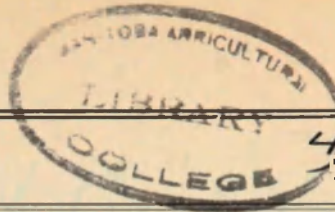


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A NEW POISONOUS PLANT
The Whorled Milkweed
(*Asclepias verticillata*)

BY
GEO. H. GLOVER, I. E. NEWSOM, and
W. W. ROBBINS



Fig. 1...750 sheep were killed by whorled milkweed in 24 hours near Cor ez, Colorado, in the fall of 1916

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Fig. 2.—A. plant of whorled milkweed just before coming into blossom. Note the narrow leaves that come off in groups at each joint of the stem. B, single pod breaking open.

A NEW POISONOUS PLANT

The Whorled Milkweed

(*Asclepias verticillata*)

By

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It has now been clearly established that the very serious losses of sheep annually experienced in Western and Southwestern Colorado are largely the result of poisoning by whorled milkweed. Although further investigations are necessary in order to establish the nature of the poisonous principle, to find remedies, and to obtain practicable methods of eradicating the plant, losses have been of such a serious nature that this preliminary bulletin is issued at this time that stockmen may become familiar with the whorled milkweed, its habits of growth, its habitat, its geographical distribution, and the conditions and symptoms of poisoning, so that they may put themselves on guard against it.

HISTORY OF WHORLED MILKWEED AS A POISONOUS PLANT

While early history mentions several species of *Asclepias* as being toxic, or having medicinal properties, the particular species in question has apparently never been suspected of being a poisonous plant of economic importance. American literature has either ignored the plant entirely or given it brief mention because of its close relationship to other plants of the same family that are known to possess toxic properties. The U. S. Dispensatory contains the following: "An indigenous species, *A. verticillata*, L., is used in the Southern States as a remedy for snake bites and the bites of venomous insects. Twelve fluid ounces of a saturated decoction are said to cause an anodyne and sudorific effect, followed by a gentle sleep."

As early as December of 1909 the whorled milkweed was suspected of being poisonous. A sheepman near Colona, Colorado, lost 85 head of lambs which he had turned into his orchard after they were brought down from the ranges. The only weed growing in the orchard which was at all suspicious was the whorled milkweed.

In Colorado the attention of the Experiment Station was first called to this plant in 1915, when specimens were sent from Grand Junction by Dr. A. P. Drew, with the assurance that cattle had been poisoned by eating it in hay, and further, that there was

much evidence to support his contention that the plant was causing much loss in livestock.

In the fall of 1916 a loss of 750 sheep out of a band of 1,400 was reported from Cortez (Fig. 1.). Stomach contents were sent to the Experiment Station and the seeds and stems of the whorled milkweed were found in large quantities. The place where these sheep were poisoned (a half mile east of Cortez) was looked upon with suspicion since it was rumored that other losses had occurred in the same locality. In the fall of 1917 a visit to this locality revealed a very dense growth of milkweed on a tract of ground that had been broken previously but not cultivated for at least two years. A little later in the season a band of sheep was held over night adjacent to this milkweed patch, and the following day nearly half of them died. The stomach contents showed that they had eaten practically nothing but milkweed.

The following case of poisoning was brought to our attention on June 2, 1918. This case was between Hotchkiss and Paonia, Colorado. A herd of 1,700 sheep had been ranged in the cedars and sagebrush. On June 2 these were turned into an old, abandoned 10-acre orchard for *one day* for the purpose of shearing and dipping. The orchard was enclosed. They were left in the orchard about eight hours, and in the evening driven out of the orchard to their bedding grounds in the cedars about 100 yards away. Between that evening and the following noon 350 sheep died. Inspection of this old orchard was made on June 14. It was very thickly grown up to whorled milkweed, in fact, there was very little succulent vegetation of any kind in the enclosure except the milkweed. Inspection showed that practically every plant had been eaten down, and that the growth present, was that made between the dates June 2 and June 14. The orchard stood in the midst of a cedar and a sagebrush growth, and examination showed no milkweed in this native association. It is clear in this instance that the sheep were forced to eat milkweed, and they came there from their range hungry.

On June 8, 1918, five miles north of Cortez, Colorado, the following case came under our observation: Sheep had been kept in a dry pen for two weeks with nothing to eat but green, bright alfalfa hay. On June 8 at nine o'clock in the morning 26 of these sheep were taken from the dry pen and driven about 75 yards over a dry road to a corral of about two acres in extent. The sheep were not fed that day and in the evening fifteen were down and thirteen had died up to four o'clock June 9. Two sheep recovered. All that could be found in this corral were a few scattering cedars, sagebrush and, in one corner of the corral a

patch of whorled milkweed, the only green thing in the enclosure. The milkweed patch had been about half eaten off. The characteristic symptoms were observed.

DESCRIPTION OF WHORLED MILKWEED

The whorled milkweed is a perennial plant from a rootstock. (Figs. 2, 3 and 4). This rootstock creeps horizontally under-

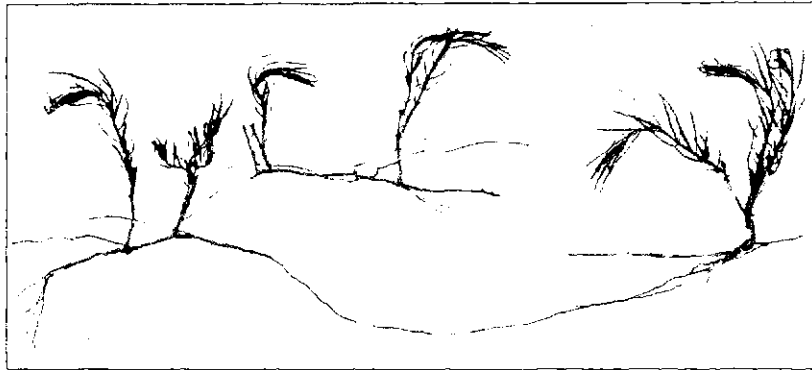


Fig. 3.—The plant has a very effective way of spreading by means of rootstocks which creep horizontally underground. Plants photographed June 8, 1918.



Fig. 4.—The rootstocks of whorled milkweed extend to considerable depths in the soil.

ground, and also extends to considerable depths in the soil. Its perennial habit, its ability to live from year to year by means of parts underground, makes it a pernicious weed, and one difficult to eradicate. Experiments are now in progress, however, which have for their object the finding of practicable methods of eradication. Needless to say, a plant which is the cause of such great loss of livestock, should be promptly exterminated, if extermination is at all possible.

In addition to its spread by means of underground stems, the whorled milkweed produces numerous seeds each of which is provided with a tuft of silky hairs which aid its distribution by wind. (Fig. 6.)

The plant grows to a height of 1 to 3 ft. The stems are slender and smooth. At each joint of the stem there are from two to six narrow leaves with margins that roll. The occurrence of several leaves at a joint to form a whorl of leaves is so characteristic of this plant as to suggest the common name, "whorled milkweed."

The flowers occur in small groups, and the grouping resembles that of onion flowers; they are greenish-white in color and peculiar in their form. The pod is of the milkweed type—dry when ripe, splitting open along one side and allowing the numerous flattened, reddish-brown seeds to fly out. The seed is aided in its distribu-

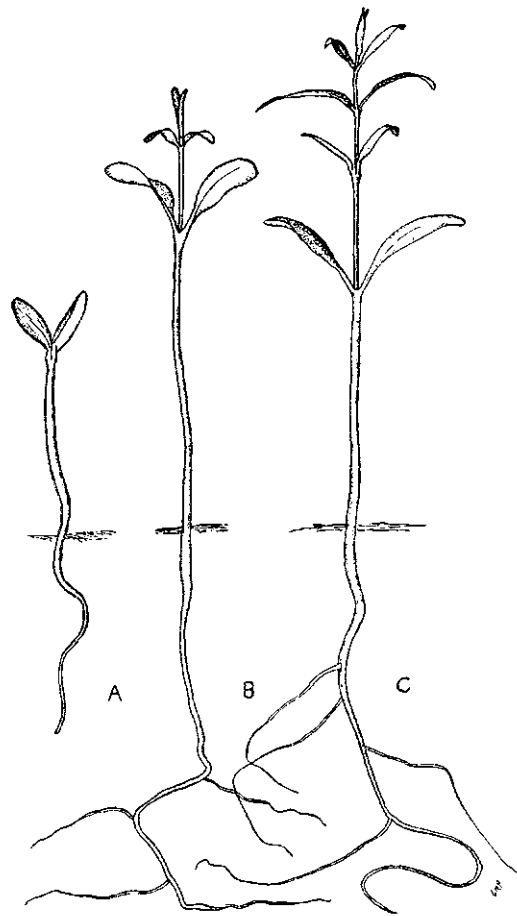
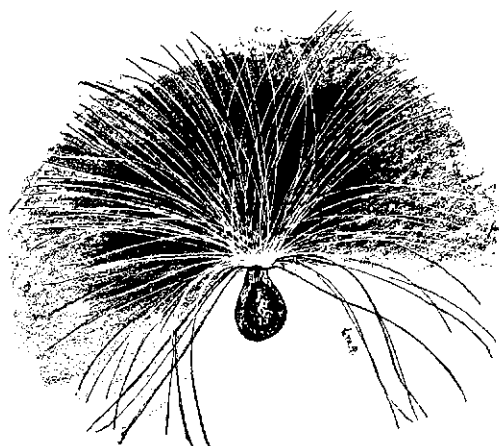


Fig. 5.—Seedlings of whorled milkweed.—A, seven days after planting; B, 21 days after planting; C, 28 days after planting. Note that the first foliage leaves rise in pairs.



tion by the bunch of hairs which is attached to its smaller end. (Fig. 6.) The pods are 2½ to 3 inches long.

The seedlings are shown in Fig. 5.

The plant has a white, milky juice, which exudes freely when the plant is injured.

Fig. 6.—The seeds of whorled milkweed are provided with a tuft of silky hairs which aid their distribution by wind.

WHERE WHORLED MILKWEED GROWS

The plant is a native of Arizona, New Mexico, Colorado, Utah,

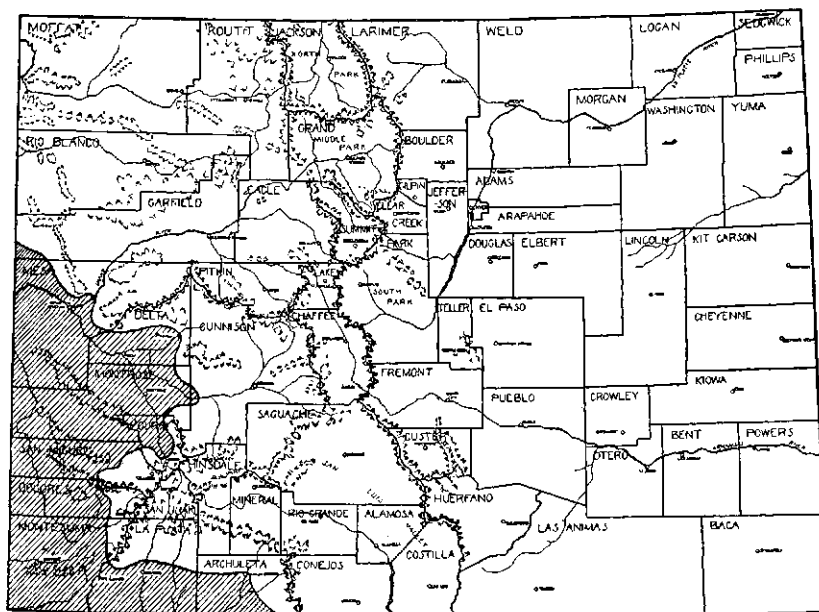


Fig. 7.—The shaded portion of the map shows the area where the whorled milkweed is most abundant and where losses of livestock have occurred.

Nebraska, and the states eastward. In Colorado it is found at low altitudes, seldom occurring above 6,000 feet, except in certain parts of the Southwest. Although found on the plains east of the mountains, it has spread most rapidly in recent years west of the mountains, and there caused the great losses to stock. The accompanying map shows the region of Colorado where the whorled milkweed is most abundant and where the losses of livestock have occurred. (Fig. 7.)

The plant grows naturally in dry soil, but is much at home and flourishes along ditches and in cultivated soils. On the Western Slope it is very commonly found in orchards, and in abandoned fields (Fig. 8), and even in alfalfa and grain fields, and in pastures. In fact, it is a troublesome weed to the farmer as well as a poisonous plant. Its frequency along ditches (Fig. 9) is not only due to the moisture present, but to the spread of seed by irrigation waters. It also prevails along roadsides in soil that has been disturbed in road or ditch building. Occasionally it may be found in corrals.

In recent years the whorled milkweed has spread rapidly, and losses from it are becoming greater every season. In general, however, it is found in large, more or less isolated patches, and it is undoubtedly altogether within the power of communities to practically eliminate it.

WHEN THE PLANT APPEARS AND PERIOD OF POISONING

The plant makes its appearance the latter part of May or the first of June, depending upon the season and locality. The foliage is fine and of a fresh green color and attractive in appearance. From July 1 to July 15 the plant is in blossom, and later the pods appear. The bare stems, with empty pods attached, may be seen standing along ditch banks and in fields late into the fall. (Fig. 9.)

Most cases of poisoning have occurred in the fall and winter on the dried plants. Several cases have been reported from feeding hay which contained the plant in relatively small quantities. Grazing on the young plants as early as June, and throughout the summer months, has proven disastrous in several instances. It appears from field observations and laboratory experiments that the whorled milkweed is poisonous at all stages of growth and does not lose its toxicity by drying.

PLANTS RESEMBLING WHORLED MILKWEED

All plants with a milky juice are not milkweeds, that is, of the group known botanically as "*Asclepias*". For example, prickly lettuce, sow thistle, and prickly poppy all have a milky juice, yet are not true milkweeds. The three above-mentioned have leaves arranged alternately on the stem, with just one leaf at a joint.

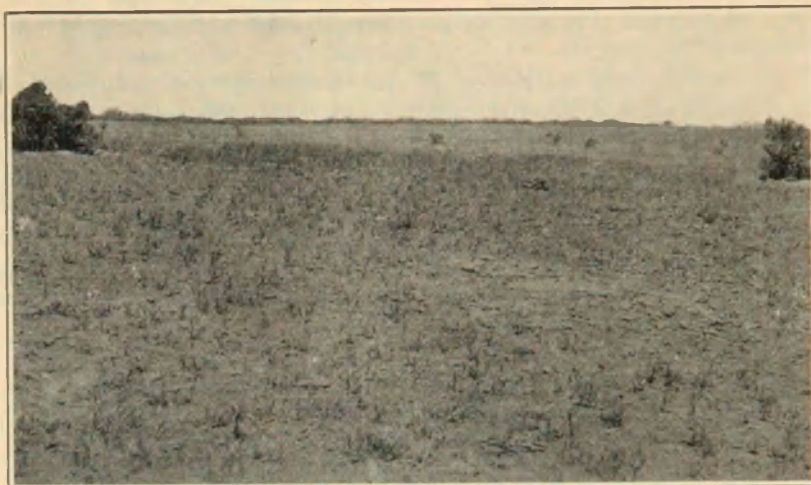


Fig. 8.—Abandoned plowed land near Cortez, Colorado, covered with a dense stand of small whorled milkweed plants. Idle cultivated soil is an ideal habitat for this plant.

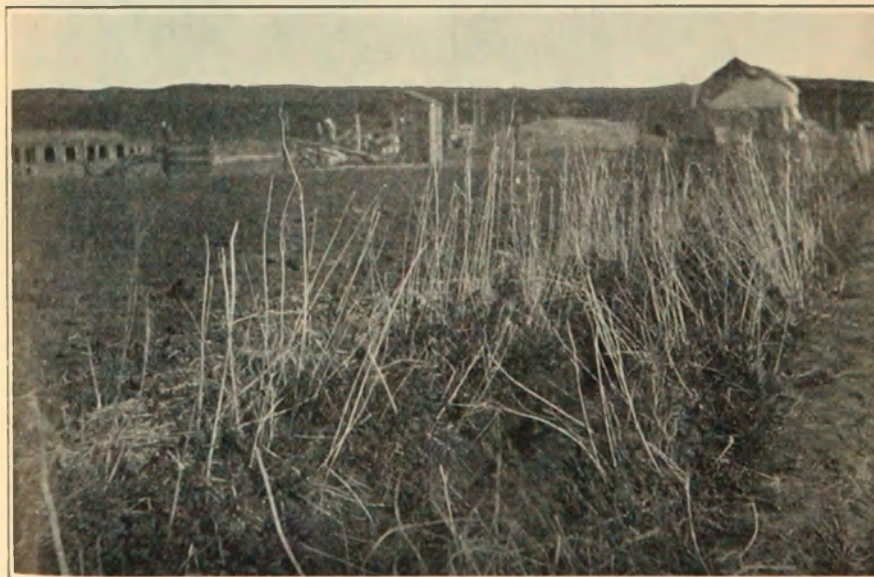


Fig. 9.—Whorled milkweed along ditch bank. The plants are shown in their fall and winter condition. Many cases of milkweed poisoning have occurred in the fall and winter from the dried plants.

whereas the true milkweeds nearly always have opposite, or whorled leaves. Prickly lettuce, sow thistle, and prickly poppy are non-poisonous.

A well-known milkweed in our section is the broad-leaved showy milkweed (Fig. 10), which is so conspicuous along ditches and roadsides in early June. It is a perennial, 2 to 5 feet high, with large, purplish flowers in spherical, terminal clusters. It often grows alongside the whorled milkweed. There are a number of other tall and low (Fig. 10) milkweeds throughout the State, and all of them are regarded with suspicion by stockmen, but the losses from milkweed within our borders can be ascribed to the whorled species only.



Fig. 10.—80, the showy milkweed (*Asclepias speciosum*), and 81, the low milkweed (*Asclepias pumila*), are both quite common in the State, but the losses from milkweed here cannot be ascribed to them.

EXPERIMENTS TO DETERMINE TOXICITY

Much of our earlier work to determine accurately the presence of a toxic principle in the plant was entirely negative. In several instances it was attempted to feed the dry plants to animals but with no success because it appears that animals would almost starve before eating it. Extracts of various kinds were made and used with very little or only partial success in showing the presence of a poisonous principle. More recently, however, we have been able to show that by feeding the whole plant to sheep and

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rabbits, poisoning would follow. Some of these experiments, which were followed by a positive result, are detailed as follows:

Experiment No. 2.—A yearling lamb had all food withheld from February 24 to February 28, 1918. On the 28th, a gallon measure of the plant, which had been cut fine, was given. This plant had been gathered some two or three months previously. By the morning of March 1, practically all of the weed had been eaten. The sheep was in a decumbent position. There was muscular inco-ordination, delirium, irregular respiration, injected conjunctiva, head turned back, some dribbling of urine. Temperature 103.6°. By 12 o'clock the temperature had increased to 104°. There was trembling movement of the muscles, the breathing was very irregular and the pulse was accelerated. By 1:15 the temperature was 105.2°. Spasms came on at irregular intervals and the animal appeared much weaker. There was froth in the mouth and on the lips; slight dilation of the pupils with rapid pulse. By 2:15 the temperature was 105.4°. There was violent gnashing of teeth, particularly during the spasms. There was much trembling. The pupils were greatly dilated, the pulse rapid and irregular. At 3:15, temperature, 107°; pupils excessively dilated; pulse rapid, weak and irregular; breathing irregular and accelerated; gnashing of teeth. At 4:15, temperature, 110°. Other symptoms about the same as before. At 4:30 the animal died.

The autopsy, made immediately, revealed no gross lesions.

Experiment No. 3.—On March 2, a small quantity of milkweed stems was placed before a lamb and other food removed. There were no symptoms until the morning of March 6, when the lamb was found lying on its side and violently kicking with all four feet. There was inability to rise and any excitement increased the violent struggles. Pupils were dilated. Temperature 99.5°. The lamb died sometime during the noon hour. No lesions were found on post-mortem examination.

Experiment No. 4.—On the 20th of June all food was withheld from four sheep. On the 22nd, No. 1 was given 300 grams of whole milkweed, which had been gathered in the vicinity of Cortez, Colorado, some two weeks previously. Nos. 2, 3 and 4 were each given 200 grams of the green plant that had been gathered in the same vicinity a few days before this date. The animals did not apparently eat the plant during the day. By the next morning at 11:30, Nos. 2 and 3 were dead, and No. 1 was lying on his side with head thrown back and occasionally undergoing violent spasms, with grinding of the teeth and twitching of the eyelids. No. 4 was found showing occasional spasms but not as violent as those of No. 1. By 11:45 No. 1 was dead. Temperature just before death was 103.4°. By 2:00 No. 4 was dead. Post-mortem examination of these animals showed nothing outside of a few hemorrhages in various parts of the body. There was weighed back from these animals uneaten plants as follows:

No. 1—85 grams

No. 2—137 grams

No. 3—90 grams

No. 4—109 grams

Since some of the plants had been scattered over the ground, it was

difficult to be sure that we had collected all of it. However, we are safe in saying that these animals did not get more than the following amounts of milkweed:

No. 1—215 grams

No. 2— 63 grams

No. 3—110 grams

No. 4— 91 grams

Experiment No. 5.—On June 22, 1918, feed was withheld from four half-grown rabbits. On the 24th, 50 grams of the ground plant which had been received from the vicinity of Cortez a few days previously were put into the pen. They began nibbling at once. By the next morning, two of the rabbits were dead. Not all of the plant had been eaten, but 50 grams more were added. During the afternoon of the next day, the 26th, one of the remaining rabbits died. By the morning of the 27th, the other rabbit was dead. Thirty-four grams of the plant were weighed back, indicating that not more than 66 grams had been eaten by these four rabbits.

Conclusion.—These experiments seem to show that the milkweed is quite toxic for both sheep and rabbits, and that our previous difficulties rested largely in our inability to get animals to eat the dry plant when hungry. They seem to eat the green plant quite readily and apparently only a very small amount is required for destruction.

EXAMINATION OF STOMACH CONTENTS

The stomach contents of poisoned animals are so frequently submitted for examination, that a study of the anatomy of the milkweed, and certain other poisonous plants, has been made with a view of being able to identify fragments of the plants in these contents. In a number of instances an abundance of milkweed has been found in the stomach contents of poisoned animals. In spring poisoning, main reliance is placed on portions of the stems, while in late summer and fall poisoning, the seeds are usually found in abundance in the stomach.

A diagrammatic cross-section of the stem of the whorled milkweed is shown in Fig. 12, A. The isolated bundles of pericyclic fibers and the continuous xylem ring are striking anatomical features. In the medulla or pith are numerous latex or milk tubes, which are most abundant adjacent to the inner boundary of the xylem. The stem is roughly quadrangular. Fig. 12, B shows a section of the stem in detail.

The hairs or surface fibers (Fig. 11, C) of the seeds are white, straight, and 30 to 40 mm. long. They vary somewhat in diameter, the average being 21 microns. Each fiber is a single cell, which is slightly enlarged at the base. They have a silky lustre and feel soft. They have characteristic, small thickened ridges

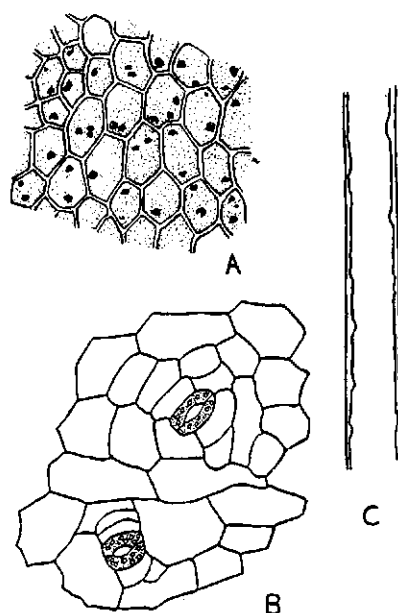


Fig. 11.—A, epidermal layer of seed coat; B, leaf epidermis (upper); C, showing thickened ridges in the walls of seed hairs; these are characteristic of milkweed fibers.

in the walls. These ridges are more prominent in the small hairs than in large ones.

The seeds are flattened and reddish-brown in color. The epidermis in surface view is shown in Fig. 12, A.

CONDITIONS UNDER WHICH POISONING OCCURS

The relative mortality is larger in most instances. In poisoning by water hemlock, death camas, loco weeds and most other plants the proportion of animals affected is relatively small, but with whorled milkweed poisoning the losses of sheep have frequently been reported as high as 25 to 60 percent. This can be accounted for by the feeding habits of sheep and the fact that the whorled milkweed grows in

patches. It is a matter of common observation that sheep, especially, follow each other in the eating of certain plants. In feeding hay containing the milkweed the losses are relatively small and poisoning may easily be prevented.

Sheep evade the milkweed when there are more palatable plants present. It is only when they are hungry and can find little else than the milkweed, that they eat it. Orchards have been observed in which there is considerable whorled milkweed and in which sheep have been run without any ill results. Examination of such areas has shown the presence of considerable grass, alfalfa and clover, and the milkweeds left untouched, for the most part.

Sheep frequently die when being driven along roads. In a number of instances their death can be ascribed to the milkweed, which they have snatched in passing. It seems that the flocks of sheep first driven down these roads seldom eat enough of the milkweed to injure them, because there is a good deal of other forage, but that later in the season, sheep driven over the same roads suffer, for the reason that the milkweed is practically the only plant which they can get as they are herded along.

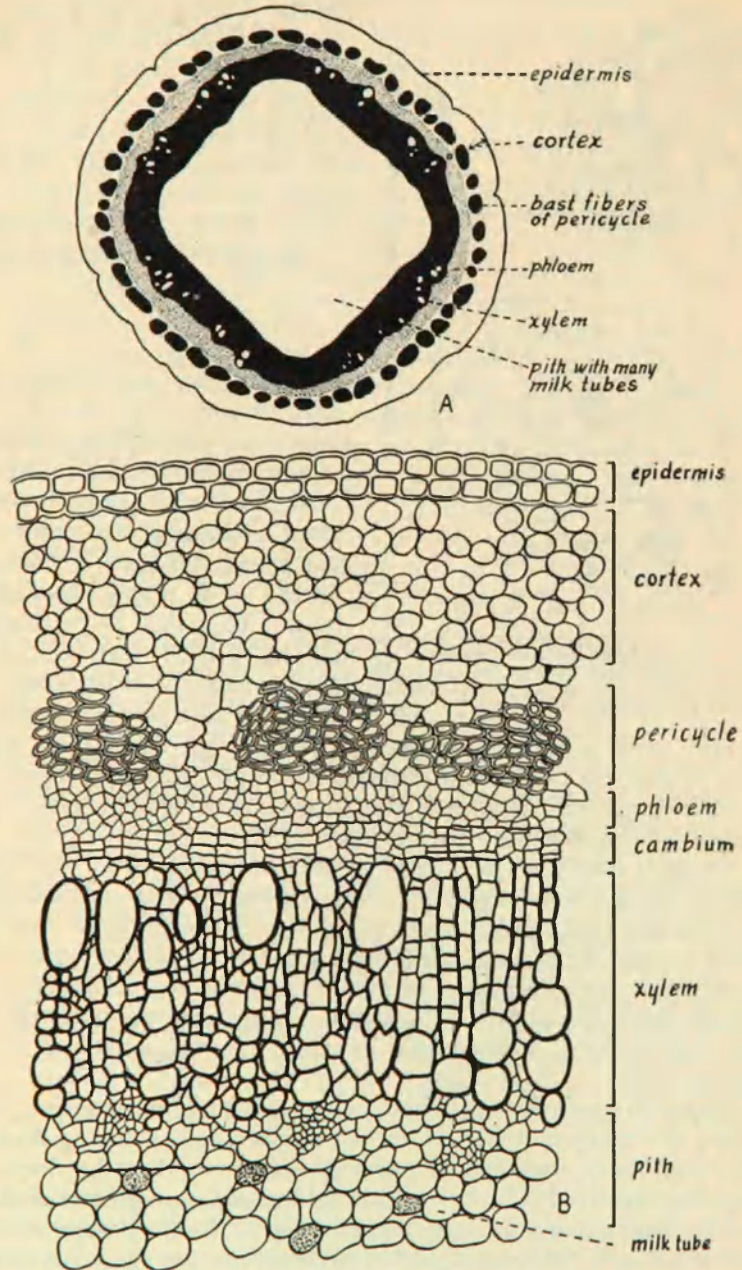


Fig. 12.—A, diagrammatic cross-section of the young stem of whorled milkweed. B, section of portion of stem showing the tissues in detail.

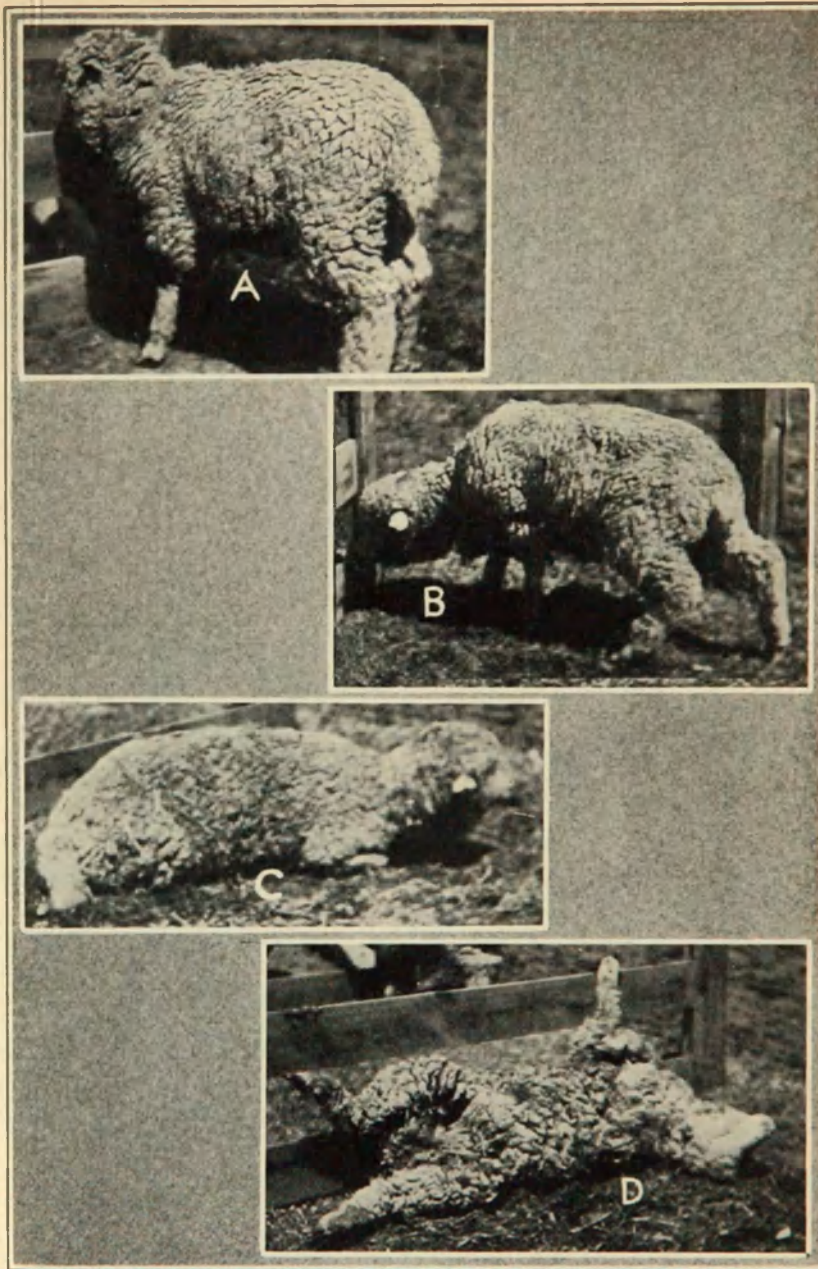


Fig. 13.—A. the first symptoms of poisoning are dullness and drowsiness. B. following a period of dullness, the animal shows weakness, some muscular inco-ordination, delirium, irregular respiration, and injected conjunctiva. C. the animal gets down, the convulsions become more irregular and violent, and at shorter intervals. The breathing is irregular and accelerated. D. in the last stages, the animal gets down on its side or back, is unable to rise, kicks most violently, and has spasms, with grinding of the teeth and twitching of the eyelids.

ANIMALS POISONED

Veterinarians at Grand Junction and Montrose report that a large proportion of their practice is on milkweed cases in sheep, cattle, and horses. The largest losses have been with sheep, with those from cattle ranking second.

SYMPTOMS OF POISONING

In the few cases observed in the field and in those animals poisoned experimentally, the following symptoms in sheep have predominated: First, there is dullness (Fig. 13), the animal rapidly becoming comatose; this is followed by convulsions at irregular but at shorter intervals until death. The heart beat is at first very rapid, becoming gradually weaker. There may or may not be a rise in temperature. The pupils of the eyes are widely dilated. Autopsy reveals no characteristic lesions. The lymph glands are injected in many cases, likewise the trachea. There is no evidence of irritation in the digestive tract.

PREVENTIONS OF LOSSES

Before turning sheep into any sort of an enclosure where there is limited forage, a very careful examination should be made of the area, to see that no milkweed is present. A small patch of it may result in a loss of sheep valued at several thousand dollars. Either evade the enclosure, if infested, or clean out the milkweed before the sheep are turned in. If the plants are hoed out, care should be taken to rake them and burn or remove them. Be cautious of corrals, orchards, and abandoned cultivated fields. In some instances it may be practicable to have several men to precede the flock several days before it is driven over a given stretch of road, to hoe out and remove the milkweed along the roadside, or to guard heavily infested areas and herd the sheep away from them.

As soon as practicable eradication measures are ascertained, communities should organize their efforts and plan to exterminate the whorled milkweed. It is very possible that several successive years of concerted action will see its reduction to a point which offers very little danger. As has been indicated, the Experiment Station is now investigating methods of eradication.

No specific remedy for milkweed poisoning has been found. This problem, too, is now engaging the attention of the Experiment Station.

ACKNOWLEDGMENTS

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