laid by the female mosquito on water, at the edge of water, or in some cases on dry soil which has previously been flooded. The larvae which emerge from the eggs, after a brief incubation period, are strictly aquatic and cannot

exist out of water. It should be emphasized that mosquitoes do not propagate themselves in weeds, other vegetation, or from soil as may be popularly supposed. The larval stage in our more common species usually lasts about 2 weeks, varying with the temperature. High temperature causes rapid development. The pupa or tumbler stage normally covers about 3 days, also varying with temperature. The length of the adult stage is extremely variable, some species hibernating through the winter. Usually, the ordinary life period of the adult in mid-summer is about 4 weeks.

In general, mosquitoes can be divided into two groups depending on whether or not their eggs enter a period of dormancy called diapause. Those mosquitoes laying non-dormant eggs are included in the genera *Anopheles, Culex, Culiseta, Mansonia,* while species of *Aedes* and *Psorophora* lay eggs which become dormant.

In those species laying non-dormant eggs, the female usually lays her eggs directly on the water surface and such eggs are adapted for floating. These non-dormant eggs develop and then hatch in a very short time. The incubation period is dependent almost entirely on temperature.

Species having non-dormant eggs often have several generations a year, the number depending, of course, on the length of the season. These species tend to be found in more permanent waters where one

A typical breeding place of *Anopheles* mosquitoes. Note the pond weed at the surface of this shallow lake.

generation succeeds another throughout the breeding season.

Species of *Aedes* and *Psorophora,* on the other hand, deposit their eggs on the moist sides of breeding places or in areas which the female mosquito seems to be able to determine have been previously flooded. While the eggs undergo a certain amount of development, they do not normally hatch immediately. Instead they enter a period of dormancy and will hatch later when proper conditions arise. These eggs are extremely resistant to drying and cold temperatures and may remain viable on the soil for several years. Typically, mosquitoes of this habit deposit their eggs in late summer or fall, the eggs remaining dormant throughout the winter months, and hatching during high water periods of the following spring. This circumstance typically produces a single generation each year.

Breeding Specificity

As noted above, certain types of mosquito larvae tend to be found in certain types of breeding places because of the selective oviposition habits of the female. Some species show a high degree of this specificity while others are much more indiscriminate.

Such breeding places can be classified according to the relative permanence of the water: temporary, semi-permanent, permanent. Other factors influencing the female choice of oviposition site include: amount of organic material (i.e., pollution) in the water, nature and amount of dissolved salts, amount of exposure to sunlight, and kinds and numbers of micro-organisms inhabiting the breeding place with the developing larvae.

Any collection of water which persists for a period of a week or more may be utilized by some species of mosquito as a place for its larval development. Water in receptacles such as tin cans, discarded tires, or old automobile bodies is frequently a source of annoying mosquitoes. Water which collects in rotted holes of tree trunks is the preferred breeding site of two South Dakota species.

MOSQUITO CONTROL

Mosquito control has become increasingly important during the past few years. In many parts of the country it has become an essential part of good living. The incrimination of *Culex tarsalis* as a vector of equine encephalomyelitis and its relation to sleeping sickness in humans has stimulated interest in mosquito control to reduce the incidence of this disease.

The mosquito problem of South Dakota is largely agricultural and recreational in character. Mosquitoes affect the farmer, his family, his employees, and his livestock. They cause financial losses to stockmen, dairymen and general farmers.

Constant annoyance by mosquitoes cause livestock to lose weight, and reduce milk flow. Mosquitoes cause livestock to go from lush pastures to barren, windswept hillsides for relief and thus further reduce flesh gain. Annoyance from mosquitoes is a severe trial for agricultural workers and may cause them to refuse to work in certain fields.

At the very time of year when most people are on vacation mosquito annoyance may mean restrictions in use of recreational areas and resorts. Losses from reduction of property values, attendance at amusement places and from injury to livestock are frequently greater than the cost of mosquito control operations.

Mosquito control is a specialized activity. It requires sound judgment, a background of entomology, and some training in engineering. Above all, one must know the different species, their life histories, and their habits in order to apply practical measures against them.

Surveys

Before an effective mosquito control program can be undertaken, a survey must be made of the area to be protected. Such a survey must be made by an entomologist or a specialist who has knowledge of the biology and habits of mosquitoes and of the diseases they carry. In addition to finding out where the mosquitoes are and what species are present, information must be obtained on their breeding places and such other data which entomologists, sanitary engineers, and mosquito control personnel

will need in planning a control program.

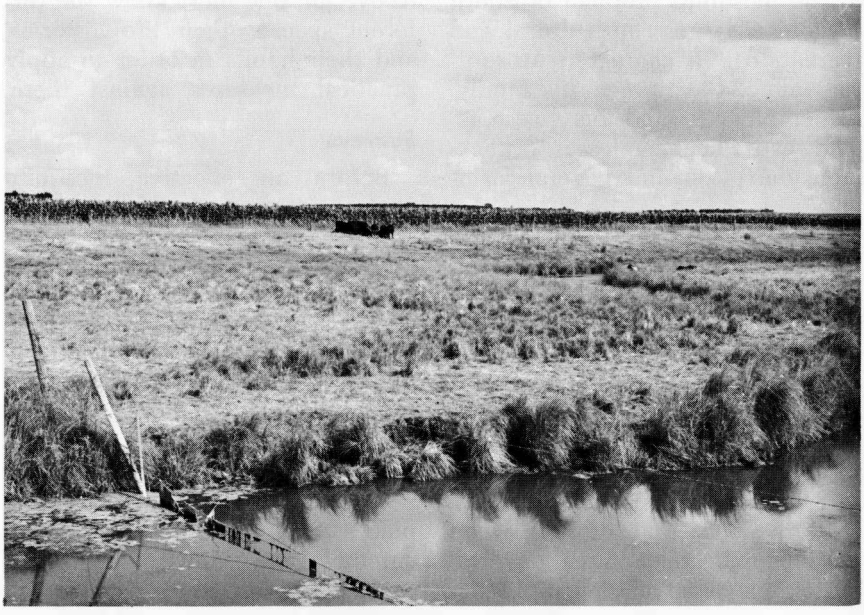
If the mosquito control project is aimed at the reduction of a mosquito borne disease, the presence of the disease itself indicates, in some measure, the species involved. A survey of mosquito species aids in developing the plan of procedure and estimating cost. If relief from mosquito annoyance is the main consideration, a survey is necessary to determine the limits of the infestation and the relative importance of each species, since more than one kind is usually present.

A mosquito survey is begun by collecting and identifying both larvae and adults. Because the flight range may be unknown, this collection should extend for some distance beyond the limits of mosquito annoyance. Mosquitoes have no regard for municipal, county, or state boundaries, so it is sometimes necessary to control them in one area to protect the citizens of another.

In connection with mosquito control projects, an engineering survey should be included to determine the possibility of eliminating breeding places. Reclamation of land, diking against floods, and maintaining water levels are permanent solutions to mosquito problems. An engineering survey will determine whether such methods are feasible and the approximate cost.

The primary aim of mosquito control is the progressive reduction of known mosquito breeding sourc-

Livestock cease grazing and seek open, wind-swept places when annoyed by mosquito attacks.



es and the prevention of the formation of new ones. This may be accomplished by land or water management activities which eliminate the aquatic habitats which are invariably sources of mosquitoes.

This preventive mosquito control activity seeks to make it impossible for mosquitoes to breed. Included are such operations as drainage, filling, careful land preparation for crops, precise irrigation based on optimum water requirements of soils and crops, clearing and shaping the margins of water impoundments to minimize marshy borders and aquatic vegetation, and the manipulation of water levels to expose the aquatic stages of mosquitoes to their natural enemies. It is recognized that this "source reduction" type of mosquito control is necessarily a long range program which will probably reach major effectiveness only as water resource developments obtain maturity; and new agricultural, residental, and industrial areas become stabilized.

Engineering surveys should include careful mapping of known mosquito breeding places in each section of land to be brought under mosquito control operations. Aerial photographs, particularly those taken with infra-red film, are useful in identifying mosquito breeding areas. Since water areas absorb infra-red radiation, mosquito breeding places will stand out in infrared photographs as dark areas contrasting greatly with the surrounding soil or herbage.

Larviciding for Mosquito Control

Efficient and large scale chemical larviciding operations are usually necessary to compliment the source reduction activities and yield immediate relief from disease bearing and pest mosquitoes. Use of chemicals is likely to require a considerable expenditure of local resources well into the future although the proportion can be expected to lessen as the source reduction activities are extended.

Before modern insecticides were developed, petroleum oils such as light distilled fuel oil or diesel fuel, were used against all species of mosquitoes. Contrary to popular opinion, such oils did not kill mosquitoes by smothering them. The action is similar to fumigation, since the larva takes in the vapors of such oils through their breathing tubes. In this respect, the lighter, more volatile oils are more efficient killers, while heavy materials, such as used motor oil, are virtually worthless. Spreading compounds which enhance distribution of the oil over the water surface increase the effectiveness of oils. When 3% to 5% of Triton B-1956 (Rhome & Haas Company) is added, about 6 gallons of oil are required to cover one acre of water surface as compared with the usual 20 to 50 gallons of oil required without such a spreading agent.

When DDT became available in 1942, the scope of chemical control of mosquito larvae was greatly enlarged. Related chlorinated hydrocarbons, such as lindane, toxaphene, and aldrin, developed since that time, have also been used.

Infra-red photograph with some temporary water areas in foreground indicated by arrows. These are typical breeding places of *Aedes vexans,* a common pest mosquito of South Dakota. Photo by author, Kodak infra-red sheet film, 1/50 sec., f 4.5., altitude 5,000 ft.

DDT in oil solution has been widely employed as a mosquito larvicide. Concentrations of 1% to 5% in fuel oil or kerosene, with or without auxiliary solvents and spreaders, will control mosquito larvae, except where resistance to chlorinated hydrocarbon insecticides has developed. These materials are effective when applied at a rate of 0.05 to 0.5 pounds of DDT per acre, depending on the species, type of water, amount of vegetation, and other factors. Emulsifiable concentrates are also satisfactory when diluted with water to give the required dosage, although they are not recommended where fish and wildlife are involved.

Within recent years, organophosphorus insecticides have been widely used for larviciding operations in mosquito control. These materials have little or no residual action and are thus materials of choice where short insecticide life is desirable to protect wildlife and the public.

Parathion, while somewhat dangerous to use, has been found to be an extremely effective larvicide when applied at dosage rates of approximately 0.01 pound per acre. Malathion, another organophosphorus compound, is effective in somewhat larger dosages and has the advantage of relative non-toxicity to mammals, and is thus safe to use.

Resistance to the organophosphate insecticides has developed among mosquitoes in some parts of the United States. For this reason the designation of any compound as an effective larvicide may be pertinent for only a relatively short time. New compounds are being developed and undoubtedly materials now in vogue will be replaced as the older ones become unreliable.

Mosquito larvae are killed by very small amounts of insecticides, usually measured in parts per million. Since mosquito larvae typical-

Amount of spray to apply per acre to kill mosquito larvae based on 0.25% insecticide concentration*

Gal. of Spray	Pounds per acre desired 0.1 Will Treat Sq. Ft.	0.25 Will Treat Sq. Ft.	0.5 Will Treat Sq. Ft.	1.0 Will Treat Sq. Ft.
1	8,712	3,484	1,742	871
2	17,424	6,968	3,484	1,742
3	26,136	10,452	5,226	2,613
4	34,848	13,936	6,968	3,484
5	43,560	17,424	8,712	4,356
	(1 acre)			(0.1 acre)

*Note: A square acre is approximately 209 feet per side, contains 43,560 square feet, and is about 70 paces (3 feet per pace) square.

ly rest at the surface of water, the insecticide is applied without regard to water depth of the larval breeding place.

The rate of application of the insecticide is then given in terms of pounds per acre, since only the surface is treated.

The preceding table gives examples of the amount of spray material to be applied to known areas to achieve four rates of application. Any amount or area may be figured by using multiples of the values in the table.

Aircraft are employed in many types of mosquito control operations. Bi-planes with a pay load of about 1,000 pounds or 180 gallons, are used chiefly in this work.

Normally, operations are not attempted if wind velocity is over 8 miles per hour. A velocity of 1½ miles per hour is considered ideal if the wind is steady. During periods of very low humidity, spray operations are not attempted because of high evaporation loss.

The rate of plane application is determined by the rate of travel, the gallons per minute delivered at each nozzle and the distance between nozzles. The number of nozzles on the spray boom has no influence on the rate of application per acre if the other factors remain

Equipment for larviciding operations in urban areas, shown here applying insecticide to sewer catchment basins, a common source of *Culex* mosquitoes. (Photo courtesy John Bean Division, FMC Corp., Lansing, Mich.)

Heavy duty mist-blower in use for larviciding. Such machines employ high-velocity air blasts to disperse insecticide, and can be used for adulticiding as well as larviciding. (Photo courtesy John Bean division, FMC Corp., Lansing, Mich.)

constant. The rate of travel is more or less constant for each aircraft as determined by physical limitations and experience. The gallons per minute delivered from each nozzle is controlled by pressure at the nozzle and the size of the orifice. The simplest method of controlling rate per acre consists, therefore, in selecting a nozzle with an orifice of the right size to deliver the desired amount. Manufacturers of spray nozzles provide tables in which the desired gallons per hour and pressure of the spray liquid are used to determine the size of the orifice.

Dosages of chemicals vary from 0.1 pound to about 1 pound per acre for larviciding by air. The following table presents values for dosages of 0.1 pound to 1 pound per acre.

Recent advances in the ultra-low volumn application of aerial sprays have made it possible to apply concentrated forms of insecticides. With slight modifications, application can be made with conventional aerial spray equipment. This type of spraying enables the operator to apply pesticides more efficiently using fewer aircraft hours. The conventional spray noz-

Mosquito Control by Aircraft Based on 5% insecticide solution, plane speed 90 MPH, nozzles spaced at 18 inches

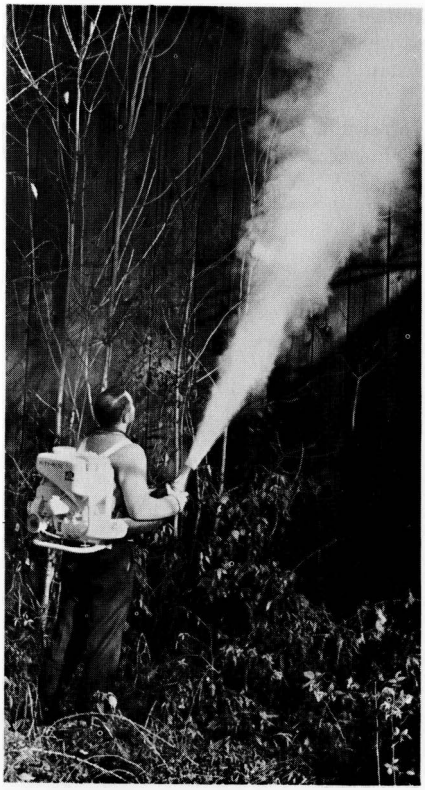
Toxicant pounds per acre	Amount of 5% solution per acre in gallons	Gallons per Hr. per Nozzle
1.0	2.5	40.50
0.5	1.25	20.255
0.4	1.0	16.20
0.3	0.75	12.15
0.2	0.5	0.81
0.1	0.25	0.405

zles are replaced by a rotary atomizer developed by the Plant Pest Control Division, U. S. Department of Agriculture. This attachment produces more-uniform droplets of low volume aerial sprays.

Using this equipment, effective mosquito adulticiding in open areas has been accomplished with applications of 2 to 4 fluid ounces of insecticide concentrate (Malathion LV Concentrate) per acre. The same method has been used effectively for mosquito larvicides with applications ranging from 4 to 8 fluid ounces per acre.

Since insecticides used in larviciding operations vary greatly in physical and chemical characteristics, manufacturers' recommendations found on the label of each insecticide container should be followed carefully.

Portable duster - sprayer in use as adulticiding unit. Such equipment is useful for maintaining mosquito control in limited areas. (Photo courtesy Buffalo Turbine Equipment Co., Gowanda, N. Y.)

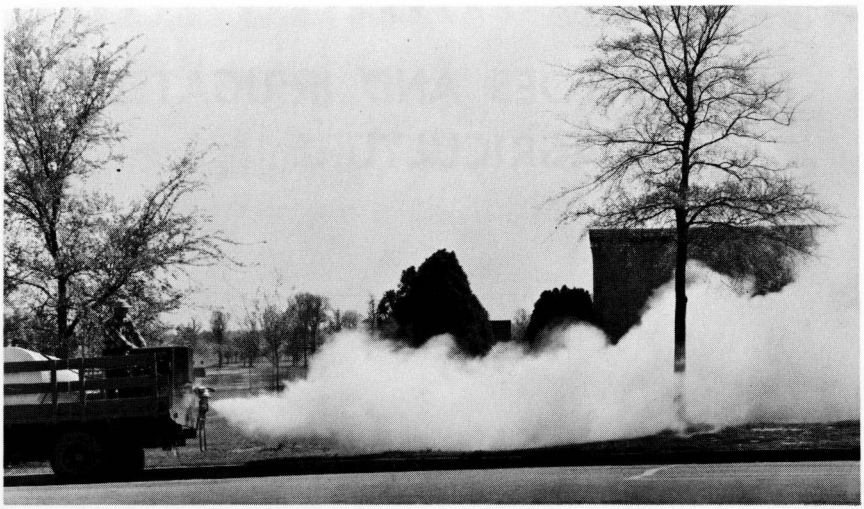


Adulticiding

Killing adult mosquitoes by insecticide applications is perhaps the least efficient and most costly method employed in mosquito control.

Theoretically, the method involves introduction of an insecticide into an air space in the form of droplets which are so small that they will remain suspended in air for a considerable length of time. Even slightly unsatisfactory meteorological conditions will defeat the objective of this type of control.

Since the insecticides employed in this control measure will usually be introduced into the atmosphere around human habitation, the materials employed should be carefully chosen with respect to safety. Materials with long residual life, such as the chlorinated hydrocarbons, should be avoided. Organophosphorus insecticides of low mammalian toxicity, such as Malathion or DDVP, are at present widely used. These materials are usually dispensed by aerosol generating machines. The insecticide manufacturers' recommendations for dilution and application methods should be rigorously followed.



A thermal aerosol generator in use for adulticiding. (Photo courtesy Todd Shipyard Corp., Brooklyn, N. Y.)

Applications of insecticide dusts are effective control measures for permanent water areas. (Photo courtesy H. D. Hudson Co., Chicago, Ill.)

MOSQUITOES AND IRRIGATED AGRICULTURE

Among the many prolific sources of mosquitoes in the western United States, irrigated lands unquestionably take first rank. Under natural conditions, mosquito production in arid and semiarid regions is seasonal and occurs principally in the spring and early summer at the time of the annual spring snow melt. This natural mosquito production season normally lasts only 1 or 2 months. In contrast, irrigation causes sustained mosquito production throughout the spring, summer, and early fall thus extending the buildup for a period of 4 to 5 months. It is well known that wherever irrigation is developed and becomes established, mosquito populations increase.

In general, reservoirs constructed for storage of irrigation water do not present serious mosquito problems. Seasonal drawdown usually occurs with the release of water for irrigation purposes. Irrigation drawdown keeps the water margin below encroaching vegetation resulting in a clean shore line which is unfavorable for mosquito production.

Conditions favorable for mosquito production do result when side pools or depressions are not connected with the main body of water, or when the water must be held in the marginal vegetation zone. Adequate shore line maintenance (removal of vegetative growth and draining of isolated pockets) will effectively eliminate these problems.

Irrigation canal seepage is responsible for a large amount of mosquito production. Sometimes as much as 40% of the water taken into the canals is lost in conveyance. Leakage may fill borrow pits and ditches with resultant mosquito production. Such problems can be remedied by the rehabilitation of existing distribution canals and by employing improved design and construction methods in future projects.

In some cases, where canals cross low areas, it has been necessary to excavate borrow pits along or near the canal to build up retaining levees. These borrow pits usually become permanently watered areas with aquatic vegetation. Whenever possible borrow pits of this type should be self-draining.

The greatest production of mosquitoes associated with irrigation occurs at the place where water is used rather than in the reservoir and main distribution systems. This mosquito production is mainly due to water wastage within the irrigated field or on the outside. Irrigated forage crop fields are of major importance in "within field" mosquito production. Mosquito producing surface water collections are caused by the absence or inadequacy of the drainage system, inadequate grading and leveling of the fields, application of water beyond crop demands, faulty design or inadequate maintenance of irrigation structures.

Although arid region farmers have been slow to recognize the necessity for drainage of irrigated lands, experience has demonstrated that nearly every irrigated area eventually requires a drainage system. An irrigation system should not be laid out without provision for drainage. Adding a drainage system which has not been planned beforehand as part of the irrigation scheme is by far more expensive.

Improper slope preparation results in water-holding depressions in fields or surface run off from the fields due to the difficulty of applying water properly. Irrigation water is wasted when it is applied in excess of crop demands. Many irrigators feel that if a little water is good a lot more is even better. In many cases water is turned into the field and left running too long

Irrigation waste water accumulates in low areas of poorly graded forage-crop fields. Note the water-tolerant weed growth which has replaced crop plants.

because of lack of attention. Excessive use of water on the land aggravates seepage and water logging problems, resulting in replacement of desirable forage crop plants by water tolerant weeds.

Irrigation of pastures and native hay meadows is often responsible for production of tremendous numbers of pest mosquitoes. As many as 20 million mosquito eggs may be found per acre of irrigated pasture (USPHS, 1951).

Aedes nigromaculis and *Aedes dorsalis* are extremely well adapted to the habitats offered by irrigation. These species are already among the most common mosquitoes encountered in western South Dakota. As irrigated agriculture develops within this section of the state, the production of these two species may well reach unendurable levels as has been the case in other irrigated areas. In California, for example, over $2\frac{1}{2}$ million is spent annually for recurrent mosquito killing activities by organized mosquito abatement districts alone. The most extensive and intensive mosquito problems in that state are associated with irrigation and the production of *Aedes nigromaculis* and *Aedes dorsalis*.

MOSQUITO CONTROL ENABLING LEGISLATION

Mosquitoes are often produced from aquatic habitats on private property or outside the area which is to be protected from mosquitoes. Thus it is often necessary to direct control operations to situations which are not included within the city or area which provides financial support for the control activity.

Many states have found it necessary to enable control activities by laws or ordinances which provide financial support and a legal basis for eliminating or treating breeding places on private land.

The enabling legislation may be grouped with respect to the specific authority as follows:

Local autonomous districts: The program is initiated, directed and financed at the local level without approval from a state authority.

State supervised districts: The program is initiated, directed, and financed at the local level but state approval of plans is required prior to execution.

State sanitary districts: A district already established under the state sanitary district law may be authorized to engage in mosquito control.

Ministerial function: Statutes expressly provide for control activities and specific authority is delegated to a government agency for execution.

Since South Dakota has no law enabling the support or operation of mosquito control activities, the provisions necessary must be provided at the local level.

Many cities in South Dakota presently engage in some kind of mosquito control, mostly adulticiding, without any legal basis. Under these circumstances, operations can be stopped by any citizen who can show cause (such as some respiratory ailment aggravated by aerosols) and who is persistent enough to obtain a court order.

Financial support for mosquito abatement may be gained in a variety of ways. Most commonly, a tax is assessed on real property. Property taxes are seldom the best source of income where land values are low and where large areas may need treatment.

Cities frequently levy special taxes for control work or add small taxes to existing levies such as sewer or water taxes.

Some states offer financial assistance to abatement districts operating on the local level. Such assistance usually involves reasonable restriction on the use of such funds.

IDENTIFICATION OF MOSQUITO SPECIES

Diagnosis of mosquitoes

An adult of the family Culicidae, to which the mosquitoes belong, can be differentiated from other two-winged flies by these characters: (1) an elongate proboscis several times as long as the head, (2) antennae much longer than the head and composed of many small, well separated segments, and (3) wings with an arrangement of veins as shown in figure 1.

Larvae of the Culicidae can be differentiated from other aquatic free-swimming insect larvae by this combination of characters: (1) absence of legs; (2) head large and with a hard covering; (3) thorax large and wider than the abdomen; (4) the respiratory system opening dorsally on the next to last segment of the abdomen; (5) four blade-like "gills" extending posteriorly from the end of the last abdominal segment. In many species the larvae have a long or stout air tube (siphon).

The pupae are compact, roughly comma-shaped, and extremely active. When disturbed they will react with vigorous abdominal movements which result in a tumbling motion. After a brief period they will rise to the surface of the water and come to rest with the twin breathing openings, called trumpets, piercing the surface film of water.

Eggs of mosquitoes are black or gray in color, spindle-shaped, and each not more than 1 mm. long, (1 millimeter is about the size of this hyphen "-"). The eggs of *Anopheles* mosquitoes are characterized by hollow expansions on each side which are termed floats.

Members of the family Culicidae are frequently confused with midges or the closely related family Chaoboridae. In the Chaoboridae the adult does not have a proboscis and neither male nor female bites. In the Culicidae the adult has a proboscis. The male does not bite but sucks nectar and free water. The female sucks either juices of plants or blood of vertebrates through a group of fine slender stylets housed within the proboscis.

Knowledge of the life history and characteristic breeding habits of mosquito species is essential to conduct effective controls. This is the reason it is necessary to know

species composition of any population of mosquitoes that is to be controlled.

A knowledge of mosquito anatomy is needed to identify different genera and species. The principal distinguishing characters are the shape, size, coloration and scaling of the different body parts.

A binocular dissecting microscope providing magnifications up to about 85x is necessary for the examination of identifying characters.

For examining larval parts and mounts of male genitalia, a compound microscope with a magnification of 400x is needed.

After some experience, one can identify the more common species in a given locality with the aid of a good hand lens giving a magnification of 10x or 15x.

Misidentification of mosquitoes may cause serious confusion. Inexperienced workers will find it helpful to have on hand for comparison a few specimens that have been correctly identified. Specimens may be sent to a specialist through any agricultural extension service office with the request that they be named and returned.

It cannot be emphasized too strongly that anyone engaged in the study of mosquitoes must make every effort to secure larvae and both sexes of the adults in good condition. The fourth stage larvae, the male genitalia, and the undamaged female greatly simplify the task of identification.

Collection and preservation of specimens

A white enamel dipper attached to a cane or smooth stick is the most convenient implement for collecting larvae. A little practice is needed before being able to dip successfully into a larval breeding site and recover specimens. Because larvae are easily frightened, they may disappear below the water surface and out of range of the dipper.

Upon selecting a spot to be sampled, it is best to first wait a full minute, then quickly skim the surface of the water without allowing the water to flow over the back edge of the dipper. Transfer the larvae from the dipper to a collecting jar with an eye dropper, the tip of which has been broken off to make an enlarged mouth.

When any collection is made, the date, locality, and other pertinent information should be recorded.

Only the last or fourth larval instar is suitable for identification. These may be preserved in 70% alcohol while awaiting permanent preparations.

To make permanent slide mounts of the larvae, they should be placed in 70% alcohol for several hours, then pierced with a needle, placed in cellosolve for 30 minutes, and finally placed in balsam on a clean microscope slide. Cover with a coverslip and allow to dry. Mounts of the male genitalia can be made in the same manner.

If the larvae are to be mailed, place them in a small vial which is completely filled with 70% alcohol, seal and pack carefully for shipment.

Small cardboard pillboxes are convenient for holding or shipping

specimens of adult mosquitoes. Place two pieces of soft tissue paper between two layers of cotton and the mosquitoes between the layers of the tissue. Without the tissue paper the tarsal claws may cling to the strands of cotton and become broken when removed. Damaged or rubbed adult specimens are usually unsatisfactory for identification.

Specimens of adults that are to be retained in permanent collections are best mounted on minuten pins or on paper points. When employing minuten pins, the pin should be thrust through the underside of the thorax of the mosquito but not protruding through the mesonotum. Paper points may be bent slightly at the tip, and the mosquito attached thereto at one side of the thorax using clear fingernail polish as an adhesive.

All specimens should be carefully labled with respect to their origin and date of capture. Take care to protect the stored specimens from insect pests and dampness. Paradichlorobenzene (moth balls) should be placed in the storage container to protect the specimens from such damage.

Adult mosquitoes that are biting or resting on walls may be captured by using a chloroform tube. A chloroform tube is made by placing a number of rubber bands, cut into small pieces, in the bottom of a widemouth test tube or any small

This roadside borrow pit may be alternately flooded and dry throughout the spring and summer. A variety of mosquito larvae may be collected from such breeding places.

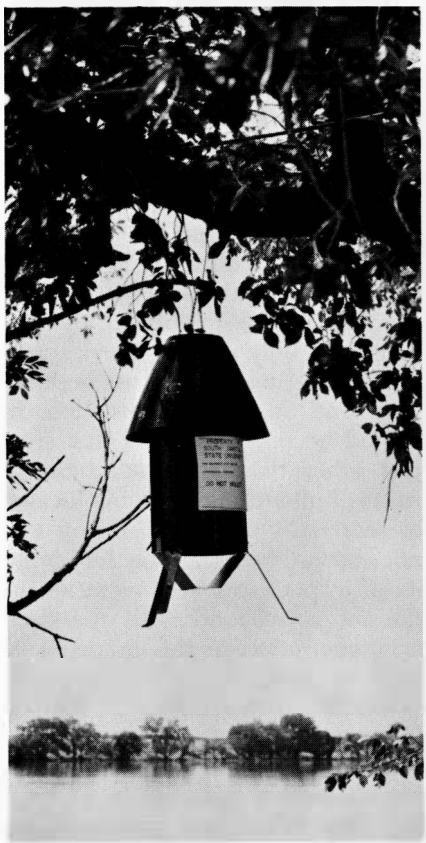
bottle having the same diameter throughout its length. The bands are saturated with chloroform, a small piece of cotton is placed on top, and the whole is covered with a disc of blotting paper cut to fit down over the cotton. The tube should be kept tightly corked. By moving the tube slowly and uniformly toward a resting or biting mosquito, the insect can be captured within the bore of the tube.

Mosquitoes may also be taken in their resting places with an aspirator or a sweeping net. Adults may be captured by sweeping vegetation. A rather light nylon net is preferable so that the mosquitoes will not be badly damaged.

One of the most widely used methods of collecting adults is by means of a light trap. The trap consists of a light suspended above a funnel leading to a killing jar or cage. A fan is often directed down into the killing jar to blow the mosquitoes in and prevent them from flying out. Light traps are useful because they catch large numbers of mosquitoes, both male and female, and require no effort. A standard mosquito light trap is available commercially. However, as a method of sampling populations, light traps are of limited value since some mosquitoes are more highly attracted to light than others.

Perfect specimens of adult mosquitoes may be obtained by rearing larvae through the pupal stage to adults. All that is needed are a few pans for rearing larvae, food for the larvae, some widemouth pipettes for handling the immature stages and a cage for adults. The larvae can be fed small amounts of dog biscuit, dried alfalfa pellets or a similar material. Aeration of the pans will help prevent excessive bacterial growth. The larvae should pupate in a few days at which time they are pipetted into clean water and put in the cage. About 2 days later the adults emerge. These should be allowed to "harden" for several hours before they are captured and preserved.

A light trap installed for collection of adult mosquitoes.



KEYS TO THE GENERA AND SPECIES OF MOSQUITOES IN SOUTH DAKOTA

Identification and classification of mosquitoes require the highest type of special training and the resources of a large collection of insects. Literally hundreds of species of mosquitoes are found in the United States so that the difficulties of accurate identification are apparent at once. Lest the beginner be unduly discouraged, it may be pointed out that in South Dakota the problem is simplified by the fact that only a few species are ever numerous enough to become pests and thus attract attention. It should be borne in mind that species other than those emphasized in this bulletin may become locally or seasonally abundant. If you are not absolutely certain of the identity of a species, or when specimens do not correspond with the descriptions found in this guide, it is well to send the specimen to a specialist in this group of insects for accurate identification.

Compare your specimens with the characters given in the following keys which are presented as alternative couplets. Those unfamiliar with the characters of mosquitoes used in their identification should refer to the accompanying diagrams. Each specimen should be carefully compared with the descriptions which follow.

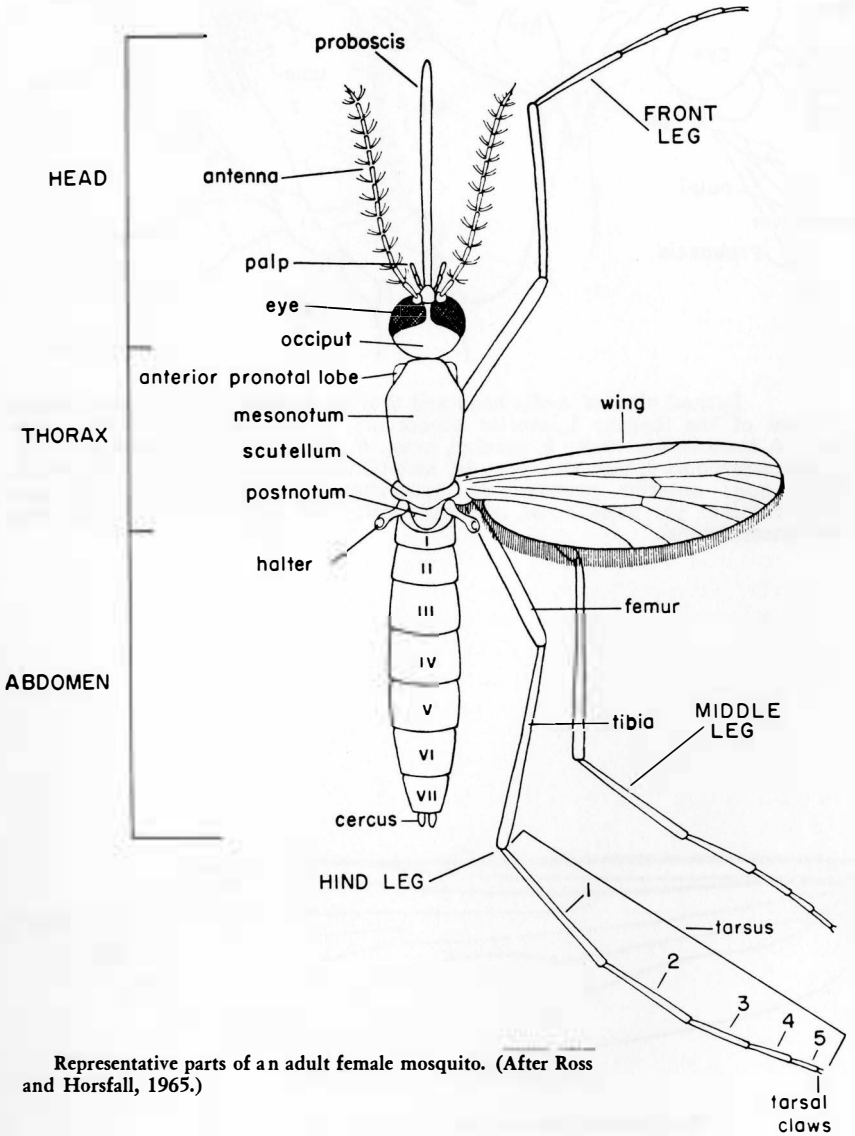
KEY TO GENERA

Adult Females

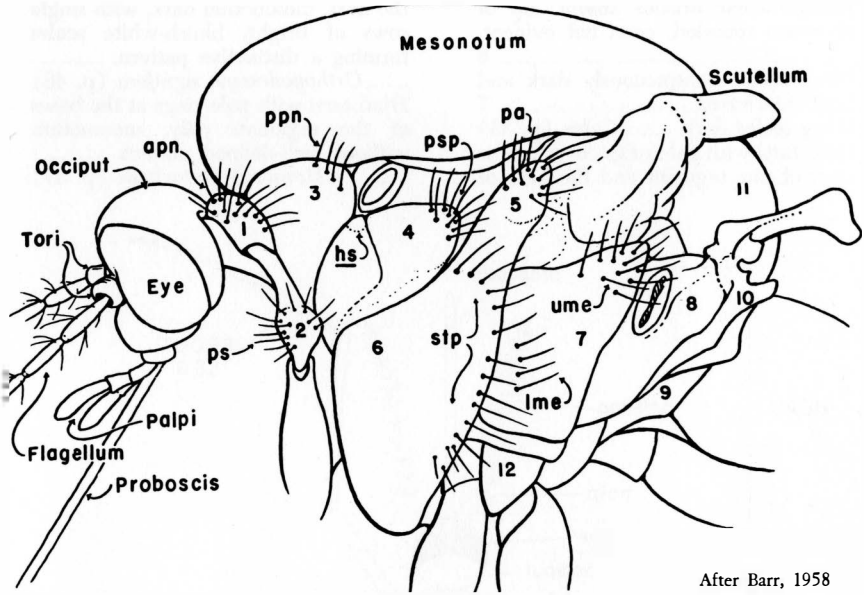
1. Maxillary palpi about as long as proboscis; scutellum rounded; thorax and abdomen with few or no scales. ..... *Anopheles* (p. 28)
   Maxillary palpi less than half as long as proboscis; scutellum tri-lobed, a tuft of bristles on each lobe; thorax and abdomen densely covered with scales. 2
2. Wings with cell R2 (second submarginal) not half as long as its petiole with lines of brilliant blue scales on head, thorax and wings. ..... *Uranotaenia sapphirina* (p. 42)
   Wings with cell R2 at least as long as its petiole; without brilliant blue scales. 3
3. Spiracular bristles present. 4
   Spiracular bristles absent. 5
4. Postspiracular bristles present; tip of abdomen narrow, pointed, cerci evident. ..... *Psorophora* (p. 32)
   Postspiracular bristles absent; tip of abdomen rounded, cerci concealed. ..... *Culiseta* (p. 32)
5. Postspiracular bristles present, tip of abdomen narrow, pointed cerci evident. ..... *Aedes* (p. 35)

Postspiracular bristles absent; tip of abdomen rounded, cerci not evident. 6

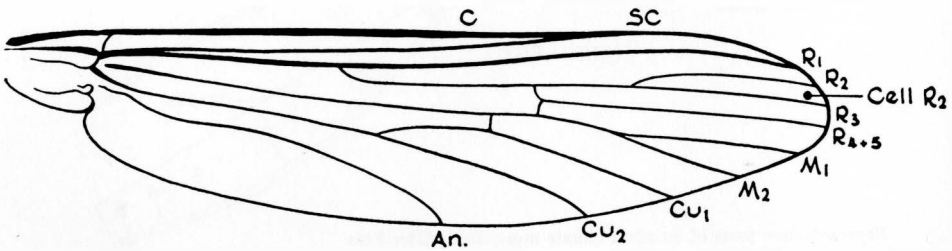
6. Wing scales conspicuously dark and light intermixed. 7
   Wing scales dark. ..... *Culex* (p. 33)
7. Hind tarsi with pale rings covering the apex of one segment and the base of the next; mesonotum dark, with single rows of bright, bluish-white scales forming a distinctive pattern. ..... *Orthopodomyia signifera* (p. 46)
   Hind tarsi with pale rings at the bases of the segments only; mesonotum without well-defined pattern. ..... *Mansonia perturbans* (p. 47)



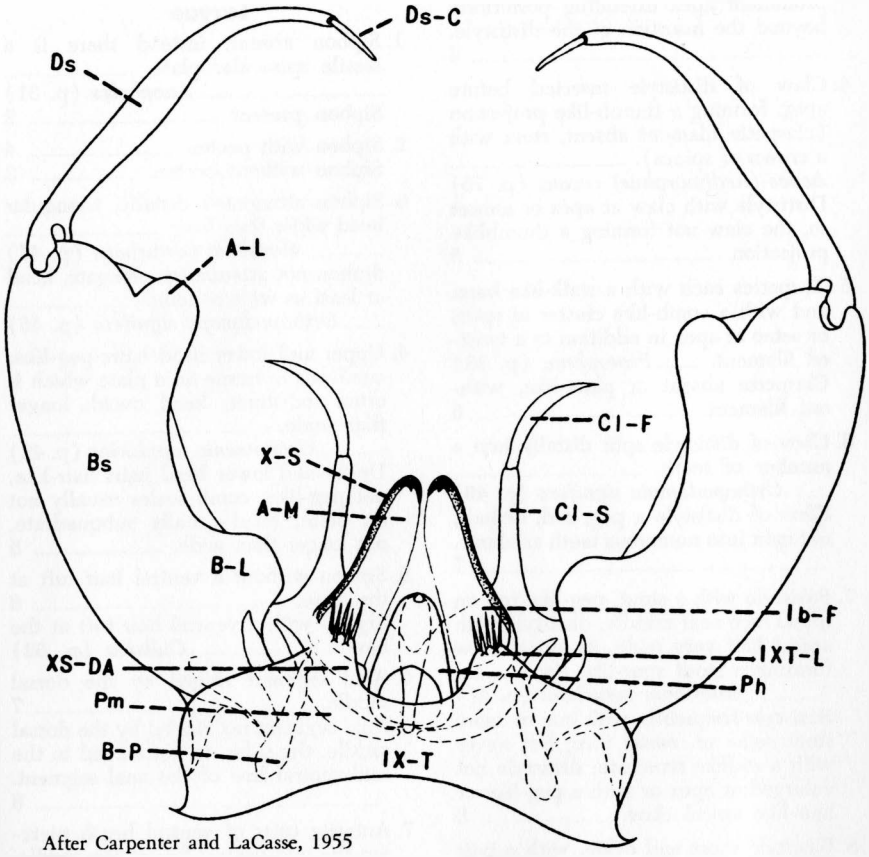
Representative parts of an adult female mosquito. (After Ross and Horsfall, 1965.)



Lateral view of *Aedes* head and thorax. *hs*, Hypostigial spot of scales. Sclerites of the thorax: 1,anterior pronotum; 2, proepisternum; 3, postpronotum; 4, mesanepisternum; 5, prealar, area; 6, sternopleuron; 7, mesepimeron; 8, metepisternum; 9, metasternum; 10, metepimeron; 11, postnotum; 12, meron. Setae: *apn;* anterior pronotal; *ps*, proepisternal; *ppn*, postpronotal; *psp*, postspiracular; *pa*, prealar; *st*, sternopleural; *ume*, upper mesepimeral; *lme*, lower mesepimeral.



Wing venation Comstock-Needham system. (After Barr, 1958).



After Carpenter and LaCasse, 1955

Diagram of male terminalia of *Aedes*. A-L, Apical lobe. A-M, Anal membrane. B-L, Basal lobe. B-P, Basal plate. Bs, Basistyle. Cl-F, Claspette filament. Cl-S, Claspette stem. Ds, Dististyle. Ds-C, Dististyle claw. Ib-F, Interbasal fold. IX-T, Ninth tergite. IXT-L, Lobe of ninth tergite. Ph, Phallosome. Pm, Paramere. X-S, Tenth sternite. XS-DA, Dorsal arm of tenth sternite.

Male Terminalia

1. A pair of subcylindrical arms (claspettes) arising from dorsum of capsule, each tipped with a sclerotized filament. ..... *Aedes* (p. 36)
   Claspettes absent or not as above; if a filament is present, there is a cluster of setae associated with it. 2
2. Basistyle with an apico-mesal shoulder (subapical lobe) bearing a cluster of specialized, blade-like or spatulate spines, which are frequently complex in structure; 10th sternum with a dense crown of spines... *Culex* (p. 34)
   Basistyle either without a sub-apical lobe or the lobe bearing only narrow spines; tenth sternum variable. 3
3. Apex of basistyle continuing as a pointed lobe beyond insertion of the dististyle (dististyle furcate at base, the longer portion again shallowly furcate at apex; without a large spine [claw] at apex of dististyle) .... *Aedes (Aedes) cinereus* (p. 70)
   Dististyle inserted approximately at apex of basistyle; basistyle without

prominent apex extending posteriorly beyond the insertion of the dististyle. 4

4. Claw of dististyle inserted before apex, forming a thumb-like projection (claspette filament absent, stem with a crown of spines). ..... *Aedes (Aedimorphus) vexans* (p. 70)
Dististyle with claw at apex or almost so, the claw not forming a thumblike projection. 5

5. Claspettes each with a stalk-like base, and with a comb-like cluster of spurs or setae at apex in addition to a twisted filament. ..... *Psorophora* (p. 33)
Claspette absent or plate-like, without filament. 6

6. Claw of dististyle split distally into a number of teeth. ..... *Orthopodomyia signifera* (p. 46)
Claw of dististyle a peg, rod, or hair, not split into numerous teeth as above. 7

7. Basistyle with a stout, peg-like rod on mesal face near middle; dististyle with apical half very wide, its apical claw forming a stout spur-like tip. ..... *Mansonia peturbans* (p. 47)
Basistyle frequently with one or more stout setae on mesal face, but never with a rodlike structure; dististyle not enlarged at apex or with a peg-like or hair-like apical claw. 8

8. Basistyle short and ovate, with a pair of large, stout spines dominating the ventral aspect of the basal portion; phallosome usually with leaflets; lateral of the phallosome are claspette lobes which bear a series of spines. ..... *Anopheles* (p. 30)
Basistyle either long and slender or without a pair of isolated stout spines on basal portion of ventral aspect; phallosome without leaflets; claspette lobes absent. 9

9. Ninth tergum a large, bilobed, sclerotized plate which is nearly as long as the basistyle; lobes of ninth tergum without setae; basistyle very short, rounded dististyle short, wide. ..... *Uranotaenia sapphirina* (p. 42)
Ninth tergum a much narrower plate; lobes with many large spines or setae; basistyle linear; dististyle long, rather evenly tapered. ..... *Culiseta* (p. 32)

Larvae

1. Siphon absent, instead there is a sessile spiracular plate. ..... *Anopheles* (p. 31)
Siphon present 2

2. Siphon with pecten. 4
Siphon without pecten. 3

3. Siphon attenuated distally, triangular head wider than long. ..... *Mansonia perturbans* (p. 47)
Siphon not attenuated, elongate, head at least as wide as long. ..... *Orthopodomyia signifera* (p. 46)

4. Upper and lower head hairs peg-like; comb scales borne on a plate which is often indistinct; head ovoid, longer than wide. ..... *Uranotaenia sapphirina* (p. 42)
Upper and lower head hairs hair-like, not peg-like; comb scales usually not on plate; head usually subquadrate, not longer than wide. 5

5. Siphon without a ventral hair tuft at the base. 6
Siphon with a ventral hair tuft at the base. ..... *Culiseta* (p. 32)

6. Anal segment ringed by the dorsal saddle. 7
Anal segment not ringed by the dorsal saddle, the sides do not extend to the mid-ventral line of the anal segment. 8

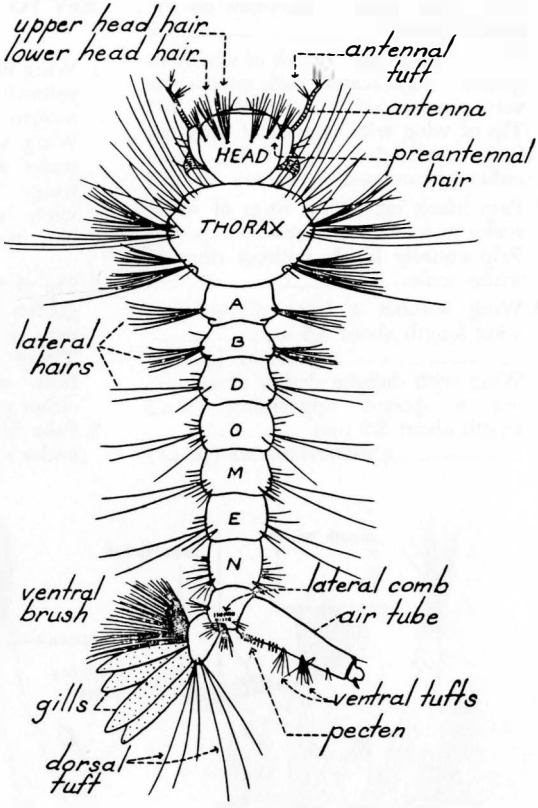
7. Anterior tufts of ventral brush piercing the mid-ventral line of the saddle. ..... *Psorophora* (p. 33)
Anterior tufts of ventral brush posterior to, not piercing, the saddle which encircles the anal segment. 8

8. Many hair tufts or hairs on the siphon, none placed between the spines of the pecten. ..... *Culex* (p. 34)
A single pair of large hair tufts on the siphon, usually close to or associated with the pecten. ..... *Aedes* (p. 37)

KEY TO SPECIES OF ANOPHELES (FEMALES)

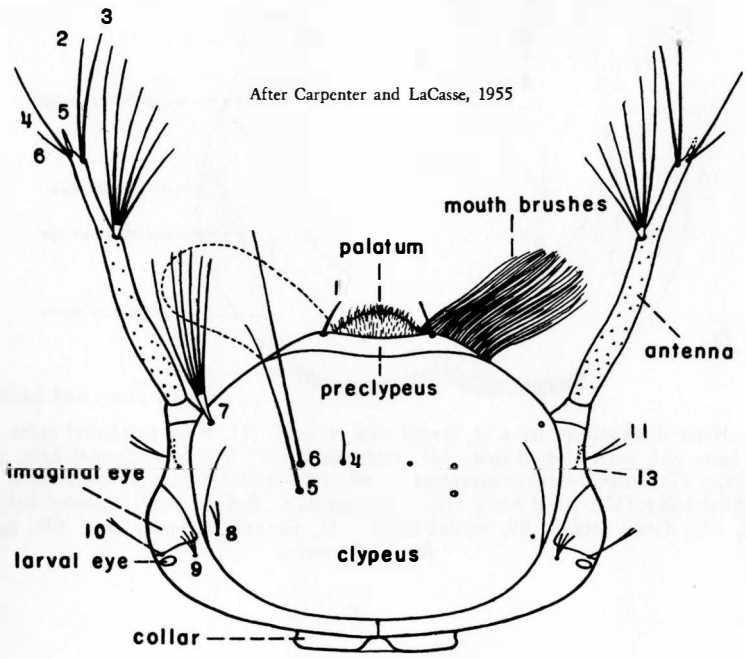
1. Wing with spots or bars of white or yellowish-white scales along anterior margin and anal vein; costa with an apical white spot and usually also a preapical spot or bar; palp black, unbanded. ..... *punctipennis* (p. 40)
Wing without any pale patches, all

Representative parts of a Culicine larva. (After Ross and Horsfall, 1965).



Head of Culicine larva (dorsal view). Antenna: (1) antennal tuft; (2), inner subapical hair; (3), outer subapical hair; (4), terminal antennal hair; (5), papilla; (6), fingerlike process. Head: (1), inner preclypeal spine; (4) postclypeal hair; (5), upper frontal hair; (6), lower frontal hair; (7), preantennal hair; (8), sutural hair; (9), transsutural hair; (10), supraorbital hair; (11), basal hair; (13), subbasal hair.

After Carpenter and LaCasse, 1955

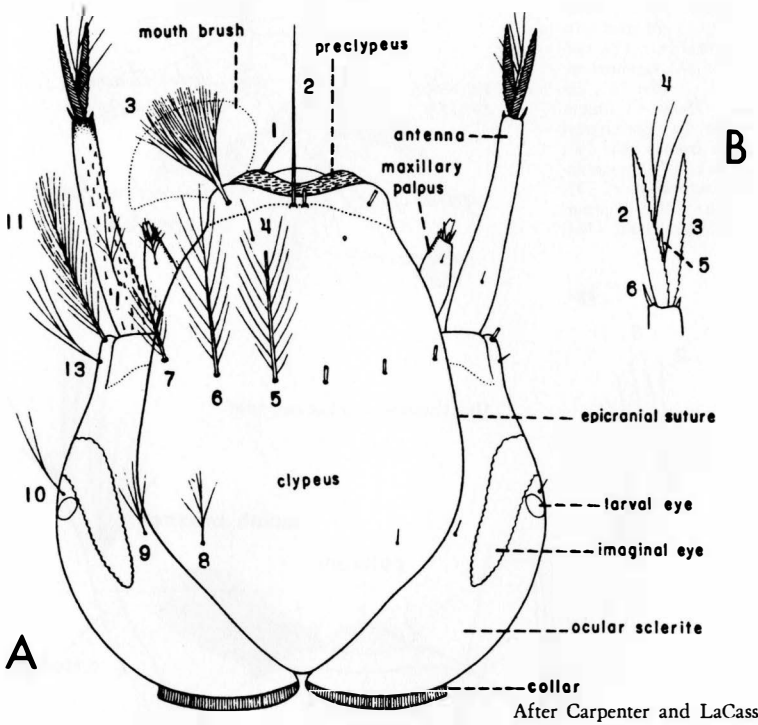


scales dark except sometimes on the apical fringe. 2

2. Tip of wing with a patch of silvery or golden fringe scales; dark wing spots very pronounced. ..... *earlei* (p. 39)
   Tip of wing with fringe not different from remainder; dark wing spots either pronounced or obscure. 3
3. Palp black except for rings of white scales at joints. ..... *walkeri* (p. 42)
   Palp entirely black, without rings of white scales. 4
4. Wing without a trace of spotting; wing length about 3.5 mm. ..... *barberi* (p. 39)
   Wing with definite darker areas, giving a spotted appearance; wing length about 5.0 mm. ..... *quadrimaculatus* (p. 41)

KEY TO SPECIES OF ANOPHELES (MALES)

1. Wing with 1 or more bars of white or yellowish white scales along anterior margin and anal vein. 2
   Wing without any pale patches, all scales dark except sometimes apical fringe scales; costa with an apical white bar and usually also a preapical bar; palp black, unbanded. ..... *punctipennis* (p. 40)
2. Tip of wing with a patch of silvery or golden fringe scales; dark wing spots very pronounced. ..... *earlei* (p. 39)
   Tip of wing with fringe not different from remainder; dark wing spots either pronounced or obscure. 3
3. Palp black but with rings of white scales at joints. ..... *walkeri* (p. 42)



After Carpenter and LaCasse, 1955

Head of *Anopheles* larva. *A,* Dorsal view of head. (1), inner preclypeal spine; (2), inner clypeal hair; (3), outer clypeal hair; (4), postclypeal hair; (5), inner frontal hair; (6), middle frontal hair; (7), outer frontal or preantennal hair; (8), sutural hair; (9), transsutural hair; (10), supraorbital hair; (11), basal hair; (13), subbasal hair. *Antenna:* (1), antennal hair. *B,* Tip of antenna. (2), dorsal sabre; (3), ventral sabre; (4), terminal antennal hair; (5), papilla; (6), fingerlike process.

Palp entirely black and without white rings 4

4. Phallosome without leaflets at apex; wing length under 3.5 mm. ..... *barberi* (p. 39)
   Phallosome with a cluster of leaflets at apex; wing length over 3.5 mm. ..... *quadrimaculatus* (p. 41)

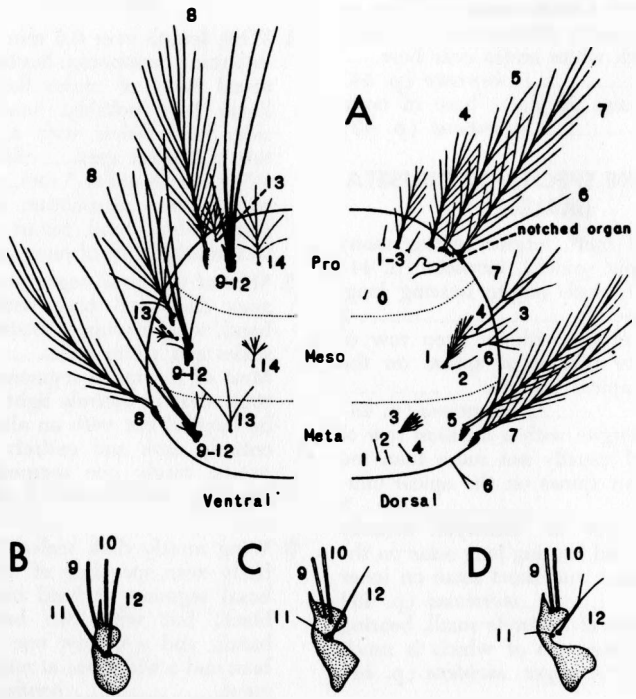
KEY TO SPECIES OF ANOPHELES (LARVAE)

1. Head hairs 5, 6 and 7 short and simple; lateral body hairs with only short feathering. ..... *barberi* (p. 39)
   Head hairs 5, 6 and 7 long and plumose; lateral hairs of thorax and first 3 abdominal segments with long feathering. 2

2. Head hair 3 densely plumose, fan-shaped from base, with only an inconspicuous basal stalk; head hair 2 sometimes feathered at tip; prothoracic hair 1 sometimes branched. ..... *walkeri* (p. 42)
   Head hair 3 less densely plumose than that above, the fan-shaped portion having a long basal stalk; head hair 2 never feathered at tip; prothoracic hair 1 rarely branched. 3

3. Hair 1 of the second and following abdominal segments, having each branch flattened, the whole hair appearing like a short spread fan. ..... *quadrimaculatus* (p. 41)
   Hair 1 of second abdominal segment with each branch nearly hair-like, fan-

After Carpenter and LaCasse, 1955



Thorax of *Anopheles* larva. *A*, Ventral and dorsal views of prothorax, mesothorax and metathorax. *Prothorax:* 1–3, submedian or shoulder hairs. 4–7, dorsal hairs. 8, dorsolateral hair. 9–12, prothoracic pleural hairs. 13, ventrolateral hair. 14, median ventral hair. *Mesothorax:* 1–7, dorsal hairs. 8, dorsolateral hair. 9–12, mesothoracic pleural hairs. 13, ventrolateral hair. 14, median ventral hair. *Metathorax:* 1–2, dorsal hairs. 3, metathoracic palmate hair. 4–7, dorsal hairs. 8, dorsolateral hair. 9–12, metathoracic pleural hairs. 13, median ventral hair. *B*, *C*, and *D*, Bases of pleural hairs.

like hairs beginning on third abdominal segment. 4

4. Bases of the two head hairs 2 wide apart. ..... *quadrimaculatus* (p. 41)
   Bases of the two head hairs 2 close ... 5
5. Head hair 2 always simple. ..... *punctipennis* (p. 40)
   At least one of the two head hairs 2 usually with a conspicuous branch. ..... *earlei* (p. 39)

KEY TO THE SPECIES OF CULISETA (FEMALES)

1. Hind tarsi with pale basal rings, narrow in some species. 2
   Hind tarsi entirely dark. 3
2. Wings with dense patches of dark scales. ..... *incidens* (p. 44)
   Wings without dark patches, uniformly scaled. ..... *morsitans* (p. 45)
3. Wing with mixed dark and white scales on costa, subcosta and vein R1; costa with white scales near base. ..... *inornata* (p. 44)
   Wing scales all dark; base of costa dark. ..... *impatiens* (p. 43)

KEY TO THE SPECIES OF CULISETA (MALES)

1. Lobes of ninth tergite bearing many short, stout spines. ..... *inornata* (p. 44)
   Lobes of ninth tergite bearing long, slender setae. 2
2. Eighth tergite with an even row of twenty to fifty stout spines on the median apical margin. ..... *impatiens* (p. 43)
   Eighth tergite with a medium row or clump of usually not more than ten short stout spines on the apical margin. 3
3. Apical lobe of basistyle broadly rounded and bearing long setae on the outer aspect and short setae on inner aspect. ..... *morsitans* (p. 45)
   Apical lobe of basistyle small, bearing several setae, one of which is much longer and stronger. ..... *incidens* (p. 44)

KEY TO THE SPECIES OF CULISETA (LARVAE)

1. Upper frontal head hair 5 and lower frontal head hair similar in size and number of branches. ..... *impatiens* (p. 43)
   Lower frontal head hair 6 with fewer branches and slightly longer than upper frontal head hair 5. 2
2. Lateral hair of anal segment as long or longer than the saddle. ..... *inornata* (p. 44)
   Lateral hair of anal segment considerably shorter than the saddle. 3
3. Ventral brush with six or seven precratal tufts; antenna curved; antennal tuft inserted beyond the middle. ..... *morsitans* (p. 45)
   Ventral brush of the anal segment with only one or none of the precratal tufts piercing the saddle; antenna not prominently spined or pigmented, tuft near the middle. ..... *incidens* (p. 44)

KEY TO SPECIES OF PSOROPHORA (FEMALES)

1. Wing length over 6.5 mm., usually 7 to 8 mm.; mesonotum having a narrow mesal band of scales flanked by a linear bare polished band on each side; hind femur with a prominent tuft of hairs at apex. ..... *ciliata* (p. 48)
   Wing length under 5 mm., usually 3.5 to 4.5 mm.; mesonotum with entire area scaled; hind femur without a well-marked tuft of hairs at apex. ... 2
2. Most of the tarsal segments each with apex dark and base with a white band, wing having a mixture of dark scales and white scales. 3
   Most of the tarsal segments each entirely dark or entirely light; a leg may be banded but with an alternation of entirely dark and entirely light segments; rarely one segment may be banded; wing having all dark scales. 4
3. Wing mostly dark scaled but with a fairly even speckling of white scales; basal segment of hind tarsus nearly black, but with two bright white bands, and a narrow one at extreme base and a wider one at middle of segment. ..... *confinnis* (p. 51)
   Wing with white scales grouped into definite lines or patches on some veins; anal vein white scaled apically. ..... *signipennis* (p. 51)
4. Mesonotum golden scaled over its entire area. ..... *ferox* (p. 48)
   Mesonotum with mesal half black

scaled, lateral portions white scaled, scales of the two colors forming longitudinal bands. 5

5. Apex of femur, or "knee," with a narrow white band. ..... *horrida* (p. 49)
Apex of femur dark, without a band. ..... *longipalpis* (p. 50)

KEY TO SPECIES OF PSOROPHORA (MALES)

1. Dististyle narrow and sinuate, with a mesal row of bristles. ..... *ciliata* (p. 48)
Dististyle expanded near or beyond middle, without mesal row of bristles. 2

2. Apical portion of claspette having two long slender filaments, each tipped with a long curved spine. ..... *longipalpis* (p. 50)
Apical portion of claspette without such filaments. 3

3. Apex of claspette with a series of simple setae or hairs and two flattened contorted leaflets at lateral corner. .. 4
Apex of claspette without contorted leaflets, at most with scales and thickened hairs. 5

4. Mesonotum golden scaled over its entire area. ..... *ferox* (p. 48)
Mesonotum with mesal half black scaled, lateral portions white scaled, the two colors forming longitudinal bands. ..... *horrida* (p. 49)

5. Claspette with about five or six seta-like filaments, on crown. ..... *signipennis* (p. 51)
Apex of claspette with a series of only five to eight long thickened hairs. ..... *confinnis* (p. 51)

KEY TO SPECIES OF PSOROPHORA (LARVAE)

1. Antenna short, slender, and without definite tufts; large predacious larvae. ..... *ciliata* (p. 48)
Antenna long, stout, and with definite tufts; small to fairly large larvae which feed on microorganisms. 2

2. Head hairs 5 and 6 multiple. ..... *confinnis* (p. 51)
Head hairs 5 and 6 double or triple. 3

3. Upper frontal and lower frontal hairs 5 and 6 with one or more hairs single; antennal and preantennal tufts strongly multiple. ..... *signipennis* (p. 51)
Upper frontal head hair 5 double, lower frontal 6 double or triple. 4

4. Antennae distinctly longer than the head. 5
Antennae about as long as the head; lower frontal head hair 6 reaching near the base of the antenna. ..... *horrida* (p. 49)

5. Head hairs 5 and 6 each having branches of nearly equal length. ..... *ferox* (p. 48)
Head hairs 5 and 6 each having branches of markedly different lengths. ..... *longipalpis* (p. 50)

KEY TO SPECIES OF CULEX (FEMALES)

1. Proboscis and hind tarsi with white bands; mesonotum with white lines. ..... *tarsalis* (p. 75)
Proboscis and hind tarsi entirely dark; mesonotum may have pale dots but without white lines on central portion. 2

2. Dorsum of abdomen with pale, apical bands or apical, lateral spots on some of the terga, without pale basal bands. ..... *territans* (p. 76)
Dorsum of abdomen with pale basal bands but without apical ones. 3

3. Wing scales on R2 and R3 not noticeably broader than those on Rs; occiput with such broad scales along margin of eyes and on sides. ..... *erraticus* (p. 78)
Wing scales on R2 and R3 not noticeably broader than those on Rs; occiput without such broad scales. 4

4. Abdominal terga with dingy basal bands of yellowish or brownish scales, the bands usually irregular and narrow. ..... *salinarius* (p. 74)
Abdominal terga with bright and conspicuous basal bands of white scales, the central bands wide. 5

5. Mesonotum usually with a pair of central pale spots..... *restuans* (p. 74)
Mesonotum without pale spots. ..... *pipiens* (p. 71)

KEY TO SPECIES OF CULEX (MALES)

1. Ninth tergal lobes large, oval, oblique, set off from rest of ninth tergum; basistyle bulbous, subapical lobe with forked anterior lobe bearing two large spines and a posterior lobe bearing a large leaflet and several spines. ..... *erraticus* (p. 78)
Ninth tergal lobes of normal size, rounded posteriorly, directed posteriorly; basistyle not bulbous, more or less linear, subapical lobe not noticeably divided into anterior and posterior lobes. 2
2. Subapical lobe of basistyle without conspicuous leaflet. 3
Subapical lobe of basistyle with conspicuous leaflet. 4
3. Ninth tergal lobes about as long as wide; a conspicuous H-shaped structure present. ..... *territans* (p. 76)
Ninth tergal lobes much wider than long, rather conspicuous, lacking a conspicuous H-shaped structure but with a series of dark, pointed phallosomal plates. ..... *tarsalis* (p. 75)
4. Phallosomal armature very simple, with only a pair or posteriorly directed arms; only the spines of the 10th sternum are heavily sclerotized. ..... *restuans* (p. 74)
Phallosome with a series of complicated plates; with a number of heavily sclerotized parts. 5
5. Phallosome with a pair of blunt, posterolaterally directed ventral arms and a pair of pointed, curved, dorsal arms which are more or less laterally directed at the tips..... *pipiens* (p. 71)
Phallosomal plates not as above; with a number of dark, more or less laterally directed points. ..... *salinarius* (p. 74)

KEY TO SPECIES OF CULEX (LARVAE)

1. Antennal tuft placed before or near the middle of the antenna, never distinctly beyond; air tube with a series of single hairs as well as one smaller pair of tufts; dorsal brush of two long, single hairs on each side; dorsolaterals of IV and V single..... *restuans* (p. 74)
Antennal tuft placed distinctly beyond middle of antenna; air tube with a series of tufts, no single hairs as a rule; dorsal brush of a single hair and a branched one on each side; dorsolaterals of IV and V usually all branched. 2
2. Upper and lower head hairs markedly dissimilar in number of branches; uppers weak, with about 5 or more branches, lowers usually single, at least twice as long as uppers; thorax, abdomen, and anal segment markedly pilose; eighth segment with less than 30 comb scales, each with strong central spine, branched; hair of dorsal brush with only two branches. ..... *erraticus* (p. 78)
Upper and lower head hairs not markedly dissimilar in number of branches; usually without noticeable pile except on sides of thorax in *territans*; eighth segment with more than thirty scales, average comb scale never with long terminal spine; branched hair of dorsal brush usually with four or more branches. 3
3. Head hairs single or double; usually with one or two tufts before the barred area; usually with noticeable pile on sides of thorax..... *territans* (p. 76)
Head hairs with three or more branches, particularly the uppers; without tufts preceding the barred area; without conspicuous pile. 4
4. Anterior three or four pairs of siphonal tufts set close to midventral line, most of these tufts with six or more branches; lateral abdominals mostly triple on III - VI; saddle hair double or better..... *tarsalis* (p. 75)
Anterior three or four pairs of siphonal tufts set well up from the midventral line, these tufts usually with four or fewer branches; lateral abdominals mostly double of III - VI; saddle hair frequently single. 5
5. Siphon less than seven times as long as wide at middle, usually only 5 to 6; dorsolaterals mostly double on IV to VI; anterior tufts of siphon well de-

veloped, usually very straight; saddle hair usually single. ..... *pipiens* (p. 71)
Siphon more than seven times as long as wide at middle, usually over eight; dorsolaterals mostly with three to five branches on IV to VI; anterior tufts of siphon weak, usually not straight; saddle hair usually double. ..... *salinarius* (p. 74)

KEY TO SPECIES OF AEDES (FEMALES)

1. Tarsal segments, at least on the hind legs, ringed with white. 2
Tarsal segments all dark or without definite rings of white. 12

2. Tarsi with white rings at both ends of some or all the segments. 3
Tarsi with white rings at basal ends of the segments only. 5

3. Wing with all scales dark; mesonotum clothed dorsally with golden brown scales; last segment of hind tarsi entirely white. ..... *canadensis* (p. 53)
Wing with dark and white scales intermixed. 4

4. Wing with dark and white scales evenly intermixed. ..... *campestris* (p. 52)
Wing with dark and white scales not evenly intermixed; vein R4+5 with more dark scales than R3 or M1. ..... *dorsalis* (p. 54)

5. Proboscis with a white ring or patch of scales near the middle; abdominal tergites with yellowish scales usually forming a median longitudinal stripe. 19
Proboscis without a definite ring or patch of white scales near the middle. 6

6. Basal white rings of tarsal segments very narrow; wider on hind tarsi where they are less than one-fourth as long as the segments. ..... *vexans* (p. 70)
Basal white rings of tarsal segments broad, especially on the hind tarsi where they are more than one-fourth as long as the segments. 7

7. Abdominal tergites clothed with yellow scales, without bands; mesonotum yellowish-brown with a darker median area. ..... *flavescens* (p. 56)
Abdominal tergites dark-scaled with distinct pale basal bands. 8

8. Tarsal claws with main tooth abruptly bent near the base of the lateral tooth; main tooth and lateral tooth parallel with each other. ..... *excrucians* (p. 58)
Tarsal claws with the main tooth bent beyond the base of the lateral tooth; lateral tooth about one-half as long as main tooth. 9

9. Lower mesepimeral bristles absent. ..... *fitchii* (in part) (p. 59)
Lower mesepimeral bristles present. 10

10. Torus without white scales on dorsal surface; palpus lacking hairs on basal half of apical segment at inner ventral surface. ..... *increpitus* (p. 60)
Torus with white scales on dorsal surface or with apical segment of palpus bearing many long hairs on inner ventral edge or both. 11

11. Lower mesepimeral bristles rarely more than two; torus with white scales on dorsal half. ..... *fitchii* (p. 59)
Lower mesepimeral bristles usually three or more; torus with or without white scales on the dorsal half. ..... *stimulans* (p. 68)

12. Mesonotum with silver-white scales at the sides and anterior margin, central area with broad median stripe of dark brown scales. ..... *triseriatus* (p. 69)
Mesonotum not marked with silver-white scales. 13

13. Mesonotum with a pair of broad submedian white or yellowish-white stripes separated by a brown stripe of about the same width. ..... *trivittatus* (p. 68)
Mesonotum not marked with two broad submedian white or yellowish-white stripes. 14

14. Wing scales distinctly bicolored, costa, R1, R4+5, and M2 veins with black scales; other veins largely with white scales. 15
Wing scales all dark or with white-scaled patches at bases of veins with scattered pale scales on the anterior veins. 16

15. Abdominal tergites with a median longitudinal stripe of white scales or almost entirely white-scaled; scales on dorsal half of posterior pronotum brown. ..... *spencerii* (p. 66)

Abdominal tergites with broad basal white bands widening at the sides; scales on dorsal half of posterior pronotum white or whitish-brown. ..... *idahoensis* (p. 59)

16. Mesonotum without contrasting lines or stripes. 17
    Mesonotum with contrasting lines or stripes. 18

17. Lower mesepimeral bristles absent; abdomen usually with a continuous lateral line of white scales. ..... *cinereus* (p. 70)
    Lower mesepimeral bristles present; abdomen without a continuous lateral line of white scales; mesonotum uniformly brown, rarely with indications of median brown lines; wing scales dark, with or without a small patch of white scales at base of costa. ..... *intrudens* (p. 61)

18. Abdominal tergites with narrow basal white bands which widen at the sides to triangular patches; mesonotum with two median stripes of fine, narrow, golden-brown scales separated by a narrow median line of pale scales which is sometimes absent; sides yellowish-white. ..... *stricticus* (p. 67)
    Abdominal tergites without basal white bands or with narrow bands on less than half of the segments; mesonotum with two narrow, brown median stripes which are sometimes fused forming a broad median stripe. ..... *diantaeus* (p. 58)

19. Abdomen with dorsal areas of cream colored scales and small lateral patches of white scales; first segment of hind tarsus with a yellow middle band. ..... *sollicitans* (p. 62)
    Abdomen with dorsal areas of white scales; first segment of hind tarsus with a white middle band or no middle band. ..... *nigromaculis* (p. 62)

KEY TO SPECIES OF AEDES (MALES)

1. Dististyle inserted before the apex of the basistyle, unequally bifurcate near the base. ..... *cinereus* (p. 70)
   Dististyle inserted at the apex of the basistyle, not bifurcate near the base. 2

2. Dististyle broad and flat throughout its length with a subapical claw; claspette stem crowned with a dense tuft of setae, filament absent. ..... *vexans* (p. 70)
   Dististyle broad and flat throughout its length, with a subapical claw; claspette with a distinct filament. ... 3

3. Basistyle without distinct apical lobe. 4
   Basistyle with a distinct apical lobe. 5

4. Basal lobe of basistyle absent, represented by a dense patch of setae; dense patch of long hairs arising on inner face of basistyle at apical third. ..... *triseriatus* (p. 69)
   Basal lobe of basistyle present, covered with fine setae; inner face of basistyle without a dense patch of long hairs at apical third. ..... *nigromaculis; sollicitans* (p. 62).

5. Basistyle with a dense brushlike tuft of long setae on the ventral side near base of apical lobe.. *diantaeus* (p. 58)
   Basistyle without a dense, brushlike tuft of long setae on the ventral side near base of apical lobe. 6

6. Basal lobe of basistyle bearing setae but lacking a distinctly enlarged spine. 7
   Basal lobe of basistyle bearing one or more distinctly enlarged spines. 9

7. Apical lobe of basistyle a broadly-rounded area, bearing numerous short, flattened, spatulate setae. ..... *canadensis* (p. 53)
   Apical lobe of basistyle not flattened, bearing slender, hairlike or slightly broadened setae. 8

8. Basal lobe of basistyle elongate, extending almost to base of apical lobe; claspette filament with an angular projection on basal third of convex side. ..... *excrucians* (p. 58)
   Basal lobe of basistyle not extending more than halfway to base of apical lobe; claspette filament with a sharp, angular, or slightly retrorse projection near the middle of convex side. ..... *increpitus* (p. 60)

9. Basistyle with a conspicuous dense tuft of long setae arising from apex. ..... *intrudens* (p. 61)

Basistyle without a dense tuft of long setae arising from the apex. 10

10. Basal lobe of basistyle with one short, stout spine, a long, curved spine and a dense group of slender setae. ..... *dorsalis* (p. 54)
Basal lobe of basistyle without differentiated strong spines other than a long, stout, dorsal one (the strong dorsal spine often followed by progressively weaker spines or setae) 11

11. Claspette filament with a spinelike retrorse projection or barb on convex side forming an acute angle. ..... *trivittatus* (p. 68)
Claspette filament ligulate, roundly expanded, or with an angular expansion on the convex side forming an obtuse angle. 12

12. Filament of claspette ligulate, not expanded on the convex side, little if any broader at middle than the distal end of the claspette stem. ..... *campestris* (p. 52)
Filament of claspette roundly or angularly expanded on the convex side, broader at the middle than the distal end of the claspette stem. 13

13. Basal lobe of basistyle represented by a large rugose area raised basally, flattened distally, and reaching well beyond the middle of the basistyle. ..... *flavescens* (p. 56)
Basal lobe of basistyle triangular, conical, or bluntly rounded, not reaching beyond basal two-fifths of basistyle. 14

14. Apical lobe of the basistyle clothed with normal, rather straight setae; claspette filament less than twice as wide at basal one-third as the apical diameter of the claspette stem. ..... *fitchii* (p. 59)
Apical lobe of the basistyle clothed with short, broadened, recurved setae, claspette filament expanded at basal one-third to about twice the apical diameter of the claspette stem. 15

15. Basal lobe of the basistyle bearing a dense tuft of fine, long setae adjacent to the strong dorsal spine. ..... *sticticus* (p. 67)
Basal lobe of basistyle with fewer fine, long setae adjacent to the strong dorsal spine. ..... *idahoensis* (p. 59) *spencerii* (p. 66)

KEY TO SPECIES OF AEDES (FOURTH INSTAR LARVAE)

1. Anal segment completely ringed by the saddle. 2
Anal segment not completely ringed by the saddle. 4

2. Pecten with two to four distal teeth rather widely separated. ..... *nigromaculis* (p. 62)
Pecten with all teeth evenly spaced, distal tooth occasionally detached.... 3

3. Dorsal preapical spine of the siphon as long as the apical pecten tooth; gills short, bud like. ..... *sollicitans* (p. 62)
Dorsal preapical spine of siphon much shorter than the apical pecten tooth; body spiculate and gills longer than the anal segment. ... *trivittatus* (p. 68)

4. Pecten with one or more of the distal teeth rather widely separated. 5
Pecten with all teeth evenly spaced. 13

5. Antenna as long or longer than the head. ..... *diantaeus* (p. 58)
Antenna shorter than the head. 6

6. Scales of the comb of the eighth segment arranged in a patch three or more rows deep. 7
Scales of the comb of the eighth segment arranged in a single or irregular double row. 11

7. Siphon about five times as long as its basal diameter; lateral abdominal hair 6 usually double on segment I and II, single on III to VI. ..... *excrucians* (p. 58)
Siphon not more than four times as long as its basal diameter; lateral abdominal hair 6 double on segments I to VI. 8

8. Anal gills budlike, much shorter than the saddle of the anal segment; pecten reaching beyond middle of the siphon. ..... *campestris* (p. 52)
Anal gills not budlike, usually as long or longer than the saddle. ..... *flavescens* (in part) (p. 56)

9. Upper frontal head hair 5 with three or more branches. 10
Upper frontal head hair 5 single. .. 12

10. Upper frontal head hair 5, lower frontal 6, and pre-antennal 7 inserted

nearly in a straight line. ..... *cinereus* (p. 70)

Upper frontal head hair 5, lower frontal 6, and pre-antennal 7 not inserted in a straight line. 11

11. Hairs of the siphonal tuft about as long as the basal diameter of the siphon; saddle of anal segment deeply incised on the ventral margin. ..... *intrudens* (p. 61)

Hairs of the siphonal tuft rarely more than half as long as the basal diameter of the siphon; saddle of the anal segment not deeply incised on the ventral margin. ..... *vexans* (p. 70)

12. Individual comb scale with the median spine long and gradually tapered from basal part, basal part with minute lateral spinules. ..... *spencerii* (p. 66)

Individual comb scale with median spine of medium length and arising abruptly from the basal part, basal part with rather prominent lateral spinules. ..... *idahoensis* (p. 59)

13. Antennal tuft represented by a single small hair. ..... *triseriatus* (p. 69)

Antenna spiculate; antennal tuft double or multiple. 14

14. Individual comb scale with the subapical spinules weak; not more than half as long as the strong median spine. 15

Individual comb scale rounded apically and fringed with subequal spinules, or with the subapical spinules at least two-thirds as long as the median spine. 17

15. Siphon slender, gradually tapered from near base, about four times as long as its basal diameter; apical pecten tooth nearly as long as the apical diameter of the siphon. ..... *fitchii* (p. 59)

Siphon stout, less than four times as long as its basal diameter, apical pecten tooth not more than half as long as the apical diameter of the siphon. 16

16. Ventral brush of the anal segment with four or more precratal tufts inserted to near the base of the segment. ..... *flavescens* (p. 56)

Ventral brush of the anal segment with fewer than four precratal tufts, all inserted on the distal half of the segment. ..... *sticticus* (p. 67)

17. Siphonal tuft inserted near distal two-fifths of the siphon (sometimes near the middle in *A. dorsalis*); anal gills short, usually not as long as the saddle. 18

Siphonal tuft usually inserted before middle of the siphon; anal gills as long or longer than the saddle of the anal segment. 19

18. Upper frontal head hair 5 single (occasionally double); pecten not extending beyond middle of siphon. ..... *dorsalis* (p. 54)

Upper frontal head hair 5 double or triple; pecten extending to near distal two-fifths of the siphon. ..... *campestris* (in part) (p. 52)

19. Upper frontal head hair 5 with four or more branches, lower frontal 6 with three or more branches; prothoracic hair 1 single, hair 5 single or double. ..... *canadensis* (p. 53)

Upper frontal head hair 5 single to triple, lower frontal 6 single or double. 20

20. Individual comb scale with the median spine a little longer than the large subapical spinules, but less than one and one-half times as long. ..... *increpitus* (p. 60)

Individual comb scale with median spine about one and one-half times as long as the large subapical spinules. ..... *stimulans* (p. 68)

DESCRIPTION, BIOLOGY AND OCCURRENCE OF SOUTH DAKOTA MOSQUITO SPECIES

Anopheles (Anopheles) barberi
Coquillett

FEMALE – Small species. Proboscis dark; palpi about as long as the proboscis, dark. Integument of scutum brown, shiny; scutum clothed with dark setae which are at least half as long as the width of the scutum. Legs entirely dark. Length about 3.0 mm. Scales slightly broadened, uniformly dark. Knob of halter dark-scaled.

MALE–Coloration similar to that of the female. Phallosome cylindrical, broad at base, tapering to a blunt, rounded point at apex, without leaflets. Dististyle much longer than basistyle, curved, with a few small papillated setae on the distal half; claw short, blunt.

LARVA–Antenna short, dark; antennal hair 1 small, simple, inserted near middle of shaft; terminal hair 4 long simple. Inner clypeal hairs 2 simple, widely spaced; outer clypeal 3 shorter than inner clypeal 2, usually simple, occasionally bifid; frontal hairs 5 to 7 small, simple.

Abdominal accessory dorsal hair 0 obsolete. Palmate hair 1 rudimentary on segment I, well developed on segments II to VII.

BIOLOGY–*Anopheles barberi* is a woodland species. The larvae are found in rot cavities in trees of many kinds, in stump holes, and occasionally artificial containers near wooded areas. In northern climates the winer is passed in hibernation as early larval instars, sometimes frozen in solid ice, larval development is very rapid following the onset of warm weather and the first adults are usually seen in June. This species is of no importance in South Dakota.

DISTRIBUTION – Known only from Yankton County.

Anopheles (Anopheles) earlei
Vargas

FEMALE – Medium-sized species. Integument of scutum with a broad median frosted stripe, brown laterally; the frosted stripe clothed with short pale-yellow hairs, the lateral areas with longer and dark setae. Integument dark brown, with frosted areas, clothed with pale yellow to brown hairs. Legs dark brown, tinted with blue. Length about 5.0 mm. Scales narrow, dark

brown; some of the scales arranged in distinct darker spots; scales on stem of radius, between fork and dark spot, raised. Fringe at apex of wing with a silver or bronze colored spot. Halter knob dark-scaled.

MALE—Coloration usually paler than that of female. Ninth tergite with band narrow, sclerotized; lobes short and broad, with apex somewhat expanded. Tenth sternite absent; anal lobe large, subtriangular, spiculate.

LARVA—Inner clypeal hairs 2 with two to five branches distally, rarely simple; usually separated at their bases by the width of one tubercle; outer clypeal 3 densely dichotomously branched; postclypeal 4 short, rarely single, 2 to 5 branched, rarely more; frontal hairs 5 to 7 large, plumose. Prothoracic hair 1 short, usually simple; hair 2 long, with about ten to twelve branches; hair 3 short, simple. Prothoracic pleural group 9 to 12 with hairs 9, 10, and 12 long, simple; hair 11 short, simple. Metathoracic pleural group 9 to 12 with hairs 9 and 10 long, simple; hair 11 simple; hair 12 short, simple or 2-branched beyond middle. Metathoracic palmate hair 3 small, with transparent leaflets. Accessory dorsal hair obsolete or minute, simple on segments IV and V. Palmate hair 1 rudimentary on segments I and II, well developed and of about equal size on III to VII.

BIOLOGY – The larvae prefer cold clear water in the shallow margins of semipermanent and permanent ponds, overgrown with emergent vegetation. They are found in woodland pools, marshes, open bogs, and along the margins of sluggish streams. The females overwinter in hiberation, leaving their hibernating places to seek a blood meal in the early spring. This species attacks man very aggressively. The larval population tends to increase throughout the summer, attaining their maximum abundance in early fall.

DISTRIBUTION – Known from Beadle, Charles Mix, Custer, Fall River, Kingsbury, and Walworth Counties.

Anopheles (Anopheles) punctipennis Say

FEMALE—Wing length about 4.0 mm. Scales black and pale yellow, in contrasting lines and spots (costa with a pale spot at outer third opposite tip of subcosta; anal vein with basal fourth and apical half dark-scaled, veins R4+5 and cubitus entirely dark-scaled). Halter knob dark-scaled.

MALE—Coloration similar to that of the female.

LARVA—Inner clypeal hairs, 2 simple, with basal tubercules separated by less than the diameter of one tubercle; outer clypeal 3 densely dichotomously branched; postclypeal 4 small, branched; frontal hairs 5 to 7 large, plumose. Metathoracic palmate hair 3 small or obsolete. Abdominal accessory dorsal hair 0 obsolete on segments IV and V; palmate hair 1 rudimentary on segments I and II, well developed and of about equal size on III to VII. Antepalmate hair 2 usually double on segments IV and V.

BIOLOGY—The larvae of this species are found for the most part in pools and eddies in drying streams, particularly those in full sunlight containing mats of green algae. The larvae are frequently abundant in shallow streams in mountain areas during the dry season when streams are not subject to flushing by heavy rainfall.

The adult females overwinter in caves, houses, and other protected situations. On warm days in the early spring, females leave their hibernating places to feed. This usually occurs in May.

Although this species is the most widely distributed anophelene mosquito in the United States, it is of no known importance in South Dakota.

DISTRIBUTION — *Anopheles punctipennis* has been collected in Beadle, Bon Homme, Brookings, Brule, Charles Mix, Fall River, Meade, Minnehaha, Union, and Yankton Counties.

Anopheles (Anopheles) quadrimaculatus Say

FEMALE — Medium-sized species. Proboscis dark; palpi about as long as the proboscis, dark, with raised scales on basal part. Integument of scutum brown to black; scutum clothed with numerous pale-yellow to golden brown hairs. Legs dark-scaled, femora and tibiae tipped with pale scales. Wing length about 4.5 mm. Scales narrow, entirely dark, some of the scales forming four rather distinct darker spots. Scales on basal part of cubitus before the fork predominantly broadly rounded at apices, without serrate edges. Halter knob, dark-scaled.

MALE—Coloration similar to that of the female. Ninth tergite with band narrow, sclerotized; lobes about two to three times as long as broad, usually somewhat constricted medially, rounded at apex. Claspette broad, consisting of a dorsal lobe bearing one to five stout, bluntly rounded or capitate spines (often fused to one another).

BIOLOGY — The larvae of *Anopheles quadrimaculatus* are found in permanent fresh water, sluggish streams, canals, ponds, and lakes containing surface growing or emergent vegetation. They are seldom found in water of a temporary nature. During the summer season the larval period is rather short; about 12 to 20 days depending on temperature.

The females are active feeders on man and domestic animals. The adults are active at night. During the daylight hours they rest in dark corners, underneath houses, in stables or other shelters. The winter is passed by the inseminated adult female. Hibernation begins in September or October with the emergence from hibernation usually in May.

This species occurs in large numbers throughout the southeastern United States and is regarded as the most important vector of malaria in that region. The species is not sufficiently abundant in South Dakota to pose a threat of the transmission of this disease.

DISTRIBUTION – This species is probably distributed throughout South Dakota but has been captured only in Beadle, Bon Homme, Brule, Charles Mix, Codington, Meade, and Yankton Counties.

Anopheles (Anopheles) walkeri Theobald

FEMALE – Medium-sized species. Proboscis dark; palpi about as long as the proboscis, dark-scaled except for a narrow white ring at apex of each segment, basal part with raised scales. Legs dark-scaled, femora and tibiae tipped with pale scales. Wing length about 4.0 to 4.5 mm. Scales narrow, entirely dark; some of the scales forming four darker spots, more or less distinct. Halter knob usually pale-scaled.

MALE – Coloration similar to that of the female. Claspette broad, consisting of a dorsal lobe bearing one or two large, blunt apical spines; ventral lobe bearing a large acuminate apical spine and a long slender subapical spine. Dististyle a little longer than the basistyle; claw short, blunt.

LARVA–Antennal tuft 1 inserted near basal third of shaft, several branched; terminal hair 4 with several branches. Inner clypeal hairs 2 with basal tubercles rarely separated by more than the diameter of one tubercle; outer clypeal 3 densely branched dichotomously; postclypeal 4 small, branched distally; frontal hairs 5 to 7 large plumose; sutural 8 and transsutural 9 with several branches. Accessory dorsal hair 0 comparatively well developed on abdominal segments IV and V (much smaller than antepalmate hair 2), with three to seven branches. Palmate hair 1 well developed, nearly equal in size on segments III to VII; palmate hairs rudimentary on segments I and II. Antepalmate hair 2 usually single on segments IV and V, sometimes double or triple. Lateral hair 6 long, plumose on segments I to III.

BIOLOGY–The hibernation of *walkeri* appears to be unique. The species is believed to produce winter eggs which are deposited in late fall, remain dormant throughout the cold season and hatch the following spring. The larvae of *Anopheles walkeri* occur in fresh water marshes, containing emergent or floating vegetation.

The species is apparently rare in South Dakota, but light traps and hand catches may give biased estimates of the relative abundance of this species since *walkeri* appears to be highly attracted to light.

DISTRIBUTION – Known from Beadle, Brule, Buffalo, CharlesMix, Corson, Custer, Fall River, Hughes, Kingsbury, Spink, and Walworth Counties.

Uranotaenia sapphirina (Osten Sacken)

FEMALE–Very small species. Proboscis long, dark-brown often with a few iridescent blue scales sprinkled on basal half, swollen apically; palpi very short, dark-scaled. Occiput margined with broad iridescent bluish scales, vertex with a patch of blue scales. Integument of scutum light brown; a narrow median line of broad iridescent

bluish scales extending nearly the entire length of the scutum and covering most of middle lobe of the scutellum; a similar line of iridescent bluish scales on lateral margin of scutum reaching from the base of the wing to the scutal angle; patches of iridescent scales also present on anterior pronotal lobe and on the mid-part of the sternopleuron. Abdominal tergites clothed with brown scales with metallic luster. Legs dark-brown scaled except for a small patch of bluish-white scales at apices of femora and tibiae and yellowish scales on the posterior surface of the femora.

MALE – Coloration and palpi similar to that of the female.

LARVA – Head longer than broad. Head hairs: Postclypeal 4 double, about as long as upper and lower frontals 5 and 6; upper frontal 5 and lower frontal 6 stout, spine-like, dark, as long as the antenna. Comb of eighth segment with seven to ten scales on the distal margin of a large sclerotized plate. Siphon slightly upturned; pecten of about twelve to fifteen evenly spaced teeth not reaching middle of siphon. Anal segment completely ringed by the saddle.

BIOLOGY–Little is known of the biology of this species. The adult females overwinter, being found in dark moist places such as caves, buildings, and hollow trees. The feeding habits of the females are not established although they have been recorded biting horses and man. It seems likely their preferred hosts are amphibians and perhaps other cold blooded animals.

Larvae are most abundant in late summer and are usually found in semipermanent or permanent water, often associated with duck weed. The larvae rest with their bodies almost parallel to the surface of the water and may be mistaken for *Anopheles* at first glance.

The females are easily attracted to light traps.

DISTRIBUTION – *Uranotaenia sapphirina* has been taken in Beadle, Bon Homme, Brookings, Brule, Butte, Charles Mix, Hughes, Kingsbury, and Yankton Counties.

Culiseta (Culiseta) impatiens (Walker)

FEMALE–A large brown mosquito. Mesonotum clothed with bronzy-brown and yellowish scales, the yellow scales forming patches on the anterior margin with two fine lines extending posteriorly from two submedian spots; mesonotal pattern often variable; margin of prescutellar space with yellow scales. Abdominal tergites dark, with basal white bands. Tarsi all dark. Wing scales all dark, denser at base of vein R4+5 and fork of vein M; cross veins without scales.

MALE – The gentilia may be separated from other *Culiseta* by the presence of twenty or more short, stout spines on the apical margin of the eighth tergite.

LARVA – Upper frontal head hair 5 and lower frontal head hair 6 similar in number and size of branches. Siphon about two and one-half times as long as its basal diameter; pecten teeth on basal fourth of siphon followed by a row

of hairs reaching to near apical fourth. Anal segment ringed by the saddle, lateral hair with two to four branches, shorter than the saddle; ventral brush well developed usually with three precratal tufts.

BIOLOGY—This species is typically an inhabitant of coniferous forests. The females overwinter and are among the first mosquitoes to be seen in the spring. The eggs are laid in water of deep, well shaded pools. The larvae are often found in pools filled by melting snow.

DISTRIBUTION — *Culiseta impatiens* is known only from Pennington County.

Culiseta (Culiseta) incidens
(Thomson)

FEMALE—This is a large brown species. Mesonotum clothed with dark-brown and yellow scales arranged in narrow, faint,longitudinal lines or spots, margins and prescutellar space with pale-yellow scales. Abdominal tergites dark, with basal segmental bands of whitish scales. Tarsi dark with narrow basal whitish rings, more distinct on the hind legs. Wing scales dark, patches of dark scales at base and forks of vein R, at middle and forks of vein R4+5, base of vein Cu1, and middle of vein A; cross veins without scales.

MALE—Apical lobe of basistyle small, bearing several setae, one of which is stronger and longer; basal lobe of basistyle small, conical, bearing two stout spines at the apex and numerous subapical setae. Eighth tergite with about four to eight stout spines on the apical margin. Lobes of ninth tergite bearing a row of rather long setae.

LARVA — Upper frontal head hair 5 usually ten to twelve branches; lower head hair 6 with about five branches. Comb of eighth segment with many scales in a patch. Siphon about three times as long as basal diameter; pecten teeth on basal fifth of siphon; row of hairs extending from pecten to apical fourth of siphon. Ventral brush of anal segment with two or three precratal tufts, not more than one of which pierces the saddle.

BIOLOGY — The larvae of *Culiseta incidens* develop in a wide variety of aquatic habitats, including ground pools, springs, pools formed by melting snow and even in grossly polluted pools. The females hibernate in the cooler regions.

DISTRIBUTION — This species is apparently restricted to the Black Hills area in South Dakota having been collected in Butte, Custer, and Fall River Counties.

Culiseta (Culiseta) inornata
(Williston)

FEMALE—A large light-brown mosquito. Mesonotum clothed with brown and pale-yellowish scales intermixed, anterior and lateral margins and prescutellar space predominantly pale yellow. Abdominal tergites dark with broad basal bands of yellowish-white scales which widen laterally to form irregular lateral stripes; eighth tergite entirely pale-scaled. Tarsi without pale rings. Wing scales dark, intermixed with white on costa, subcosta and vein R1.

MALE—The presence of numerous short, stout spines on the lobes of the ninth tergite distinguish it from all other *Culiseta* of South Dakota.

LARVAE—Upper frontal head hair 5 usually with eight branches: lower frontal head hair 6 with four branches, these longer than upper 5. Siphon about three and one-half times as long as its basal diameter; pecten teeth on the basal fourth of siphon, followed by a row of long hairs which extend to apical fourth of siphon. Lateral hair of anal segment double, as long or longer than the saddle.

BIOLOGY – Hibernation is by the adult female. The females may be fairly active early in the spring and may attack humans readily at this time. As a rule they seem reluctant to attack humans, apparently preferring the blood of domestic animals.

Culiseta inornata is exceptional in that the larvae may be taken easily in early spring while the larvae of other species are not yet apparent.

The species may be of some nuisance importance in South Dakota but in view of its usual reluctance to bite humans it is not so annoying as more aggressive species.

DISTRIBUTION—*Culiseta inornata* is found throughout South Dakota.

Culiseta (Culicella) morsitans (Theobald)

FEMALE – Medium to rather large species. Proboscis dark-scaled palpi short, dark. Integument of scutum brown, with two rather broad sub-median reddish-brown bare stripes, two shorter bare stripes, one on either side of the prescutellar space; scutum clothed with fine golden-brown scales except for coarser white scales medially. Numerous yellow spiracular bristles present. Abdominal tergites dark with broad appressed bronze-brown scales and rather narrow basal bands of yellowish-white scales. Tarsi dark, except for rather faint pale rings involving both ends of joints, more pronounced on basal segments, indistinct or absent on distal segments. Wing length about 5.0 to 5.5 mm. Points of origin of cross veins R4+5-M and M-Cu1 on vein M separated by more than the length of either cross vein; scales narrow, dark brown; cross veins without scales.

MALE—Coloration similar to that of the female. Palpi long and with ventral brushes at apex of second and on all of third and fourth segments.

LARVA—Upper frontal 5 usually four to six branched, shorter than hair 6; lower frontal 6 very long, double, sparsely barbed; preantennal 7 long, multiple, barbed. Pecten of a few teeth on basal fifth or fourth of siphon, distal teeth detached; siphonal tuft large, usually four or five branched, inserted within the pecten near base of siphon. Anal segment much longer than wide, completely ringed by the saddle; lateral hair single, a little shorter than the saddle.

BIOLOGY – The life cycle of *Culiseta morsitans* is imperfectly known. Most observations have

been made in Europe, where the species also occurs and it appears that the American and European forms are not identical.

It is reported that the eggs are laid singly in dried up hollows or above the water level of partly filled hollows after the manner of *Aedes* mosquitoes. The eggs hatch in the fall and the larvae develop to the fourth instar by late fall. The full grown larvae remain on the bottom during the winter and pupate the following spring.

This life cycle is very peculiar since most species of this genus oviposit on the water surface and hibernate as adult females.

The adults apparently seldom bite man and since the species distribution in South Dakota is sparse it is of little importance.

DISTRIBUTION—*Culiseta morsitans* has been collected from Jones, Lawrence, Marshall and Fall River Counties.

Orthopodomyia signifera (Coquillett)

FEMALE — Medium-sized species. Proboscis dark, with numerous white scales forming narrow longitudinal lines dorsally. Palpi about one-third as long as the proboscis, dark-scaled, with a white-scaled line dorsally. Tori dark, torus and first four or five flagellar segments of antenna white scaled on inner surface. Scutum clothed with long dark setae and small reddish-brown scales, except for three paired narrow longitudinal lines of silver-white scales. Femora with posterior surface pale-scaled; anterior surface brown, with white scales intermixed. Pale knee spots present. Tibiae dark, speckled with white, tipped with white apically. Front tarsi with segments 1 and 2 faintly marked with pale scales at joints or all segments. Middle tarsi with base and apex of segment 1 and base of segment 2 narrowly ringed with white, remaining segments usually entirely dark brown. Hind tarsi with all segments broadly ringed with white apically and basally, rings broadest on first and second segments, narrower on third and fourth, segment 5 entirely white on one side.

MALE—Coloration similar to that of the female. Claspette absent. Basistyle about three times as long as mid-width, clothed with scales and long and short setae; basal lobe conical, appressed to the basistyle, bluntly pointed at apex; claw short, split distally into numerous comb-like teeth.

LARVA—Antenna about half as long as the head, swollen basally and tapered apically, smooth; antennal tuft multiple, barbed, inserted near basal third of shaft, not reaching tip. Pecten absent; siphonal tuft five to twelve branched, barbed, inserted a little beyond basal third of siphon, individual hairs varying from about three-fourths as long as to a little longer than that part of the siphon beyond point of insertion of the tuft. Anal segment completely ringed by the saddle; a small linear sclerotic plate at base of segment.

BIOLOGY—This mosquito is extremely rare in South Dakota, and its habits are not well known. Over-

wintering appears to be by larvae which typically inhabit water accumulations in tree holes and artificial containers. The food of the adults is unknown and the females are not known to take vertebrate blood.

DISTRIBUTION – This species is known only from Yankton County.

Masonia (Coquillettidia) perturbans (Walker)

FEMALE – Moderately large species. Proboscis dark, sprinkled with white scales basally and with a broad median ring of pale scales. Integument of scutum mottled dark brown and black; scutum clothed with dark-brown lanceolate scales intermixed with pale-golden lanceolate scales. Spiracular and postspiracular bristles absent. First abdominal tergite dark-scaled; remaining tergites dark-scaled, with white or pale-yellow basolateral patches and occasionally with narrow basal segmental bands of pale scales. Front and middle tibiae dark-scaled, speckled with white, narrowly ringed with white scales at apices; hind tibia dark-scaled, speckled with white, ringed with white scales at outer third and at apex. First tarsal segment of all legs with a narrow white ring basally and a broader white ring a little beyond middle; remaining tarsal segments each with basal half white, apical half dark. Wing scales broad, mixed dark and white, the dark scales predominating.

MALE–Coloration similar to that of the female. Claspette absent. Basistyle about one and one-half to two times as long as midwidth, clothed with broad scales and setae; basal lobe flat, triangular, fused to basistyle, bearing a thick, blunt, dark rod and a smaller stout spine at apex; apical lobe absent.

LARVA – Head much broader than long. Siphon short, strongly attenuated and heavily sclerotized beyond middle; attenuated part of siphon bearing sawlike projections dorsally and stout hooks apically; arising before the heavily sclerotized part of the siphon are a long stout recurved dorsal spine, a single stout dorsolateral hair, and a multiple siphonal tuft; pecten absent.

BIOLOGY – This mosquito is characterized by larvae which obtain respiratory oxygen by inserting the highly modified siphon into plant tissues rather than obtaining this respiratory gas by the usual method of piercing the water surface film with the siphon. The larvae are difficult to find since they are attached, for the most part, to the roots of aquatic plants and will dislodge themselves when the plant is disturbed. The larvae may attach themselves to a wide variety of plants but cattails and sedges are most frequently utilized.

The adults are aggressive biters and usually attack at dusk.

DISTRIBUTION – *Mansonia perterbans* has been collected from Beadle, Bennett, Brookings, Brule, Butte, Spink and Walworth Counties.

Psorophora (Psorophora) ciliata
(Fabricius)

FEMALE—Very large species. Proboscis long, scales on basal half long,dark, brown, suberect, yellow and speckled with dark beyond middle, tip dark. Scutum marked as follows: A narrow median stripe of pale-golden lanceolate scales extending to the scutellum; a narrow nude submedian stripe on either side extending from the anterior margin of the scutum to the prescutellar space; a narrow stripe of narrow brown scales and dark setae extending from anterior third of scutum posteriorly along the sides of the prescutellar space, followed by a broad nude area on either side; sides of scutum with broad appressed pale-yellow to white scales; prescutellar space with white scales on either side of the median gold stripe. Femora yellow-scaled, speckled with dark on basal two-thirds to three-fourths, apical part of each densely clothed with long dark erect scales. Tibiae each with long dark erect scales except for a narrow basal ring of yellow appressed scales. Front and middle tarsi with appressed scales; each segment of hind tarsus with a basal ring of pale appressed scales; scales beyond basal ring long, dark, erect. Wing length about 6.0 mm. to 6.5 mm. Scales narrow, brown; a few inconspicuous pale scales distributed on costa, subcosta and vein R1.

MALE—Coloration similar to that of the female.

LARVA — Large larva. Head quadrate and concave anteriorly, broader than long. Antenna about one-third as long as the head, inserted at distal third of head. Mouth brushes composed of stout prehensile hairs, each hooked at tip and with a row of comb-like teeth along the sides.

BIOLOGY—This is the largest mosquito in South Dakota. It is additionally unusual because the larvae are predacious and readily feed on the larvae of other mosquito species as well as being cannibalistic.

Eggs are laid in small groups around the edges of temporary pools and apprently must be dried and reflooded before they will hatch. Larvae appear in breeding places shortly after rains, and develop quickly.

The females are reported to prefer domestic animals rather than humans, however, they will bite aggressively during twilight hours.

DISTRIBUTION — *Psorophora ciliata* has been collected from Bon Homme, Lincoln, Union and Yankton Counties.

Psorophora (Janthinosoma) ferox
(Humboldt)

FEMALE — Medium-sized species. Proboscis dark-scaled, palpi short, dark. Scutum with integument black; Scutum clothed with rather broad dark-brown and golden-yellow scales in no definite pattern, the dark scales more abundant. First tergite with median patch of dark purplish scales; remaining tergites dark-scaled with purplish reflection on the dorsum, with prominent apicolateral trian-

gular patches of whitish-yellow to golden-yellow scales. Sternites yellow-scaled on segments II to VI, mainly dark on segment VII. Femora dark, pale on posterior surface; knee spots present. Tibiae and tarsi of front and middle legs dark-scaled; segments 4 and 5 of hind tarsus, and often the apex of 3, white-scaled. Scales suberect, appearing rather shaggy and with purple reflection on apical part of hind tibia and on segments 1 and 2 of hind tarsus. Wing length about 3.7 to 4.0 mm. Scales dark, narrow.

MALE – Coloration similar to that of the female.

LARVA—Antenna much longer than the head, spiculate; antennal tuft multiple, barbed, inserted near middle of shaft. Head hairs: Postclypeal 4, small, branched; upper frontal 5 and lower frontal 6 long, usually double (hair 6 occasionally triple), barbed, about equal in length; preantennal 7 multiple, barbed. Comb of eighth segment with about 6 to 8 scales in a curved row on the posterior margin of a weakly sclerotized area. Siphon strongly inflated; pecten of three to five widely spaced teeth on basal fourth of siphon.

BIOLOGY—Larva of this species occur in temporary rain-filled pools, in overflow pools along streams, and occasionally in pot holes of stream beds after summer rains. They develop very rapidly.

The females are persistent and aggressive biters attacking in the open on cloudy days. The species is not sufficiently abundant in South Dakota to constitute a problem.

DISTRIBUTION – *Psorophora ferox* has been collected from Beadle, Bon Homme, Kingsbury, Butte, and Yankton Counties.

Psorophora (Janthinosoma) horrida (Dyar and Knab)

FEMALE – Medium-sized species. Palpi dark, less than one-third as long as the proboscis, the fourth segment usually curved and about equal in length to the first three combined. Integument of scutum black; scutum with a broad median stripe of narrow dark bronze-brown scales; this stripe bordered laterally with broad grayish-white scales. Front and middle femora dark purplish-scaled, the posterior surface pale; hind femur with the basal half to two-thirds pale on all aspects, dark apically; knee spots present. Front and middle legs with tibiae and tarsi entirely dark-scaled. Segments 4 and 5 of hind tarsus, and occasionally the apex of 3, white-scaled, other segments dark (segment 4 rarely with a few dark scales). Scales somewhat suberect, appearing rather shaggy on apical part of hind tibia and segments 1 and 2 of hind tarsus.

MALE – Coloration similar to that of the female. Proboscis slender, not swollen apically. Palpi with the last two segments much stouter than the preceding segments. Antenna reaching apex of the third palpal segment or only slightly beyond; the last two antennal segments comprising less than half the length of the entire antenna.

LARVA—Antenna about as long as the head; antennal tuft multiple,

barbed, inserted near middle of shaft. Head hairs: Postclypeal 4 small, multiple, upper frontal 5, short, double, barbed; lower frontal 6 short, triple (sometimes double), barbed, reaching near base of antenna (hairs 5 and 6 nearly equal in length); preantennal 7 multiple, barbed. Comb of eighth segment with about six to nine scales in a curved row. Siphon strongly inflated; pecten of about three to five widely spaced teeth on basal fourth of siphon.

BIOLOGY—The biology of this species is apparently similar to that of other members of the genus although it is imperfectly understood. The eggs are deposited by females in moist depressions or scattered over the surface of the soil. These hatch shortly after flooding and the larvae develop rapidly. The females apparently remain near the breeding site and will readily attack if they are disturbed.

The species is rare in South Dakota and consequently of no known importance.

DISTRIBUTION — *Psorophora horrida* has been collected in Bon Homme, Brookings, Hyde and Union Counties.

Psorophora (Janthinosoma) longipalpis Roth

FEMALE — Medium-sized species. Proboscis dark-scaled with violet reflection; palpi dark with violet reflection, usually a little more than one-third as long as the proboscis, with the fourth segment straight, more than one and one-half times as long as the other segments combined. Scutum with a broad median stripe of narrow dark bronze-brown scales, bounded laterally with broad white to yellowish scales; narrow pale scales intermixed with the broad ones on the posterior third of the scutum; prescutellar space margined laterally with broad pale scales. Front and middle femora dark, posterior surface pale; hind femur with basal two-thirds pale on all aspects. Tibiae and tarsi of front and middle legs entirely dark-scaled with violet reflection; segments 4 and 5 of hind tarsus, and sometimes the apex of segment 3, white; other segments dark.

MALE — Coloration similar to that of the female. Proboscis slender, swollen apically. Palpi long, the last two segments not much stouter than preceding segments. The last two segments of the antenna as long or longer than the preceding segments combined.

LARVA — Antenna longer than the head. Siphon strongly inflated; pecten of three or four widely spaced teeth on basal fourth of siphon; siphonal tuft minute, multiple, about as long as the apical pecten tooth, inserted laterally at apical third of siphon. Comb of eighth segment with about seven (rarely five or six) scales in a curved row.

BIOLOGY — *Psorophora longipalpus* is limited to the mid-continental United States. The larvae are found in heavily shaded temporary pools following heavy rains.

Little is known of the life cycle of this species but it is apparently

similar to that of other members of the genus.

DISTRIBUTION – *Psorophora longipalpus* is known only from Bon Homme County.

Psorophora (Grabhamia) confinnis (Lynch Arribalzaga)

FEMALE – Medium-sized to rather large species. Proboscis dark-scaled, except for a very wide yellowish-white median band; palpi short, dark, apical half of segment 4 white. Integument of scutum dull black; scutum clothed with fine narrow bronze-brown to blackish scales, except for lavender-tinted narrow white scales on the prescutellar space, the anterolateral angle of scutum, a streak on scutal angle, a patch above wing base, and a small submedian spot near middle of scutum. Femora dark-brown to black-scaled, liberally speckled with white scales, posterior surface largely pale-scaled; each femur with a narrow subapical white-scaled ring; knee spots white. Tibiae black, with numerous small white-scaled spots on outer surface. Hind tarsi with a broad basal white ring on each segment, first segment with a median white ring as well; front and middle tarsi similarly marked, but with white rings reduced or lacking on segment 4, absent on 5. Wing length about 4.0 to 4.5 mm. Scales rather broad, speckled dark brown and white, the white scales in no definite pattern; fringe entirely dark.

MALE – Coloration similar to that of female, but with the band on proboscis narrower.

LARVA–Antenna shorter than the head. Comb of eighth segment with six (rarely five) scales on the posterior margin of a weakly sclerotized area. Siphon slightly inflated; pecten of three to six widely spaced teeth, not reaching middle of siphon; siphonal tuft small, multiple, inserted at outer third of siphon.

BIOLOGY – The females lay eggs on damp soil in depressions subject to flooding. The winter is passed in the egg stage. The larval period is relatively short usually requiring only 4 to 10 days.

Psorophora confinnis is a strong flyer; the adults travel up to 10 miles. The females are persistent biters, attacking any time during day or night. In Florida and in the rice growing areas of Arkansas, where this species reaches its greatest abundance, livestock have died as the result of attacks by this mosquito. The species is apparently extremely rare in South Dakota and thus of no importance in this state.

DISTRIBUTION – *Psorophora confinnis* has been collected from Brule County only.

Psorophora (Grabhamia) signipennis (Coquillett)

FEMALE – Medium-sized species. Proboscis dark-scaled basally and apically, with a very wide whitish-yellow median band, palpi short, dark, speckled with a few pale scales. Scutum clothed with fine narrow golden-brown scales, becoming pale yellow on sides and on prescutellar space. Femora dark,

liberally speckled with pale scales; each with a narrow, often indefinite, subapical whitish-scaled ring; knee spots present. Tibiae dark, speckled with pale scales. Hind tarsus with segment 1 predominantly pale-scaled, sprinkled with dark scales, dark-ringed sub-basally and apically; segments 2 to 5 pale-scaled basally, dark scaled apically; front and middle tarsi similarily marked, but with the pale scaling reduced on segment 4, absent on 5. Wing length about 3.2 to 4.0 mm. Scales rather broad, intermixed white and dark brown to black. Apical half of costa with two dark-scaled spots separated by an area of white scales; vein A with intermixed dark and white scales on basal half to two-thirds, a dark-scaled patch at distal two-thirds, distal part white-scaled. Fringe scales arranged in alternating dark and pale patches.

MALE — Coloration similar to that of the female.

LARVA—Antenna a little shorter than the head; antennal tuft about eight to fifteen branched, barbed, inserted near middle of shaft. Comb of eighth segment with 4 to 8 scales in a curved row in the posterior margin of a weakly sclerotized area. Siphon moderately inflated; pecten usually of four to six progressively longer teeth on basal third of siphon.

BIOLOGY—This species is apparently well adapted to temporary pools on the arid plains where, under favorable conditions, it may complete its life cycle in one week. The larvae occur in temporary ground pools or in depressions of dried up stream beds.

There is some question of the aggressiveness of this species to humans. In places where they are abundant, females are rarely observed to bite. The species has been reported to be annoying at times in Nebraska and Iowa. Since it is sparsely distributed in South Dakota it is probably of no great importance.

DISTRIBUTION — *Psorophora signipennis* has been collected in Bon Homme, Brookings, Charles Mix, Harding, Fall River, Hughes, Union and Yankton Counties.

Aedes (Ochlerotatus) campestris Dyar and Knab

FEMALE — A rather large light-colored species similar in appearance to *A. dorsalis*. The mesonotum has a broad median stripe of brown scales and short posterior lateral stripe; the lateral margins are bronzy-brown; the remainder of the mesonotum with yellowish-white scales. The abdominal tergites are clothed with white and dark scales; posterior tergites often all white, others with submedian dark patches. Some tarsal segments of middle and hind legs with apical and basal white rings; fifth segment of hind tarsus almost entirely white; fifth segment of middle tarsus almost all dark; front tarsus with white basal rings only on segments 2 and 3; 4 and 5 all dark. Wings with white and dark scales evenly intermixed, the white predominating.

MALE—Apical lobe of basistyle broadly rounded, covered with rather long setae; basal lobe slightly conical, bearing one large spine on the basal margin and covered with many fine and coarse setae. Filament of claspette nearly as long as the stem, sickle-shaped, roundly expanded or ligulate.

LARVA — Upper frontal head hair 5 with two or three branches; lower frontal 6 usually single. Comb of eighth segment a triangular patch of twenty to thirty scales. Siphon about three times as long as its basal diameter; pecten extending beyond middle of siphon with from one to four of the distal teeth more widely separated. Gills shorter than the saddle, often small, budlike.

BIOLOGY—The winter is passed in the egg stage and there is apparently only 1 generation each season. Eggs hatch in the early spring and larvae are frequently found in the same pools with *A. dorsalis*. Preferred larval habitats include irrigation waste water, and small alkaline pools rich in organic matter. The females attack at any time during the day and are strong flyers. Adults may be encountered from early spring until the first frost.

This is a common mosquito in the western part of South Dakota and may appear in sufficient numbers to be annoying locally.

DISTRIBUTION — *Aedes campestris* has been collected from Beadle, Brule, Codington, and Perkins Counties.

Aedes (Ochlerotatus) canadensis canadensis (Theobald)

FEMALE — A medium-sized brown mosquito. Mesonotum clothed with golden-brown scales; yellowish-white scales on anterior and lateral margins and on the prescutellar space. Abdominal tergites dark-scaled, with narrow basal white bands. Tarsal segments with apical and basal white rings; hind tarsal segment 5 entirely white. Wing scales narrow, all dark.

MALE — Apical lobe of basistyle a large, broadly rounded area bearing many short, flattened, spatulate setae; basal lobe of basistyle large, somewhat triangular, and bearing many short setae. Claspette stem slender, pilose, and bearing two setae near apex; claspette filament slender, about two-thirds as long as the stem.

LARVA — Upper frontal head hair 5 usually with four to nine branches, lower frontal head hair 6 usually with four to eight branches. Siphon about three times as long as its basal diameter; pecten teeth uniformly spaced, extending slightly over one-half of the siphon. Comb of eighth segment with many scales in a triangular patch.

BIOLOGY — This mosquito overwinters in the egg stage and hatches in the spring. The larval habitats are usually small, tree-shaded pools with an accumulation of dead leaves or decaying vegetation. The females are aggressive and feed on man in shaded places at any time.

Aedes canadensis has not been

found in sufficient numbers to be regarded as an important species in South Dakota.

DISTRIBUTION – *Aedes canadensis* has been collected from Bon Homme, Brookings, and Spink Counties.

Aedes (Ochlerotatus) dorsalis
(Meigen)

FEMALE – A medium-sized mosquito, usually yellowish-white in appearance. Mesonotum variable in color pattern, a median longitudinal brown stripe may be prominent or reduced to a few brown scales, posterior brown half-stripes may or may not be present; remainder of mesonotum with yellowish-white scales. Abdominal tergites predominantly white, with submedian patches of dark scales. Some tarsal segments on all legs with apical and basal white rings; fifth segment of middle tarsus entirely dark; fifth segment of hind tarsus almost entirely white. Wing scales brown and white intermixed, vein R4+5 with more dark scales than R3 and M2.

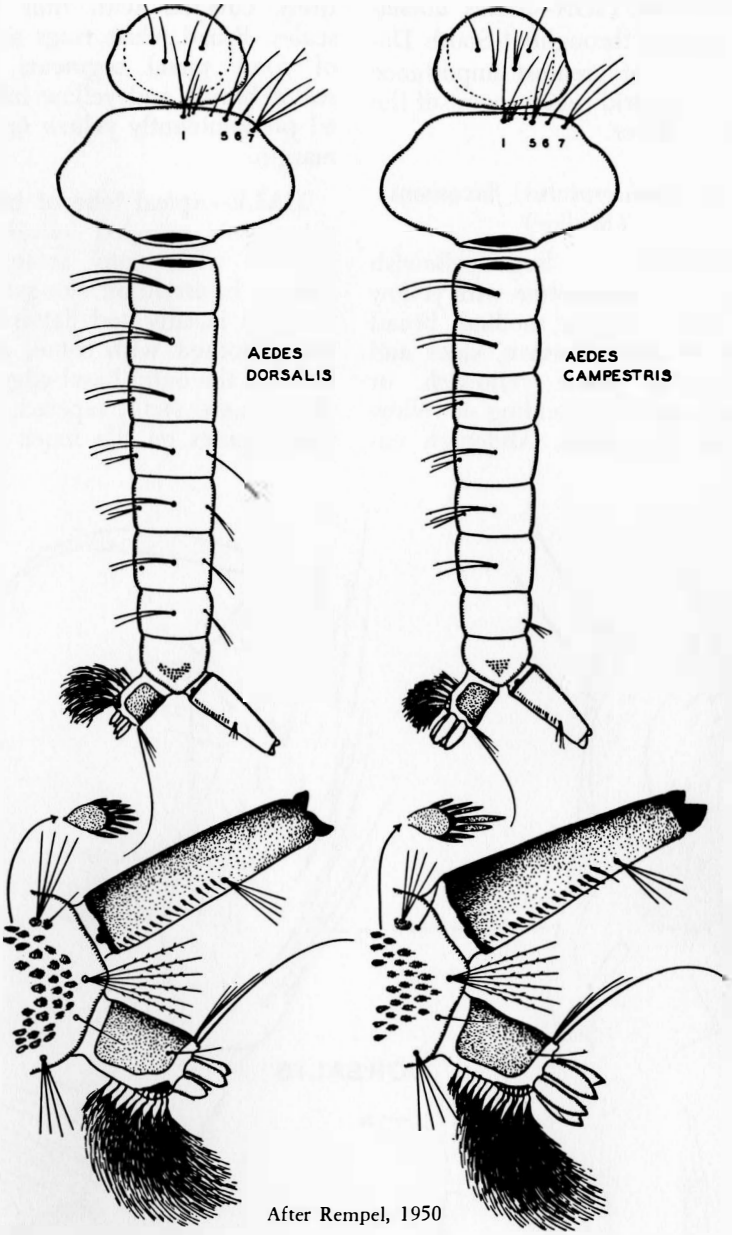
MALE–Apical lobe of basistyle rather broad, rounded, with short curved setae; basal lobe of basistyle slightly expanded apically, bearing a long, curved spine, one short, stout spine and a dense group of setae. Claspette stem pilose to near apex; filament of claspette nearly as long as the stem, broadly expanded in the middle on convex side, tapered to a tip.

LARVA – Upper frontal head hair 5 and lower frontal head hair 6 single, rarely double. Comb of eighth segment with twenty to thirty scales in a patch. Siphon about three times as long as its basal diameter; pecten teeth uniformly spaced, extending to middle of siphon. Anal gills usually not longer than the saddle.

BIOLOGY – This species overwinters in the egg stage and there may be several generations during the summer months. Under field conditions the eggs may hatch in a few days after being deposited or they may remain dormant. The number of broods each summer is apparently determined by the frequency with which small pools are flooded. The first larvae to appear in the spring are from eggs that have survived the winter. The larvae occur in a great variety of habitats. They may be found in shallow alkaline pools, semi-permanent ponds, irrigated meadows, or irrigation waste water.

Indiscriminate flooding of hay meadows and pastures, the typical irrigation method in western South Dakota, creates ideal conditions for the breeding of *Aedes dorsalis*. The females are attracted to man and all large domestic animals. In certain localities they occur in enormous numbers, feeding aggressively at any time during the day or night.

Aedes dorsalis is the most abundant mosquito in many localities in western South Dakota and is a major pest of man and animals. In addition to being a pest mosquito it must be numbered among those species of importance in the transmission of encephalitis.



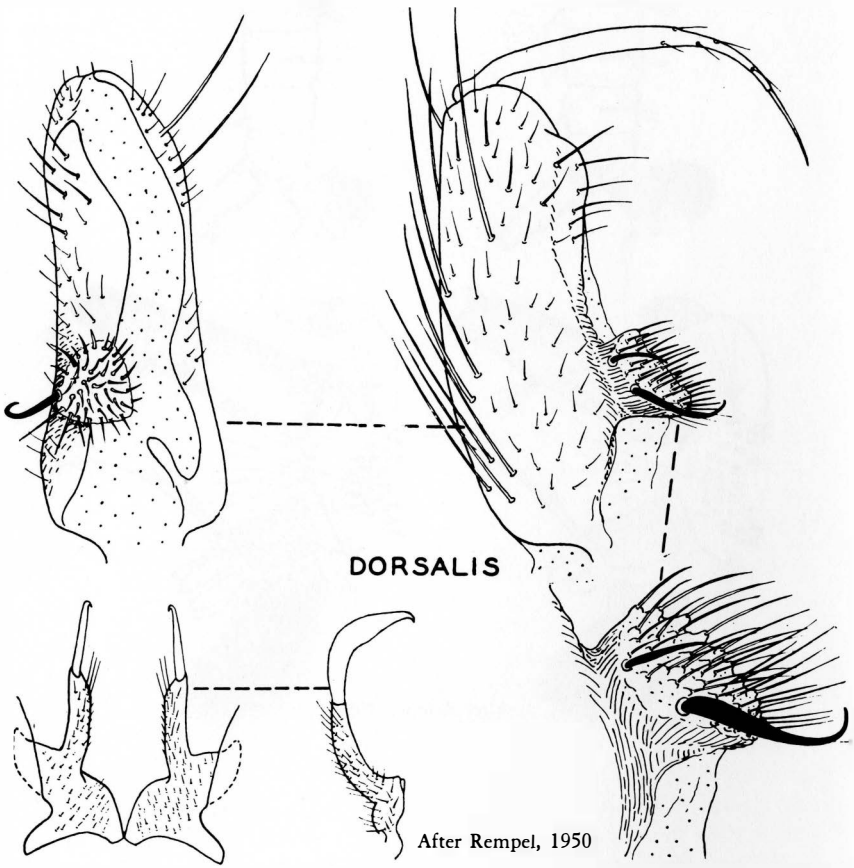
After Rempel, 1950

DISTRIBUTION—*Aedes dorsalis* is present throughout South Dakota. It is of greatest importance in the semi-arid regions west of the Missouri River.

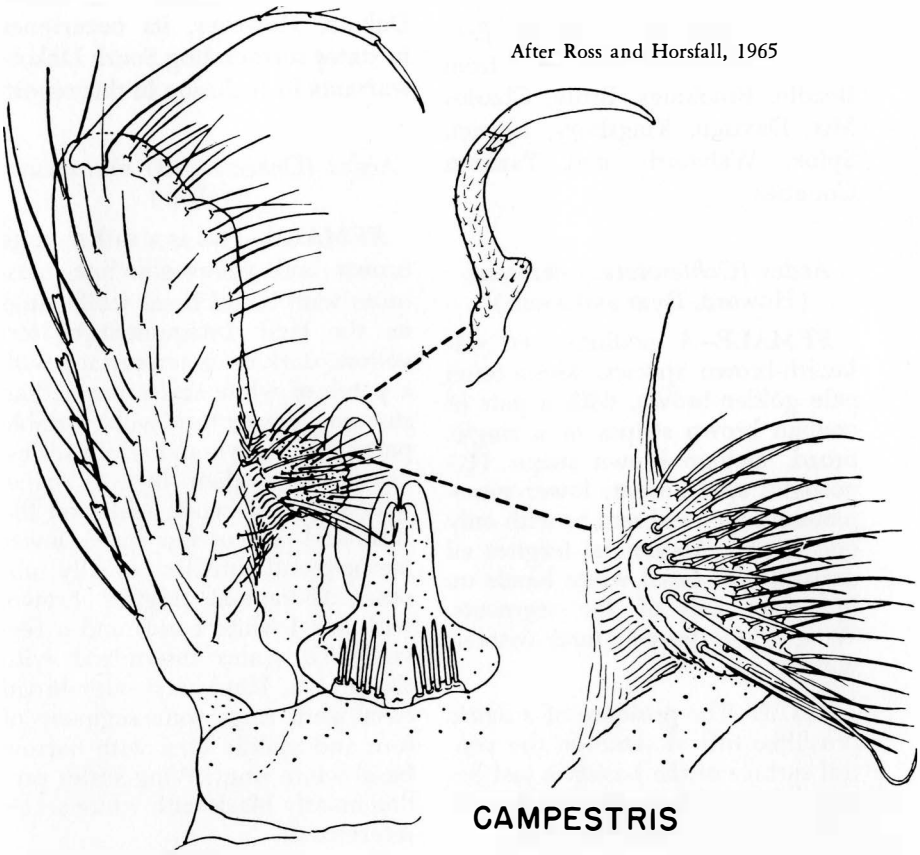
Aedes (Ochlerotatus) flavescens (Muller)

FEMALE – A large yellowish mosquito. Mesonotum with yellow to brown scales, median broad stripe of bronzy-brown, sides and prescutellar space yellowish, or sometimes with blending of yellow and brown scales. Abdomen entirely covered with dull yellow scales. Broad white rings at bases of some tarsal segments. Wing scales brown and yellow intermixed predominantly yellow on costal margin.

MALE—Apical lobe of basistyle prominent, rounded apically and covered with many setae; basal lobe of basistyle an elongate area, elevated basally and flattened distally, clothed with setae, a stout spine at the outer basal edge. Stem of claspette stout, tapered, pilose, three spines on the inner surface



After Rempel, 1950



near the base; filament of claspette almost as long as stem, angularly expanded in the middle and tapered to a recurved point.

LARVA – Upper frontal head hair 5 with three or four branches; lower frontal head hair 6 usually double. Lateral abdominal hair 6 double on segment I to VI. Comb of eighth segment with twenty to thirty-six scales in a triangular patch. Siphon about three times as long as its basal diameter; pecten reaching to near middle of siphon, one or two distal teeth may or may not be more widely separated. Anal gills usually longer than the saddle.

BIOLOGY—The eggs survive the winter months and hatch in the spring. The larvae are often found in the same pools with *Aedes dorsalis*. The preferred breeding places are irrigated meadows and temporary pools filled by overflow from streams.

Aedes flavescens is not a serious pest of man in South Dakota. It is a prairie species that attacks live-

stock but does not occur in large numbers in the state.

DISTRIBUTION – *Aedes flavescens* has been collected from Beadle, Brookings, Brule, Charles Mix, Davison, Kingsbury, Lyman, Spink, Walworth, and Yankton Counties.

Aedes (Ochlerotatus) dianteus
(Howard, Dyar and Knab)

FEMALE—A medium-sized yellowish-brown species. Mesonotum pale golden-brown, with a pair of median brown stripes or a single, broad, median brown stripe. Hypostigial spot absent; lower mesepimeral bristles absent or with only one or two. Abdominal tergites all dark or with basal white bands on less than half of the segments. Wing scales brown; tarsi without white rings.

MALE—The presence of a dense brushlike tuft of setae on the ventral surface of the basistyle just beyond the middle separates it from all other South Dakota *Aedes*.

LARVA—Antennae as long as or longer than the head, slender, spiculate. Upper frontal head hair 5 with three or four branches; lower frontal head hair 6 double or triple. Comb of eighth segment with about eight or ten scales in an irregular row. Pecten with one to three or more widely separated teeth. Gills longer than the saddle, pointed.

BIOLOGY—The winter is passed in the egg stage. Larvae are found in cold shaded pools in forested areas.

DISTRIBUTION – This species has not been collected in South Dakota. However, its occurrence in states surrounding South Dakota warrants its inclusion in this report.

Aedes (Ochlerotatus) excrucians
(Walker)

FEMALE—This is a rather large brown and yellowish-white mosquito with broad basal white rings on the tarsi. Integument of tori yellow, dark on inner surface with a patch of white scales on median surface. Mesonotum with variable pattern of brown and white scales, usually a median brown stripe, with yellowish white scales on the sides and prescutellar space; lower mesepimeral bristles usually absent. Abdominal tergites brown, with basal white bands and a few yellowish scales intermixed with the brown. Hind tarsi with broad basal white rings; some segments of fore and middle tarsi with narrow basal white rings. Wing scales predominantly black with white scales intermixed.

MALE – Apical lobe of basistyle broadly rounded and clothed with short setae; basal lobe of basistyle broad, long, extending to near base of apical lobe and covered with numerous small setae arising from tubercules. Stem of claspette long, slender; filament of claspette shorter than stem, angularly expanded near its base.

LARVA – Upper frontal head hair 5 and lower frontal head hair 6 usually double (hair may be triple on one side, either 5 or 6 sometimes single); lateral abdom-

inal hair 6 usually double on segments I and II, single on III to VI; comb scales in a triangular patch. Siphon about five times as long as its basal diameter; pecten extending to near middle of siphon, one to three of apical teeth more widely separated.

BIOLOGY—There is one generation each year and the winter is passed in the egg stage. Larvae have been found during the first week of June and adults persist until August. Larvae occur in temporary pools in wooded areas and at times in shaded pools on grasslands. The females feed most actively at dusk.

DISTRIBUTION – *Aedes excrucians* has not been collected in South Dakota, but undoubtedly occurs here.

Aedes (Ochlerotatus) fitchii
(Felt and Young)

FEMALE – A medium-sized brown and yellowish-white species that is difficult to separate from *A. excrucians, A. increpitus,* and *A. stimulans.* Tori with white scales on dorsal half. Mesonotum clothed with yellowish-white scales around the sides and prescutellar space, a median brown stripe in the middle, pattern somewhat variable; lower mesepimeral bristles either absent or usually not more than two in number. Abdominal tergites with broad basal white bands. Hind tarsi with broad basal white rings on all the segments; some segments of fore and middle tarsi with narrow basal white rings, fifth segment usually dark on these tarsi.

MALE—Apical lobe of basistyle prominent, rounded, bearing rather long stout setae; basal lobe of basistyle triangular, clothed with setae and bearing a stout spine on the outer basal side. Stem of claspette extending beyond basal lobe; filament of claspette short, bladelike, notched at base on concave side and ending in a recurved point.

LARVA – Upper frontal head hair 5 with three or four branches; lower frontal head hair 6 usually double; lateral abdominal hair 6 double or triple on segments I and II, double on segments III to VI. Comb of eighth segment in a triangular patch. Siphon long, gradually tapering from base, about four times as long as its basal diameter; pecten extending to near middle of siphon teeth regularly spaced.

BIOLOGY—The winter is passed in the egg stage and there is only one generation each year. Larvae occur in a variety of habitats and are commonly associated with irrigation waste water.

DISTRIBUTION – *Aedes fitchii* has not been collected in South Dakota, but as it is found in surrounding states it seems likely to occur here as well.

Aedes (Ochlerotatus) idahoensis
(Theobald)

FEMALE – A medium-sized dark-gray mosquito with many characters similar to *A. spencerii.* Nielson and Rees (1959) are of the opinion that *idahoensis* is a sub-species of *spencerii.* Mesonotum clothed with gray scales; two

narrowly separated median bands of brown scales usually evident. Posterior pronotum clothed on dorsal half with white or light-brown scales. Lower mesepimeral bristles absent. Abdominal tergites with broad basal white bands, sometimes pale scales on apical margin of some segments. Tarsi dark scaled. Wing with light and dark scales; costa; veins R1, R4+5 and M1 dark, others with light-colored scales.

MALE – Similar to *A. spencerii*. Apical lobe of basistyle broadly rounded and covered with short, curved setae; basal lobe of basistyle constricted at base and broadly expanded apically, bearing many setae and a long spine with curved tip which arises from inner angle of lobe. Stem of claspette short, pilose on basal half; filament of claspette expanded near base on concave side, tapering to a curved tip.

LARVA – Separated from *A. spencerii* by minor differences. Upper frontal head hair 5 and lower frontal head hair 6 single (rarely either double). Comb of eighth segment composed of thirteen to twenty-nine scales in a patch, single scale with a spine of medium length arising abruptly from basal part, many lateral spinules. Siphon about two and one-half times as long as its basal diameter; pecten reaching above the middle, two or three distal teeth more widely spaced.

BIOLOGY – *Aedes idahoensis* overwinters in the egg stage and has only one generation each year. Eggs hatch in the spring when small pools are filled by overflow of streams, irrigation of meadows, or spring rains. Females are attracted to man and domestic animals; and feed during daylight hours.

Aedes idahoensis is a common mosquito in the Rocky Mountain States. It probably occurs more frequently in the western part of South Dakota than present records indicate. It is not sufficiently abundant to be of any importance in this state.

DISTRIBUTION—*Aedes idahoensis* is known only from Charles Mix County.

Aedes (Ochlerotatus) increpitus (Dyar)

FEMALE – A medium-sized gray mosquito; mesonotum with a broad median stripe of dark scales and a varied pattern of dark and yellowish-white scales on the submedian area, anterior margin and prescutellar space with narrow yellowish-white scales. Lower mesepimeral bristles one to five in number. Abdominal tergites dark with basal white bands. Tarsi with broad white rings on some of the segments.

MALE—Apical lobe of basistyle prominent, with scattered small setae; basal lobe of basistyle a rounded rugose area extending about halfway to apical lobe, bearing many short setae. Stem of claspette long, slender, pilose; filament of claspette as long as the stem, expanded in the middle to form a

toothlike projection, tapering to a recurved point.

LARVA—Upper head hair 5 usually double or triple; lower head hair 6 single or double. Lateral abdominal hair 6 usually double on segments I to VI. Comb of eighth segment with twenty or more scales in a patch. Siphon about three times as long as its basal diameter; pecten extending to near middle of siphon, teeth evenly spaced. Saddle extending more than halfway down sides of anal segment; spicules well-developed at apex. Anal gills usually about the length of saddle.

BIOLOGY — Eggs of *Aedes increpitus* are among the first to hatch in the spring after surviving the winter. There is only one generation a year. The larvae are found in a great variety of small pools and semipermanent ponds which appear in the spring following snow runoff. The species is frequently associated with stream courses.

Although *Aedes increpitus* is a common mosquito in the Rocky Mountain area, its distribution in South Dakota seems to be limited to the Black Hills where its occurrence is sporadic.

DISTRIBUTION — *Aedes increpitus* has been collected from Custer, Fall River, and Pennington Counties.

Aedes (Ochlerotatus) intrudens
(Dyar)

FEMALE — A medium-sized dark-gray mosquito; mesonotum covered with light-brown scales, shading to yellowish white on the anterior and lateral margins; some specimens show faint, paired, median dark-brown lines. Lower mesepimeral bristles one to five. Abdominal tergites black, with broad basal white bands. Tarsi dark. Wing scales dark, with or without a small patch of white scales at base of costa.

MALE — Basistyle with dense tuft of long setae arising from ventral surface near the apex; apical lobe of basistyle rather long, two stout spines at apex and a single long spine on outer surface at base. Filament of claspette pilosé on basal half, projection in middle ending in a stout seta, part beyond projection more slender; filament of claspette expanded on convex side to form a pointed angle.

LARVA — Upper frontal head hair 5 with three or more branches; lower frontal head hair 6 double or triple. Comb of eighth segment with twelve to sixteen scales in an irregular double row, individual scale thornshaped with minute lateral spinules on basal half. Siphon about three times as long as its basal diameter; pecten extending to about two-thirds the length of siphon, with one to three distal teeth more widely separated. Saddle deeply incised on ventral margin.

BIOLOGY — This is a single brooded species. The larvae occur in June and early July, usually at higher elevations. The females are persistent biters. The species is rare in South Dakota and of no importance.

DISTRIBUTION — *Aedes intrudens* is known only from Butte County.

Aedes (Ochlerotatus) nigromaculis (Ludlow)

FEMALE — A rather large yellowish-gray species,with a white ring or patch of scales near the middle of the proboscis. Mesonotum with a broad median golden-brown stripe, remainder of dorsal surface clothed with scales varying in shades of yellow, lateral margins darker. Hypostigial spot of scales present. Lower mesepimeral bristles absent or, rarely, only one. Abdominal tergites with yellowish scales usually forming a longitudinal median stripe. Some tarsal segments with basal white rings, broad on hind legs. Wing scales dark with a few yellow scales intermixed.

MALE — Basistyle without a distinct apical lobe; basal lobe of basistyle small, slightly rounded bearing numerous fine setae. Stem of claspette pilose, stout, extending to middle of basal lobe of basistyle; claspette filament as long as the stem, slender, curved at the tip.

LARVA — Upper frontal head hair 5 and lower frontal head hair 6 single. Comb of eighth segment with six to twelve scales in an irregular single row. Siphon about two and one-half times as long as its basal diameter; pecten reaching outer fourth of siphon, with two to four distal teeth more widely separated. Anal segment ringed by the saddle.

BIOLOGY — *Aedes nigromaculis* is a multi-brooded species. The larvae occur from April until late September and are found particularly in pools produced by irrigation flood water. The females are strong flyers and bite persistently.

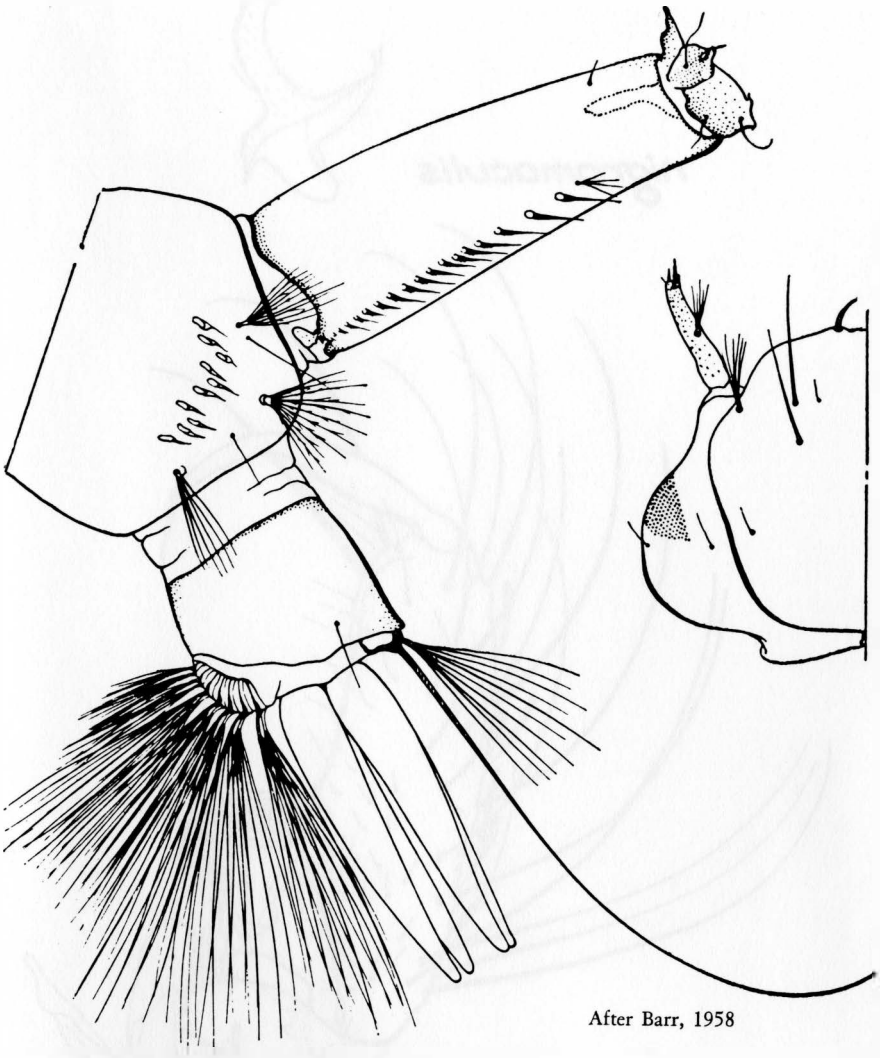
This species has adapted itself to the habitats offered by irrigated agriculture in California, where *Aedes nigromaculis* is the object of most mosquito control efforts. The species is distributed throughout South Dakota and is particularly abundant west of the Missouri River. As agricultural irrigation spreads throughout this region this mosquito can be expected to be increasingly important.

DISTRIBUTION — *Aedes nigromaculis* occurs throughout South Dakota but reaches its maximum abundance in the semi-arid portion of the state west of the Missouri River.

Aedes (Ochlerotatus) sollicitans (Walker)

FEMALE — Medium-sized species. Proboscis dark-scaled, ringed with white near middle. Scutum with narrow golden to golden brown scales dorsally, becoming dark bronze-brown laterally. Scales on sternopleuron extending to anterior angle, not distinctly separate from patch on prealar area. Mesepimeron bare on lower one-third to one-half. Hypostigial spot of few to many scales. Lower mesepimeral bristles zero to one. First tergite with a median patch of yellowish-white scales; remaining tergites

nigromaculis

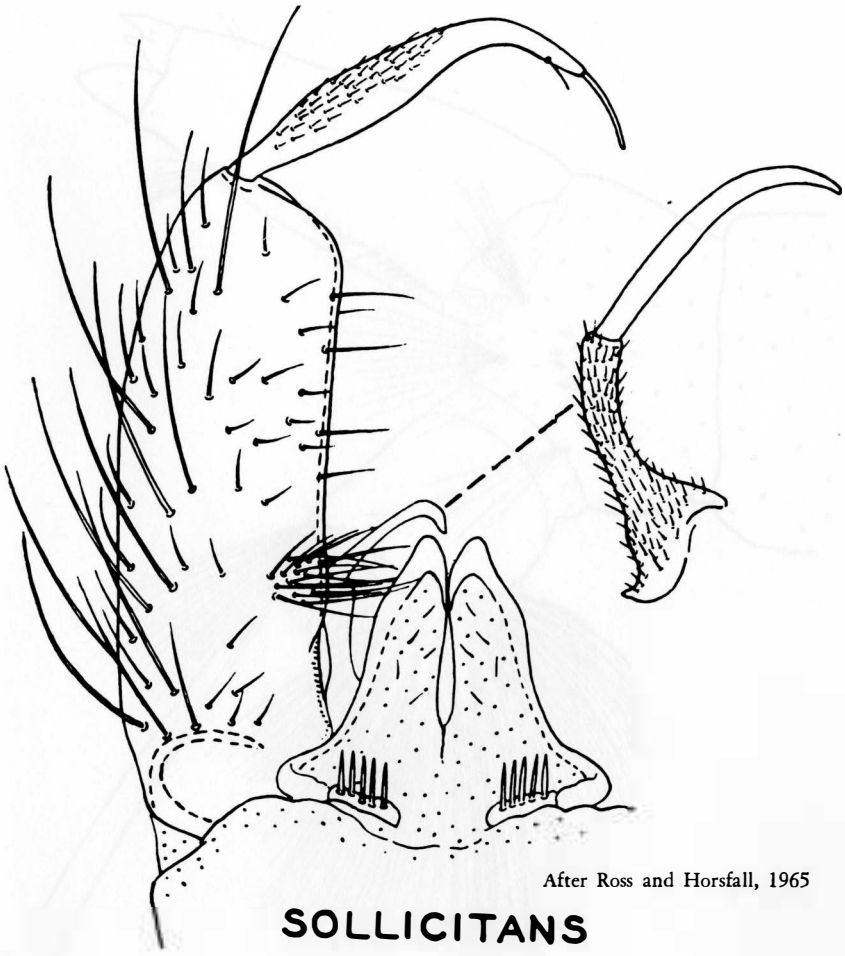


After Barr, 1958

dark, with a yellowish longitudinal median stripe. Hind tarsus with segment 1 ringed with white at base and with a yellow ring at middle, segments 2 to 4 with broad white basal rings, segment 5 entirely white; front and middle tarsi similarly marked.

MALE – Coloration similar to that of the female. Terminalia appear to be almost identical with *A. nigromaculis.*

After Barr, 1958



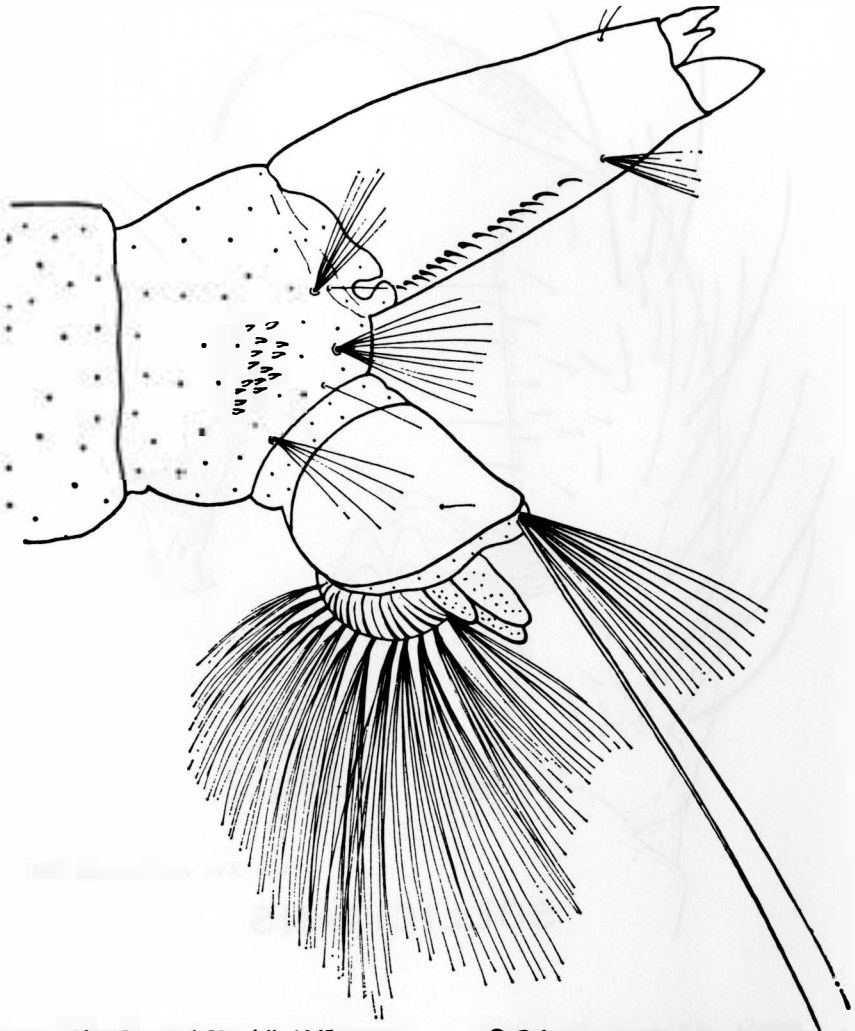
After Ross and Horsfall, 1965

SOLLICITANS

LARVA—Antenna about half as long as the head, spiculate; antennal tuft multiple barbed, inserted near middle of shaft. Head hairs: upper frontal 5 and lower frontal 6 long, usually single, smooth or finely barbed. Comb of eighth segment with about eleven to twenty-one scales in a patch; individual scale thorn-shaped, with a long apical spine and smaller lateral spinules. Pecten of about fifteen to twenty-seven evenly spaced teeth reaching middle of siphon or slightly beyond (the distal tooth occasionally detached on one side).

BIOLOGY – Larvae of *A. sollicitans* occur mostly in salt marshes in coastal areas. The species is found inland associated with brackish water swamps.

The adults are strong fliers and migrate many miles from their scource. The females are persistent



After Ross and Horsfall, 1965

biters and will attack at any time, day or night.

DISTRIBUTION – *A. sollicitans* has been collected from Brookings, Buffalo, Butte, Day, Hand, Harding, Hyde, Lake, and Union Counties.

Aedes (Ochlerotatus) spencerii
(Theobald)

FEMALE – A medium-sized pale-yellow mosquito with color markings similar to *A. idahoensis.* Mesonotum clothed with yellowish-white scales, a broad median

longitudinal stripe of brown scales extending from near anterior margin posteriorly to prescutellar area. Posterior pronotum clothed with brown scales, with white scales usually present in the lower corner. Lower mesepimeral bristles absent. Abdominal tergites with apical and basal white bands, with a median white stripe, or almost entirely white-scaled. Tarsi largely dark-scaled, without white rings.

MALE – Indistinguishable from *A. idahoensis.*

LARVA – The larvae are very similar to *A. idahoensis.* Upper frontal head hair 5 and lower frontal head hair 6 single. Comb of eighth segment with seven to thirteen scales in an irregular double row, each scale with a long spine gradually tapered from the basal part, with minute lateral spinules on basal part (length of scale about one-third greater than in *A. idahoensis*). Siphon about twice as long as its basal diameter; pecten extending beyond middle of siphon, with one to three distal teeth more widely spaced.

BIOLOGY – Overwintering is by the egg stage and hatching occurs in early spring. According to Rempel, (1950) two or even three broods may appear if weather conditions are favorable during the summer. The larvae are found in temporary rain pools, irrigated meadows, roadside ditches and marsh areas. Females are active at all hours of the day and are persistent biters.

DISTRIBUTION – *Aedes spencerii* has been collected from Brookings, Butte, McPherson and Fall River Counties.

Aedes (Ochlerotatus) sticticus (Meigen)

FEMALE – A medium-sized pale-brown species. Mesonotum clothed with yellowish-white scales; two stripes of golden-brown scales extending to the prescutellar space, these stripes separated by a narrow median line of pale scales which is sometimes indistinct; posterior half stripes of golden-brown scales; sides yellowish-white. Lower mesepimeral bristles absent. Abdominal tergites dark-scaled, with narrow basal white bands. Tarsi dark, with scattered pale scales. Wing scales dark.

MALE–Apical lobe of basistyle broadly rounded, bearing many short retrorse setae; basal lobe of basistyle prominent, expanded apically, bearing many short setae; a large spine near base followed by a tuft of setae. Stem of claspette stout on basal third, constricted toward apex; filament of claspette shorter than stem, bladelike, slightly expanded at middle.

LARVA – Upper frontal head hair 5 with two to four branches; lower frontal head hair 6 usually double. Lateral abdominal hair 6 usually double on segments I and VI. Comb of eighth segment of eighteen to twenty-five very short scales. Siphon about two and one-half times as long as its basal diameter; pecten teeth evenly spaced, reaching to near the middle of the siphon.

BIOLOGY—This species has a single generation each year. The larvae are commonly found in flood water pools along streams. This mosquito is not abundant in South Dakota but may be of local pest importance.

DISTRIBUTION — *Aedes sticticus* has been collected from Bon Homme, Butte, Hutchinson, Spink, and Yankton Counties.

Aedes (Ochlerotatus) stimulans
(Walker)

FEMALE — A medium - sized light-brown mosquito. Mesonotum clothed with light-brown scales, with a broad median longitudinal stripe of brown scales, sometimes a varying pattern of brown and paler scales; prescutellar space and lateral margins whitish. Hypostigial spot of scales absent. Lower mesepimeral bristles one to four. Abdominal tergites with broad basal bands of pale-yellow scales, apical half of each tergite dark, with scattered pale scales. Tarsi with broad basal white rings on hind legs, narrower on front and middle legs. Wing scales dark, with pale scales intermixed along the anterior veins.

MALE—Apical lobe of basistyle prominent, rounded, with rather long setae; basal lobe of basistyle low, broadly rounded, bearing numerous setae and a stout curved marginal spine. Stem of claspette slender, slightly curved and pilose on basal half; filament of claspette almost as long as the stem, sickle-shaped, with an angular expansion near the middle.

LARVA — Upper frontal head hair 5 usually double; lower frontal head hair 6 single. Lateral abdominal hair 6 double or triple on segment I, usually double on segments II to V, single on VI. Comb of eighth segment with twenty-five to thirty-five scales in a triangular patch; each scale with an apical spine about one and one-half times as long as the subapical spines. Siphon about three times as long as its basal diameter; pecten teeth evenly spaced, confined to basal third of siphon. Saddle extending about two-thirds down sides of anal segment, apical part spiculate.

BIOLOGY — There is a single generation each year. Eggs hatch in early spring after overwintering in dry depressions of ponds which will be flooded by melting snow and spring rains. Larvae are usually most common in woodland pools. The adults bite in shaded areas during all hours of the day. This species is rare in South Dakota and thus of no major importance.

DISTRIBUTION — *Aedes stimulans* has been collected from Brookings, Spink, and Yankton Counties.

Aedes (Ochlerotatus) trivittatus
(Coquillett)

FEMALE — A medium-sized yellowish-brown mosquito. Mesonotum clothed with bronzy-brown scales, a pair of submedian stripes of yellowish-white scales separated by a median brown stripe of about equal width; anterior margin and

prescutellar space with yellowish-white scales. Lower mesepimeral bristles absent. Abdominal tergites dark with basolateral patches of white scales, sometimes, small median basal patches of white scales present. Legs dark-scaled. Wing scales dark.

MALE—Apical lobe of basistyle short, rounded, bearing a few minute setae; basal lobe conical, bearing numerous short setae, a long, curved spine near base associated with long fine setae. Stem of claspette short; filament of claspette almost as long as stem, expanded, blade-like near middle, with short spine-like projection.

LARVA – Upper frontal head hair 5 and lower frontal head hair 6 single. Comb of eighth segment with seventeen to twenty-six scales in a triangular patch, each scale with a large apical spine about one and one-third times as long as the subapical spines. Siphon twice as long as its basal diameter; pecten teeth evenly spaced, reaching beyond middle of siphon. Anal segment ringed by the saddle; gills more than twice as long as the saddle, tapered to a point.

BIOLOGY– Overwintering is by the egg stage. The spring emergence of adults is rather late. Thus it is a summer species rather than spring. Females apparently remain close to their points of origin; resting in vegetation.

DISTRIBUTION – *Aedes trivittatus* has been collected from Beadle, Bon Homme, Brookings, Brule, Butte, Corson, Davison, Fall River, Hughes and Spink Counties.

Aedes (Finlaya) triseriatus (Say)

FEMALE – A medium-sized dark mosquito with scales of silvery-white on the head and thorax. Mesonotum with a wide median stripe of dark-brown scales which becomes wider posteriorly; anterior margin and sides with silvery-white scales. Lower mesepimeral bristles absent. Abdominal tergites black, basal patches of white scales on the sides. Tarsi dark. Wing scales all dark.

MALE – Basistyle without a well-defined apical lobe; a small patch of long setae in area of apical lobe; basal lobe reduced to a small raised area at base of basistyle, bearing a dense patch of setae. Stem of claspette short, pilose to near apex; filament of claspette longer than the stem, slender, tapering at the point.

LARVA – Upper frontal head hair 5 single; lower frontal head hair 6 double or triple. Comb of eighth segment with none to fifteen scales, each scale evenly fringed with small spinules. Siphon about three times as long as its basal diameter; pecten scales evenly spaced, reaching near middle of siphon. Anal gills about as long as saddle, bluntly rounded at apex.

BIOLOGY—The winter is passed in the egg stage and there may be more than one generation during the summer. Larvae are found in water which accumulates in holes in deciduous trees. Eggs are laid on sides of the holes above the water line and hatch when the eggs become submerged.

The adults are typically found

in woodland areas, and they will bite aggressively at any time during the day.

DISTRIBUTION — *Aedes triseriatus* has been collected in Bon Homme, Brookings, Butte, Fall River, Harding, Lincoln, Pennington, and Yankton Counties.

Aedes (Aedimorphus) vexans (Meigen)

FEMALE — A medium - sized dark-gray mosquito. Mesonotum clothed with bronzy-brown scales, those on the anterior and posterior-lateral margins and prescutellar space lighter in color. Hypostigial spot of scales absent. Lower mesepimeral bristles absent. Abdominal tergites dark-scaled, with basal white bands which widen laterally into triangular patches; last three tergites with some white scales on the apical margins. Tarsi dark, with narrow basal white rings. Wing scales dark.

MALE — The genitalia differ from other South Dakota *Aedes* as follows: dististyle with the claw arising before the apex, filament of claspette absent.

LARVA — Antennae spiculate, a multiple tuft near the middle of shaft, upper frontal head hair 5 with three to five branches; lower frontal head hair 6 double or triple. Comb of eighth segment with nine to twelve scales in an irregular single or double row, each scale with a long median spine and short lateral spinules at the base. Siphon about three times as long as its basal diameter, pecten reaching beyond the middle, with one to three distal teeth more widely spaced. Saddle extending about seven-eighths down the sides of the anal segment, ventral margin not incised.

BIOLOGY — This species is unquestionably the most important pest mosquito occurring in South Dakota. *Aedes vexans* overwinters in the egg stage. Hatching begins in the early spring when the breeding places are flooded. Not all the eggs hatch at this time. Later in the season when the pools become dry and are flooded again, additional numbers hatch. Eggs of this species laid in the spring may hatch the same summer if subjected to desiccation and are later flooded.

The larvae are found in temporary ground pools of all types. Irrigated meadows, and pools formed by overflow of streams are common larval habitats. Females are persistent in attacks on man and domesticated animals and will feed in the shade during the daytime but are mostly active at dusk.

DISTRIBUTION — *Aedes vexans* is found abundantly throughout the entire state of South Dakota.

Aedes (Aedes) cinereus (Meigen)

FEMALE—The adults are rather small, dark mosquitoes. Mesonotum evenly covered with reddish-brown scales; somewhat lighter on the margins and prescutellar space; lower mesepimeral bristles absent. Abdominal tergites dark, with narrow basal white bands, and usually with a continuous lateral line of

white scales. Tarsi and wings dark.

MALE—The first couplet of the key distinguishes the genitalia of this species from all other *Aedes* in South Dakota.

LARVA – Upper frontal head hair 5 with five to nine branches; lower frontal head hair 6 with four to eight branches; head hairs 5, 6 and 7 almost in a straight line. Comb scales five to sixteen in an irregular row. Pecten with one to three detached teeth; tuft beyond the pecten.

BIOLOGY – This species overwinters in the egg stage with only one generation each year. The preferred larval habitats are shaded woodland pools containing dead leaves and grasses.

A. cinereus occurs in small numbers in South Dakota and is of no importance.

DISTRIBUTION – *A. cinereus* has been collected from Beadle and Butte Counties.

Culex (Culex) pipiens (Linnaeus)

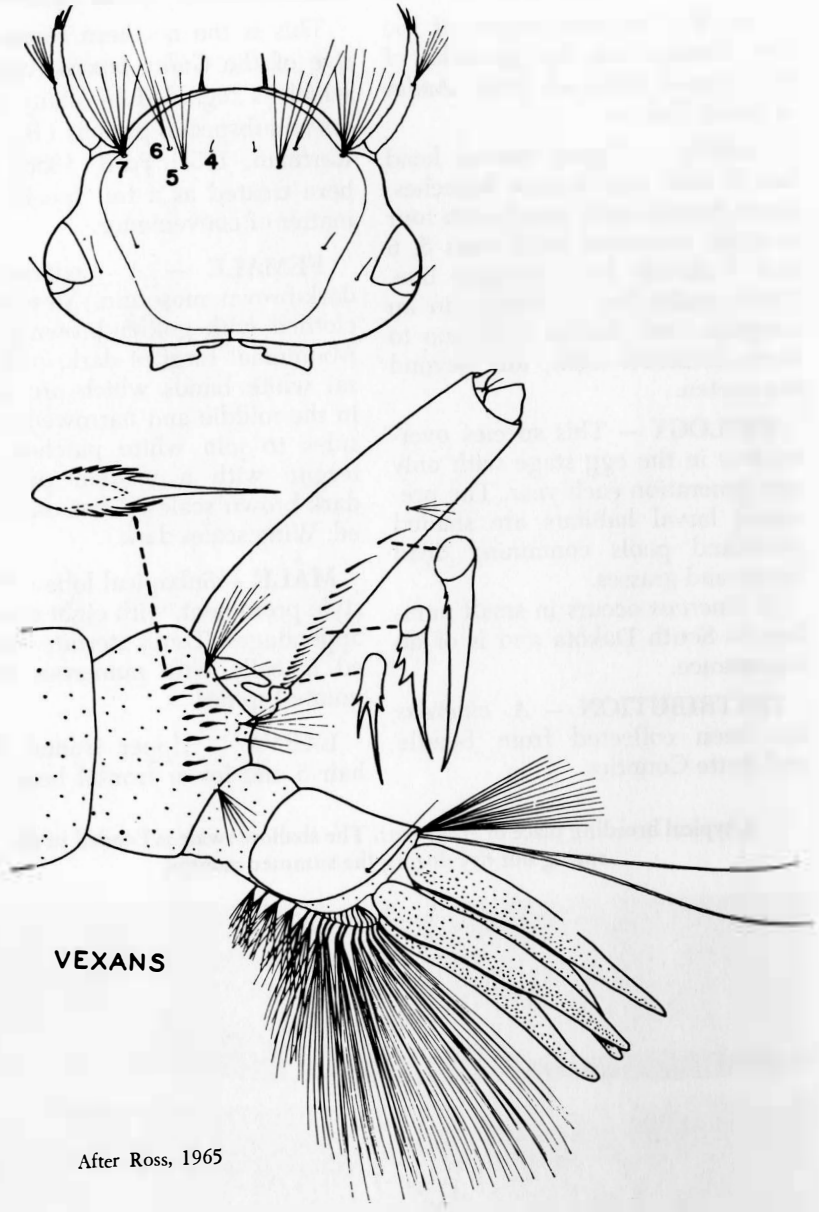
This is the northern representative of the *Culex pipiens* complex which is regarded by many workers as subspecies *pipiens* (Barr and Kartman, 1951; Pratt, 1956). It is here treated as a full species as a matter of convenience.

FEMALE – A medium-sized dark-brown mosquito. Mesonotum clothed with golden-brown scales. Abdominal tergites dark, with basal white bands which are broad in the middle and narrowed at the sides to join white patches; first tergite with a median patch of dark-brown scales. Tarsi dark-scaled. Wing scales dark.

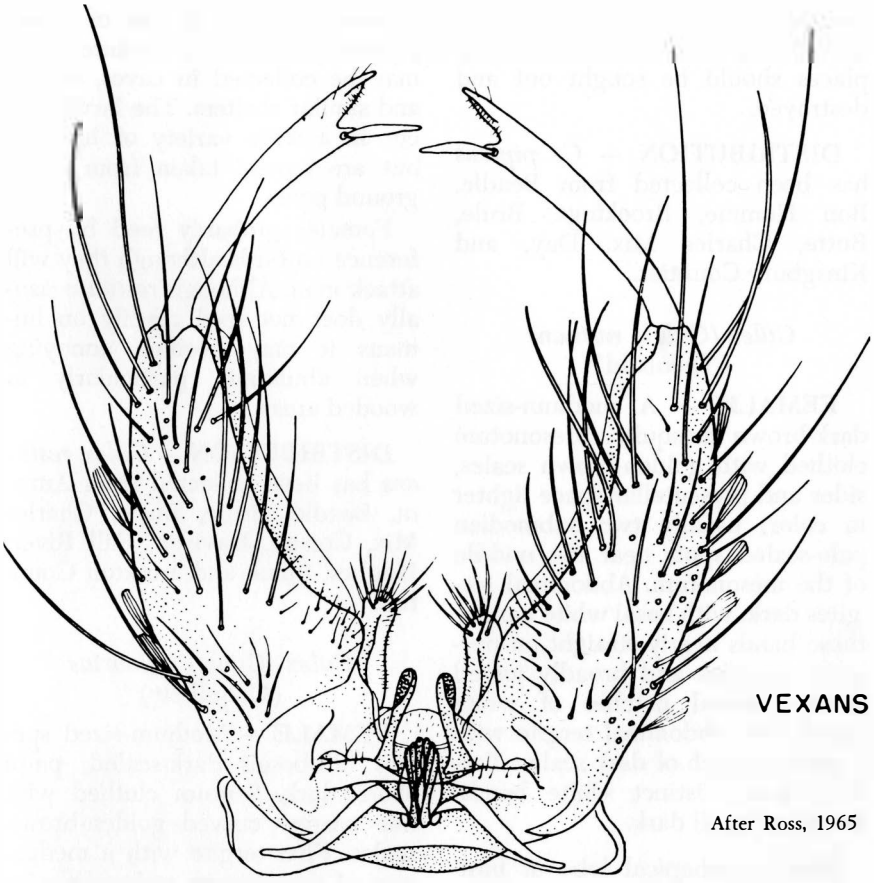
MALE – Subapical lobe of basistyle prominent, with eight or more appendages. Tenth sternite crowned apically with numerous short, pointed spines.

LARVA – Upper frontal head hair 5 and lower frontal head hair

A typical breeding place of *A. vexans*. The shallow swale is flooded in the spring but dry during the summer months.



After Ross, 1965



VEXANS

After Ross, 1965

6 with five or more branches. Comb of eighth segment with many scales in a patch. Siphon four times as long as its basal diameter; pecten on basal third of siphon; usually four pairs of siphonal hair tufts inserted beyond the pecten, the subapical one laterally out of line.

BIOLOGY—Overwintering is by the adult female. These can be collected easily during the winter months in caves, root cellars, and similar protected places.

Larvae are said to be found particularly in artificial containers, but they also can be collected from clear unpolluted ground pools. The aquatic stages require about one and one-half weeks to complete their development during warm weather.

Although *pipiens* females will feed on humans they are not annoying as a rule, since they appear to be reluctant to feed. If large populations occur, due to breeding in artificial containers, the species can be a major pest. Under such

conditions it is rather easily controlled. In such cases breeding places should be sought out and destroyed.

DISTRIBUTION – *C. pipiens* has been collected from Beadle, Bon Homme, Brookings, Brule, Butte, Charles Mix, Day, and Kinsgbury Counties.

Culex (Culex) restuans
(Theobald)

FEMALE – A medium-sized dark-brown mosquito. Mesonotum clothed with golden-brown scales, sides and prescutellar space lighter in color; usually two submedian pale-scaled spots near the middle of the mesonotum. Abdominal tergites dark, with basal white bands, these bands nearly straight on posterior margins and broadly joined to the lateral patches of white scales; first abdominal tergite with a median patch of dark scales. Tarsi without distinct white bands. Wing scales all dark.

MALE–Subapical lobe of basistyle with six appendages; leaf-like filament broad. Tenth sternite crowned with pointed spines. Each plate of phallosome with a single short tooth.

LARVA–Upper head hair 5 and lower head hair 6 with four to eight branches. Siphon about four and one-half times as long as its basal diameter; pecten on basal third; siphonal hair tufts beyond pecten consisting of three long, single hairs irregularly placed and a pair of small, subapical tufts of two to three branches.

BIOLOGY–The biology of this species is similar to that of *Culex pipiens*. Females overwinter and may be collected in caves, cellars and similar shelters. The larvae occur in a wide variety of habitats but are mostly taken from clean ground pools.

Females probably feed by preference on birds although they will attack man. Although *restuans* usually does not feed readily on humans it may become annoying when abundant, particularly in wooded areas.

DISTRIBUTION – *Culex restuans* has been collected from Aurora, Beadle, Brule, Butte, Charles Mix, Corson, Davison, Fall River, Hughes, Spink and Yankton Counties.

Culex (Culex) salinarius
(Coquillett)

FEMALE – Medium-sized species. Proboscis dark-scaled; palpi short, dark. Scutum clothed with fine narrow curved golden-brown scales. First tergite with a median area of dark-brown scales; remaining tergites primarily dark-brown scaled with bronze to metallic blue-green reflection, often with narrow to moderately broad basal bands of dingy-yellow scales. Legs dark-scaled with bronze reflection, posterior surface of femora and tibiae pale.

MALE – Coloration similar to that of the female, but with pale bands on abdominal tergites much broader. Phallosome consisting of two sclerotized plates connected near base. Each plate with a stout, pointed dorsal arm bent medially at a right angle; a stout, bluntly

pointed ventral arm bearing a small projection on its inner margin, and a group of strong pointed teeth. Claspette absent.

LARVA – Antenna shorter than the head, constricted beyond insertion of antennal tuft, with part before constriction pale and spiculate, part beyond constriction darker and with few spicules; antennal tuft large, multiple, barbed, inserted at outer third of shaft, reaching well beyond tip. Head hairs: Postclypeal 4 short, single; upper frontal 5 long, three to six branched, barbed; lower frontal 6 long, three to four branched, barbed, preantennal 7 long, multiple, barbed. Pecten of about ten to sixteen teeth on basal fourth of siphon; individual tooth with two to five coarse teeth on one side; usually four (occasionally five) paired two to four branched siphonal tufts inserted beyond pecten (the proximal tuft as long or longer than basal diameter of the siphon), the subapical tuft inserted laterally.

BIOLOGY – Females overwinter and larvae occur in ground pools containing brackish as well as fresh water. This species is reported to bite humans although its host preferences have not been studied.

Culex salinarius is widespread in South Dakota but seldom occurs in sufficient abundance to be a serious pest mosquito.

DISTRIBUTION – *Culex salinarius* has been collected from Beadle, Bon Homme, Brookings, Brule, Butte, Charles Mix, Corson, Davison, Fall River, Hughes, Spink, and Yankton Counties.

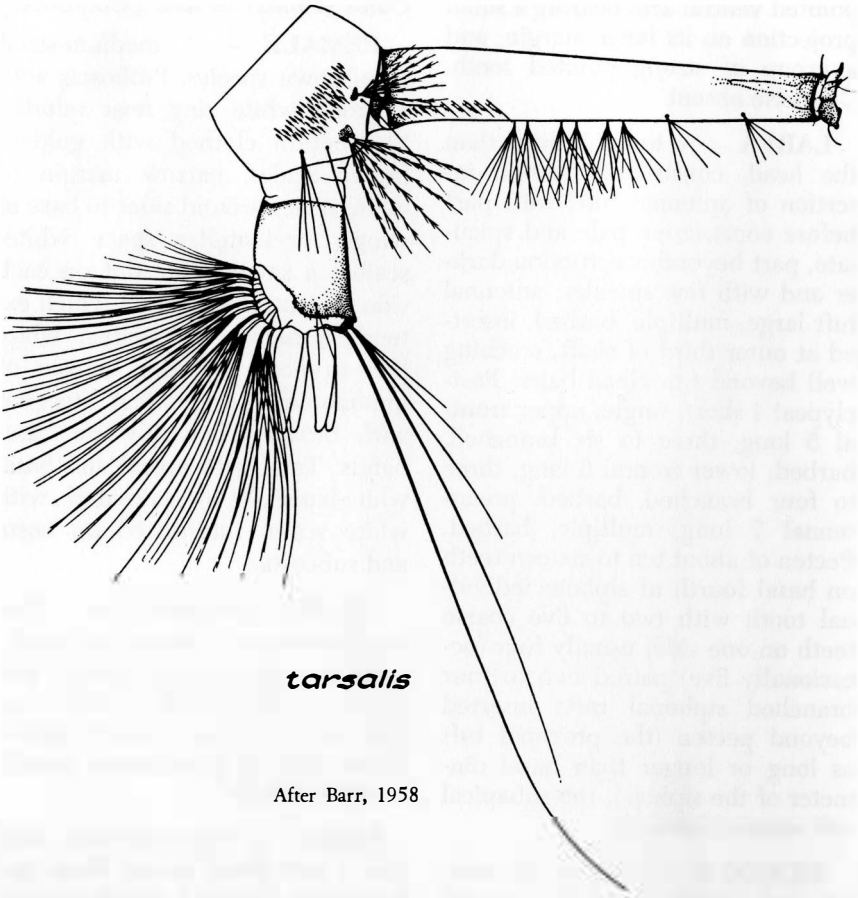
Culex (Culex) tarsalis (Coquillett)

FEMALE – A medium-sized pale-brown species. Proboscis with a broad white ring near middle. Mesonotum clothed with golden-brown scales, narrow margin of white scales around sides to base of wings; prescutellar space white-scaled; a small white dot on each side of central area from which extends a narrow submedian white line to near posterior margin of mesonotum. Abdominal tergites with broad yellowish-white basal bands. Tarsi with apical and basal white bands. Wing scales dark, with white scales intermixed on costa and subcosta.

MALE– Subapical lobe of basistyle prominent, triangular, usually with five appendages; leaflike filament narrow, clublike. Tenth sternite crowned with short spines. Outer half of phallosome usually with four teeth.

LARVA – Upper frontal head hair 5 and lower frontal head hair 6 multiple. Comb of eighth segment with many scales in a patch. Siphon four to five times as long as its basal diameter; pecten confined to basal third. Five pairs of siphonal hair tufts, all multiple and inserted in a straight line.

BIOLOGY – Overwintering is by the adult female. These can be collected during the winter months in food storage cellars and natural resting places such as hollow logs, tree stumps, and caves. Females appear to prefer bird blood although they will readily attack domestic animals and man.



tarsalis

After Barr, 1958

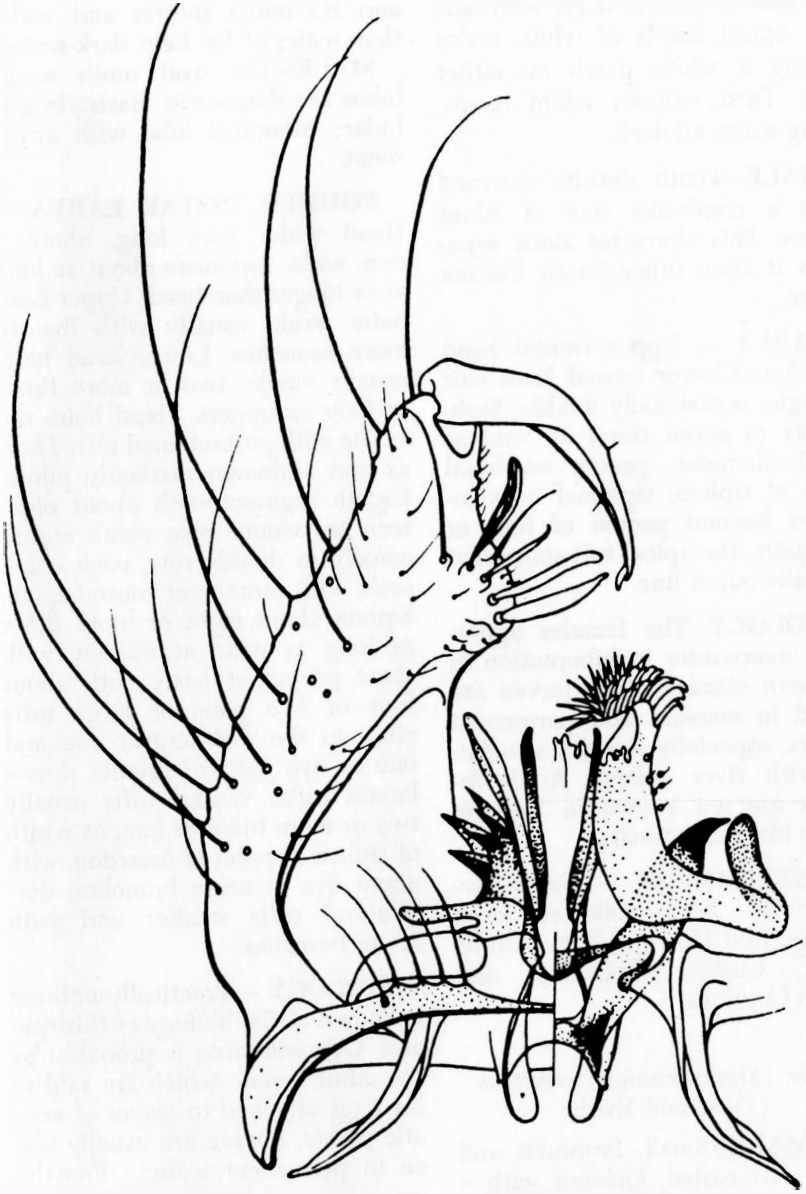
Larvae have been collected from an extremely wide variety of aquatic habitats, although they appear to prefer clear ground pools in northern climates. There are several generations each year. Larval development may be completed in from one and one-half to two weeks during warm weather. Numbers of adult mosquitos encountered increase steadily during the summer, with the peak just prior to the first killing frost of fall.

This species is the most important vector of equine encephalitis in the United States. *Culex tarsalis* is the most frequently encountered member of this genus in South Dakota.

DISTRIBUTION – *Culex tarsalis* occurs throughout South Dakota.

Culex (Neoculex) territans (Walker)

FEMALE—A small dark mosquito. Mesonotum clothed with rather dark-brown scales, sides and prescutellar space lighter in color.



After Barr, 1958

tarsalis

Abdominal tergites dark, with narrow apical bands of white scales joining a white patch on either side. Tarsi without white bands. Wing scales all dark.

MALE—Tenth sternite crowned with a comb-like row of blunt spines. This character alone separates it from other South Dakota *Culex.*

LARVA — Upper frontal head hair 5 and lower frontal head hair 6 single, occasionally double. Siphon six to seven times as long as basal diameter, pecten on basal third of siphon; siphonal tufts inserted beyond pecten of four or five pairs, the apical tuft somewhat laterally out of line.

BIOLOGY—The females apparently overwinter in hibernation in northern climates. The larvae are found in marshes and permanent waters, especially sloughs associated with river valleys. Adult females are not known to feed on warm blooded animals.

DISTRIBUTION — *Culex territans* has been collected from Beadle, Bon Homme, Butte, Brule, Clark, Custer, Kingsbury, and Union Counties.

Culex (Melanoconion) erraticus
(Dyar and Knab)

FEMALE—Small. Proboscis and palps dark-scaled. Occiput with a line of broad, appressed scales bordering the eyes. Mesonotum without prominent markings. Dorsum of abdomen dark brown, usually with basal white bands on the terga. Wing scales dark; scales of R2 and R3 much shorter and wider than scales of Rs. Legs dark-scaled.

MALE—The oval ninth tergal lobes are diagnostic. Basistyle globular; subapical lobe with armament.

FOURTH INSTAR LARVA — Head wider than long, about 1 mm. wide. Antennae about as long as or longer than head. Upper head hairs weak, usually with five or more branches. Lower head hairs usually single, two or more times as long as uppers. Head hairs not in line with postantennal tuft. Thorax and abdomen markedly pilose. Eighth segment with about eighteen to twenty pale comb scales, usually in double row, each comb scale with prominent central spine. Siphon about eight or more times as long as wide at middle, with short pecten at base; with about four or five pairs of large tufts close to the mid-ventral line and one or two pairs of smaller dorsolateral tufts; ventral tufts usually two or more times as long as width of siphon at point of insertion, with about five to seven branches; dorsolateral tufts smaller and with fewer branches.

BIOLOGY — Practically nothing is known of the biology of this species. Overwintering is probably by the adult female which are said to lay eggs attached to leaves of aquatic plants. Larvae are usually taken in permanent water. Females are known to bite man, but probably prefer bird blood.

DISTRIBUTION — *Culex erraticus* has been collected from Bon Homme, Charles Mix and Yankton Counties.

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