beings or domestic animals. If it is not used in liberal quantity, however, a proportion of the caterpillars are merely numbed by this mixture and recover. Younger caterpillars are more susceptible.

Hand-picking.—For the kitchen garden where, for obvious reasons, it is undesirable to use arsenicals, hand-picking is sometimes practiced, especially when plants are first set out.

The corn-meal remedy.—According to Prof. L. Bruner, corn meal dusted on cabbage causes the "worms" to drop off, and protects the crop until the meal is washed away by rain. It is applied in the morning while the dew is on and is said to act as a deterrent.

Clean farming and trap crops.—If cooperation in clean methods of farming and in the use of arsenicals could by any possibility be secured, much of the loss due to the ravages of this pest might be averted. The practice of leaving cabbage stalks in the field after the main crop is off is a reprehensible one. All remnants should be gathered and destroyed with the exception of a few left at regular intervals through a field as lures for the females to deposit their eggs. Such stalks, being useless, should, where feasible, be freely poisoned with arsenicals so that the last generation will have no place to develop in the fields.

The utilization of natural enemies.—It is matter of common observation, frequently recorded, that the two parasitic enemies of this species (*Pteromalus puparum* and *Apanteles glomeratus*) do excellent service in reducing the numbers of their host. The means by which they can be encouraged is described on page 6.

Attempts have also been made to utilize diseases of this insect for its control, but without very encouraging results.

Hellebore will kill this "worm," but is not as satisfactory a remedy as the arsenicals.

Trap leaves.—A remedy suggested by one of our correspondents was tested by the writer against this and other cabbage "worms," including the looper, and found worthless. It consists in placing fresh cabbage leaves over the heads at night, the supposition being that the "worms" will gather under these traps and can be destroyed next morning.

Approved:

JAMES WILSON,
Secretary of Agriculture.

WASHINGTON, D. C., *April 28, 1905.*

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CIRCULAR NO. 61.

United States Department of Agriculture,

BUREAU OF ENTOMOLOGY,
L. O. HOWARD, Entomologist. (1905)

BLACK CHECK IN WESTERN HEMLOCK.

By H. E. BURKE, *Special Field Agent.*

ECONOMIC IMPORTANCE.

Black check is the lumberman's name for a common defect, consisting of a dark brown or blackish resinous scar, in the wood of the western hemlock. A few layers of the wood beneath this scar are slightly stained for a short distance around, and all of those above are thickened, curled, or in some way abnormal. When seen in a quarter-sawn board (radial section) the defect appears as a small, thin seam (fig. 1) from one-half to one inch long, with one side curly. In a bastard-sawn board (tangential section) it is an oval or circular spot (fig. 5, *g*) that varies in diameter from one-half to one inch. In both cases it lies with the grain of the wood.

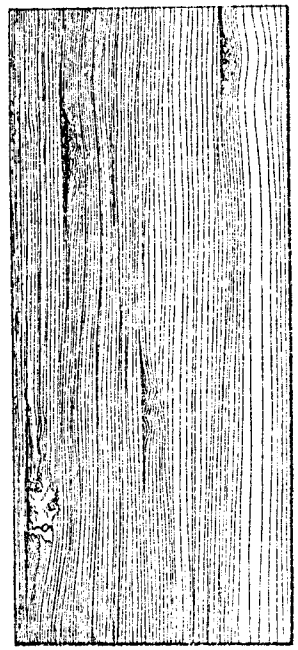

FIG. 1.—Longitudinal section of a board approximately quarter-sawn containing checks (radial section) (original).

Hemlock timber growing on lowlands is often seriously affected, while that on higher land, especially above an altitude of 1,800 feet, appears to be free from the injury. In a large quantity of box stock cut from lowland timber, nearly every board examined by the writer contained numerous examples of the defect.

Timber badly affected with this defect is nearly worthless for finishing, turning, staves, and woodenware, for which it would otherwise be excellent. The injury is very conspicuous in bastard-sawn lumber, unfitting it for finishing or turning, while in that quarter-sawn (fig. 1) or cut across the grain it is apt to form an open seam which renders it worthless for staves and woodenware, where tightness is required, but it would appear that it is not materially detrimental to timber for construction and other purposes.

Taking into consideration the common occurrence and injurious effect of the blemish in lumber for certain purposes, and the large amount of timber concerned, the total loss caused by the check must be considerable.

Cheilosia burkei

This form of injury is due to the attack of the bark maggot (*Cheilosia alaskensis*) subsequent to primary injury by the hemlock barkbeetle (*Hylesinus* n. sp.).

HISTORICAL.

In 1902 Mr. Edward T. Allen, of the Bureau of Forestry,[1] described the defect which he had found to be caused by a maggot or larva of an unknown fly.

In 1903–4 the writer made special investigations of the trouble, under instructions from Dr. A. D. Hopkins, to determine: (1) The species which is responsible for the damage; (2) the life histories and habits of the principal species and closely related forms, their natural enemies, etc.; (3) whether or not the larvæ are capable of entering healthy, uninjured bark; and (4) the character and causes of previous injuries which induce attack.

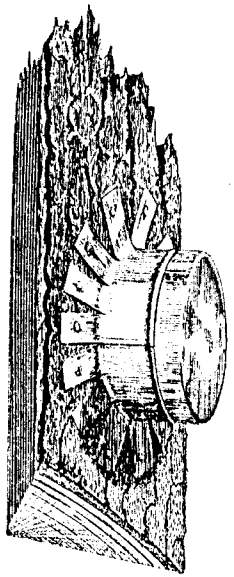

FIG. 2.—Box cage fastened to side of tree to catch adult fly (original).

The principal localities in which the work was carried on in connection with that on forest insects in general, were Hoquiam, Aberdeen, Satsop, Copales, Kent, Puyallup, North Bend, South Bend, and Seattle, in the State of Washington, and the vicinity of Portland, Oreg.

The first examination of infested trees was made in August, 1903, when maggots of various sizes were found to be quite common in the bark of the trunks of living trees. Their presence was indicated by small masses of resin on the surface of the bark. In and beneath each of these a single maggot was at work in a cavity or hole which extended to the surface of the wood, where there was a wound, evidently caused by this insect. Similar wounds, partially healed, and others several years old were found in the same trees, from near the outer layers of the sapwood to layers deeply buried in the heartwood. The latter were readily recognized as the black-cheek defect and there was no doubt left as to their being caused by this insect, which should, therefore, be hereafter known as the hemlock bark maggot.

Experiments with different methods of rearing the adult insect were at once started. At first the infested resin masses with a portion of the adjoining wood were cut out and placed in jars and tin boxes, but they soon dried up or molded. Then cages of netting placed over the resin masses on the trees were tried. These proved too flimsy and were hard to examine. Finally, cages were made from small baking-powder and spice cans, by knocking off the bottoms, cutting the sides into narrow

[1] Bur. For., U. S. Dept. Agric., Bul. 33, "The Western Hemlock," pp. 19, 20, 23.

strips, and punching holes for tacks in the tips of the strips (fig. 2). This was found to be admirably adapted to the work; it was durable, could be readily fitted to any surface, and was easily examined by simply removing the lid.

The investigations were started too late in the season to secure the pupæ or adults, but many larvæ in various stages of development were collected and studied, and a number of the infested wounds were covered with the tin cages.

The most important result of the first season's work was the discovery that the primary cause of the attack and subsequent injury by the bark maggot was the work of the hemlock barkbeetle (*Hylesinus* n. sp.) (fig. 3, *a*)[1] which was found excavating short burrows (fig. 3, *b*, *c*) in the healthy bark, and through it to the surface of the wood, where a small wound was made, causing a slight flow of resin (fig. 3, *f*). These burrows were evidently made by the beetles for the purpose of obtaining food, and not for the purpose of depositing eggs, since neither eggs nor larvæ of the beetle were found, and the burrows were soon abandoned. Some of these food burrows were healed over without further injury to the wood, while others were open and contained a small amount of resin. These abandoned galleries, with the resin, formed ideal places for the young bark maggots to begin their work, and were, apparently, utilized in preference to any other wounds.

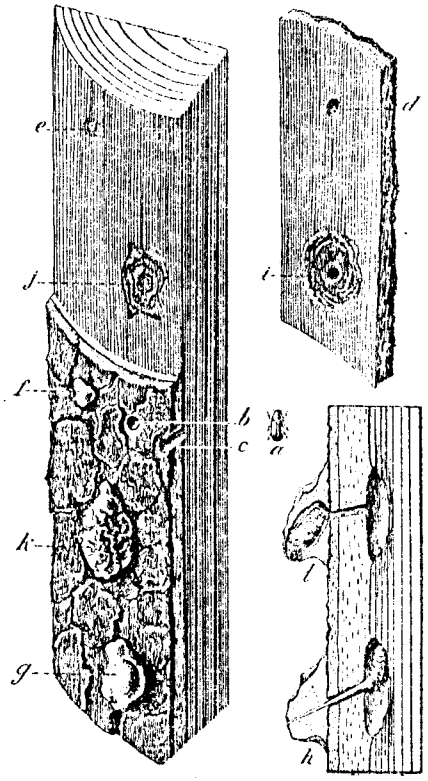

FIG. 3.—Development of the black cheek in western hemlock: *a*, the beetle (*Hylesinus* n. sp.) that makes the primary injury—natural size; *b*, entrance of beetle in outer bark; *c*, longitudinal section of a similar entrance; *d*, same as *b*, showing wound in inner bark; *e*, same, showing wound in outer sapwood; *f*, resin exuding from an entrance after beetle has gone; *g*, fresh resin mass on outer bark, indicating hemlock bark maggot at work; *h*, longitudinal section of similar mass, showing position of maggot; *i*, maggot wound in inner bark; *j*, same, in outer sapwood; *k*, resin mass after maggot work is done and the pupa is formed; *l*, longitudinal section of similar mass, showing pupa, the wound beginning to heal (original).

The investigations of 1904 were more successful. Upon the first examination of the breeding cages on April 27 one adult male was found. On April 30 a female emerged, and May 8 two males were secured from resin masses placed in cages in the laboratory. Another female was

[1] Bul. No. 48, Div. Entom., U. S. Dep. Agric., p 20.

taken on May 10, while it was flying in the sun in a field near the forest. No adults were found in the cages or collected after May 10, which would indicate that in this locality the adults emerge during the last of April and the first of May. Specimens of the fly were sent to Mr. D. W. Coquillett, who identified them as *Cheilosia alaskensis* Hunter.

The last examination of the field breeding cages was made on October 10. A number of the resin masses that were caged in October, 1903, still contained larvæ. This would indicate that the insect lives several years in the larval state. The fact that larvæ of various sizes were

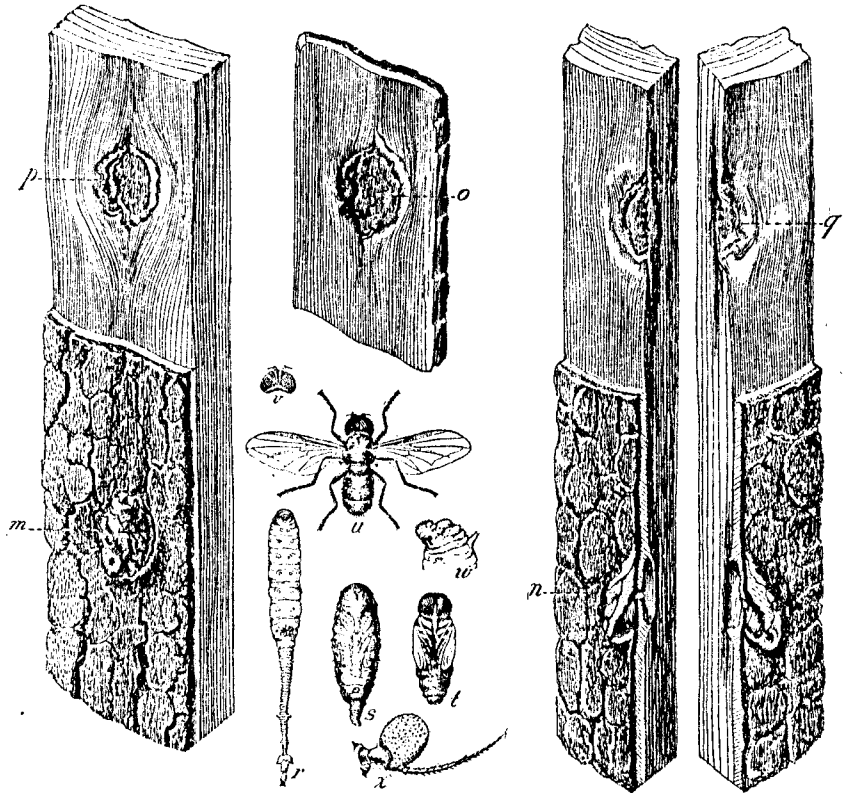

FIG. 4.—Hemlock bark maggot (*Cheilosia alaskensis*): *m*, Resin mass with exit hole, adult fly having emerged; *u*, longitudinal section of similar mass, showing wound in inner bark and outer sapwood, pupal chamber and exit hole in outer pitch mass, and original beetle entrance connecting them; *o*, healing wound in inner bark beneath mass like *m*; *p*, healing wound in outer sapwood beneath mass like *m*; *q*, longitudinal section of wound *p*; *r*, maggot; *s*, puparium; *t*, pupa; *u*, adult, male; *v*, head of female—all about twice natural size; *w*, larval head—enlarged about 20 times; *x*, antenna—enlarged about 45 times (original).

found at all times of the year and adults only in the spring strengthens this belief.

LIFE HISTORY AND HABITS OF THE HEMLOCK BARK MAGGOT.

The female fly was not observed ovipositing, nor was the egg found, but young larvæ were collected from the barkbeetle wounds. It therefore seems evident that the egg is laid on or in the slight flow of resin that exudes from such a wound (fig. 3, *f*). No evidence was found that the larva could make an independent entrance through the bark.

DESCRIPTION OF THE STAGES.

The larva.—The larva (fig. 4, *r*) is a whitish maggot with a small, wrinkled head almost buried in the front end of a plump, subcylindrical, segmented body that terminates behind in a long, telescopic, protractile tail. The head (fig. 4, *w*) has a pair of stout, black, forked mandibular hooks, and is densely clothed with short brown spines. When examined with a microscope, a pair of small branched feelers (antennæ) are found just above the hooks. The body seems smooth to the naked eye, but it is quite thickly covered with minute spines. Just back of the head, upon the dorsal surface of the first segment, is a pair of widely separated, small, fleshy tubercles. Each bears a dark brown breathing organ (spiracle). Most of the segments have a pair of fleshy appendages, probably false feet, on their ventral surface. Upon the ventral surface of the last segment, and surrounding the anus, which opens there, are often seen five or six heavily convoluted, bladder-like protrusions. These are probably the rectal glands.

The tail is about the same length as the body. It bears several pairs of the fleshy foot-like organs, and terminates in a dark-brown fork, each branch of which is armed with a whorl of four strong plumose bristles. It is simply a long breathing tube that may be lengthened or shortened at will to meet the varying depth of the resin mass covering the body. The tip, or fork, bears and protects the spiracles, which must always be kept out to the air. The full-grown larva, including tail, is from 0.6 to 0.8 inch in length, and 0.08 to 0.12 inch in width at its largest part.

The puparium.—The puparium (fig. 4, *s*, *t*) is formed within the last larval skin. The larva lies doubled up with the tail bent over the back and the head just within the outer surface of the resin mass. The tail shortens up, appears to lose its breathing function, and the body becomes more compact and solid. The two spiracle-bearing tubercles on the back of the first segment become elongated into horns, and form the breathing tubes. The larval skin does not seem to become very much thickened, nor any darker, as is usually the case in related forms. It remains quite transparent and the outlines of the puparium can be seen through it quite plainly. The puparium, including the inclosing larval skin, is 0.28 to 0.36 inch in length, and 0.12 to 0.16 inch in width.

The adult.—When full development is reached, the head of the larval skin is pushed out and the adult emerges. This usually takes place in April or May. The adult (fig. 4, *u*) is a small black fly, about 0.36 inch in length, 0.12 inch in width, with wings 0.32 inch in length, and is rather densely covered by medium black hairs. The male is more

slender than the female, which has a rather broad pointed abdomen. The eyes of the male are contiguous on the top of the head, while those of the female (fig. 4, *v*) are quite widely separated. Little is known of the habits of the adults. Though carefully sought for, only one specimen was taken in the field. This was flying in the sun in a little meadow at the edge of a forest. The species was described[1] from a single female taken at Cook's Inlet, Alaska. There is also a female from Yakutat, Alaska, in the U. S. National Museum Collection.

HABITS OF THE LARVA.

The larva is usually found in the wound (fig. 3, *h*), surrounded by the soft resin. The head and body lie in the inner part next to the sapwood, while the tail extends out through the bark and outer resin mass, with the spiracles opening into the air. The cambium, or growing layer, which is composed of soft, living, outer sapwood and inner bark, is bruised and torn by the mandibular hooks until quite a wound is made. This is enlarged as its occupant grows in size. The resin is pushed out of the entrance and forms an irregular, globular, reddish-gray mass on the outer bark (fig. 3, *g*, *k*, and fig. 4, *m*).

Breathing through its tail and feeding on the sap and soft tissues of the tree, the larva lives in the wound until it becomes full-grown. This takes, in some cases at least, several years. Some larvæ, from eggs laid, probably, in May, 1903, had not changed to adults in October, 1904. All sizes of larvæ are found at all seasons of the year, but the adults during April and May only. The wounds (fig. 3, *i*, *j*) show that as many as five successive layers of new growth may be eaten, although the usual number seems to be three. These facts seem to indicate that living representatives of several broods may be found at any time, and that the length of the larval stage is variable. It is probable that under unfavorable conditions it may be prolonged to four or five years, while if the conditions are favorable it may be shortened to one year.

Although the larva is usually found in the wound as described before, it sometimes moves around in the outer resin mass and even on the outer surface of the mass. In the spring the fully developed larva withdraws to the outer mass to pupate (fig. 3, *l*).

The primary wound made by the barkbeetle through the bark remains the same size as the beetle leaves it, and the bark maggot occupies the chamber between the inner bark and wood. Both entrance and chamber are filled with resin. The completed wound (fig. 4, *o*, *p*, *q*), therefore, consists of the beetle burrow, which is about 0.08 inch in diameter, through the outer and inner bark to the inner chamber, which is one-half inch to 1 inch in diameter. The external resin mass is 0.6 inch to 1 inch in diameter, and 0.4 to 0.6 inch in depth.

[1] W. D. Hunter, Can. Ent., Vol. XXIX, p. 124, June, 1897.

As soon as the maggot leaves the inner chamber the irritation ceases and the wound begins to heal. The cambium grows down into it year after year, and the annual growth of wood formed there slowly covers it over until in three or four years it is completely buried (fig. 5) beneath the new growth and thus forms the black check.

As the wood grows down into the wound in healing it over, a depression is formed in each new layer, but sometimes the new layer thickens around the depression and forms an elevation above the surrounding surface. In both cases an ornamental curl is formed that will show as a bird's-eye effect in bastard-sawn or longitudinal sections of the wood.

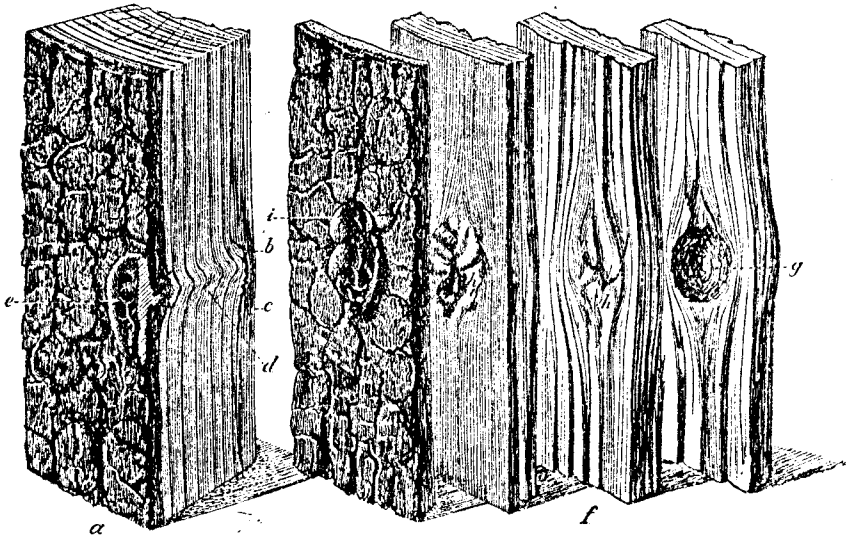

FIG. 5.—*a*, Longitudinal section of wood containing a black check; *b*, the check; *c*, the stain in the wood beneath it; *d*, the curls in the wood covering it; *e*, the resin mass on and in the bark; *f*, section *a* split into four sections to show tangential views; *g*, tangential view of check; *h h*, tangential view of curls; *i*, black spot or old resin mass (original).

NATURAL ENEMIES.

Two hymenopterous parasites were bred from the syrphid puparia. Dr. Wm. H. Ashmead, of the U. S. National Museum, identified one of these as an ichneumonid (*Syrphoctonus maculifrons* Cr.) and the other as a chalcidid (*Eutelus flavipes* Walk.). Both species are fairly common, and probably aid greatly in keeping the trouble in check.

Syrphoctonus maculifrons Cr.—This is a small wasp-like ichneumon fly about 0.36 inch in length. It has a dark body marked by a few white patches at the bases of the wings and legs. The face is nearly covered by a square of white, and the legs are reddish brown. The abdomen of the male is more slender than that of the female, and the white square on the face is larger. The earlier stages are not known. Pupation takes place in the body of the maggot in the outer resin mass. The adult emerges during the latter part of June or the first of July.

Each maggot furnishes subsistence for but a single parasite. Adults were bred from resin masses of both the hemlock and the lowland fir bark maggots.

Eutelus flavipes Walk. is one of the small chalcidid flies. The females have dark metallic-green bodies, cherry eyes, light brown legs, rather dark antennæ, and are about 0.12 inch in length. The males are smaller, about 0.08 inch long, and have a broad yellow band across the abdomen. Their bodies are a lighter green and the legs and antennæ are yellow. Each maggot supports a number of parasites, usually about a dozen. The pupæ are formed in the body of the host in the outer resin mass. The adults emerge during the latter part of June. This species was bred only from the hemlock resin masses.

These two parasites were the only natural enemies found. There was no evidence of any bacterial or fungous disease, and the maggot is so concealed in the bark and resin that it is well protected from predaceous enemies.

ASSOCIATES.

Two small pill beetles (*Amphicyrta simplicipes* Mann. and *Simplocaria nitida* Mots.) were frequently found on and near the resin masses. Their relation, if any, to the syrphid was not determined.

METHODS OF PREVENTING LOSSES.

Since the black check is the result of the work of the insects during past years, or even centuries, and is thus distributed all through the wood of the trunks of the matured affected trees, the only methods which appear to be available for preventing losses are:

(1) Where clear stuff is required, select timber which, as indicated by the absence of the old resin masses on the bark, is free from the trouble.

(2) Utilize timber from badly affected trees for box material and other purposes where the checks are not objectionable.

(3) Utilize the bird's-eye or curled wood for natural-wood finish.

BARK MAGGOTS IN OTHER TREES.

THE LOWLAND FIR BARK MAGGOT.

In 1903, while studying the black check of the hemlock at Satsop, Wash., a similar trouble was discovered in the white or lowland fir. The insect causing it was reared and proved to be *Cheilosia hoodianus* Bigot, a species closely related to the hemlock fly. The maggot is very similar in size, appearance, and habits. The adult is a trifle larger and not so dark in color. The thorax is dark brown, and the abdomen a light chocolate. The emergence of the adult takes place a little later in the season than that of the hemlock species. Most of those reared emerged about the middle of May, but the last one did not come out of the resin mass until August 12.

The work of the two species is very similar. The fir is a more rapidly growing tree than the hemlock and the wounds under the bark, therefore, go deeper into the sapwood. These wounds, also, occur more often in patches. The primary injury is made by several species of barkbeetles, viz, the western hemlock barkbeetle (*Hylesinus* n. sp.), the larger fir-tree barkbeetle (*Hylesinus granulatus* Lec.), and probably other species.

Two specimens of the parasite *Syrphoctonus maculifrons* Cr. were bred from the resin masses. No other enemies were seen.

Satsop was the only place where the trouble was noticed. The amount of damage done and the distribution of the insect causing it are not known.

THE ALPINE FIR BARK MAGGOT.

On October 24, 1904, a bark maggot was found in a resinous wound on the trunk of an alpine fir at Smith's Ferry, Boise County, Idaho. The wound seemed to have been started from an old limb scar. Only one specimen was found. It resembled the maggots of the hemlock and lowland fir, and is probably the larva of another species of Cheilosia. The amount of damage it causes was not determined.

THE SITKA SPRUCE BARK MAGGOT.

A maggot closely resembling the other species, except that it has a short tail, is quite common in the wounds on the trunks of Sitka spruce. It is usually found in the pitch around the edges of the large resinous wounds caused by the spruce pitch-worm (*Parharmonia picea* Dyar). Several maggots live in the same wound, and the irritation produced by their feeding keeps it open for so long a time that an ugly scar is formed in the wood. Several generations may live in the same wound. Pupation takes place in the drying resin of the wound. This is probably a species of Cheilosia. Hoquiam, Wash., was the only place where the trouble was noticed.

THE YELLOW PINE BARK MAGGOT.

A dark, subcylindrical dipterous puparium was very common in pitch exuding from axe and other wounds in the bark of young yellow pine (*Pinus ponderosa*) trees at Moscow Mountain, Idaho, and barkbeetle (*Dendroctonus* sp.) and sapsucker wounds in the bark of the young trees of yellow pine, and the lodgepole pine (*Pinus murrayana*) at Smith's Ferry, Idaho. No adults were reared. The species is probably a syrphid, possibly a Cheilosia, though the puparium does not resemble those of *Cheilosia alaskensis* and *hoodianus*. The amount of damage done is unknown.

CONCLUSIONS.

(1) Western hemlock timber growing on low land is often affected by a defect known as black check, which renders a large percentage of the

wood worthless for finishing, staves, and woodenware, but apparently is not seriously detrimental to timber for other purposes.

(2) The black check is caused in nearly every case by an injury to the cambium (growing layer) of the trunk by the hemlock bark maggot, *Cheilosia alaskensis* Hunter. Somewhat similar defects may be caused by barkbeetles, bark-borers, sapsuckers, or anything that makes a wound in the cambium, which afterwards heals.

(3) The maggot enters the bark through an abandoned food burrow made by the hemlock barkbeetle (*Hylesinus* n. sp.). It gradually enlarges the burrow into a small wound, in which it lives for several years, feeding on the sap and cambium. In the spring, when full grown, it pupates in the resin mass which has formed on the outer bark around the entrance to the wound. The puparium soon changes to the adult, which emerges in April or May. The egg is probably laid on the resin exuding from the abandoned gallery of the barkbeetle.

(4) A near relative (*Cheilosia hoodianus* Bigot) of the hemlock bark maggot causes, in a similar manner, a black check in the timber of lowland, grand, or white fir (*Abies grandis*). It enters the bark through the abandoned food burrows of several species of barkbeetles.

(5) The alpine fir (*Abies lasiocarpa*), the Sitka spruce (*Picea sitchensis*), and probably many other trees are injured more or less by bark maggots that enter wounds and enlarge them or keep them open until the conditions are such that checks form in the timber.

(6) For preventing losses in timber cut for purposes requiring clear stuff, select trees growing at altitudes above 1,800 feet and those at lower elevations which are free from the black indicating spots (old resin masses) on the bark.

Approved:

JAMES WILSON,
Secretary of Agriculture.

WASHINGTON, D. C., *May 24, 1905.*

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CIRCULAR NO. 62, REVISED EDITION. Issued July 28, 1908.

United States Department of Agriculture,

BUREAU OF ENTOMOLOGY.

L. O. HOWARD, Entomologist and Chief of Bureau.

THE CABBAGE HAIR-WORM.

By F. H. CHITTENDEN,
Entomologist in Charge of Breeding Experiments.

Not since the "kissing-bug" craze which originated in Washington, D. C., in June, 1899, and spread generally throughout the country, has there been anything like such a furore as was created by the discovery of the so-called "cabbage snake," a species of hair-worm, in the heads of cabbage in Tennessee, South Carolina, and Louisiana, in the fall of 1903. That year the cabbage-snake scare was practically confined to Tennessee and neighboring States southward. The first specimen of *Mermis albicans* Diesing (fig. 1), which is the cause of the trouble,[a] was identified from McCays, Tenn. This creature and its still somewhat mysterious occurrence in cabbage have become a matter of much perplexity and annoyance to many of our correspondents, to economic entomologists, and to chemists and physicians of the States where the Mermis most abounds. Many reports have been received from reliable correspondents of *rumors* of persons being poisoned by eating cabbage affected by this hair-worm. Some of these were gleaned from the daily press, and many clippings of the "yellow journalism" order were received. Among them were alleged reports from a physician who stated that when cabbage affected by hair-worms was eaten it produced instant death, and from a "State chemist" who made an examination of the worm and reported that it contained enough poison "to kill eight persons." In Raleigh County, W. Va., the cabbage crop was reported a complete failure, and "there was

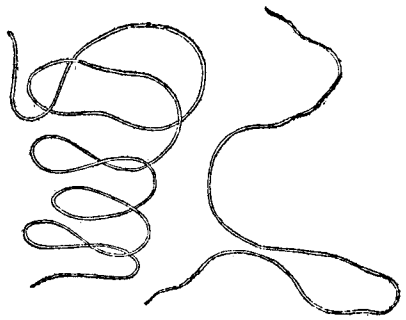

FIG. 1.—Hair-worm (*Mermis albicans*). Natural size (original).

[a] So many inquiries in regard to the identity of the creature and its alleged poisonous nature were received that a short account was furnished under the title "Hair Worms in Cabbage," in Bul. 44, of this office, pp. 93–95; and similar inquiries are being made to date of publication. During 1904, frequently five or six communications were received daily.