A KEY TO THE BITING MOSQUITOES OF NEW ENGLAND*

By George S. Tulloch

A study of the infestation and distribution of biting mosquitoes in Massachusetts was made during the spring and summer of 1930. To facilitate the identification of the mosquitoes found, the following key[1] was constructed; it being taken from Dyar[2] and Matheson[3] and modified to include those species known to occur to New England. It is accompanied by a plate illustrating many of the taxonomic characters used in identification and by a few notes concerning mosquitoes considered to be of interest.

Table of Genera

Adults

1. Metanotum with a tuft of setæ ..... *Wyeomyia*
   Metanotum without a tuft of setæ 2
2. Wings with the second marginal cell not half as long as its petiole ..... *Uranotænia*
   Wings with the second marginal cell more than half as long as its petiole 3
3. Scutellum rounded—not lobed ..... *Anopheles*
   Scutellum not rounded—distinctly trilobed 4

* Contribution from the Entomological Laboratory of Harvard University, No. 337.

[1] This key was based on the list given by Johnson, 1925. Fauna of New England. 15, The Diptera or two-winged flies. Boston Soc. Nat. Hist. VII.

[2] 1922—The Mosquitoes of the United States. Proc. U. S. Nat. Mus. Vol. 62, Art. 1, pp. 1-119.

[3] 1929—The Mosquitoes of North America. C. C. Thomas.

4. Cross veins tending to lie in line, or mesonotum with bare impressed discolorous lines or both....*Theobaldia*

   Cross veins normal, mesonotal integument without impressed discolorous lines 5

5. Abdomen of female blunt, with short cerci..... 6

   Abdomen of female pointed, cerci exserted 7

6. Wing scales normal .....*Culex*

   Wing scales distinctly large and broad.....*Mansonia*

7. Abdomen of female with the eighth segment wholly retractile, nude; spiracular bristles present *Psorophora*

   Abdomen of female with the eighth segment only partially retractile, spiracular bristles absent..*Aedes*

Larvæ

1. Eighth segment of abdomen provided with a distinct elongate dorsal siphon or respiratory tube..... 2

   Eighth segment without a distinct elongate dorsal siphon .....*Anopheles*

2. Anal segment without ventral brush .....*Wyeomyia*

   Anal segment with ventral brush 3

3. Air tube without pecten .....*Mansonia*

   Air tube with pecten 4

4. Air tube with several pairs of ventral tufts.....*Culex*

   Air tube with a single pair of tufts 5

5. Head elongate, elliptical .....*Uranotænia*

   Head nearly circular or transverse 6

6. Air tube with tufts close to base.....*Theobaldia*

   Air tube with tufts near the middle or beyond 7

7. Anal segment ringed by the dorsal plate, with hair tufts piercing the ring ..... *Psorophora*

   Anal segment not ringed by the dorsal plate or if ringed, the hair tufts posterior to the ring..... *Aedes*

Table to Species of Theobaldia

Adults

1. Tarsi with faint whitish rings at both ends of joints *morsitans*

   Tarsal white rings, if present, basal 2

2. Scales of the wings all black or brown, no white scales *impatiens*

   Scales of the wings mixed, black or brown or white, especially along the costal margin ..... *inornata*

Larvæ

1. Pecten of the air tube produced into long hairs on the outer half 2

   Pecten not produced into long hairs on outer half *morsitans*

2. Both pairs of head hairs multiple (6) and of about equal length ..... *impatiens*

   Lower head hairs of three or four long hairs; upper multiple and shorter than the lower head hair *inornata*

Table to Species of Anopheles

Adults

1. Wings with white or yellowish white spots along costal margin .... *punctipennis*

   Wings without such marking 2

2. A bronzy or coppery spot at apex of wing.. *maculipennis*

Apex of wing uniformly dark colored 3

3. Segments of palpi white scaled at apices.....*walkeri*

Segments of palpi uniformly dark scaled *quadrimaculatus*

Larvæ

1. Abdomen with six pairs of dorsal palmate tufts.. 2

Abdomen with five pairs of dorsal palmate tufts.. 3

2. Mandibles with eleven terminal teeth; six branched hairs on mandibles arranged in an outward projecting row .....*quadrimaculatus*

Mandibles with nine terminal teeth; ten branched hairs on mandibles, arranged in a forward projecting row .....*walkeri*

3. Lateral plate of the eighth abdominal segment with 22-29 (8 to 9 long) teeth .....*maculipennis*

Lateral plate of the eighth abdominal segment with 17-22 (usually 6-7 long) teeth .....*punctipennis*

TABLE TO SPECIES OF CULEX

1. Abdominal segments transversely white banded apically .....*apicalis*

Abdominal segments with white bands basally or none 2

2. Abdominal segments without basal white bands *salinarius*

Abdominal segments with basal white bands..... 3

3. Basal white band of the second abdominal segment usually not triangularly produced medianly *territans*

Basal white band of the second abdominal segment triangularly produced medianly .....*pipiens*

Larvæ

1. Antenna with the tuft at or before the middle *territans*

   Antenna with the tuft well beyond the middle..... 2

2. Both upper and lower head hairs multiple 3

   Both upper and lower head hairs not multiple....*apicalis*

3. Air tube long and slender—7 x 1, slightly expanded before the apex .....*salinarius*

   Air tube not over 5 x 1, uniformly tapering toward the apex .....*pipiens*

TABLE TO SPECIES OF AEDES

Adults

1. Tarsi not white marked 2

   Tarsal joints or some of them white marked..... 12

2. Mesonotum with silvery or golden markings 3

   Mesonotum gray, brown, or golden yellow with a single median dark longitudinal band, two narrow lines, or unmarked 6

3. Mesonotum with two yellowish or yellowish silvery stripes on a dark ground .....*trivittatus*

   Mesonotum marked with silver, rarely absent..... 4

4. Silver in a broad or narrow line reaching scutellum or mesonotum entirely silvered (in the male).... 5

   Silver on the sides of the mesonotum, the center dark *triseriatus*

5. Both sexes with a narrow silver stripe.....*atlanticus*

   Female with stripe, male mesonotum entirely silvery *dupreei*

6. Mesonotum with central broad undivided dark band 7

   Mesonotum with divided central band or none 9

7. Mesonotum with median band very broad, lateral lighter color narrow 8

   Mesonotum creamy yellow at the sides.....*hirsuteron*

   Mesonotum golden or reddish brown at the side, median stripe sometimes divided or obsolete.....*punctor*

8. Yellow lateral lines straight and narrow .....*aurifer*

   These lines narrowed posteriorly, pale gray....*trichurus*

9. Mesonotum with paired brown lines..... 10

   Mesonotum uniformly colored, without lines 11

10. Mesonotum yellow or gray, very variable, sometimes suffused with brown centrally, or the lines obsolete; medium-sized to rather large species, legs black, venter yellowish white .....*communis*

    Legs black with bronzy reflection, venter white *implacabalis*

    Mesonotum yellow, lines slender, often conjoined into a median stripe, deep black .....*diantæus*

    Mesonotum gray with central brown shade, lines fine, dark, a small species .....*impiger*

11. Mesonotum uniformly dark brown, somewhat bronzy, lower mesepimeral bristles present, a medium sized species .....*intrudens*

    Mesonotum uniformly brown; abdomen with continuous lateral white line, male with short palpi; mesepimeral bristles absent .....*cinerus*

12. Tarsi with white rings involving both ends of the joints 13

    Tarsal white rings basal only..... 15

13. Wing-scales markedly bicolored .....*dorsalis*

    Wing-scales uniformly dark, or nearly so 14

14. Mesonotum uniformly brown, or nearly so....*canadensis*

    Mesonotum pale, with broad dark median stripe *atropalpus*

15. Proboscis of the female white ringed 16
Proboscis of the female without white ring..... 17

16. Abdomen with a longitudinal page dorsal stripe *sollicitans*
Abdomen without a dorsal stripe.....*tæniorhynchus*

17. Tarsal pale rings broad, especially on hind legs.... 18
Tarsal pale rings narrow; mesonotum entirely brown 20

18. Wing scales broad, inflated .....*grossbecki*
Wing scales narrow, normal 19

19. Large, without the red tint, mesonotum usually not whitish on the sides, wing scales dark; without mesepimeral bristles .....*excruciens*
With 3-5 lower mesepimeral bristles.....*stimulans*
Mesonotum often whitish on the sides, wings often with scattered white scales. 2 lower mesepimeral bristles .....*fitchii*

20. Terminal abdominal segments with normal pale brands .....*vexans*
Terminal abdominal segments largely pale-scaled *cantator*

Larvæ

1. Air tube with tuft within pecten 2
Air tube with tuft beyond pecten 3

2. Air tube with several dorsal hair tufts.....*trichurus*
Air tube without several dorsal hair tufts....*atropalpus*

3. Pecten with detached teeth outwardly 4
Pecten without detached teeth outwardly 9

4. Air tube at least 3½ times long as wide 5
Air tube less than 3 times long as wide 6

5. Both pairs of dorsal head hairs multiple.....*cinerus*
Both pairs of dorsal head hairs double .....*excrucians*

6. Antennæ enlarged basally ..... *aurifer*
   Antennæ not enlarged basally 7
7. Antenna as long as head ..... *diantæus*
   Antenna not as long as head 8
8. Lateral abdominal hairs single beyond second *intrudens*
   Lateral abdominal hairs multiple on 1st and 2nd, double 3-5 ..... *vexans*
9. Comb scales in a single row 10
   Comb scales in a triangle 11
10. Anal segment ringed by plate ..... *implacabalis*
    Anal segment not ringed by plate ..... *triseriatus*
11. Anal segment ringed by plate 12
    Anal segment not ringed by plate 15
12. Upper and lower head hairs double ..... *punctor*
    Upper and lower head hairs single 13
13. Anal gills at least as long as anal segment ..... *trivattatus*
    Anal gills shorter than anal segment 14
14. Lateral abdominal hairs double on 3-6 ..... *sollicitans*
    Lateral abdominal hairs triple 3-5, single on 6 *tæniorhynchus*
15. Air tube at least 4 times as long as wide ..... *fitchii*
    Air tube 3 times or less as long as wide 16
16. Head hair single 17
    Head hairs double or multiple 19
17. Anal gills at least as long as anal segment 18
    Anal gills much shorter than anal segment ..... *dorsalis*

18. Scale of comb with broad apex, 4-7 stout spines *communis*

    Scale of comb with single stout spine ..... *impiger*

19. Both pairs of dorsal head hairs multiple 20

    Both pairs of dorsal head hairs not multiple 21

20. Anal gills budlike ..... *cantator*

    Anal gills well developed ..... *canadensis*

21. Lower head hairs double—upper 3 ..... *hirsuteron*

    Upper double—lower single ..... *stimulans*

The following genera are each represented by a single species: *Mansonia perturbans, Uranotaenia sapphirina, Psorophora ciliata, Wyeomyia smithii.*

A large part of the study was restricted to the habits and biology of *A. sollicitans.* The eggs of this species are distributed over the salt marshes and during the summer months hatch when flooded by the waters of the tides and rains. The larvæ appear soon after the marshes are flooded and under favorable conditions develop in 7 to 12 days. Usually only the larvæ in the pools left by the peak tides (those most distant from the ocean, within 100 to 200 yards of the mainland)[4] successfully complete their development since these pools are free from larva-eating fish and are not flushed by the succeeding lower tides. In a particularly dry season the water in many of the smaller pools along the edge of the marsh evaporates before the larvæ complete their development, thereby effecting a natural means of control. Pools formed by heavy rainfall are usually small and dry out rapidly and the larvæ are destroyed.

[4] This observation based on conditions existing along the North Shore, Massachusetts, in 1930.

Several chlorine determinations[5] of water from pools containing larvæ of *A. sollicitans* were made. The results of these determinations indicate that the larvæ can live and develop in water having a chlorine content ranging from 400 to 2900 parts per 100,000 parts of water. Since the chlorine content of open sea water contained only 2000 parts, it is evident that larvæ can developed in water having a chlorine content greater than sea water as well as in water having a chlorine content considerably less than sea water.

Several evening collections of fresh water species were made in the Charles River Valley. The collections made in late May and early June yielded *A. cinerus, A. excruciens* and *A. implacabalis* in about equal numbers. During July and August the collections contained a majority of *M. perturbans.* Of 120 specimens taken in one collection at Needham, Mass., in August, 118 were of this species, 1 of *A. punctipennis* and 1 of *C. pipiens.* *M. perturbans* is a difficult mosquito to control as the larvæ are not free swimming but attached to roots and stems of various aquatic plants. The adults are fierce biters but fortunately are weak flyers.

[5] These determinations were made through the courtesy of the Massachusetts State Department of Health.

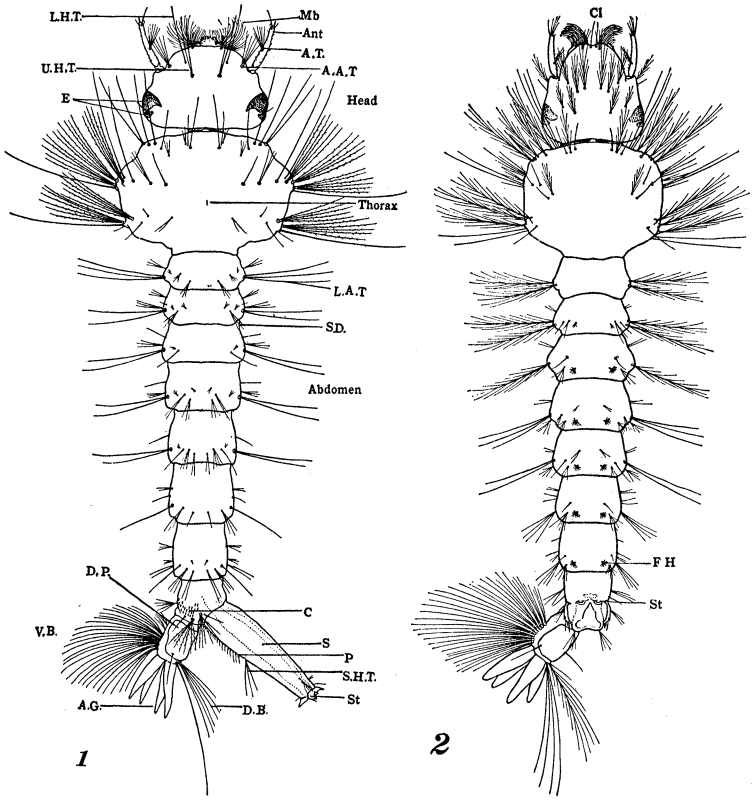

Fig. 1. Larva of *Aedes stimulans.*

Ant., antenna; A. T., antennal tuft; A. A. T., anteantennal tuft; A. G., anal gills; C., comb; D. B., dorsal brush; D. P., dorsal plate; E., eye; L. A. T., lateral adbominal tufts; L. H. T., lower head tuft; Mb., mandible; P., pecten; S., siphon; S. D., subdorsal tuft; S. H. T., siphonal hair tuft; St., stigma; U. H. T., upper head tuft; V. B., ventral brush (after Matheson).

Fig. 2. Larva of *Anopheles punctipennis.*

Cl., clypeal hairs; F. H., float hairs; St., stigma (after Matheson).