THE "CDC SWEEPER," A SIX-VOLT MECHANICAL ASPIRATOR FOR COLLECTING ADULT MOSQUITOES

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Several different types of portable traps have been described in recent years for the collection of adult mosquitoes. These include traps that are mounted on automobiles or trucks that collect flying mosquitoes in a large funnel which leads to a bag or cage (Chamberlin and Lawson, 1945; Sommerman and Simmet, 1965; Nelson, 1966), the truck and tractor traps that utilize the vacuum cleaner type of action to collect mosquitoes resting on or near the ground (Bidlingmayer, 1966), and small battery powered aspirators that utilize modified clothes brushes (Husbands, 1958) or are designed specifically as a mosquito collecting aspirator (Nelson and Chamberlain, 1955). Last year de Frietas, Shope, and Causey (1966) described a suction apparatus powered by a 3-volt battery that was effective in collecting flying mosquitoes and other insects in the foliage and around tree trunks within a rain forest. The 6-volt mechanical aspirator herein described is somewhat similar, but we believe it to have advantages over that aspirator.

DESCRIPTION OF ASPIRATOR. The mechanical aspirator has been called the "CDC Sweeper" by those of us who developed it. It is constructed from lightweight material and weighs only 1.75 pounds. Six-volt batteries, by which the aspirator fan is powered, range in weight from 4 to 11 pounds.

The initial CDC Sweepers were made from the body and motor units from commercially available CDC miniature light traps (Sudia and Chamberlain, 1962), plus other sections of cast acrylic tube, a pint carton, and a wood handle. However, purchasing the miniature light traps for constructing CDC Sweepers is not financially practical, so sweepers are made from separately purchased components as described herein. Figure 1 shows the motor, fan, the collecting container, the electrical wires, and a portion of the handle. A detailed mechanical drawing with parts list will be provided to individuals submitting such a request to any of the authors.

An electric motor, 2¾" long x 1" diameter, operates the fan. The motor[3] used is an Aristo-Rev No. 1 and is rated at 3 to 4½ volts direct current, but it operates very efficiently at 6 volts. It is housed within a cast acrylic (plastic) tube 3½" outside diameter, 4" long x ⅛" thick.

At the end of the aforementioned housing are two 1½ inch slots cut on opposite sides of the plastic tube. The brackets for holding the motor, centered within the housing, are mounted within the two slots. The motor support brackets are made from two 22- or 23-gauge galvanized sheet metal strips, ¾" x 7". At the center of each bracket a 1" diameter semicircle is formed. The two brackets are placed together and riveted on one side of the 1" circle they have formed; they are clamped together on the other side of this circle. The motor is then placed within the motor support bracket, the bracket slipped into the 1½" slots at

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[3] NOTE: Trade names are used as a means of identifying the product and their use does not constitute endorsement by the Public Health Service.

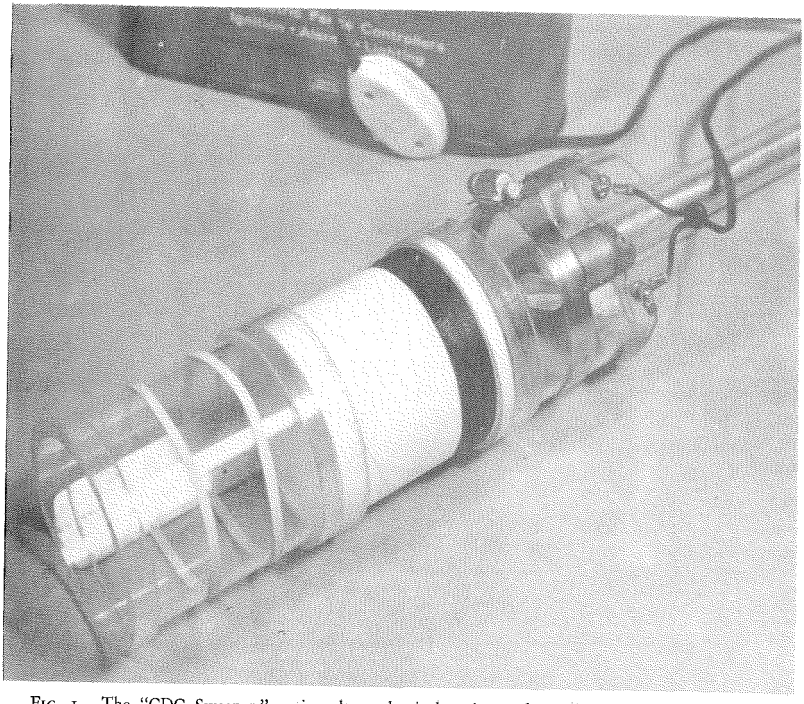

FIG. 1.—The "CDC Sweeper," a six-volt mechanical aspirator for collecting adult mosquitoes.

the base of the plastic housing, and the ends of the brackets are bent around the outside of the plastic housing.

At the other end of the plastic fan and motor housing a 1″ long section of larger diameter plastic tubing (3½″ *inside* diameter) is slipped over the outside of the 3½″ *outside* diameter plastic tube housing the motor. It is slipped down over the smaller tube about ⅜″ and glued in place using Duco cement; the remaining ⅝″ forms a flange that extends beyond the end of the smaller tubing.

Each of the electrical leads from the motor is soldered to the head of a machine screw, ½″ long, 6-32 in. diameter. The screws are inserted through 9/64″ diameter holes drilled on one side of the plastic housing, 2″ apart and equidistant from the top of each of the aforementioned 1½″ long slots. The electrical leads from the battery are attached to the outside of these terminals between two nuts. An 8-foot long electric cord connects the battery to the mechanical aspirator. A standard through-cord single pole electric snap switch is installed in the wire about 2 feet from the battery terminals.

The two-blade propeller for the fan is made from 25-gauge aluminum sheet and is 3″ long. Each blade is rounded at the ends, its widest dimension of ⅜″ is about 3/16″ from the center of the propeller. The hub of the propeller is made from a ⅛″ pop rivet through a brass sleeve 3/16″ long. This propeller was designed and constructed in shops at the Communicable Disease Center, Atlanta, Georgia. A commercially available 10-blade propeller[4] was tested and found to be comparable with respect to air flow. Both propellers

[4] W. W. Grainger, Inc. Cat. No. 316, Stock Number 2C950, 695 Bryant Street, Denver, Colorado.

delivered approximately 9 miles per hour wind velocity when measured by a wind meter. The Grainger propellers are available with a variety of bore sizes to accommodate different sizes of drive shafts.

A pint-size paper carton is used as the collecting container. Its bottom is removed and replaced with 24-mesh nylon net, and the bottom assembly of the pint carton is taped to the carton with a piece of plastic electrical tape. The base of the pint carton, 3½" outside diameter, is inserted ⅝" into the flange extending beyond the plastic motor housing.

The final section of the trap is attached to the top of the pint carton. This section is similar to that housing the fan and motor and is 3½" outside diameter x 4" long x ⅛" thick cast acrylic tube. A 1" long flange, similar to that into which the base of the pint carton was inserted, is glued to the outside on one end of this section. A ½" long section of the larger, 3½" *inside* diameter plastic tubing, is glued flush to the other end of this section. The flanged end is fitted ⅝" over the open top of the pint carton to complete the collecting unit of the trap.

The collecting unit is attached to an aluminum handle. The handle consists of 1" aluminum tubing 24" long, to which is riveted a pice of 1" aluminum angle 15" long. Only 12" of the aluminum angle extend beyond the end of the aluminum tubing which is equal to the length of the collecting unit of the trap. A gear-type stainless steel hose clamp is used to attach the plastic motor and fan housing to the aluminum angle of the handle unit. The other two portions of the collecting unit, the pint carton and the final section, are removable. Two rubber bands, size number 64, are used to attach the final section to the end of the aluminum angle.

OPERATION OF THE ASPIRATOR. The wire terminals are attached to the battery so that the fan draws air through the collecting unit (reversal of the terminal connections results in blowing air through the collecting unit). The operator carries the battery in one hand and collects with the unit in the other. The light-weight 6-volt battery can be carried with a shoulder strap arrangement to free one hand for using a flashlight or for other purposes. In our studies, we preferred to use the heavier, and longer lasting, hot spark-type of 6-volt battery unit contained in a heavy duty, sealed-in, moisture-resistant metal case. This case can be obtained with plastic handles to facilitate carrying. When the unit is being used for mosquito collections in shelters, the battery generally can be set down during the collection.

Mosquito collections can be obtained in foliage by walking slowly through an area and moving the collecting unit slowly back and forth in a sweeping motion several inches above the ground. It was during such trials that the name, "CDC Sweeper" was adopted. However, the unit has been found to be more useful for the collecting of resting mosquitoes in shelters, and mosquitoes that have been disturbed during such collections can be collected easily while they are flying.

Special uses of this mechanical aspirator can be made by minor modifications of its component parts. A shorter handle unit is found to be advantageous for aspirator collections in confined areas—such as under houses, whereas, longer cords and longer handles enable rapid collection of mosquitoes resting on ceilings of porches, buildings, under house eaves, etc.

A different pint carton is used for the collection at each shelter site. When a collection is completed, and while the fan is still operating, the front section of the collection unit is removed by unfastening the rubber bands. The lid of the pint carton is put in place, and the collection data are written on the outside of the pint-size collecting container. The pint carton containing the collected mosquitoes is then placed in a cooled container until returned to the laboratory. A quart carton, or 2 pint cartons taped together, are sometimes used to increase the depth of the collection unit. The increased depth increases the collecting capacity and re-

duces the potential for escape. However, it also reduces the force of the suction of the aspirator.

Collections of several hundred mosquitoes from walls or overhead surfaces can be obtained without the need for transferring specimens. However, when collecting necessitates making rapid downward thrusts of the CDC Sweeper, it is advisable to periodically transfer captured mosquitoes to a holding container to avoid any loss of specimens.

RESULTS AND DISCUSSION. The CDC Sweeper was used throughout 1966 to collect adult mosquitoes on the island of Oahu, and intermittently on other Hawaiian islands. It was found to be best suited for collecting mosquitoes resting in shelters. In 175 trials, 305 *Aedes albopictus* and 3,862 *Culex quinquefasciatus* were obtained. These species and *A. vexans nocturnus* are the three species on Oahu that attack man. The *C. quinquefasciatus* usually are found within shelters and the two *Aedes* species usually are found outside of buildings or shelters.

Based upon the early spring success of the CDC Sweeper in shelter collections on Oahu, it also was utilized for mosquito collections in Hale County, Texas and in Weld and Larimer Counties, Colorado during the summer and autumn of 1966. In these areas it was readily adopted by the field men because of its efficiency in rapidly collecting mosquitoes from shelters. In the Hale County area the collectors often had developed chronic sore throats from making mosquito collections with the standard type of mouth aspirators, and the use of the mechanical aspirator eliminated this problem. *Culex tarsalis, C. pipiens, C. quinquefasciatus, Culiseta inornata, Aedes dorsalis, A. nigromaculis, A. vexans* and *Psorophora signipennis* were the species most commonly collected in the Texas and Colorado studies.

Other advantages of the CDC Sweeper are its relatively low initial and operating costs and the ease with which it can be assembled. The cost of the materials for its construction is approximately $10.00, plus battery and labor, and it can be operated on one of the hot spark-type of battery units for several months with a minimum of maintenance. The use of a separate pint carton for each shelter collection eliminates the need for transferring the specimens to another container for transport to the laboratory, and the writing of the collection data on each carton facilitates record-keeping. Direct aspiration of the collected mosquitoes into the collecting unit, without their passing through fan blades, enhances the collection of undamaged specimens. The CDC Sweeper is quiet-operating, easy to use, and expedites collections of adult mosquitoes from shelter-type habitats.

SUMMARY. A six-volt battery powered mechanical aspirator, called the "CDC Sweeper," is described. Mosquito collections were obtained with this collecting unit in Hawaii, Texas, and Colorado during 1966, and its performance indicated its usefulness for collecting adult mosquitoes from shelters and other resting habitats. Some of the advantages of the CDC Sweeper are its relatively low cost, its economical operating expense, its direct collecting action that eliminates the need to transfer specimens, its collection of undamaged specimens, its quiet operation, its ease of operation, and the speed with which it collects large numbers of resting or flying mosquitoes.

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COLONIZATION OF *CHIRONOMUS PLUMOSUS* (DIPTERA: CHIRONOMIDAE)

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Recently several species of chironomids have been successfully colonized in indoor cages. Syrjamaki (1965) colonized *Chironomus strenzkei* Fittkau, and Biever (1965) colonized *Chironomus sp.* #51 *Chironomus monochromus* van der Wulp, *Chironomus fulvipilus* Rempel, *Pentaneura pilosella* Loew, *Tanypus grodhausi* Sublette, and *Microspectra nigripilus* Johannsen.

Several efforts to colonize *Chironomus plumosus* (L.) using the techniques of Syrjamaki and Biever were unsuccessful, the chief obstacle being the inability to induce swarming and mating in captivity. *C. plumosus* normally mates in very large swarms, the swarms forming about one hour before sunrise and dispersing about one hour after sunset, with the greatest swarming intensity at dawn and dusk (Hilsenhoff, 1966). Swarming and mating were induced in the laboratory by employing some of the techniques used by Brennan and Harwood (1953) to colonize the mosquito *Culex tarsalis* Coquillett. The techiques described below can probably be used to colonize other species of chironomids.

MATERIALS AND METHODS. A 5¼ x 4½ x 7 ft. high cage (Figure 1) was constructed in an air-conditioned 10 x 13½ x 10½ ft. high windowless room maintained at 25° C. The top, front and sides of the cage were 4 mil transparent polyethylene, the back of the cage being flush with one wall of the room. The polyethylene on the front was fastened at the sides with rubber bands and the bottom was weighted with a wooden strip. By unfastening the rubber bands along one side, this flag could be easily opened to enter the cage. The room was illuminated by twelve 40-watt fluorescent lamps at a height of 7½ ft. Five 150-watt incandescent silver-neck lamps controlled by a rheostat were mounted 1½ ft. above one corner of the cage. All lamps could be controlled either manually or by time clocks.

Two 75-gal. aquaria, 48 in. x 20 in., x 14 in. high, were placed on the floor of the cage and filled with a 3-inch layer of mud from Lake Winnebago, Wisconsin, that had been sieved through a 60-mesh sieve to remove predatory leeches. A 9-inch layer of Madison city water was added

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