METHODS EMPLOYED TO KILL MOSQUITOS.

An Instructive Article by D. L. Van Dine, Entomologist Hawaii Experimental Station, on Mosquitos in Hawaii—First Introduction of Pest—Widespread Area of Habitat—How to Remedy the Evil.

Previous to the year 1826 mosquitoes were unknown tn Hawaii. During that year they were brought to the port of Lahaina, on the Island of Maui, in the ship "Wellington" from San Blas, Mexico. The story, as told by the late Rev. Wm. Richards, at the time in charge of the Mission Station at Lahaina, is as follows: Mr. Richards was returning to Lahaina one evening and met a native who informed him that there was a new "fly" in the place. The native described the insect as being a very peculiar "fly" that made its presence known by "a singing in the ear." Shortly after this, Mr. Richards being on the outlook for the new fly, heard the "singing" in his ear and recognized the sound as that of the mosquito, which up to that time had never been seen or heard of in the Islands. Furthermore, there was no word in the Hawaiian language for mosquito. The native term is "makika," a corruption of the word mosquito. Lahaina was at the time the port for incoming and outgoing ships. It is easy to understand that the ships coming here were few and far between and how general opinion could center on the ship "Wellington" as the carrier of the pest.

The mosquitoes were a long time spreading over the Islands. Two generations ago there were many districts entirely free from this pest. Today such places are exceptional. In the eighties there were no mosquitoes on Kalawao on the same island as Lahaina. Mokawao is some fifty miles from Lahaina "as the crow flies," with a mountain range nearly six thousand feet in elevation intervening. The building of roads, making settlements and communication possible, and the intimate inter-island communication of late years, has so favored the distribution of this pest, that only a few places at the higher elevations can offer to visitors the inducement that the district is free from mosquitoes.

The abundance of mosquitoes in Hawaii may be accounted for by the facts that up to this time there has been no effort to do away with their breeding places, that the number of natural breeding places is unusually large, and the pest is not checked at any season of the year by climate conditions, it being possible for them to breed uninterruptedly during the entire year.

Dr. L. O. Howard, Entomologist of the Dapartment of Agriculture, conducted during the summer of 1892 experiments in the Catskill Mountains, New York, the success of which became widely known throughout the United States. Since that time it has been repeatedly demonstrated in different mosquito-ridden sections of the country that it is unnecessary for any community to submit to the mosquito nuisance. Particularly convincing are the experiments being carried on in the State of New Jersey in which Dr. J. B. Smith of the New Jersey Experiment Station is taking an active interest.

The development of the mosquito, that is, the interval between the egg state and the adult winged form, occurs entirely beneath the surface of the water. The young during this portion of their life are true aquatic insects with one exception, they do not breathe the air dissolved in the water as do fish, but by a special structure, a respiratory siphon, breathe the free air above the surface of the water; deprived of this they perish. By nature of their structure the young of mosquitoes can develop only in water and then only under certain conditions. As a rule mosquitoes breed in small collections of standing fresh water. Specimens are sometimes found in streams and some species are known to breed in solt or brackish water.

All insects undergo during their developmental period remarkable changes in form, structure and habits. One can certainly detect no resemblance between the wriggling larva of the mosquito in the water and the adult winged insect in the air.

The eggs of the common mosquito, Culex, are deposited on the surface of standing water. Under the right conditions of temperature they hatch in about twenty-four hours, The larvae develop to their full size in the course of eight to fourteen days during which time they moult or cast off their outer covering several times to provide for increase in size. The development of the larvae depends on the temperature of the water and the food supply. Their food consists of the plant and animal matter, often microscopical in size, common to standing water.

The pupa of the mosquito is also aquatic, normally resting inactive at the surface. This is the period during which the mosquito transforms from an aquatic insect to one of the air. The young or growing stage has yassed. The pupa takes no food and moves only when disturbed as a matter of protection. In two or three days the pupa transforms to the adult mosquito and becomes the notorious household pest, its entire life being a matter of eleven to eighteen days.

The only remedy for adult mosquitoes is protection by screening, or burning insect powder. These remedies bring only temporary relief and do not remove the source of the nuisance. The importance, then, of not allowing mosquitoes to develop beyond the pupal or final aquatic stage is evident. No practical meteod of destroying adult mosquitoes is known.

The length of the life of adult mosquitoes varies. It is difficult to get insects to repeat correctly in confinement what their life-history and habits would be under natural conditions; therefore the length of the adult cannot be determined by experiment. As a rule the males of insects do not live any great length of time after maturity, and the females die soon after depositing their eggs. In a tropical country, like Hawaii, where no difficulty is encountered by the gravid female in securing favorable breeding places throughout the year, the length of the adult life is probably at the most only a matter of several weeks. In cold countries the male mosquitoes are known to die in the early winter and the females hibernat during the cold season, a period of several months, until suitable conditions for egg-laying prevails.

The adult mosquito is a very feeble flyer and is usually foumd in the vicinity of its breeding place. Instances are on record where mosquitoes have been carried in large numbers for long distances by the wind, but invasions from one locality to another are exceptional. It can be stated without qualifications that the source of mosquitoes is generally the immediate vicinity of the infested places.

Mosquitoes are normally plant-feeding insects and only the female is a blood-feeding insect when that is obtainable. The male satisfies his appetite on the juices of fruits or other liquids since the proboscis is not constructed, as is that of the female, for piercing anything with any degree of resistance, as the skin of animals or the epidermis of plants. The greatest impetus to the warfare against mosquitoes was given by the recent positive demonstrations that certain species are the carriers of disease. This has changed the mosquito problem from one of discomfort alone to one of health also. The most complete work in preventive medicine is the result of experiments along these lines. That yellow fever and malaria are conveyed from diseased persons to healthy people by the bites of certain species of mosquitoes is an acknowledged fact in recent medical literature. Aside from yellow fever and malaria, mosquitoes are credited with the dissemination of elephantiasis, filariasis, and possibly the dengue fever and leprosy. The relation of certain insects to diseases, both plant and animal, is a study which in tne future will do much to prevent their present serious work.

A tropical country is an out-of-door country and the mosquito problem becomes at once a serious question. A conservative estimate, based on figures furnished by the wholesale importing houses of Honolulu, places the sum annually spent in these Islands for insect powder, wire mosquito-cloth and mosquito-netting at $27,243.00, of which $7,008.00 is for insect-powder, $9,735.00 for wire mosquito-cloth, and $10,500.00 for mosquito-netting.

The rule for ridding any particular community of mosquitoes are simple and effective and do not require any great amount of expenditure of money. They may be summed up as follows:

(1) Mosquitoes to breed require water, the larvae being as truly aquatic as fish. To do away, then, with all bodies of standing water by filling or draining is the first step.

(2) Collections of water which cannot of necessity be removed, such as water tanks and barrels used for storing water should be tightly screened to prevent the gravid female from reaching them, drawing off the water for use from below.

(3) Mosquitoes can breed in water only under certain conditions, the main one being a free supply of air above the surface, which they obtain by means of breathing-tubes. Bodies of water which cannot be done away with by drainage or protected from adult mosquitoes by screening, should be treated in such a manner as to prevent the developing larvae from obtaining the necessary supply of air. The coal-oil treatment, widely understood, consists in covering the surface of exposed water with a thin layer or film of oil. The oil does not affect the water for use if the water is drawn off from below. One ounce of oil will cover about fifteen square feet of surface.

(4) If the use of oil is undesirable, for example, in the case of a lily-pond or a watering-trough for stock, the introduction of gold-fish will keep the water free from larvae.

(5) All such artificial containers of water about the door-yard as tin cans, bottles, broken pottery and crockery on rubbish heaps, etc., should be collected and carted away.

(6) Other containers, as tubs and buckets under watertaps, cuspidors, firebuckets, water in chicken coops and dog kennels, etc., should be frequently emptied.

(7) The plumbing about the place should be carefully inspected since mosquitoes are known to breed in cess-pools, water-traps in sinks and closets, catch-basins from leaders and in eaves that are imperfect or have become clogged. Make the covers of the cess-pools absolutely tight and place a screen over the opening of the vent pipe for eggs deposited in the closet tank are flushed down into the cess-pool and will hatch and develop.

(8) The work in any community must be general since a neglected tub in one yard can breed enough mosquitoes to make an entire community uncomfortable. It is seen from this that though the mosquitoes infesting any household are usually bred in the same dooryard and that invasions from any distance are exceptional, yet to do away with the pest the members of any community must co-operate in the work.

(9) The adult mosquitoes seek shelter in weeds, grass, bushes and trees in the vicinity of water. Therefore all such vegetation about ditches, pools and other collections of water should be cleared away.

It should not be necessary to present in detail the arguments why the various communities in these Islands should take concerted action against the mosquito. The reasons are self-evident. Not only does their presence detract from the natural charm of the country, but the danger attending the presence of a disease-carrying species is also apparent.

The one great rule of health and comfort in the tropics is to do away with or treat by methods well known to be effective all standing water because of the fact that only in such places mosquitoes are known to breed.

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