HOW WEEVILS GET INTO BEANS.

By E. A. Back,
Entomologist in Charge, Stored-Product Insect Investigations,
Bureau of Entomology.

READING NATURE'S SIGN LANGUAGE.

THE New England farmer strolling about his small farm during Sunday leisure is quick to read Nature's signs which tell him whether his crops and cattle are growing well. The Hawaiian ranchman mounts his horse and gallops off into the mountains to read the same signs as they appear differently under the semitropic sun. The color of the grass, the level of the water in his springs, or the drip of water from the roof of the mountain cave—all have their meaning to his practiced eye. No one versed in farm life need dig all the potatoes in a field before he knows pretty nearly what the yield will be. The tightly rolled corn leaf spells dry weather; the heating haycock means a blackened, moldy, worthless crop unless immediate action is taken. These signs of nature are too simple to need discussion among farmers. They are recognized facts. They are the common experience of centuries of farm life.

But Nature is just as generous in sharing her knowledge governing all phases of agriculture. She writes her signs large for those who will and can read them. One of the great works of the United States Department of Agriculture has been, and still is, the study of these signs, and the recording of them so that they may be more readily available to those who earn their living by means of agricultural pursuits. Each profession has its sign language; the best farmer is he who learns to use to his advantage the signs that aid him to understand better the forces working against his success.

DETECT WEEVILS BY THEIR SIGNS.

Just as the peach grower can tell by a mere examination of the buds on his trees during the fall whether his trees will blossom well the following spring, if weather conditions are right, so can the grower of beans, peas, and cowpeas, or any
other crop attacked by bean weevils, tell whether his seeds will be weevilly even before the plants have matured in the field. Thanks to the excellent work of the agricultural county agents, and of the agricultural high schools and colleges, there is growing up a generation of young farmers who are becoming acquainted with these and other signs which are being discovered and recorded by the State and Federal departments of agriculture.

UNFAMILIARITY WITH WEEVIL SIGNS GENERAL.

Experience is a good teacher. It teaches us many things that we do not understand. Many growers of beans and peas have learned from experience that their crops become weevilly after they have been placed in storage. They have lost so many crops that they have been forced either to abandon bean and pea culture or to treat their seeds to kill the weevils. Literally thousands of samples of beans and peas are sent annually to the Department of Agriculture from all parts of the United States with the same monotonous story: "I am greatly worried about my beans. Last year I grew as fine lot of beans as you ever saw and put them away in a pail so nothing could get to them. Imagine my surprise on opening the pail this spring to find them full of bugs and eaten full of holes."

The broker often writes: "Several months ago I purchased a carload of black-eyed cowpeas that seemed to be in A No. 1 condition, but weevils are now developing in them. Where did the weevils come from?"

The representative of a railroad claims department wrote: "Last May we received a consignment of cowpeas at ———, which arrived at destination one month later at ———. The consignee refused to accept the shipment because it was weevilly. The consignor is now suing this railroad for negligent handling of the cowpeas, stating that they were free from weevils when delivered to the railroad. What information has the department that bears upon this subject?"

The gardener, the broker, and the railroad claims agent could have known in advance whether weevils would develop had they watched and recognized the weevil signs that Nature makes plain.
LACK OF KNOWLEDGE LEADS TO FICTION.

In talking once with a buyer of beans in a foreign land, the writer inquired if he had had experience with weevils. "Oh, yes," he replied, "I buy beans from many farms. Sometimes they are very weevilly; sometimes the beans from certain farms are very bad, while those from other farms are not weevilly. I think it is all in the weather. If it is rainy, foggy, and warm the weevils are apt to be bad. The weevils come in the fog and rain. Don't you think so?"

He knew the weather conditions that favored weevil increase in that country, but no statement of fact could make him believe that the weevils did not "come from the air."

But the most common belief is that weevils develop "from the germ" of the seed or by "spontaneous generation." These false beliefs have grown out of the fact that the round weevil holes come in beans and peas that previously had appeared perfectly sound. How could a weevil eat his way out of a sound bean, leaving behind a large round hole, if he did not develop "from the germ" or "spontaneously" within? Otherwise, how did he get into the bean in the first place?

Right here is where nearly all who handle beans make a mistake. They never see the hole by which the weevil enters. They do not realize that bean weevils, like animals, grow; that they enter beans and peas when they are young and leave when they are fully grown. It is common sense that they enter by a minute hole and leave by a large one.

LIFE CYCLE OF BEAN WEEVILS.

We speak of the life of a man, meaning his existence from birth to death. Every farmer boy learns early that the robin begins life as an egg, later hatches into a helpless, featherless birdling in the nest, and becomes full grown and able to fly only after it has been fed by its parents for some time. More people every year understand that the silkworm moth comes from a silken cocoon made by a worm that hatched from an egg laid by a mother moth. Just because the silkworm moth in becoming adult is first an egg, then a worm, and later a chrysalis or pupa in a protected silken cocoon, we speak of its life as a "life cycle" because each generation goes through the same round of life from egg to adult.
Bean weevils have their life cycles also. Each weevil passes through the egg, worm or larva, and pupa or chrysalis stages before it is fully grown or adult. But the worm or grub of the bean weevil does not crawl about like the ordinary caterpillar, neither does it feed on mulberry leaves as does the silkworm. But it burrows into beans and peas and eats out their substance like a cancer hidden from sight in the human body. It has jaws with which it gnaws out a cavity as it eats the seed tissues. When it becomes as large as it is its nature to become, it turns into a pupa or chrysalis. But instead of making a silken cocoon like the silkworm, it makes a frail cocoon or cell out of the chewed-up parts of the bean seed right in the cavity where it has been feeding. After it has remained a time in the pupal stage it transforms to the male or female adult. The adult weevil eats its way out from cocoon and seed, leaving behind the round hole in the seed so familiar to all bean growers.

LIFE CYCLE SHOWN IN PICTURES.

The life cycle of the bean weevil may be traced in the illustrations of Plate XLI. In figure 1 is shown the weevil eggshell resting where it was laid by the mother weevil on the bean. It is the small white object on the skin on the upper left-hand side. When the weevil grub, or worm, is ready to hatch from the egg, it eats a hole in the side of the eggshell next to the skin of the bean, and then burrows straight through into the bean and down into the pulp of the bean. The empty eggshell remains still attached to the skin of the bean; if it be rubbed off, the tiny hole by which the weevil entered the seed can be seen, although it may be so small that a microscope must be used. For a short distance the grub burrows, making a tiny streak no larger than a pin prick. Notice that the weevil grub comes from the egg and not from the germ of the bean. The germ is shown at a in figure 1, and may be also seen in figures 2 to 6, which represent the bean split to show the inside of one of the cotyledons.

As the grub continues to feed in the bean it eats out a larger and larger cavity, as shown by the illustration in figures 2, 3, and 4. By the time the grub has grown to be as large as the one shown in the cavity of figure 4 it has reached full growth. It then makes the cocoon and turns
LIFE CYCLE OF A WEEVIL IN A BEAN.
BROAD AND NAVY BEANS INFESTED WITH WEEVILS.
WEEVIL-INFESTED BEANS AND COWPEAS.
into the pupal stage as stated above. In figures 5 and 6 may be seen the cocoon cut open to show the pupa (in fig. 5) and the adult weevil (in fig. 6). Often the adult weevil remains a long time quietly waiting in the cocoon until conditions are favorable outside, and many even die still in the cocoon. But the more active ones eat their way out. In doing this they cut the round openings in the seeds, the appearance of which is the first evidence to most people who can not read weevil signs that their beans are being destroyed. In figure 7 can be seen the weevil crawling out from the seed after cutting out the round opening in the skin. In figure 8 is shown, on the left side, the emergence hole and within it the edge of the cocoon, while on top of the bean is a female weevil laying her tenth egg on the bean. The eggs are laid here and there without attention to any definite pattern and sometimes even loosely among the seeds. The grubs hatching from the eggs laid on the bean of figure 8 will hatch and eat into the bean, and grow just as did the grub hatching from the egg shown in figure 1. They belong to the next generation. And so generation after generation or life cycle after life cycle follow each other.

**WEEVIL SIGNS IN THE FIELD.**

The parent weevils (shown in figs. 7 and 8, Pl. XLI, and in fig. 4, Pl. XLII) are not often seen in the field, because they are very small and fly or drop to the ground when disturbed. They are scarcely one-quarter of an inch long. But the eggs they lay can be found on the maturing green pods. The eggs appear as mere white specks, as shown about natural size on the green pod of the broad bean (fig. 1, Pl. XLIII), or about twice the normal size on the cowpea pod (fig. 3, Pl. XLIII). An examination of the ripening pods of a crop will give an idea as to the relative abundance or absence of weevils. If many eggs are seen on the pods in the field, plans must be made for a campaign against weevils when the seeds are harvested and put in storage. (Write for Farmers' Bulletin 983 for control measures.)

**NO WEEVIL EGGS ON FRESHLY HARVESTED SEEDS.**

When the weevil eggs laid in the field upon the pods hatch the young grubs burrow through the pod into the bean. When the eggs are laid on the bean in storage, as shown in
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figure 1, Plate XLI, or figures 2 and 4, Plate XLIII, the shell sticks to the bean and is easily seen. But eggs laid in the field on the pods are exposed to the weather, and the eggshells are either washed off by rains or are thrown away with the pods when the crop is harvested. So the beans, just after they are shelled or thrashed, have no weevil eggs upon them. But even then the presence of weevils within can be detected by the presence of the minute hole in the skin of the seed made by the grub after it has burrowed through the pod and into the seed. In figure 1, Plate XLII, are shown 10 such entrance holes and 1 large emergence hole in the upper broad bean, while in the lower bean are 6 entrance and 2 emergence holes. In the center navy bean of figure 4, Plate LXII, can be seen 5 entrance holes close to each other arranged in an irregular line; compare their size with the 7 emergence holes in the same bean. When one learns to look for these entrance holes there is little difficulty in detecting weevil infestation. Of course, these entrance holes are so very small that a person with poor eyes or one not looking for weevil signs will pass them unnoticed and purchase a consignment of seeds as sound because they appear outwardly sound, only later to find them weevilly. The numbers of entrance and emergence holes do not usually correspond, because some of the entrance holes seem to heal over after they have been made, and quite a percentage of the young grubs entering die while they are very small.

 EGGS ON SEEDS IN STORAGE SIGN OF WEEVILS.

When a bean broker in Havana receives a consignment of beans or peas he samples carefully the various sacks with the aid of a grain trier. If he finds a single weevil egg (such as those shown about twice normal size on the Whippoorwill cowpeas of fig. 4, of Pl. XLIII) he says to himself: "There are weevils in this lot of seeds. I shall have to sell them soon or take a loss." Experience in a warm climate where bean weevils multiply fast has taught him to look for weevil signs in the eggs attached to the seeds, and with true business acumen he makes the consignor knock off something from the price to cover costs of fumigation or a loss due to immediate or early sale. Weevil eggs on dried seeds are laid by the generations of adult weevils following the generation.
laying eggs in the field. If weevilly beans and peas are placed in storage and the weevils not killed, the adult weevils emerge and lay eggs in storage on the dried beans. These eggs are so easily seen that one has only to look to see them.

COMMON BEAN WEEVILS RARELY LAY EGGS ON SEEDS.

In handling navy beans grown in more northern States, one can not depend upon the presence of eggs upon the beans to reveal infestation. This is true because the common bean weevil in storehouses lays its eggs loosely among the seeds, and rarely attaches them to the seed as do the common cow-pea weevils. For this reason gardeners and brokers handling navy beans infested by the common bean weevil must look for the entrance holes and not for the eggs. Small as these are, they are large enough to be seen by the knowing eye.

ATTENTION TO WEEVIL SIGNS PREVENTS LOSS.

And so it happens that the signs by which weevils reveal their presence in beans, peas, cowpeas, broad beans, lentils, etc., can be easily seen by anyone who watches. The gardener in caring for his garden during the summer has only to examine carefully the ripening pods on his bean and pea vines to learn whether weevils are present in his garden. It does not take much time as he rests from his labors, and he has the satisfaction of knowing a new secret of nature, besides sparing himself the painful surprise of finding later in his house a ruined weevil-eaten lot of seeds. The newly harvested crop can be examined by the owner or prospective buyer for the presence of the tiny entrance holes which spell disaster later on. And the eggs on the dried seeds and the emergence holes are there for the information of the shrewd conservationist, the broker, or the railroad freight agent. If they can and will read these weevil signs, much of the enormous loss now taking place will be prevented. How to act upon reading weevil signs, and more general information regarding the differing habits of the different kinds of weevils, are discussed in Farmers' Bulletin 983, which can be had free of cost by writing to the Department of Agriculture, Washington, D. C.

1 This is true except in the case of the broad or horse bean weevil, the lentil weevil, and the common pea weevil. These do not breed in dried seeds. See Farmers' Bulletin 983 for details.
DESCRIPTION OF PLATES.

PLATE XL. Life cycle of a weevil in a bean—Note that in figures 1 to 6 the bean has been split to show the “germ” at a. The development of the weevil is shown as follows: In figure 1, a weevil egg has been laid on the upper left side of the bean and the young weevil grub in hatching has gnawed through the eggshell and is tunneling down into the seed, making a hole no larger than a pinprick; in figures 2 and 3, the grub is eating out a larger and larger cavity in the seed as it grows; in figure 4, the grub has become full grown and has eaten the bean substance out to the very skin of the bean; in figure 5, the grub has made a cocoon and has transformed to the pupa; in figure 6, within the same cocoon, the pupa has transformed to the parent weevil; in figure 7, the adult weevil has eaten its way out from the cocoon, has gnawed a round hole in the skin over the cocoon, and is shown crawling out of the bean; figure 8 shows the emergence hole with the rounded edge of the cocoon beneath, and a female weevil laying an egg. Note that she has laid 10 eggs. These will hatch as did the egg of figure 1, and begin new life cycles.

PLATE XLII. Broad and navy beans infested with weevils.—Figure 1, two broad or horse beans showing the speck-like entrance holes of the young broad-bean weevil grubs, and the larger emergence holes made by the escaping adults. Figure 2, a badly infested navy bean cut to show cocoons made by common bean weevils. Figure 3, an enlarged bean showing the darkened spots in the skin where four weevils will emerge. Figure 4, a group of common navy beans enlarged to show an adult bean weevil at the lower left, emergence holes, and on the central bean five entrance holes made by young grubs. These five holes appear in the illustration as mere black specks no larger than a pin pricke. Figure 5, broad bean cut open to show damage by broad-bean weevil. Figure 6, a broad bean cut open and greatly enlarged to show weevil damage.

PLATE XLIII. Weevil-infested beans and cowpeas.—Figure 1, green pod of the broad or horse bean showing, about natural size, the white, speck-like eggs of the broad-bean weevil (Campbell). Figure 2, a cowpea greatly enlarged to show the relative size between the white eggs of a cowpea weevil and the emergence hole made by the adult weevil. Figure 3, a portion of the pod of a Whippoorwill cowpea, about twice natural size, to show the white eggs laid on it by a cowpea weevil. Figure 4, Whippoorwill cowpeas in a dried pod bearing many eggs of a cowpea weevil. Figure 5, portion of a necklace of cowpea seed worn by a Malayan princess and seized by quarantine officers of the Federal Horticultural Board. Note eggs and emergence holes of weevils in the seeds.