In 1939 he found by careful laboratory experiment that, contrary to what had been generally accepted, the codling moth adult could be killed by the use of a certain type of insecticide that it absorbs as it takes moisture from the surface of apple foliage. Laboratory research in 1940 confirmed his first results, so in 1941 he undertook to demonstrate by field experiment that his discovery was applicable to commercial practice. Week after week, Sundays and holidays, throughout the season he plunged into the investigation. He was far from well but he stuck to it until by October he had proved his point. A month later he left his desk and entered hospital. Even then he insisted on writing up and summarizing his data. This spring he published one of the most original contributions to the literature on the codling moth.

In addition to publications bearing on entomology, which are listed below, he often wrote short articles on natural history or hunting experiences, and gave several radio talks on entomological subjects over Station CKOV, Kelowna.

He was a photographer of unusual ability and handled all the photographic work at the Vernon Fruit Insects Laboratory. Among other devises he constructed a useful piece of apparatus for micro-photography.

In his passing the public has lost a fine servant and his host of friends and acquaintances a true friend.

E. R. Buckell.

Partial List of Articles by A. A. Dennys

1928. Some notes on the hibernating habits of insects in dry trees in the interior of B.C. Proc. Ent. Soc. British Columbia (1927), **24**: 19-25, 1 text fig.
1933. Materials used as canker paints in woolly aphis control. Proc. Ent. Soc. British Columbia (1933), **30**:8-10. (Abstract in Rev. Applied Ent. **22** (Ser. A, Pt. 2): 108).
1937. An orthopterous pest of apple trees in the interior of B.C. Proc. Ent. Soc. British Columbia (1936), **33**:6-7, 1 text fig.
1938. Vigorous and varied tests being made as to new methods of combatting codling moth: interesting experiments at Vernon insectary. Country Life in British Columbia [Vernon, B.C.], **22**(7): 20.
1942. Recent progress in codling moth control in British Columbia. II. Killing the adult. Scientific Agric. **22**(10): 577-583.

Mr. G. O. Day, enthusiastic member and past President of our Society, died last spring. We have not yet been able to get the necessary information for a full obituary notice.

BIOLOGY OF THE KLAMATH MIDGE, CHIRONOMUS UTAHENSIS (Diptera, Chironomidae) *

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Introduction. During the past decade, midges have occurred in epizootic numbers in the Klamath Lakes area of Oregon and have occasioned annoyance and financial loss to the residents. The hordes of tiny winged insects, which superficially resemble mosquitoes, have upon many occasions been so great as to impede breathing and induce nausea in some persons. Tourist trade, summer residents, and resort owners were seriously disturbed. The radiators of travelling automobiles became clogged with the insects, causing the motors to overheat and the cars to stall. Cows became so irritated by the clouds of midges in the air and

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on pasturage, that they refused to eat, thus substantially reducing milk and butterfat production. Midges flew in such swarms at the big sawmills that their bodies were crushed in lumber during piling, and the resultant staining made resurfacing of the lumber necessary. An increase in the numbers of spiders and of blue-bottle flies followed midge concentrations.

Concurrent with the midges, vast masses of algae have appeared in Upper Klamath Lake. This suspended blue-green algae is filamentous in form *(Aphanizomenon)* and during the summer so dense as to give the water only a quasi-liquid appearance. These filaments may reach the number of 20,000,000 per cubic meter. The stench from decaying matter is often almost intolerable. Boating and swimming are impaired.

Chironomus utahensis is the most important of several species of midges in this area. Its breeding season and complete life history is, as yet, not fully known. Adult midges are common from June until cold weather in October. The true scope and enormous numbers of midge larvae on the bottoms of Upper Klamath Lake and Lake Ewauna, is best realized when compared with the numbers found by other investigators in the United States. Richardson (1928) reports more than 10,000 larvae, mostly *Chironomus plumosus,* per square yard in the Illinois River below Lake Pepira. Juday (1922) obtained an average of 2,000 larvae per square yard in Lake Mendota. Adamstone (1924) obtained an average of 293 larvae for all dredgings. Johnson (1930) reported an estimated average of 3,000 chiromid larvae per square yard in Lake Pepin. Compare these figures with Klamath's conservative minimum average of 1,000 larvae and ranging to a peak of 133,000, per square yard. Also conservatively estimated is the total population, at any given time during the summer months of the early 1930's, of over 500,000,000,000 larvae.

Description of the Area. Upper Klamath Lake, including its northward extension, Agency Lake, is one of the largest bodies of fresh water in the United States. It is roughly 35 miles in length from north to south, very irregular in outline, and varies from 2½ to 12 miles in width. Although it contains a few deeper areas of 8 to 13 meters, the bulk of the lake is very shallow and averages less than 3 meters in depth.

Sprague River, entering the Upper Lake at its north and east end, is the largest inflow. Several smaller streams and springs, notably Barclay Springs, Williamson River, and Crystal Creek, also enter the northern part. From Upper Klamath Lake, at an elevation of 4,141 feet above sea level, flows Link River, 1¼ miles in length, discharging into Lake Ewauna at an elevation of 4,080 feet. The Klamath River flows from Lake Ewauna through flat marshy country for 20 miles, to the town of Keno. There it breaks over a dam and begins its precipitous fall of 100 to 200 feet per mile on its way to the Pacific Ocean. The outflow of water from Upper Klamath Lake, via Link River, is checked by a dam. Power is used to service the industries and population of Klamath County. A portion of the water is diverted for irrigation purposes by the federal Bureau of Reclamation.

Geologically, the area is very old. The lake type is designated as eutrophic and is gradually filling up, with the area diminishing more slowly than the volume. The decreased depth has resulted in high water temperatures at all seasons except winter. The bottom, except for a few areas of shale, is largely diatomaceous ooze. The tule and lily beds and vast planktonic population of small plant and animal forms result in a rich organic deposit. The water is alkaline. The plankton population, and particularly algae, is so dense that secchi disc recordings are usually less than 1 meter during the late spring, summer and fall. Oxygen

and carbon-dioxide content varies exceedingly in different areas. Winds are prevailingly NW-N.

Biology of the Klamath Midge. Adult insects appear on wing in the late afternoon, early evening, and occasionally at dawn. A swarm starts with a few individuals, increasing in size as more enter; it is long, symmetrical, and top-shaped, and often composed largely of males. Swarms do not form during winds, and a gust of wind will drive one downward until the disturbance abates. A strong screaming hum is emitted and is often audible at a distance of more than a hundred yards. Occasionally a female will dart up from vegetation into the swarm. There she seizes a male by the thorax. They remain clasped for an instant and then drop downward, separating before contacting the ground. The male returns to the swarm. The female seeks concealment in vegetation and later deposits eggs on the water.

The eggs of *Chironomus utahensis* are light brown in colour, and measure about .09 mm. by .75 mm. They are embedded in a gelatinous mass that terminates in a thread with an attached disk for adhesion to some object floating in the water. Each mass contains from 1,000 to 2,000 eggs, and the masses vary in shape from a hollow "C" approximately 18 mm. long by 5 mm. in diameter, to a hollow sphere about 9 mm. in diameter.

The newly hatched larvae are transparent and about 2.5 mm. in length. In two or three days they begin to build body tubes, utilizing silk spun from glands in the mouth, and tiny bits of debris. The tubes are open at each end, larger in diameter than the body of the larvae, and are enlarged as growth requires. Undulation of the body sets up a current, providing an inflow of oxygenated water and food. As the larvae develop they respire by blood gills and become red in colour. The number of instars for *C. utahensis* has not yet been accurately determined but observations indicate 4 as in other species of chironomids. When the larvae have obtained their greatest size they are about 18 mm. long and 2 mm. in diameter. The larval stage usually extends for about 20 days, but may be much longer depending upon water temperature and possibly other factors.

Larvae apparently choose their food with care. One may anchor its caudal end just inside the tube by means of hooks on the end of its posterior legs, and feed over a circular area, the radius of which is determined by the larval reach. Midge larvae were brought into the laboratory. (1) Those in a little detritus and clear tap water showed distress. They built tubes but some, apparently unable to find food, deserted their habitations and ranged the bottom of the jars. The water was frequently replaced but no additional detritus was added. These larvae, without exceptions died within 3 days. (2) Others in a similar situation, but which had occasional detritus offered to them, survived for 5 days with the emergence of one adult female. (3) Larvae in 10 mm. of detritus and 300 cc. of lake water, which was not changed, lived from 5 to 13 days, but without emergence. (4) Those in frequently changed lake water but without detritus had two individuals survive 19 days. These larvae were divested of their tubes before immersion in the jars. They seized upon descending algae filaments and attempted to build tubes. The larger algae filaments were left undisturbed in the bottoms of the jars. Smaller filaments were apparently consumed. A microscopical examination of the alimentary tracts of some of these larvae revealed diatoms, desmids, fragments of minute crustacea, other bits of unidentifiable algae and, in one case, a live rotifer. Algae appears to be the predominant food, the crustacean fragments being, probably, ingested only incidentally.

Some larvae were divested of their tubes and placed in fresh well-oxygenated tap water. Water from Link River was strained through many thicknesses of fine-mesh silk cloth and 25 cc. added to each jar daily. The larvae apparently thrived, with some emergences. Possibly bacteria also, are an important item of diet. All laboratory rearing was done in semi-darkness under muslin.

An examination of several hundred larvae revealed them to be free of mites and nematodes.

Pupation takes place within the larval tubes. The pupal stage lasts three or four days. At the end of this period the pupae emerge and move about in the water by a jerking motion of their bodies, finally arising to the surface. After the pupal case breaks the surface film, oxygen is taken in, causing the pupae to glisten like silver. The pupal case splits dorsally along the thorax, the adult emerges, rests a moment on the floating cast pupal skin, then flies away.

The adult midge is approximately 12 mm. in length. The males are black, the females brownish gray. So far as is known at present, the adult midges do not feed. They are ephemeral and apparently do not live more than 4 or 5 days even under optimum conditions.

Midge adults, as a general rule, do not venture far from marginal vegetation. In light trap experiments, it was noticed that flying midges were taken in much smaller numbers in traps set away from the immediate vicinity of water than in those close to the water. Traps of the same type and light intensity that were set 200 yards from the water captured only 25% as many midges as the traps immediately adjacent to the water. Traps placed upon a bluff about 75 yards higher than the water and 100 yards distant from it, took even fewer midges, indicating that height above the water is also a limiting factor. On several occasions midge swarms were observed above the waters of Upper Klamath Lake more than 2 miles from the shore. Night flight range may be considerably shorter than day flight range.

Predators. The larvae are probably preyed upon by all 18 species of fish in Upper Klamath Lake. They form an important item in the diet of *Tigoma bicolor*, the Klamath chub, and *Siphateles b. bicolor*, the Klamath roach. The larvae are also food for aquatic beetles, larval dragonflies, and hemipterous nymphs, and also small marsh birds.

Adult midges are captured in considerable numbers by dragonflies, toads, small song birds, and spiders. Dragonflies, of the family Aeschnidae, are especially active during the periods of midge swarming, darting into swarms and seizing numbers of flies. Great numbers of toads, chiefly the western toad *(Bufo b. boreas)*, gather in the evenings near lights and capture adult midges. Examination of the stomach contents of 20 toads collected near light traps, revealed that each had consumed 10 cc. or several thousand midges. Spiders also consume quantities of midges and frequently become so numerous that they and their unsightly webs are a secondary problem.

Possibility of Control. Can an adequate control, either artificial or natural, be developed to decrease the numbers of the twin nuisances of algae and midges? Algae is apparently intimately associated with the midges and must be given consideration.

Much attention was given to light traps during 1939. Several of various sizes and designs were tested and those at the Bureau of Entomology Gnat Control at Clear Lake, California, were observed. While they capture an amazing number of insects, it is doubtful if present types would constitute a control measure. It is true that if sufficient labor could be employed, traps manufactured, and miles of electric wires strung, the midge nuisance might be abated, but the area could never be completely cleared

of midges, and discontinuance of the practice would allow reinfestation from adjacent waters. Light traps would be of value only to resorts and private residences.

A number of chemicals were tried, usually at the rate of one pound per 50 square yards of surface area, and then checked under field conditions. Some were applied on the surface to kill ascending pupae, and others, by tube sprayers, to the bottom to contact larvae. Midge larvae, in the experimental section of Lake Ewauna, were counted before and after application. A sub-surface apparatus was devised for preliminary chemical control.

Calcium arsenate, basic copper sulfate, Bordeaux, pyrethrum, and Paris-green all gave a fair degree of control ranging from 50 per cent to 98 per cent in different areas. Crushed salt, sown by hand gave a 100 per cent kill in the area examined. Phenothiazine and miscible oil destroyed great numbers of ascending pupae. Some of the chemicals approached laboratory expectations, particularly phenothiazine and crushed salt but at present no recommendations can be made.

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THE BLACK WITCH MOTH EREBUS ODORA (L.) IN BRITISH COLUMBIA

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Introduction. The capture of two specimens of this phalaenid moth in Victoria last season has led to inquiries regarding its occurrence in British Columbia. Authentic records have proved to be so few it is thought desirable to bring them together in this paper as a basis for future reference and investigation. Allusions to mysterious and elusive gigantic moths have been made from time to time; some of them may refer to the species in question, but lacking confirmation we suspect the Polyphemus or Cecropia moths, of the same size and well-known residents of British Columbia.

Description. The Black Witch, *Erebus odora*, was described by Linnaeus in 1758 as *Bombyx odora*, *Erebus* being assigned in 1810 by Latrelle. It early attracted the attention of naturalists, yet is sufficiently distinctive to have only one synonym, *agarista* Cramer, 1887. It is a large moth with wings extending over 6 inches and broad in proportion. The forewings suggest the clean-cut lines of a hawk; the nervures and membranes