ALASKAN SNIPE FLY IMMATURES AND THEIR HABITAT (RHAGIONIDAE: *SYMPHOROMYIA*)

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Introduction. Biting snipe flies are frequently encountered in the mountainous regions of western North America, from central Alaska southward. In some localities the females, (Figure 1) are extremely troublesome to humans during the summer on bright, warm, calm days, both indoors and out. They are robust, medium-size, dark, moderately pilose flies with a tapering abdomen, and long legs, the middle ones having two tibial spurs and the hind ones only one. The empodia are pulvilliform. There are five posterior cells in the wings. The third antennal segment is usually kidney- or hatchet-shaped with a sub-dorsal arista (Figure 2). The males (Figures 3 and 4) possess the same distinguishing characters as the females, but some are densely pilose. Males are seldom seen and are not blood-sucking. It has never been possible to use source-control measures against these biting *Symphoromyia* because the immatures and their specific habitat were unknown.

Beling (1882) described the larva and pupa (reared) of *Symphoromyia crassicornis* Panz., a non-biting European species. His larvae were taken in the upper layer of soil on a turf road at the edge of a beech forest, May 12, 1880 and June 10, 1881. Malloch (1917), Seguy (1926), Hennig (1952) and Brauns (1954) repeated Beling's characters for identification of *Symphoromyia* immatures but gave little or no additional information.

This paper is based on 128 larvae and 48 pupae taken during the spring and summer of 1960 and 1961 in the following Alaskan localities: Arctic Valley, 16 miles east of Anchorage; mile 94 on Seward Highway; mile 7 to 10 on Crow Creek Road or Trail (also called Girdwood Mine Road) northeast from Girdwood; mile 67 to 70 on Seward Highway in Johnso[n] Pass; at the outskirts of Granite Cree[k] Basin about 5 miles east from Juneau; o[n] Gastineau Peak along Mt. Roberts Tra[il] southeast of Juneau; and in Upper Basi[n] of Sheep Creek about 1½ to 3 miles nort[h] east from Thane. These localities furnishe[d] larvae and pupae of three species [of] *Symphoromyia* and larvae of a fourt[h] species. Adults of only two species we[re] reared from larvae. Dr. J. G. Chillco[tt] who is revising this genus (based on study of the adults) considers both of the[se] species new. To avoid confusion in t[he] literature all four species are here de[s]ignated by letters.

Immatures. The eggs (Figure 5) a[re] 1.0 to 1.5 mm long, somewhat sausa[ge] shape, unsculptured, an off-white wh[en] laid, but they turn light brown as devel[op]ment progresses. An irregular, se[mi]circular slit is made around the anter[ior] end of the eggshell by the young lar[va] and this flap folds back as the la[rva] emerges.

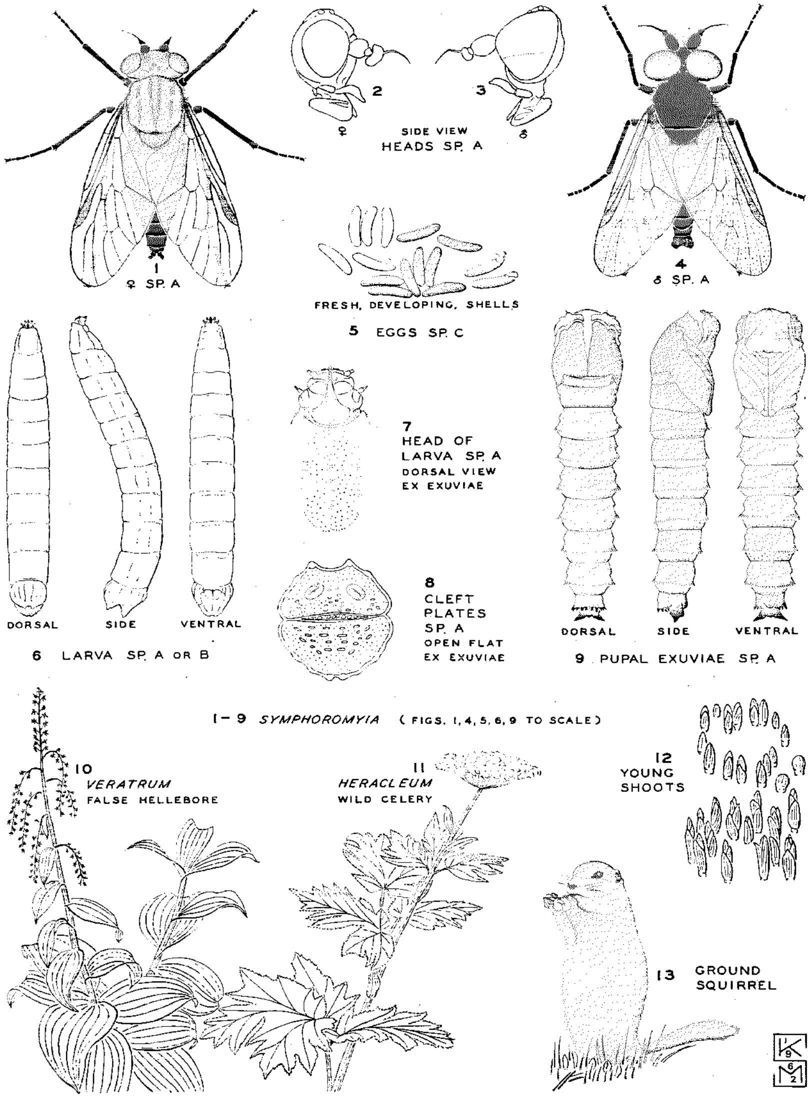
The first instar larva is white, about [1] to 1.5 mm long and has the general [ap]pearance of the mature larva. The [ma]ture larva (Figure 6) is cream-color, 1[2-]16 mm long and about 1 mm in diame[ter]. The body is 12-segmented, cylindrical, tapering at the anterior end to a slen[der] partly retractile head (Figure 7), bea[ring] obvious antennae and palps. Ventr[ally] each abdominal segment bears two [l]mesad swellings near the anterior mar[gin]. The last segment of the body (Figur[es] 14, 15, 16) is deeply cleft horizontally, the upper and lower surfaces of the [cleft] are lined with two heavily sclerot[ized] semi-circular, yellow-brown plates (Fi[g.] 8). The upper plate bears two [l] brown spiracles. These plates are hi ong their relatively straight inner mar-n, therefore the cleft can be closed when e larva backs up in the soil. The con-x margins of these plates are armed with veral heavily sclerotized, tubercle-like or inted, projections. This last body seg-ent also contains six longitudinal grooves rsally, three ventrally, and one each lat-ally. Upon dissection, the dark, knotty, bon-like malpighian tubules are con-icuous.

Characters for identification can be seen arly on the larvae and their exuviae. *mphoromyia* larvae can be distinguished adily from larvae of closely related gen-a, *Chrysopila, Ptiolina,* and *Rhagio,* by e two hinged, semi-circular, heavily erotized, yellow-brown plates which e the horizontal cleft at the end of the dy.

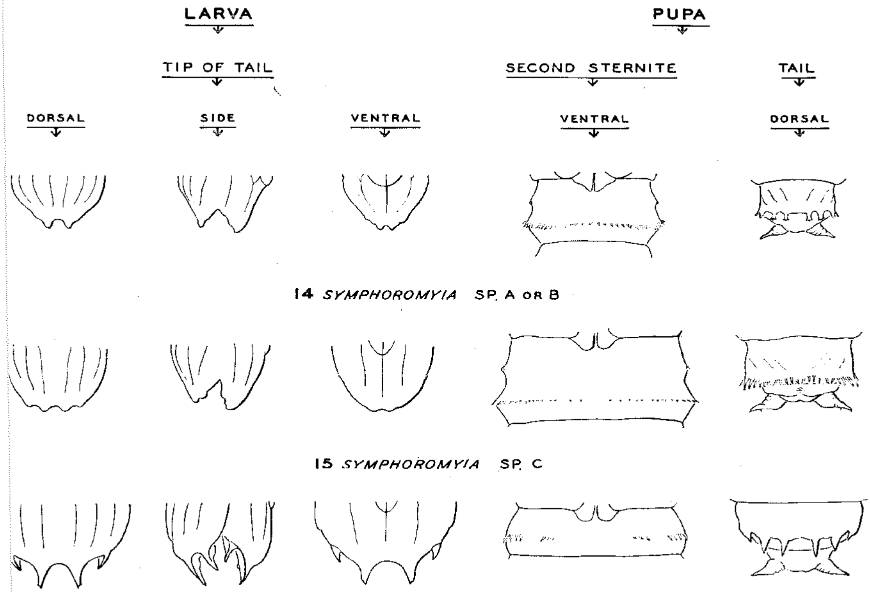
The pupae (Figure 9, exuviae) are 7 to mm long, with a freely movable abdo-n. Shortly after pupation the pupae n brown and the dorsum of the head d thorax becomes almost black. In dorsal w, a tubercle is conspicuous at the base each antenna, as well as several other irs of less-pronounced tubercles on the rsum of the head, but the antennae can t be seen because they are on the ventral e. The tarsi reach just a little beyond wing tips to the second abdominal ment. The thoracic and abdominal racles are prominently raised, with the eption of the last pair which is hidden the dorsal fold of segment 8. Near the terior margin of abdominal segments or 3 through 7, there is an unbroken v of spines completely encircling the ments; there are no other *spines* else-ere on these segments. The abdomen minates in two laterally-directed, rply-pointed stout prongs whose spread roaches the basal width of segment 8. These characters concerning the spines l caudal horns appear to distinguish *nphoromyia* pupae from those of the ated genera, *Chrysopila, Ptiolina* and *agio.*

HABITAT. *Symphoromyia* larvae and ae have been found in mountain meadows near and above timberline, especially on steep, well-drained slopes facing southeast, south and southwest. These slopes are also occupied by ground squirrels and other small mammals. The habitat of the immature snipe flies tends to be restricted to sheltered patches that are generally well-drifted with snow during the winter. Such patches are often associated with depressions, or clumps of alders or willows. Here the immatures live in the damp soil under the two most conspicuous herbs in these meadows, *Veratrum eschscholtzii* Gray, commonly called false hellebore (Figure 10), and *Heracleum lanatum* Michx., also known as wild celery or cow parsnip (Figure 11). Both of these "indicator" plants grow waist- to shoulder-high and their large spreading leaves produce damp shade, favorable for the growth of at least two species of prostrate mosses, *Brachythecium bestii* Grout, which has narrow leaves, and *Mnium drummondii* B.S.G., a broad-leaved species. Papers by Frohne (1957, 1959) and Shemanchuk and Weintraub (1961) also cite one or both of these species of tall plants as conspicuous components of the habitat of the adults. (Around these same "indicator" plants which were growing in *moist and wet soil,* I have found both *Ptiolina* and *Rhagio* larvae, but no *Chrysopila* in any soil conditions.)

Maturing and mature *Symphoromyia* larvae are most numerous and easiest to find early in May, just as soon as these high steep slopes become free of snow, though the valleys may still be covered with several feet of well-packed snow. At this time the young shoots of false hellebore and wild celery (the first plants to break through the soil) are only a few inches high (Figure 12). The larvae are generally in the top inch or two of soil, where the temperature may already be 50° F. and above, though there may be receding snow drifts just a few feet away. Larvae are sometimes in the bottom layer of decaying vegetation, or just under the thin layer of moss. They are usually less than eight inches from the shoots, which



1
♀ SP. A
2
3
♀
♂
SIDE VIEW
HEADS SP. A
4
♂ SP. A
FRESH, DEVELOPING, SHELLS
5 EGGS SP. C
7
HEAD OF
LARVA SP. A
DORSAL VIEW
EX EXUVIAE
8
CLEFT
PLATES
SP. A
OPEN FLAT
EX EXUVIAE
DORSAL
SIDE
VENTRAL
6 LARVA SP. A OR B
DORSAL
SIDE
VENTRAL
9 PUPAL EXUVIAE SP. A
1-9 SYMPHOROMYIA (FIGS. 1, 4, 5, 6, 9 TO SCALE)
10
VERATRUM
FALSE HELLEBORE
11
HERACLEUM
WILD CELERY
12
YOUNG
SHOOTS
13 GROUND
SQUIRREL



14 *SYMPHOROMYIA* SP. A OR B

15 *SYMPHOROMYIA* SP. C

16 *SYMPHOROMYIA* SP. D (FIGS. 14–16 TO SCALE)

vell within the area later shaded by the ture plant. This is often the only place : can dig easily in the soil because be- ıd this area the roots of competing sses, briars, and other herbs form a ıt network.

Iature larvae are present in diminishing nbers through June, but are more diffi- to find because of poor light condi- ıs due to high vegetation and overcast . The pupae are closer to the surface he soil, just under the moss, and they most numerous from mid-June through , when these plants are about waist- h or taller. Nine specimens (larvae pupae) were the maximum taken ınd any one plant. Chewed-off pupae e been found in areas where the moss been scratched away and little pits in the soil, perhaps by ground squir- (Figure 13) or other small animals ;ibly in search of pupae for food.

COLLECTING, REARING AND PRESERVATION. The equipment used was standard, easily obtained, or simple to make. Collecting required gardening gloves, 4-inch straight forceps, and a trowel with a slender, pointed, concave blade, about six inches long and two inches wide. Shell vials two inches long and three-quarters of an inch in diameter, fitted with nylon mesh caps, were used to transport larvae and pupae (one per vial) to the laboratory, and also for larval rearing.

The caps were made in the following manner as described to me by Dr. W. C. Frohne. A piece of one-inch wide masking tape, with about ¼-inch overlap was wrapped around the open end of the shell vial *sticky side out.* Then a small piece of nylon stocking was placed smoothly over the open end of the vial and the half-inch or so margins pressed gently to the sticky surface. Another strip of masking tape, *sticky side down,* was wrapped directly over the first, but with the overlapping seam on the opposite side. This makes a close-fitting, fairly rigid, removable cap which can be reused many times. A small square of masking tape was stuck to the side of the cap so the number referring to the specimen could be written on it with a wax pencil and later this label was peeled off and applied to the pupal-adult cages.

These vials were carried in a cigar box fitted with strips of cardboard to keep them in rows. One larva or pupa was put in a vial half-filled with some of the soil and vegetable matter in which it was found, then a little moss added.

Rearing to adults for identification was a simple procedure because it involved only maturing and mature larvae and pupae. Fifty-one larvae were reared to adults and these preserved with their larval and pupal exuviae. At the laboratory the larvae were kept in the collecting vials in a cigar box which was placed in a well-ventilated north window-box where the maximum temperature seldom reached 70° F. Each day the contents of these vials were examined carefully for exuviae, and the soil was dampened if necessary.

In the rearing vials some larvae remained in the moss, others in the decaying vegetation in which they were found, but most crawled extensively through the soil. On two occasions one specimen even managed to span the quarter-inch from the top of the moss to the vial cap (in this case made of cotton gauze) and was partly protruding through the cap. Apparently the larvae are not predaceous, at least not on any very active animals, because they are slow-moving. Some specimens were dissected and the foregut contained a liquid "emulsion," which suggests predigestion. No solid food particles were found in any part of the gut. Once a drop of clear liquid was observed excreted from the anus.

For pupal rearing, porcelain mosquito rearing pans, 16½ x 10 x 2 inches were filled 1¾ inches with clean sifted sand which was kept damp with water spri[nk]led from a bottle fitted with a clothe[s] sprinkler stopper. Pupal-adult cages we[re] made the same as the shell vial caps d[e]scribed above, except that they were large[r,] the masking tape being wrapped around [a] vial 1¼ inches in diameter.

One vial served as a form for all t[he] cages. Pupae were transferred from t[he] vials to the pans of damp sand, which we[re] also kept in the window-box. A little ho[le,] slightly longer than the pupa, was ma[de] in the sand with a pencil and the uprig[ht] pupa dropped in and lightly covered wi[th] sand. Then, with the pupa in the cent[er,] a circular trench was made by pressi[ng] the "form" vial about ¼-inch into t[he] sand. A pupal-adult cage, bearing t[he] specimen number transferred from the c[ol]lecting vial, was placed in the trench a[nd] the sand tamped lightly around it. T[his] anchored the cage and made it esca[pe] proof.

One porcelain pan comfortably acco[m]modated 32 pupae covered with pu[pal-]adult cages. The contents of these p[ans] were sprinkled lightly with water once [or] twice a day to keep the sand dam[p.] Forty-one field-collected pupae were rea[red] to adults. The adults seemed complet[ely] darkened and hardened by the second [day] after emergence, but could be kept [for] much longer periods in good condition [in] these cages with no further care ot[her] than sprinkling twice a day and putt[ing] a tiny drop of syrup on the nylon. W[hen] the pans were jarred the adults usu[ally] crawled to the nylon; then the cage co[uld] be raised and a card slipped under it[, so] handling individuals was no problem.

Preservation was routine except [for] slight modifications. After moulting [to] pupation the larval exuviae were remo[ved] and placed in a vial of alcohol bearing [the] same number as the living specimen. [Lar]vae dropped directly into 80 percent et[hyl] alcohol or Carnoy's fixative became h[ard,] contracted, dehydrated and discolo[red.] The most natural-looking specimen [was] obtained by dropping a larva, which [had] been frozen in the freezing compartm[ent] an ordinary refrigerator, into simmering ater and allowing it to cool, then transrring it to 30, 50 and 80 percent ethyl cohol. Pupal exuviae and pupae were opped directly into 80 percent alcohol were adults. However, some adults ere chloroformed and pinned, then imediately put into the freezing compartent of a household refrigerator where ey were left to dry for about a month. hese specimens were less shrivelled than n-frozen dried ones. Almost all reared lults are accompanied with their larval d/or pupal exuviae.

SPECIES IDENTIFICATION. Reliable charters have not been found to differentiate vae of species B from species A. Mare larvae of both these species are about mm long. The mature larvae of species and D are about 16 mm long, and each n be distinguished from the others by shape of the cleft-plates and their ocesses (Figures 14, 15, 16).

The pupae of species A and B are 7 to mm long and many of their spines are npound. The spines are continuous oss the middle of the second abdominal rnite, but are interrupted and grouped oss the eighth abdominal tergite (Fig- 14). The pupae of species C and D are out 16 mm long and their spines are the most part simple. The spines of cies C are small and numerous, rather onspicuous toward the middle of the ond abdominal sternite; and continuous, almost so (though reduced in size) midy across the eighth tergite (Figure 15). e spines of species D are stout, less merous, and absent from the midsection the second sternite and eighth tergite gure 16, drawings partly reconstructed m deformed pupa).

BIONOMICS AND DISTRIBUTION. The feed- habits of the larvae of these four species l the duration of the larval period are known.

Species A is the most common and lespread and the females do bite hums. Eggs, almost 1 mm long, were laid the moss in the laboratory. Because cies A and B are indistinguishable in the immature stages, the habitat and locality records are based on larvae and pupae that were reared to adults. Forty-six adults (25 males, 21 females) were reared from larvae, and 27 (15 males, 12 females) from pupae. Of these immatures, 63 were taken under *Veratrum* plants, 5 between *Veratrum* and *Heracleum* growing side by side, and 5 under *Heracleum* alone. All 73 immatures were taken from the top inch or two of soil, or in the moss, under the "indicator" plants which were growing for the most part on the typical slopes by alders or willows.

A male and female were reared from pupae taken at mile 9 on Crow Creek Trail at 2,000 ft. elevation, August 6, 1960. The remaining 71 immatures reared to adults were taken in 1961 at the following localities: Arctic Valley at 2,900 ft.; Crow Creek Trail mile 7.6 at 1,300 ft. to mile 10 at 2,400 ft.; Seward Highway mile 67 to 70, in Johnson Pass, at 800 ft.; Mt. Roberts Trail at 2,000 ft. on Gastineau Peak; and at the outskirts of Granite Creek Basin at 1,600 ft. These larvae were taken between May 11 and June 22, and the pupae between June 15 and July 18. Immatures of species A have been taken on some of the same slopes with each of the other three species, as noted. In the laboratory the pupal stage lasted 14 to 22 days with the males averaging 19 and the females 20 days.

Seventy-five additional larvae were taken, but not reared, and it is quite likely that most of these are species A, and a few species B. They furnish the following additional information on habitat and seasonal and geographic distribution of A and/or B. On September 16 and October 17, 1960 at mile 8 to 9 on Crow Creek Trail at 1,500 to 2,000 ft. a total of four larvae were taken. The remaining 71 were taken from May 9 to July 7, 1961, with 17 of them under *Heracleum* and the other 54 under *Veratrum*. The additional localities are: mile 94 on Seward Highway at about 500 ft.; Upper Basin of Sheep Creek at 800 ft.; and about mile 7 on Crow Creek Trail at 1,200 ft. A considerable number of pupal exuviae of these two species have been found sticking up through the moss from late June until the snow comes.

Species B also bites humans, but appears to be less common than A. The following locality and habitat records are based on reared specimens only, although it is quite likely (as already mentioned) that some of the preserved immatures also are species B. All larvae and pupae reared to adults were found in the typical *Veratrum* habitats. One pupa was found August 3, 1960, at mile 9 on Crow Creek Trail at 2,000 ft., and the other five larvae and five pupae were taken in 1961 at the following localities. Larvae were taken at mile 9 on Crow Creek Trail, May 23; above timberline on Mt. Roberts Trail at 2,000 ft. on June 4; and near Granite Creek Basin at about 1,600 ft. on June 5. Pupae were taken at mile 68.3 on Seward Highway at 800 ft., June 15; and at mile 9 on Crow Creek Trail, June 16. Four males and seven females were reared.

Immatures of species A were taken from the same slopes as B in all these localities and immatures of both species were found under the same plants on Crow Creek Trail and Seward Highway. Larvae of species D were also found in the same small collecting area as B near Granite Creek Basin. In the laboratory the pupal stage lasted 17 to 20 days.

Species C females are non-biting and this species probably is *Symphoromyia montana* Aldrich. The field-collected immatures consisted of 1 larva, 10 pupae, and 4 pupal exuviae, all taken during 1961 on the typical slopes, in the moss or soil under *Veratrum* plants, some of which were growing in scrub willows. A pupal exuviae was taken in the Talkeetna Mountains, at 3,000 ft., three miles below Independence Mine on August 1, but all the other specimens were from Arctic Valley at 2,900 ft. Two of the 10 pupae taken on July 14, 15 and 18 were preserved and the remainder reared, producing 3 males, and 5 females. The lone larva, apparently a late maturing specimen, was taken in the soil (temperature 42° F.) October 3 when there was fresh snow, and the ground cover was partly frozen. The larva was kept in the laboratory until October 17 then preserved. Presumably it is species C because none other besides species A was taken at Arctic Valley. Eggs (Fig. 5) about 1.5 mm long, were deposited in the laboratory, a few singly and some in clusters of more than a hundred, in and under the moss. The eggs hatched in 19 days and the young larvae quickly burrowed into the soil.

Species D is represented by two larvae both taken on June 2, 1961 on a slope at the outskirts of Granite Creek Basin at about 1,600 ft. elevation. The larvae were about an inch down in the soil under the moss under *Veratrum* plants growing at the edge of, and in, alders. One was in rather fine brown soil, and the other in fine-textured, soft, grey soil. One larva was injured in digging and the other did not molt properly so its pupa is deformed and partly encased in the larval exuviae. Larvae of species A and B were also taken in this same small collecting area where D was found.

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WINTER MORTALITY IN LARVAE OF *AEDES TRICHURUS* (DYAR)

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In general, mosquito larvae in north temperate and subarctic regions are adapted to survive the low temperatures of their environment. Larvae of certain species can endure freezing without ill effect (Matheson, 1944; Gjullin *et al.*, 1961), though Bates (1949) pointed out that larvae of most species are killed when frozen.

The present note shows that larvae of snow-melt *Aedes* are killed under certain pool conditions when winter temperatures fluctuate abnormally. Evidence of winter mortality was obtained at Chatterton, near Belleville, Ontario, in 1961, following the earliest recorded hatching of mosquito eggs in that district. Newly-hatched larvae of *Aedes trichurus* (Dyar), *Aedes* sp. (probably *stimulans* (Walk.)), and the chaoborine *Mochlonyx velutinus* (Ruthe) were collected from the narrow, thawed margins of semi-permanent pools of the swamp on March 3, about one month before their usual occurrence. The temperature subsequently dropped to −19.4° C. during March 10–18 and froze the thawed pool margins into solid ice.

The ice was not continuous to the bottom in the whole pool: a hole cut through five inches of ice on March 14 revealed a half-inch layer of water below the ice and above the frozen pool bottom. This water was at 0° C., had a strong odour of hydrogen sulphide, and contained live though torpid larvae of *A. trichurus.* When thawing resumed a week later, a three-litre sample of water from the reopened ice hole (Figure 1) contained 32 larvae of which 6 were dead; a similar water sample from the pool margin contained 6 dead out of 35 larvae. Some of the dead larvae were newly-hatched and of normal appearance, but four older first-stage larvae were contorted and partially flattened.

The possibility that freezing injured the larvae was further investigated by cutting sections of marginal ice that had frozen to the pool bottom and thawing them in the laboratory. Of a total of 21 larvae found in about one and one-half cubic feet of ice, all were dead, first-instar *A. trichurus.* Only one larva was not flattened or contorted (Figure 2, A). The others were compressed in various degrees, either dorso-ventrally or laterally (Figure 2, B) and in some larvae the head capsule was crushed and the thorax or the abdomen squeezed to from a third to a sixth of its normal width.

An explanation for this larval mortality is as follows. Mild weather in February resulted in early hatching of culicid eggs, first at the margin and then farther from shore beneath the thick accumulation of swamp ice. Low temperatures in mid-March refroze the marginal water solidly to the pool bottom and trapped many of the young larvae, but most of them escaped