LABORATORY FEEDING OF CULICIDAE

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The raising of mosquitoes under caged or laboratory conditions has been extensively practiced with Anopheline mosquitoes for many years, but only a few practical feeding procedures have been derived. Bates (1941), working with *A. maculipennis* var. *atroparvus*, found unfavorable a routine medium of mud, rain water, and bread in water with a high nitrate content. Mud (soil) and sand in routine breeding favored larval growth by furnishing necessary minerals in solution, by serving as a source of organic food, and by acting as an absorbing agent for unfavorable material. A standard medium of calcium sulphate, sodium chloride, and magnesium sulphate in the proportion 5-5-1 parts per thousand made the best medium for early growth when dry bread crumbs were added. Russell and Mohan (1941) used a ten per cent glucose solution for males and rabbit blood for females of *A. stephensi mysorensis*. Gravid females were forced to oviposit by being placed in a test tube which was then knocked gently on the side and the mosquitoes then flung into water in a dish by vigorously swinging the tube. If her legs caught in the water, the mosquito then began to oviposit. Hackett and Bates (1939), while working with *A. maculipennis* in Albania, found the best food for larvae was fine dried bread crumbs. The rearing pans contained a sub-stratum of seived mud and were kept in a heated room in winter with a roof of cellophane and wire screening to admit sunlight. As many as three thousand Anophelines were raised per day with the labor of one man.

Russell and Mohan (1939), in maintaining a colony of *A. stephensi*, removed the eggs from oviposition cages and placed them in paraffined cork rings in a large basin of tap water. Hay infusion and small amounts of a mixture litmus milk and dehydrated blood serum (2-1) were added occasionally and the water was aerated once daily by large pipette. Females were given opportunity to oviposit in bowls of tap water, sea water, and cow-dung water. Eggs were removed in equal numbers from cow-dung and tap water; on only rare occasions were eggs taken from sea water. The rate of growth appeared similar but larvae from cow-dung water seemed best, whereas, larvae from sullage seemed most robust. Development from egg to adult took five to nine days, the gestation period was five to six days. The colony cages were wooden boxes with sides two feet square and a wire screen front with a cloth sleeve entrance. The relative humidity was kept high (seventy per cent) by means of bags of wet sand and pieces of wet cloth suspended in the cages. Glucose (10 per cent) water on cotton wool was kept in each cage and a rabbit was put in every night.

Bertram and Gordon (1939), working with *A. maculipennis* in Liverpool, used a technique similar to that used by Bates. Earth with grass attached, gathered from a small stream bank was brought to the laboratory, broken up by hand and allowed to dry over newspapers and thinned by passing through different wire meshes. Finally, it was stored in five-pound fruit jars which were sterilized at 160°C. for twenty minutes on two successive days. When required for use, nine parts of the prepared earth were mixed with fifty parts of rain water. The mixture was then allowed to settle and the particles floating to the surface were skimed off, since they might inhibit proper development of the larvae. At intervals fresh mud and water were added to another dish of the mixture (2c cm. per larva), to which the larvae were transferred and to which sifted bread crumbs were added daily until the larvae reached the fourth instar. At this point it was found necessary to make a final transfer.

The author, in the winter of 1942-1943 experimented with adult *Culex restuans* and *Theobaldia inornata* to determine their food habits under laboratory

conditions. Since bananas, a known source of food for mosquitoes, were unobtainable, raisins were placed in distilled water in a small glass inkwell and then placed within the mosquito cages. During the first night, December 8, among a series of thirty mosquitoes (T. inornata and C. restuanas) the females (app. 15) engorged 100%, while the males engorged only 80%. On December 15, a similar experiment was run in which raisin juice without the raisins in the solution was fed to *C. restuans*, with the same results. It was thus concluded that the mosquitoes did not necessarily feed but merely drank the extract. On January 4, 1 cc of mallard duck blood mixed wtih 1 cc of an 0.85 per cent physiological saline solution containing 0.05 per cent sodium citrate was offered to thirty female Culicines, but only one engorged. On January 23, ½ cc of frog blood (*Rana clamitans*) plus 1½ cc sodium citrate solution was offered to fifteen females, three of which engorged. On January 26, ½ cc of duck blood pus 1½ cc of saline citrate solution was fed to fifteen mosquitoes (*C. restuans* and *T. inornata*), two were actually seen to feed, and one fell into the solution after engorging and died there. This final experiment was run on the survival mosquitoes from a series of sixty collected in October. Since October, forty-five or 75 per cent had died and the remaining fifteen were fed the blood. All the males had died by December 11. The females had lived well over three months in captivity and if they had been allowed to exist until spring, the mortality might have reached 80 per cent. Of those mosquitoes which do engorge, about three out of fifty die. The highest mortality rate by far occurs among those which will not feed. The above species of mosquitoes are repelled from feeding on duck blood, probably due to its peculiar odor, and could only be induced to feed by diluting the blood to 25 per cent. After feeding the indwell, the mosquito rests from 10 minutes to half an hour before slowly walking away. The mosquitoes used in the above experiments were kept between 60 to 70°F., humidity, 50-60 per cent. They were active from emergence to death; none appeared to be hibernating though several collected on the roof of the cage and moved very little. These mosquitoes are abundant only in fall and spring. *T. inornata* seldom attacks man.

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