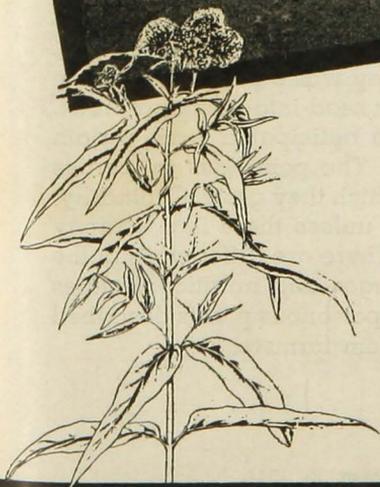
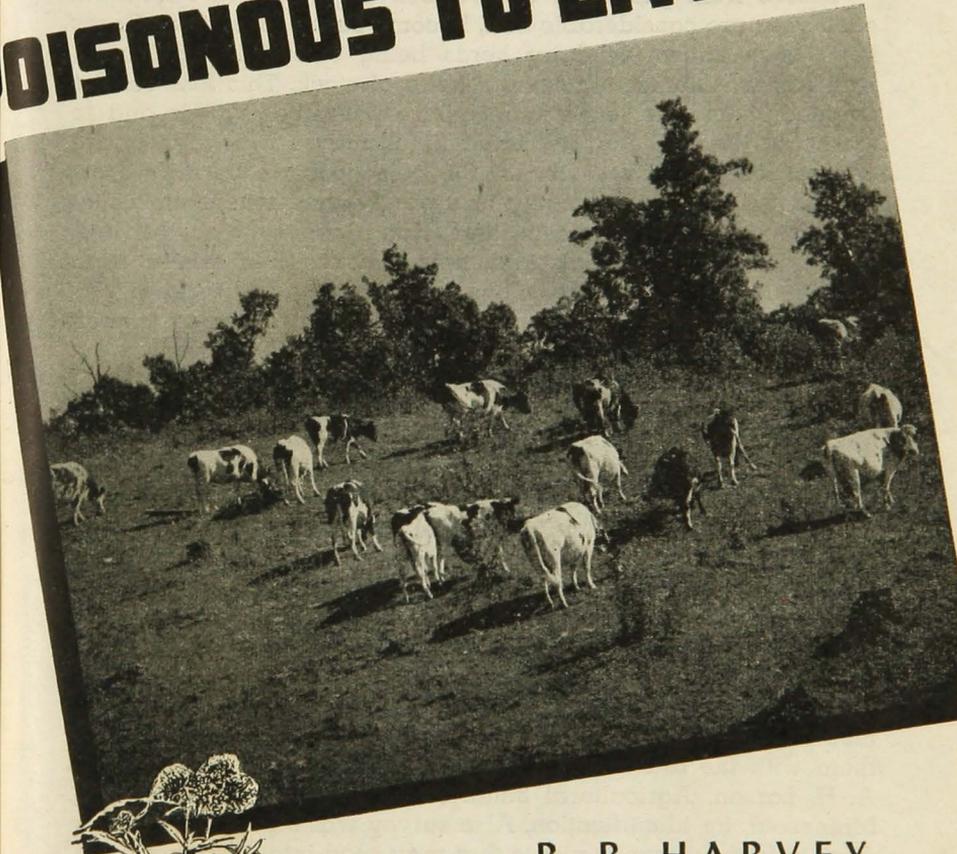


WEEDS

POISONOUS TO LIVESTOCK



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Agricultural Experiment Station
UNIVERSITY OF MINNESOTA

Introduction

Losses from poisoning of livestock by weeds in Minnesota each year are considerable and, in some cases, disastrous. Cases have been known of dairy herds being extensively poisoned, with losses running into several head of stock. This loss can be avoided if farmers learn to recognize poisonous weeds and to eradicate them. Clean cultivated fields may not always insure against losses of livestock, for the poisonous weeds may grow around buildings or on stony or swampy land where the usual cultivation will not eradicate them. Hand labor with scythe, hoe, and spade, or chemical eradicants are required where farm machinery cannot be used. Swampy places may be rid of poisonous weeds in some cases by drainage and reseeding to profitable pasture crops. Rough land that cannot be plowed or put into clean pasture might better be put into reforestation that will shade out certain poisonous plants. Most poisoning occurs in pastures.

If symptoms of poisoning in livestock are recognized or suspected, the first thing to do is to get a veterinarian, as establishing a diagnosis and providing successful treatment of poisoned livestock is usually beyond the equipment of the average farmer. First aid can often be used in some cases until the veterinarian arrives. When the emergency has passed, livestock should not be pastured on weed-infested land, or not be fed questionable hay, until the cause of the poisoning has been determined. Make a thorough survey of all land available to the livestock to recognize and eradicate all poisonous plants. If you cannot identify them with the aid of this bulletin, send complete specimens to A. H. Larson, Agricultural Botany, University Farm, St. Paul 8, Minnesota, for identification. Also survey waste places and fence rows to find poisonous plants that may seed into pastured areas.

The poisoning of livestock may be anticipated from certain weeds at particular times of the year. The poisonous properties of weeds vary with the type of soil in which they grow. Ordinarily, animals will not eat poisonous plants unless there is a scarcity of good pasture and they are hungry. There are differences in the susceptibility of animals at different ages and nutritional states to combinations of feedstuffs. All of the poisonous plants described in this bulletin should be eradicated from farmsteads.

Weeds Poisonous to Livestock¹

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Bracken Fern

Pteris aquilina

The bracken fern is a common plant in open woodlands, pastures, and hill-sides of the state, preferring comparatively open locations but also invading heavy woodlands. Bracken fern sometimes becomes a very persistent weed that can be eradicated only by the most intensive cultural practices or chemical applications. Numerous publications have been issued by various agencies in England on methods of eradication, as this is one of the most noxious weeds in the British Isles. Ordinarily this plant is not particularly hazardous to the livestock raiser, but if other vegetation becomes scarce and the animals must satisfy their hunger on bracken fern, injuries often result. Western stock raisers regard it as very poisonous, and many deaths of both horses and cattle are attributed to it.

Toxicology. The plant is injurious to cattle and horses, particularly during the late summer and fall when green herbage becomes scarce. The poisoning is attributed to pteritannic acid, a substance similar to, and probably identical with, the filicic acid of the male shield fern. Hogs eat the fresh rhizomes greedily without harm.

Symptoms. Cattle feeding upon bracken fern often develop intestinal hemorrhages and various other complications. Horses, on the other hand, develop a somewhat stupefied, timid, and sleepy condition. Cattle usually exhibit a body temperature several degrees above normal. Both cattle and

horses show loss of appetite, bloody discharges from the nose and mouth, great depression, difficult breathing, and coma. Death, caused by hemorrhages in various parts of the body, usually follows in 12 to 72 hours after the first symptoms are noticed. Sudden deaths are often due to hemorrhages into the heart tissue. Bloat often results immediately after death.

First Aid. Supplement the feed when pasture is short or remove stock from pasture. Give a saline cathartic. Discard hay containing dry fern fronds.

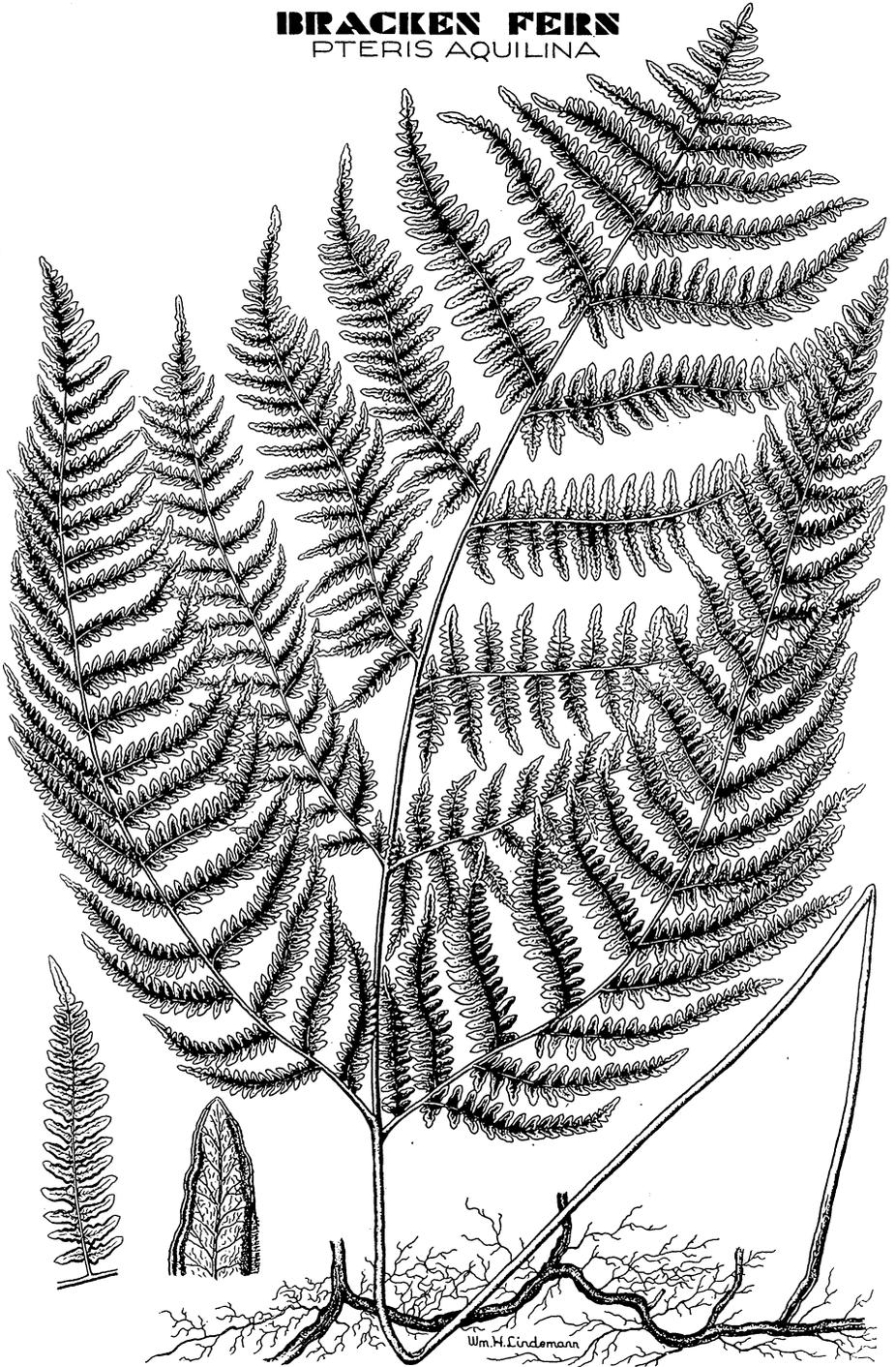
General Appearance. The bracken fern is a perennial, growing 1 to 4 feet high, with leaves (fronds) arising directly from a short, scaly, underground stem that runs horizontally beneath the ground. Each leaf (frond) is three-parted or branched; each of these is composed of many leaflets segmented many times. On the underside of each leaflet is borne a continuous edging of little, round, brown, spore-forming structures. These are noticeable during the fruiting season, from June to September. The three-parted leaf is characteristic of this plant and is a major feature in its identification. The rootstalk is black, one quarter to one half inch in diameter and sometimes growing to a length of 20 feet.

Control. Cut two or three times a year, preferably in June and August. Apply lime where cultivation cannot be managed. The plant thrives only on acid soils. Any recommended rotation cropping system will bring this plant under control. Hogs may be pastured on it in areas that cannot be cultivated.

¹Prepared with the assistance of Works Progress Administration, Official Project No. 465-71-3-350, Subproject No. 417, sponsored by University of Minnesota, Department of Agriculture.

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BRACKEN FERN
PTERIS AQUILINA



Male Shield Fern

Aspidium filix-mas

This fern is commonly found in the heavy forests of Minnesota, usually in rocky soils where moisture is abundant. It requires a heavily shaded environment and is therefore limited in its distribution to the timbered areas of the state.

Toxicology. The male shield fern contains filicic acid and a number of other injurious substances. The extract from this plant has been used as a vermifuge since ancient times. Filicic acid is widely used as an effective agent against tapeworm, but acts as a poison if too large a dose is administered. The rootstalk is the most poisonous part of the plant, containing 8 per cent filicic acid. The root is ground and powdered when used as a vermifuge or in the removal of tapeworms. The concentrated extract is very poisonous; 6/16 of an ounce killed an 88-pound sheep, and 3 ounces killed a cow of 660 pounds. Poisoning usually occurs in the fall when the majority of our grasses have matured and the animals are in search of green succulent forage.

Symptoms. Large doses cause nervousness, drowsiness, hemorrhages, and blindness. In animals where the poisoning is fatal, spasms indicating excruciating pain are exhibited; later the animal becomes comatose and dies.

First Aid. Oils must not be given in the treatment of fern poisoning because they aid in the absorption of the acid. This makes the case more serious than if no treatment were given. Stimulants have proved beneficial. Pick out all fern fronds from wild hay.

General Appearance. The male shield fern is a perennial having a coarse, rough, scaly, and woody rootstalk. Several leaves (fronds) arise at one point from the short, scaly, underground stem that grows horizontally almost at the surface of the ground. The leaves grow erect and rise to a height of 2 to 4 feet. The leaf blade is 1 to 3 feet long

and 6 to 12 inches wide. The leaflets (50 to 100) are 2 to 4 inches long, $\frac{3}{4}$ inch wide, then divide again into many segments cut back to the midvein. At the base and on the lower side of each segment, there are two to six brown spore-bearing structures. During July and August these structures are easily visible to the naked eye.

Control. Cut close with a scythe at least twice a year, preferably in June and August, to prevent any spores from maturing. This practice will eventually starve the perennial rootstalk to death.

Horsetail

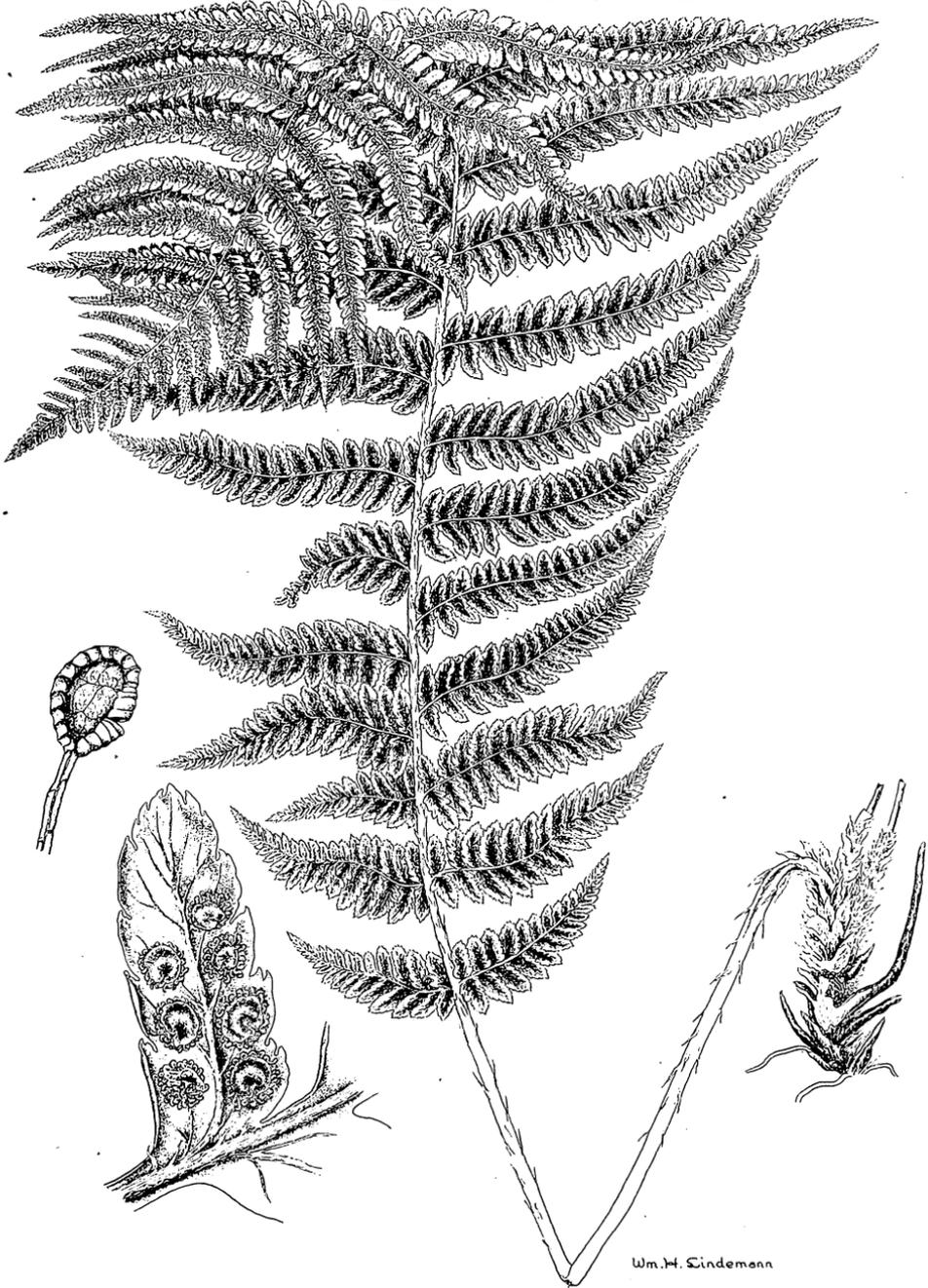
Equisetum arvense

On water-leached hillsides and in low, depleted fields and pastures, the horsetail makes its appearance along with the first vegetation in the spring. It is most commonly found in poorly drained, depleted, acid soils. This plant is persistent in maintaining its poisonous properties under varying climatic, soil, and geographical conditions. It is, therefore, recognized as being poisonous in all stages of development and in all parts of the United States, and annually takes the lives of a large number of horses. This weed has no feeding value.

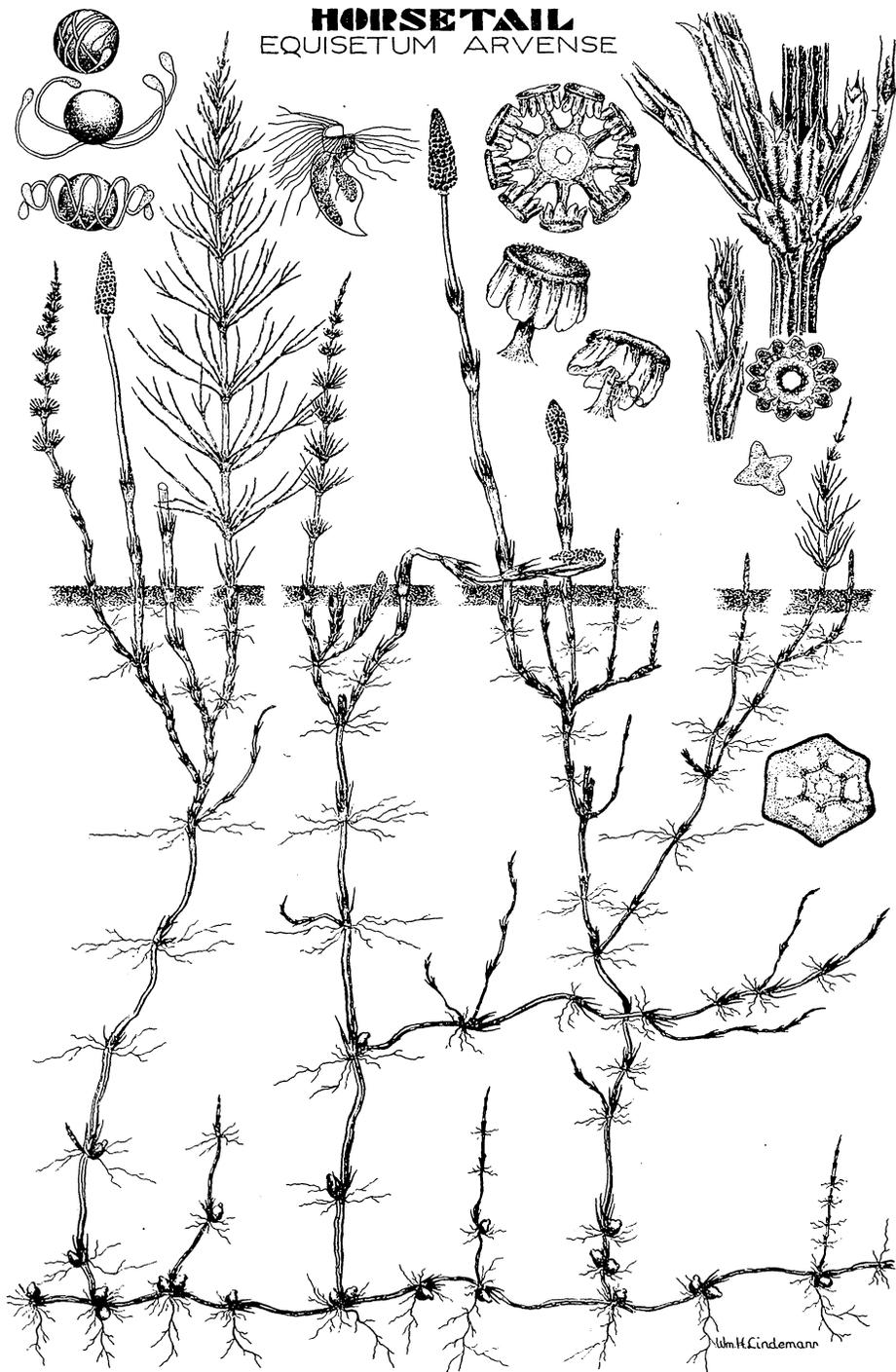
Toxicology. The horsetail is a dangerous plant, being especially poisonous when fed in hay. Colts are more susceptible to the poison than mature horses, who often develop a craving for the plant. After having once eaten it, they will pick it out from hay or bedding, and eat it in preference to good hay or grain. Sheep are known to be affected by it also, but fatal cases have not been witnessed under experimental conditions. The alkaloid, equisetin, may be the cause of nerve poisoning.

Symptoms. The first effect upon the animal is a loss of vigor and vitality. After a time the body muscles begin to waste away. The animal trembles and shows lack of resistance to cold. Later the limbs stiffen and general paralysis

MALE SHIELD FERN
ASPIDIUM FILIX-MAS



HORSETAIL *EQUISETUM ARVENSE*



of the entire body is noticeable. The horse then falls or sags to the floor and is unable to rise, and dies in a state of total exhaustion. Many horses, however, recover if their condition is treated in time.

First Aid. The contaminated hay should be taken away and replaced by clean, nourishing hay. Stimulants may be necessary to bring the animal back on feed; nux vomica or Fowler's solution of arsenic are among a number that can be used. It is also desirable to administer a mild physic.

General Appearance. The plant is perennial with two types of shoots. The first shoot is a hollow, jointed, branchless, leafless stalk with a toothed sheath at each joint. It grows to a height of 5 to 12 inches. The stalk is yellow at first, but changes to dark brown as it matures. A slender, pointed, spore-bearing head or cone about 1½ inches long and ⅓ inch wide develops at the top of the stalk. From these spores new plants grow. They serve the same function as seeds do in crop plants. Later in the spring an entirely different looking plant grows from this same root. It is bushy and wiry, with long, slender, three- to four-sided and jointed stems and branches. Often as many as a dozen branches arise at each node or joint. Each branch looks somewhat like a coarse, elongated pine needle. It is from this bushy structure that the plant gets its common name of "horsetail."

Control. Applying lime is probably the easiest way of suppressing this plant, since it grows only in acid soil. If drainage and cultivation are then carried out, little difficulty should be experienced in its eradication.

Black Nightshade

Solanum nigrum

Many plants are poisonous under certain conditions. Temperature, moisture, sunlight, type of soil, and stages of growth are all factors that determine the amount of the toxic properties con-

tained in certain plants. Many of the members of the potato family are known to have this characteristic, and black nightshade is a good illustration of that family.

As the certain conditions that cause black nightshade to be poisonous are not known, it is best to regard it as poisonous at all times. The early pioneers often made pies of the fruit of this plant, and were fortunate in that ordinarily it had no bad effects. More often the plant is somewhat toxic and poisoning results. There is some evidence that it is most poisonous toward fall when the leaves have a greyish color and while the berries are still green. It has been found to be poisonous to sheep, cattle, hogs, horses, and poultry, but is most injurious to lambs and calves. It grows in farmyards, pastures, roadsides, and waste places. It seems to thrive under almost any condition except where the ground is cultivated.

Toxicology. The poisonous glucoside solanine and the alkaloid solanidine contained in this plant are common to almost all the members of the potato family. The plant is less toxic after it is dried, and no cases of poisoning have been recorded when it has been fed mixed in dry hay. The poisonous substance solanine is found in all parts of the plant, but it is most concentrated in the green berry. Sheep are the most susceptible to the poison.

Symptoms. The symptoms of poisoning are stupefaction, staggering, dilation of the pupils of the eyes, convulsions, paralysis of the body muscles, and paralysis of the respiratory muscles. Difficult breathing is exhibited in severe cases and death is due to paralysis of the respiratory muscles. Fatal cases are rare, and most animals return to normal vigor in a few days.

General Appearance. Black nightshade is an annual, growing 1 to 2 feet high, generally much branched, spreading, and round in outline. The leaves are borne alternately, are smooth, shiny,

BLACK NIGHTSHADE
SOLANUM NIGRUM



and somewhat heart shaped, and are 1½ to 3 inches long and 1 to 2 inches wide, with wavy edges. The stem is irregular, angled, rough, and edged. The flowers resemble those of the potato, being small and white with yellow centers, and are borne in clusters of three to ten on short, drooping branches. The plant blooms continuously from May until it freezes in the fall. The berries are black when ripe, measuring ¼ to ½ inch in diameter. Each berry contains a large number of seeds.

Control. Any type of cultivation will suppress this weed. Hoeing is preferred to mowing because the berries are often borne very close to the ground, and cannot be reached with a scythe or with an ordinary hay mower.

Bitter Buttercup

Ranunculus sceleratus

The appearance of the first buttercup in the spring is looked forward to with great enthusiasm by most people, but when animals are pastured where the buttercup grows abundantly, the farmer often spends sleepless nights in caring for the horse with colic, or the sick cow or sheep. All of the buttercups are toxic, but the bitter buttercup is generally the most dangerous. It is found in low places, ditches, and marshy ground, or wherever water stands in early spring.

Toxicology. Bitter buttercup contains an extremely acrid, volatile substance, anemonol, which blisters the skin and causes inflammation of the intestinal tract. Cattle and horses are most susceptible, but all animals may be affected. Cows may produce milk with a bitter taste and a reddish color. Hay containing buttercups is not poisonous.

Symptoms. Animals often develop sore mouths and inflamed digestive tracts from the acrid juice of the plant. External sores and blisters may result if an animal crushes the plant by lying on it and the juice comes in contact with its skin. The sores are very ir-

ritating and difficult to heal. It is said by some farmers that this plant will cause abortion, but this is without proof. The plant has a very detrimental effect upon the kidneys, and may also affect the reproductive organs.

General Appearance. This buttercup is a spreading herbaceous annual plant, growing 6 inches to 2 feet tall. The leaves are alternate, three- to five-lobed, thick, smooth, and shiny. The basal leaves are somewhat heart shaped and thicker than those on the upper parts of the stem. The stem is hollow, smooth, many branched, and sometimes over an inch thick at the base. The flowers are small and have five shiny yellow petals. As the flower matures, it develops into a cone-shaped head containing many seeds.

Control. Livestock will not feed upon this plant if other vegetation is available. Therefore, do not pasture them in the low wet places in early spring where this and other poisonous plants may grow.

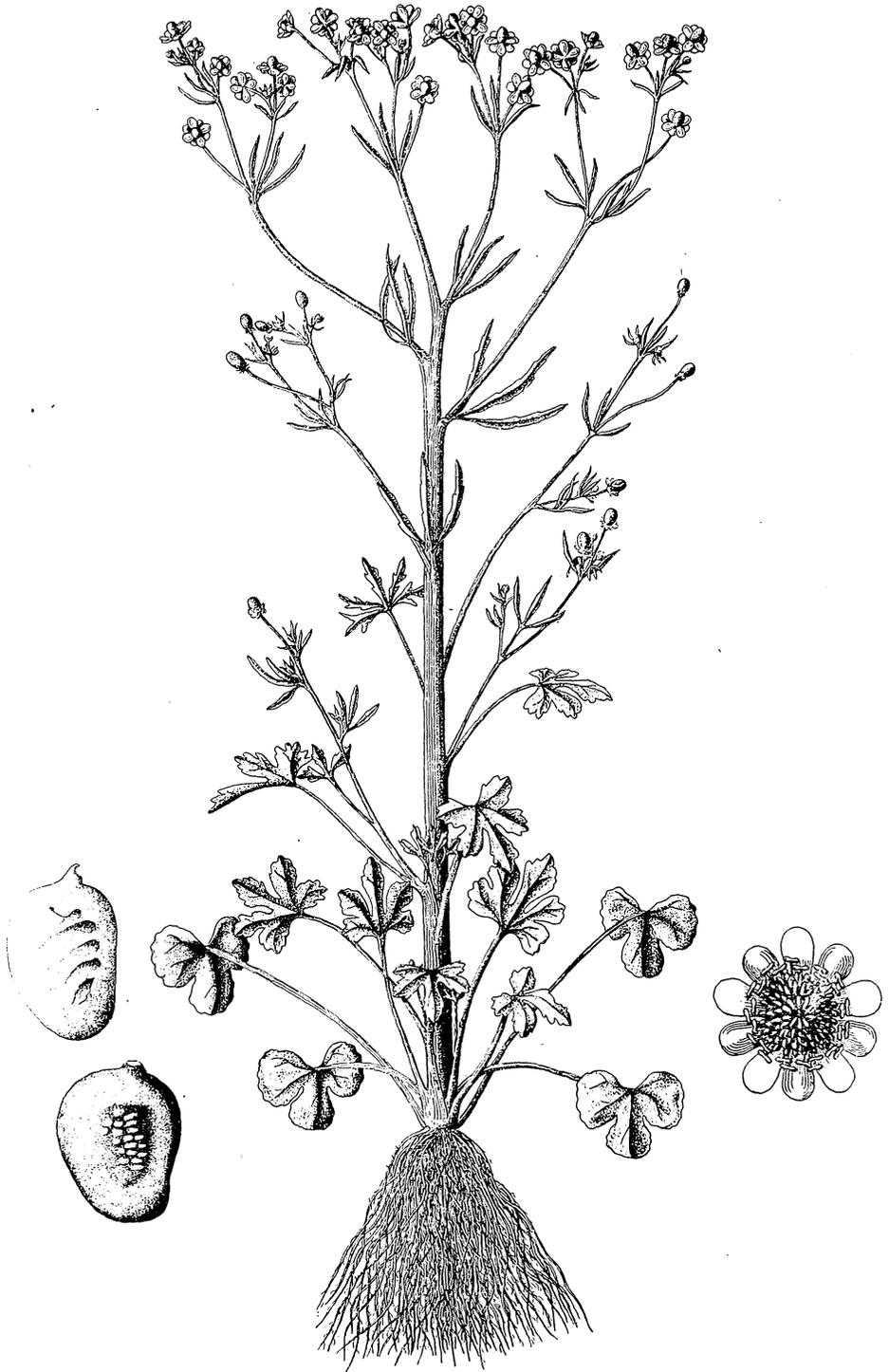
If the pasture is open, plow and reseed it. If the plants are scattered in a woodland pasture, hoe or pull the plants. Small open patches also can be handled in this manner.

Pasque Flower

Anemone patens

The pasque flower is the very first flower to appear in the spring throughout central and southern Minnesota. It is generally found in high, dry places, especially on bald points of hills, and also on partially shaded ground. It is often found growing in thick patches on bare knolls while snow still covers the rest of the ground. The dense patches of blue flowers create a beautiful landscape, and many people try to propagate them. This plant can cause an immense amount of trouble if livestock are permitted access to it in the early spring. After being kept indoors all winter, animals crave greens, and the pasque flower appears at a time

BITTER BUTTERCUP
RANUNCULUS SCELERATUS



PASQUE FLOWER
ANEMONE PATENS



Wm. H. Lindemann

when the grasses and other plants are still dormant.

Toxicology. The pasque flower contains a very acrid alkaloid, anemonin. This produces irritation and inflammation of the digestive tract.

Symptoms. All parts of the plant are extremely acrid and will cause sores and blisters where the juice comes in contact with the skin. Animals develop inflamed digestive tracts from grazing upon it. It is known to have caused colic and uremic poisoning that is not easily or quickly cured. Livestock will not feed upon this plant if there is anything else available. Therefore, prevention lies merely in not permitting the stock to range for themselves until the grasses are tall enough to be pastured. Many persons, especially children, get blisters on their hands and faces from picking bouquets of this flower.

General Appearance. This is a perennial herb growing 4 to 8 inches tall and having one or more stems arising from a woody basal crown. Each stem bears only a single flower. The stem is very hairy, and naked of leaves except for the finely divided, hairy leaves (involucre) that arise all at one point on the stem and completely surround it. This involucre arises anywhere from 2 to 6 inches below the flower. The flower is white to purplish blue, about an inch across, and $\frac{3}{4}$ to $1\frac{1}{4}$ inches long. The leaves arise from the base and grow to a height of 3 to 6 inches.

Control. The plants generally grow in patches and can easily be controlled by a little persistent hoeing or by digging out the roots.

Dutchman's Breeches

Dicentra cucullaria

Dutchman's breeches, a common plant in the rich woodlands of Minnesota, is a beautiful spring flower that almost always escapes the suspicion of being poisonous. The tops die soon after seed sets.

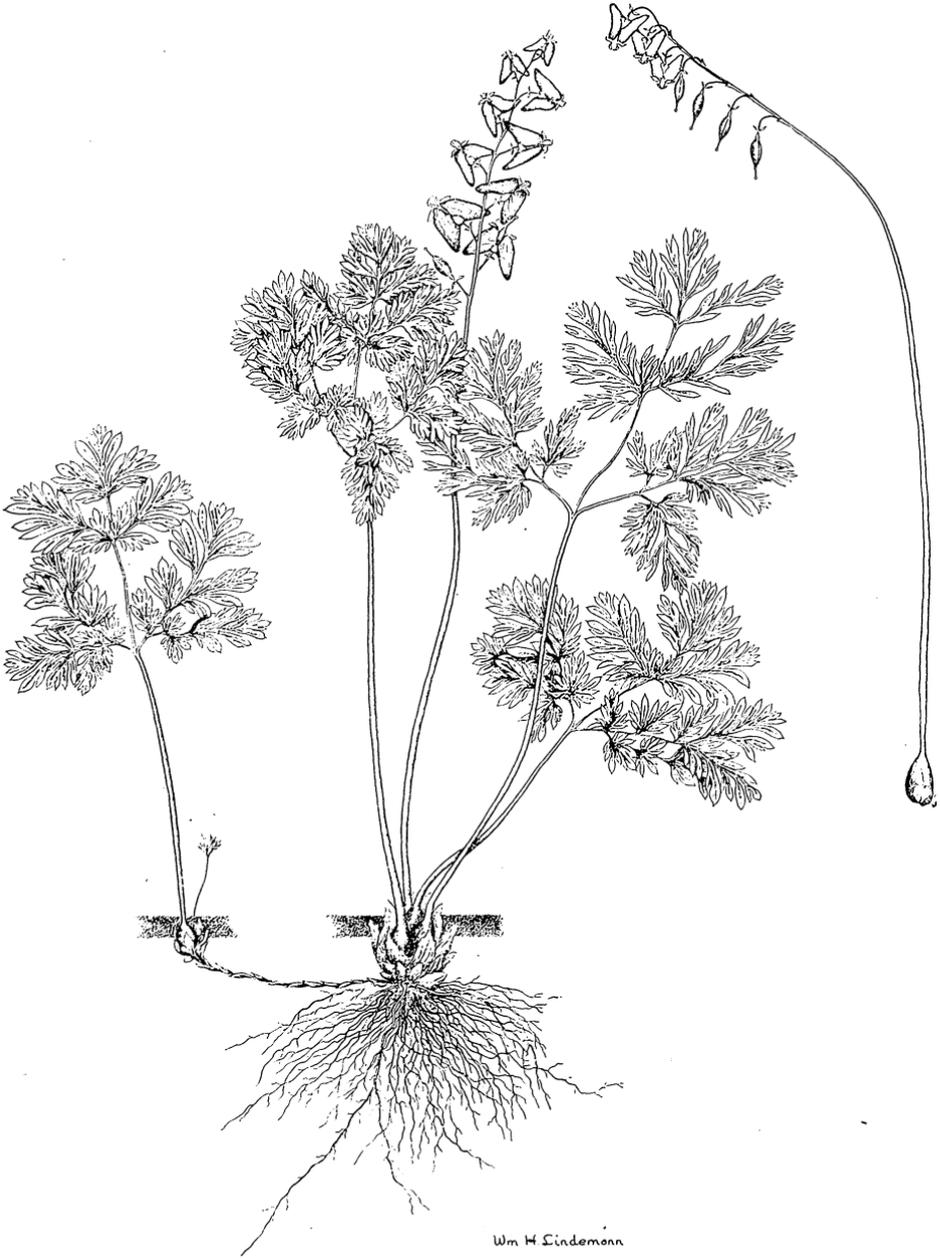
Toxicology. A number of cattle have apparently been killed by grazing upon this and related plants. Laboratory analysis shows that it contains a highly poisonous alkaloid, cucullarine, and feeding experiments have proved it to be poisonous to livestock. This plant is also known as "little staggerweed" and "wild bleeding heart." It is the most poisonous during the early spring up to the time of blossoming in May and June. If proper precautions are taken in pasturing during this period, the possibility of poisoning will be very limited. Most animals will recover if the dosage is not too heavy, and if they are kept in clean pasture. Both tops and tubers are poisonous. Under experimental conditions, bad cases of poisoning have been developed in cattle by feeding only 3 pounds of Dutchman's breeches.

Symptoms. The symptoms of poisoning arise very suddenly, usually beginning by body trembling, then frothing at the mouth and staggering aimlessly about. Often the animal will run wildly as if in pain. Loss of balance and convulsions follow, breathing is difficult, and severe pains precede death.

General Appearance. This is a perennial herb growing 5 to 10 inches high, arising from an underground bulb. The leaves arise directly from the crown, having a stem (petiole) about 6 inches long, and then divide into three branches, making the finely cut and divided leaf. The flowering stalk is very slender and grows to a somewhat greater height than the leaves. The flowers are like the bleeding heart, but are smaller. They are white or slightly pinkish with pale tinges of yellow at the outer end and are borne singly on short branches, generally not exceeding eight to ten flowers to a flower stalk.

Control. Ordinarily the plant grows in woodlands where cultivation is not possible. A good procedure is to spade up the roots if only a few plants are present. Continued cutting also will kill the plant.

DUTCHMAN'S BREECHES
DICENTRA CUCULLARIA



Common Sneezeweed

Helenium autumnale

The sneezeweed is particularly disastrous in the drier areas because it grows most abundantly around water holes, streams, and ditches where the animals spend much of their time.

Toxicology. The poisonous substance in this plant is different from that in most other plants in that the poison is accumulative. Under normal conditions, cattle eating 2 pounds of the plant per day for 20 days will show symptoms of the poison. A much smaller amount will affect sheep. It is difficult for any animal to eat enough at one time to become sick. Some animals develop a craving after once eating the plant, and thus go on eating it until it eventually kills them. Many animals will never eat it because of its acrid taste. The plants are poisonous in either the green or cured state, and many cases of poisoning occur during the late winter when low grade wild hay is being fed. The plant normally grows in low rich ground, primarily along rivers or where water is plentiful. Hay from such areas often contains this plant. The flowering tops are most poisonous. Although it is poisonous to both sheep and cattle, sheep are the more susceptible.

Symptoms. The first indication of poisoning is a general state of depression; the animals are sluggish and lack vigor. They fail to respond to orders and act very stupidly; this is particularly noticeable in horses. Further feeding creates coughing, weakness, irregular pulse, and attempted vomiting. This is very common in advanced stages. By continued feeding, the animal becomes gradually weaker and then dies. There is no indication of pain, spasms, or convulsions before death.

General Appearance. *Helenium autumnale* is an erect-growing perennial, 2 to 5 feet tall, with a stem that is slender, smooth to rough, and narrowly branched. Winged appendages appear along the stem and especially on the

upper parts. The leaves are alternate, slender, pointed, and three times as long as wide. They are grey and hairy when young, becoming greenish, smooth, and tinged with brown as they mature. The flowers are yellow and borne on short branches so that they form a comparatively dense yellow mass at the top of the plant during July, August, and September. The flower head is 1 to 1½ inches across with the ray flowers characteristically turned downward.

Control. Continued cutting will starve the perennial roots to death. Pulling or digging the roots may be advisable if there is only a limited number of them. If the plants grow in open pasture, plow and seed to a good pasture crop. Drainage of lowlands also will aid in the control of this plant.

Wild Lupine

Lupinus perennis

The wild lupine that is native to Minnesota is much less poisonous than many of the species growing on the western plains and mountain regions. This species is most commonly found in dry, sandy soils, in meadows, and in open woodlands.

Toxicology. Although lupines have long been known to be poisonous, it was not until about 1900 that both alkaloids and glucosides of a very poisonous nature were extracted. Extensive investigations regarding the poisonous effect of lupines upon livestock showed that sheep, horses, cattle, and swine all were susceptible to the poisonous substances, but that sheep were the most easily affected. In some cases many sheep, sometimes a thousand or more from a flock of two thousand, have died in a single night after grazing upon lupines during the day. The plant is bitter and acrid tasting, and no animal will eat it if a sufficient amount of other feed is available. It contains the alkaloids lupinine, lupanine, and sparteine, but not all of these are

COMMON SNEEZEWEED
HELENIUM AUTUMNALE



WILD LUPINE
LUPINUS PERENNIS



Wm. H. Lindemann

found in all lupines. Lupines differ in one characteristic from most all other poisonous plants in that other plants are most toxic in the spring and early summer, but the lupines are the most toxic during the late summer and fall. Under experimental conditions no symptoms of poisoning have been witnessed by feeding lupines previous to blossoming, but many fatal cases have been developed during August and increase in number and intensity as fall comes on. The seeds are more poisonous than any other part of the plant. Wild hay cut late in the season should be carefully inspected because the lupines are poisonous in the green or dried state. Sheep may eat pods that are above light snow.

Symptoms. Heavy, labored breathing is present in all cases. In mild cases the animal falls into a sleep or coma which may continue for days. In severe cases violent spasms of kicking and heaving are exhibited, and the animal often dies in convulsions in which the legs are extended rigidly, a close resemblance to strychnine poisoning.

First Aid. Administer potassium permanganate as soon as possible. Keep the animal quiet to relieve convulsions. This will also aid the animal in maintaining its strength.

General Appearance. Wild lupine is a perennial growing 1 to 2 feet tall. The leaves are palmately compound, divided into seven to eleven leaflets, and together give a fan-shaped appearance. The stem and leaves are slightly hairy. The entire plant has a bluish appearance, which is caused by the reflection of light upon the tiny hairs. The flowers have the shape of sweet peas, are purple blue, rarely light blue, and are borne in spikelike heads for a distance of 2 to 7 inches at the summit of the stem. The plant is common in the pastured woodlands of the state.

Control. If the plants are found in open pasture, it is advisable to plow and plant a cultivated crop for one or more seasons, thus stirring the ground

to induce germination of the seeds and killing the new plants as they appear. In wooded areas, dig or pull out the plants.

Dwarf Larkspur *Delphinium tricorne*

Larkspur poisoning of cattle is a common occurrence on the western ranges where several poisonous species grow. In Minnesota, we have mainly the dwarf larkspur, which is found in rich woodlands and in heavy clay soils. This plant emerges in early spring, and is very toxic in its early growth. After blooming it loses most of its poisonous properties, and no cases of poisoning are known to occur after June 15.

Toxicology. In 1905 the United States Department of Agriculture definitely established the poisonous properties of this plant and its effect upon livestock. The plant contains several very poisonous alkaloids, the most poisonous being delphinine. Very small amounts will kill a large mature animal. It is fatally poisonous to cattle, somewhat poisonous to sheep, but has not been found poisonous to either horses or swine.

Symptoms. The first evidence of poisoning is unsteadiness of gait and straddling of the hind legs. This unsteadiness increases until the animal loses its balance and falls. The skin becomes very sensitive to touch, and the animal generally quivers all over its body. Convulsions are common, and the animal dies while in this condition. Death, caused by paralysis of the heart and respiratory system, usually results in 15 minutes to 2 hours after the first symptoms of poisoning are shown. Bloating generally follows death.

First Aid. Move the animal so that the head is higher than the rest of the body; this will aid breathing. A veterinarian should be called at once, as death occurs very soon after the first symptoms are noticed.

General Appearance. A stout perennial, growing 6 inches to 3 feet high, it

DWARF LARKSPUR
DELPHINIUM TRICORNE



has a single stem, with a leafstalk (petiole) 1 to 6 inches long. The leaves are five-parted and then cleft three to five times. The flowers are blue, sometimes white, borne singly on short branches at the top of the stem, and form a spikelike head 2 to 3 inches wide and 2 to 4 inches long. The root is tuberous, clustered, $\frac{1}{2}$ to 3 inches long, and very compact. This is a very helpful factor in its identification. The flower is about $\frac{3}{4}$ -inch across and $1\frac{1}{4}$ inches long, having a straight basal spur about 1 inch long. It blooms in April and May.

Control. If the infested area is not too large, dig the plants out by the roots and destroy them. The roots should not be left exposed to dry in pastures because they are the most poisonous part of the plant.

Swamp Milkweed

Asclepias incarnata

While several species of milkweed are found in Minnesota, the swamp milkweed is the most common in the lowlands and bogs.

Toxicology. Swamp milkweed contains the poisonous resinous substance asclepidin. This is a bitter, yellow, emetic substance found in the acrid milky juice in the stems and leaves. It causes a number of complications when eaten by horses, cattle, or sheep. Congestion of the liver, kidneys, heart, lungs, nervous system, and other parts is found when autopsies are made on animals killed by feeding upon this plant. Livestock will not graze it if good feed is available, because the plant is very unpalatable and bitter. All of the milkweeds are toxic; and some of the species of the western plains are considered among the most dangerous plants with which the stockman has to contend.

Symptoms. Symptoms of poisoning are weakness of hind quarters and trembling and staggering as if intoxicated. In cases that are fatal, violent

spasms are exhibited; this has not been noted in any cases that have recovered.

General Appearance. Swamp milkweed is a perennial 2 to 5 feet tall. The stem is slender, smooth, hollow, bunched, often reddish, and generally branching at the top. The leaves are opposite, smooth, 3 to 6 inches long, and $\frac{1}{2}$ to 1 inch wide. The flowers are small, borne in umbels as in the carrot, and form a mass of deep red color at the top of the plant during July and August, each head or umbel growing to 3 or more inches across. The roots are fibrous, thin, and spreading, forming a mat of 1 inch or more along the base of the stem.

Control. Drainage, pulling by hand, and close, continued cutting will eradicate this plant. Drainage alone is a major factor in its control.

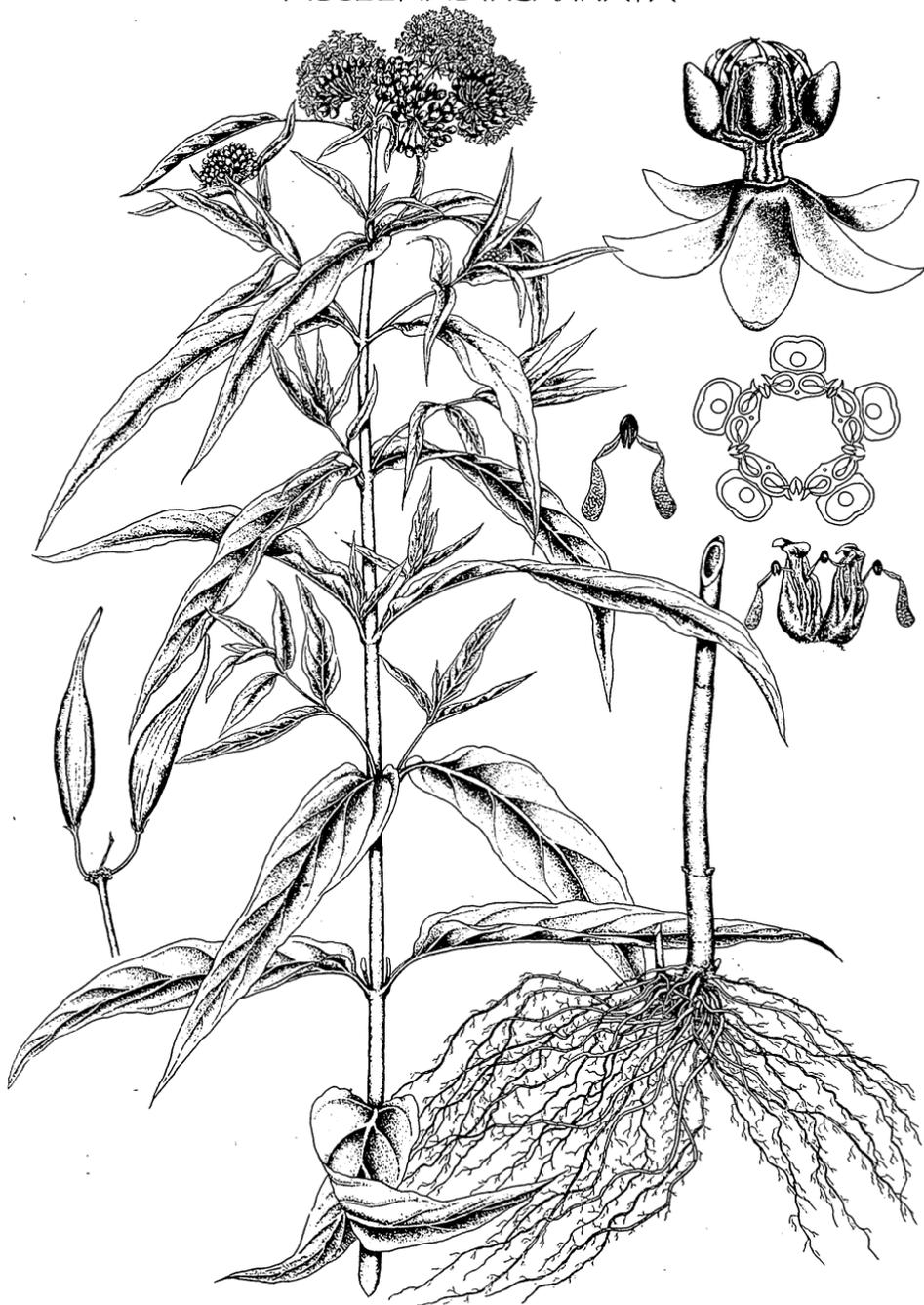
Butterfly Milkweed

Asclepias tuberosa

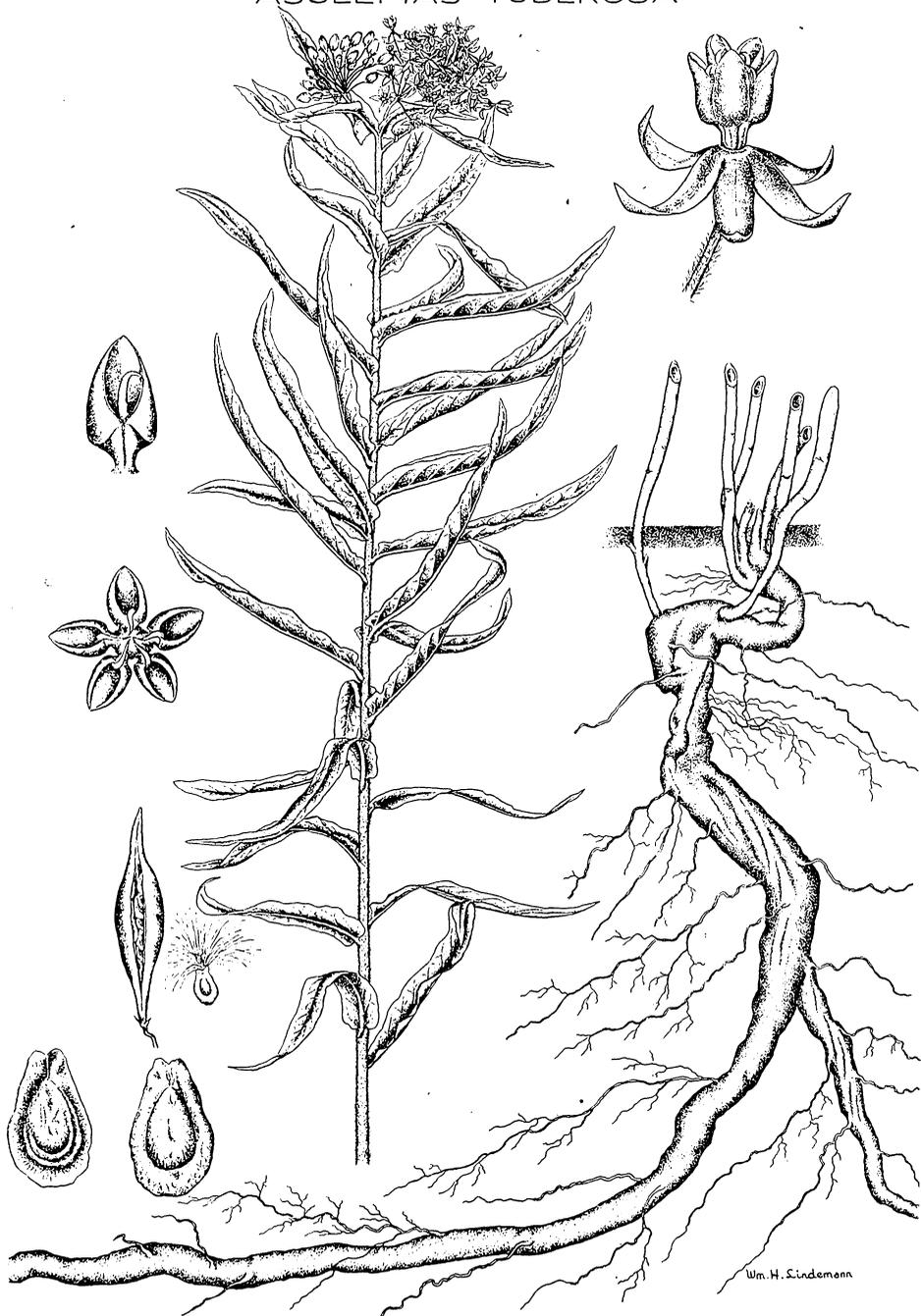
Centuries ago the butterfly milkweed was recognized by the Europeans as a poisonous plant. It is the most showy of the milkweeds and is sometimes grown as an ornamental. The tuberous roots when dug and properly stored will bring 6 to 10 cents per pound on the drug market. During the months of July and August thick patches of this plant make a very beautiful landscape because of their bright orange color. It is commonly found on hillsides or prairies and in pastures of southern and western Minnesota.

Toxicology. This plant differs somewhat from the other milkweeds in that there is no noticeable amount of milk in the stems. It has a strong acrid taste and is very unpalatable, but when pastures become short cattle will graze upon it, generally with disastrous results. A poisonous substance, asclepidin, is found in the stem and roots. It contains the same poison that is present in the deadly milkweeds of the western plains. The losses of livestock in Minnesota due to the butterfly milkweed

SWAMP MILKWEED
ASCLEPIAS INCARNATA



BUTTERFLY MILKWEED
ASCLEPIAS TUBEROSA



are very difficult to estimate because, under normal conditions, other vegetation is sufficient for grazing, and animals are not forced to eat such acrid-tasting plants.

Symptoms. Many of the animals affected by this plant do not die, but show a lack of vigor and an emaciation that lingers for a long time. Eating the plant causes a general weakness of the muscles of the limbs, and, if eaten in any quantity, later brings complications of the kidneys.

General Appearance. This is a perennial plant with stems 1 to 2 feet tall. The stem is very hairy, leafy, erect-growing, occasionally branching toward the top, but ordinarily growing straight upward and forming a dense cluster of orange flowers at the top 2 to 3 inches across. The leaves are many, opposite, and smooth to hairy; the midrib is always hairy on the lower side. They are $\frac{1}{4}$ to $\frac{1}{2}$ inch wide and 3 to 4 inches long. The plant has a clustered, tuberous, woody root that also aids in its identification. It is generally found in sandy soils, in dry fields, meadows, pastures, hillsides, and roadsides.

Control. Cut persistently from the time the first flowers appear until fall and continue the next season until the tuberous root is starved to death. If the plant appears in an open pasture, plow the ground and seed it to a good nutritious grass.

Cocklebur

Xanthium canadense

For many years it was thought that the only injurious effect upon livestock from eating cocklebur was mechanical injury and congestion of the digestive tract. It has been found more recently that the seedlings are poisonous, and many pigs are lost each year where cocklebur grows in the pasture. When mature burs are eaten, they form a matted ball in the stomach that cannot be digested. The spines become so securely fastened to the intestines that

the animal cannot pass them. If only a few burs are eaten, infection of the digestive tract is a common after effect, owing to the rasping of the burs upon the stomach and intestinal tissue.

Toxicology. Cases are on record of the poisoning of horses, hogs, cattle, and sheep. All these cases occurred when the plants were in the seedling stage. Young pigs are especially susceptible to this poisoning, and in nearly all cases it is fatal. A poisonous glucoside, xanthostrumarin, is found in germinating seeds and young seedlings. This decreases in quantity as the plant grows.

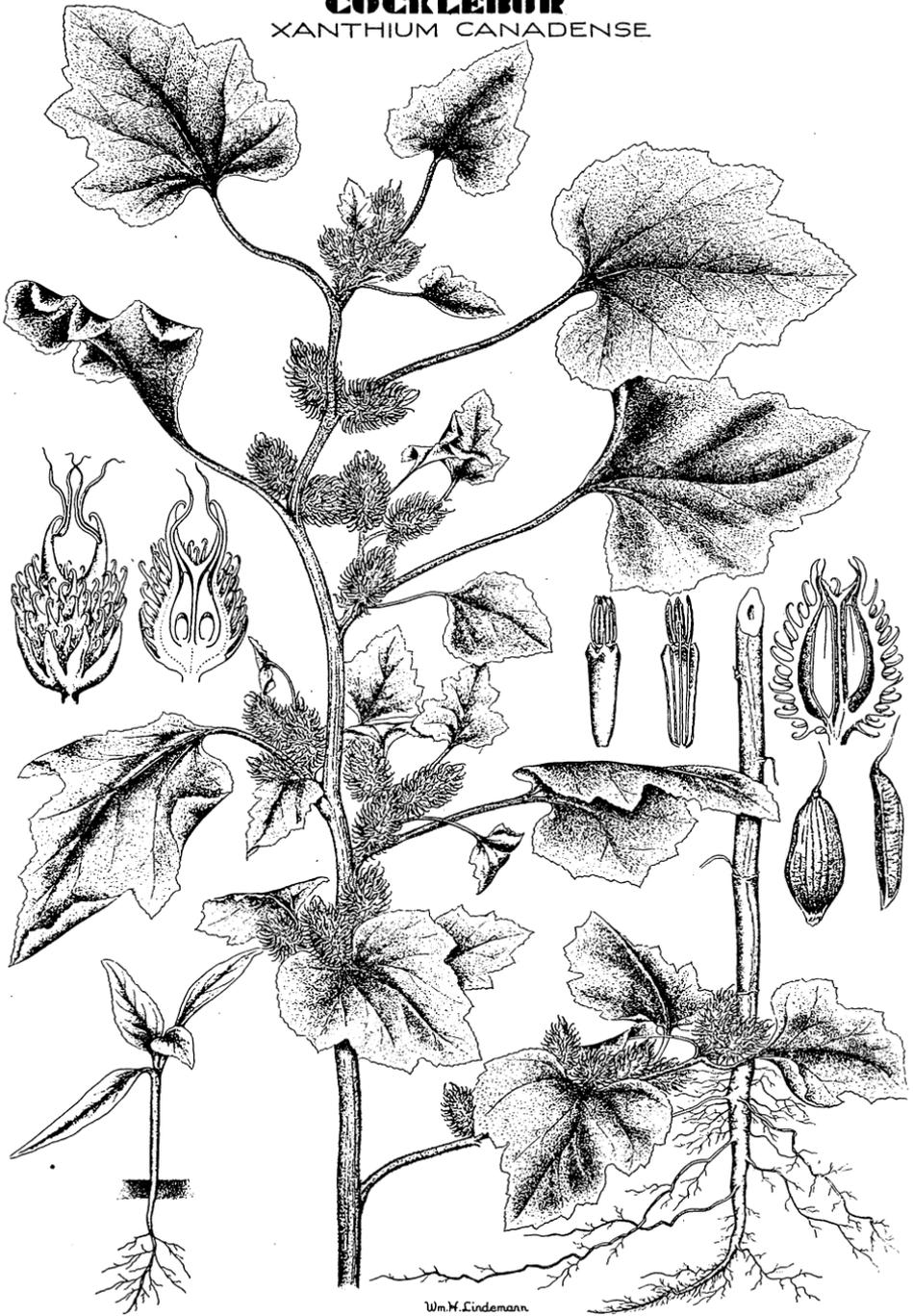
Symptoms. The pig throws its head back in an unusual position. It becomes weak and loses its appetite. It lacks control of its hind legs and staggers, falling and lying on its side, and squealing as though in pain. Spasms develop and the eyes turn white. Death is almost certain to follow if the latter symptoms develop.

First Aid. Pigs fed milk or fatty foods are reported not to be susceptible to this poison. The administration of fatty substances, such as lard or linseed oil, has proved beneficial in some cases.

General Appearance. An annual growing 1 to 3 feet high, the cocklebur is branched and spreading in form. The stem is rough, thick, angled, and often reddish or brown. The leaves are broad, somewhat heart shaped and rough, 2 to 5 inches long, and usually equal in width. The leafstalk (petiole) is 2 to 5 inches long. The flowers are inconspicuous; the infertile ones are clustered at the end of branches, while below these are the fertile flowers that produce seeds. The seed pod develops into a spiny bur about one inch long and containing two seeds. One of these seeds germinates the following spring and the other a year later, or they may lay in the ground for many years before growing, but both seeds will not germinate during the same year.

Control. Cut plants before burs have developed. If only a few plants are present, pull and burn them. The prac-

COCKLEBUR
XANTHIUM CANADENSE



Wm. M. Lindemann

tice of crop rotation will bring this weed under control. If the land is open, it should be put into a cultivated crop. Stirring the soil is very beneficial as it causes the cocklebur seeds to germinate so that they can be killed by the next cultivation.

Hemp

Cannabis sativa

Hemp is scattered throughout the United States, primarily the eastern half. In certain localities of southern Minnesota, the plant has been grown spasmodically for a number of years in the hope that there would be a demand for its fiber. No constant market has been found for the fiber and, in most instances, the crop has been a financial loss. A very high-grade paper is made from this plant, as well as various forms of tying twine and coarse cloth. Large quantities of fiber from hemp are imported from India and other Asiatic countries annually. Recently the public has learned of the opiate qualities of hemp, and its use as a narcotic has greatly increased. The detrimental effect upon horses was well known by the horse traders of a few years ago, and anyone who pastured horses first rid the pastures of this pest. The corrupt horse trader sometimes used the so-called marihuana to stimulate the actions of an old spiritless horse. These horses often died from the effect after the sales transaction. Large doses of marihuana act like strychnine, and its use results in a horribly painful death.

Toxicology. The plant contains a powerful resinous substance known as cannabinal and probably alkaloids also, which in large doses cause hemorrhages and severe pains. The poison is produced mostly in the seeding heads of female plants. Hemp causes depression, dizziness, congestion, earache, aching of the jaws, dryness of the throat and mouth, weakness of the limbs, and rapid beating of the heart, followed by depression. The heart condition is de-

pendent upon the amount of the drug taken. In fatal cases the fast heart beat and high blood pressure kill the animal. This plant has the same effect upon humans as upon livestock.

First Aid. No remedy is known.

General Appearance. Hemp is an annual with a hollow, fibrous stem, growing 3 to 6 feet high. The leaves are alternate along the stem and branches. They have a fan-shaped appearance, the palmately compound leaf consisting of 5 to 7 leaflets. The leaflets are pointed and narrow, with toothed edges. The male and female flowers are on separate plants so there will be no seeds upon the male, while they are borne in very dense clusters on the female plant. Hemp is most commonly found in waste places along roadsides and railways, and especially in the outskirts of towns.

Control. Cut the plant to prevent the production of seed. This should bring the weed under control except for seeds that will germinate the following year. Clean cultivation will eradicate it.

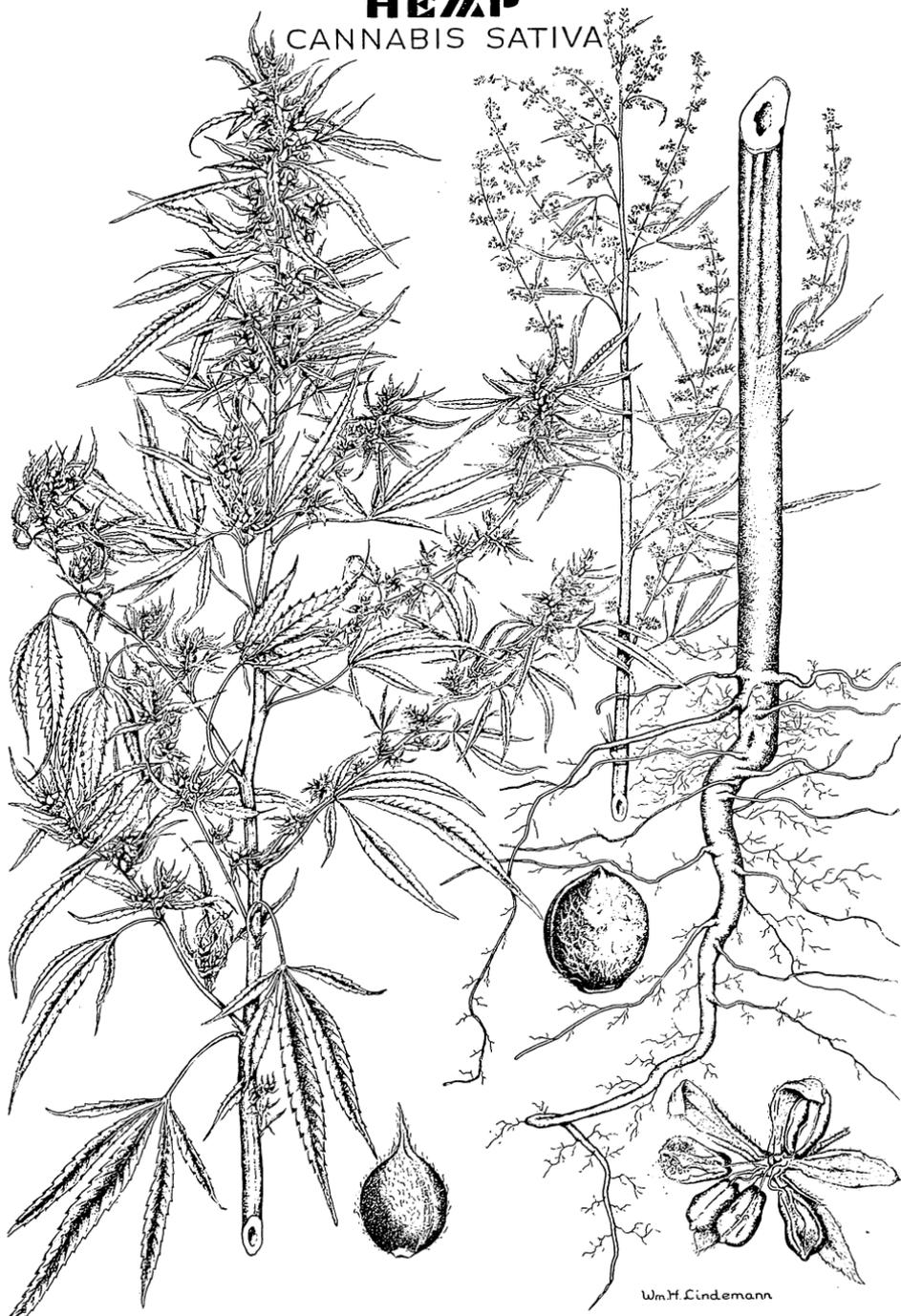
Marsh Arrow Grass

Triglochin palustris

An alkaline soil is the first requirement for the growth of marsh arrow grass. This plant prefers bogs and marshes or any low moist soil that contains an ample amount of alkali. It is localized, because of its soil requirement, to certain areas of western and southern Minnesota commonly spoken of as the "alkali swamps." The soil in which this plant grows is unproductive because the alkali has an adverse effect upon crop plants. As a result, the land is not cultivated, but is generally used for pasture or wild hay. Other species of arrow grass cause considerable losses of livestock in the United States, particularly to cattle in the western states. The extent of the fatalities or detrimental effects upon livestock in Minnesota is not known.

Toxicology. The plant produces hydrocyanic or prussic acid poisoning

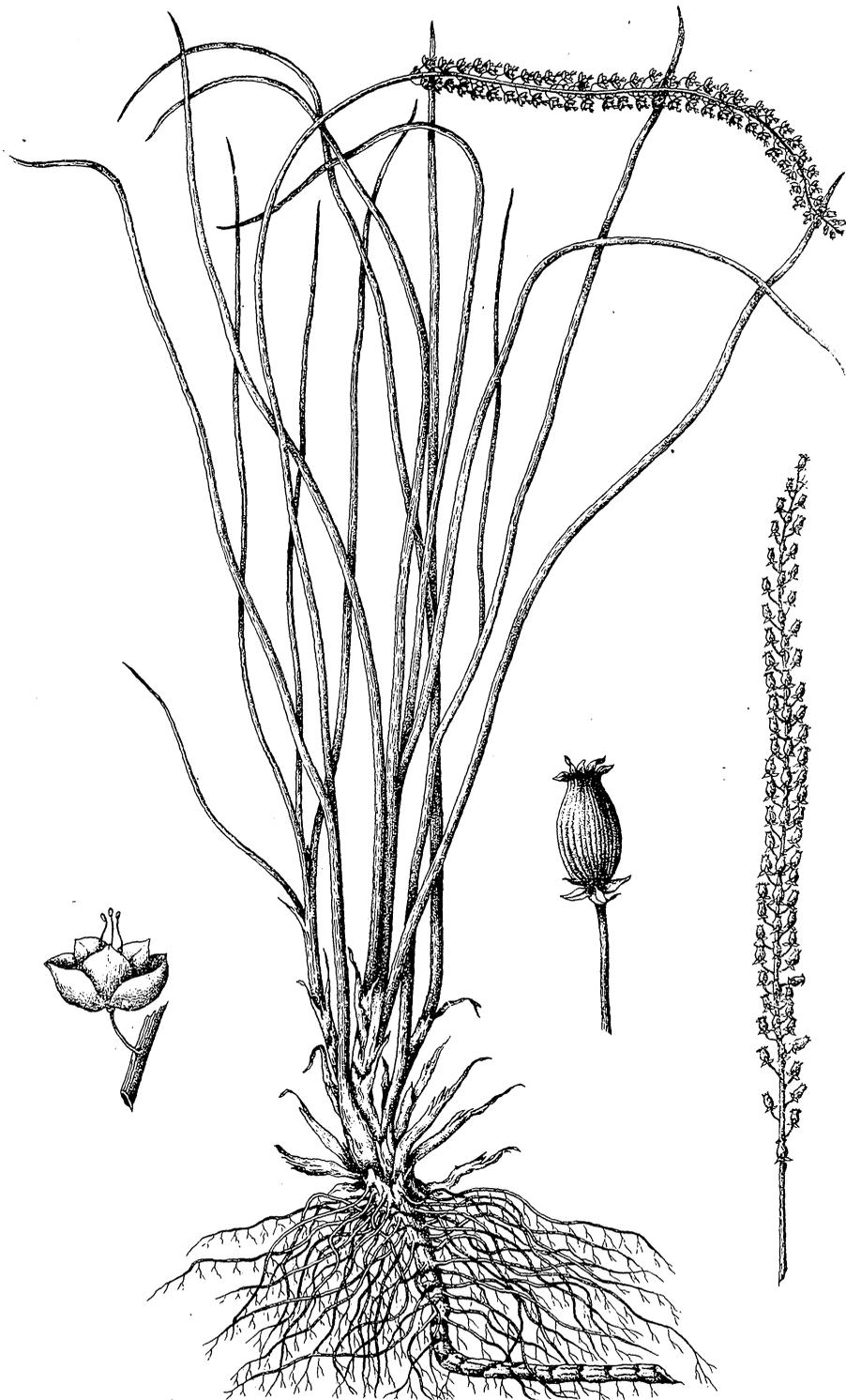
HEMP
CANNABIS SATIVA



Wm. H. Lindemann

MARSH ARROW GRASS

TRIGLOCHIN PALUSTRIS



when eaten by livestock, and is one of the most toxic plants of this group in the state. This type of poisoning is caused by several plants in Minnesota, and a number of animals are lost each year. Hay may be poisonous if it contains marsh arrow grass. A common practice in the more open section of the state is to permit livestock to range for themselves during the late summer and fall because pastures are too short to supply the necessary feed. It is at that time that waste land and open haylands will be grazed. Where meadows have been cut, and marsh arrow grass is present, it will lead other plants in second growth. Under such conditions, it is not surprising to find a large amount of sickness or deaths due to marsh arrow grass poisoning. The livestock raiser should keep two things in mind: first, that marsh arrow grass will exceed other grasses in second growth; second, that the second growth is more poisonous than the first.

Symptoms. No definite order or set of symptoms can be given in hydrocyanic acid poisoning, but ordinarily deep rapid breathing is the first sign, followed by staggering and loss of balance. Breathing becomes more difficult, and convulsions usually follow. The animal indicates pain at this stage by bleating and bellowing. Partial or total paralysis takes place before death, which is due to paralysis of the respiratory muscles.

General Appearance. This plant is a perennial with rushlike, slender, fleshy leaves 1 to 1½ feet long and ¼ inch wide. From the basal crown grows a slender, jointless, flowering stalk 2 to 2½ feet high. At the top of this stalk little greenish white flowers are borne for a distance of 4 to 8 inches. These grow in a whorled arrangement on the stem.

Control. If the plants are not too numerous, pull or dig them out. Although any type of clean cultivation will eradicate this weed, it is not practical under most circumstances.

Glaucous Anticlea *Zygadenus chloranthus*

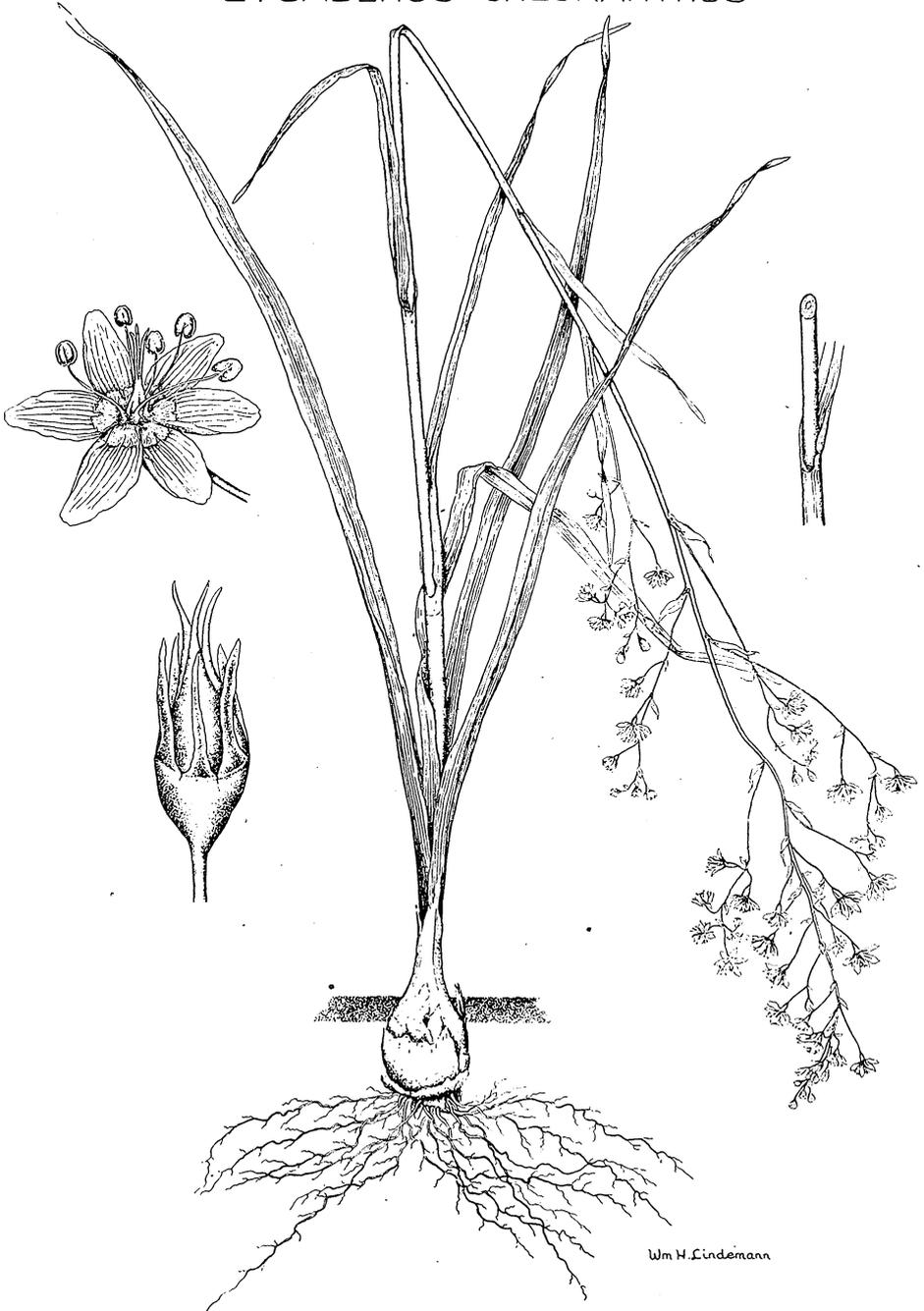
The losses of livestock due to poisoning by the glaucous anticlea or other species of death camas are tremendous in the western states. The number of animals lost in Minnesota is not known, but losses are reported which indicate that this plant is the cause. Since the plant is adapted to strongly alkaline soils, its range is limited principally to the alkaline soil areas of the western and southern parts of the state. The early settlers called this plant "lobelia" and thus the word "lobeliated" came to be applied to animals that acted crazed or intoxicated after eating only a small amount of the plant.

Toxicology. Glaucous anticlea contains the alkaloid, zygadenine. Any part of this plant is poisonous at any time of the year. Most sheep are poisoned in the early spring when the plants first appear, while most cattle are poisoned later in the season when the flowering stalk emerges. Hogs are immune to the poison. The floral parts are more toxic than the leaves. The bulb is the most toxic part of the plant, and, when the ground is wet, it is often pulled up and eaten by livestock with usually fatal results. The glaucous anticlea is poisonous in either the green or the cured state.

Symptoms. The symptoms of poisoning are, generally, a state of great excitement, frothing at the mouth, vomiting, unsteadiness of gait, and lack of muscular coordination. Later the animal falls and is unable to rise. It may lie in this somewhat paralyzed condition for hours or even days before death. Sometimes the poisoned animal becomes crazed, having violent spasms and showing no sense of recognition of its surroundings. This is, however, the exception rather than the rule, because ewes ordinarily recognize their lambs until a few minutes before death.

First Aid. A mixture of potassium permanganate, $KMnO_4$, and aluminum

GLAUCCUS ANTICLEA
ZYGADENUS CHLORANTHUS



sulfate, $Al_2(SO_4)_3$, in equal parts by weight, given as a drench has proved beneficial both as a chemical and as a physiological antidote. The following amounts are suggested for mature animals: sheep, 8 to 12 grains, horses, 30 to 50 grains, and cows, 60 to 100 grains. Dosages for young animals should be based upon size and age.

General Appearance. *Zygadenus* is a member of the lily family. It is a perennial, growing from an underground bulb to a height of 1 to 3 feet. The leaves are 1 to 1½ feet long and ¼ to ½ inch wide, and are shiny and flat with a definite central vein on the lower surface. Late in the spring a central flowering stalk emerges, 2 to 3 feet tall, narrowly branched, and bearing many flowers scattered for a distance of 4 to 10 inches at the top. They are small, greenish white, and about ½ inch across.

Control. Any type of clean cultivation will suppress this weed, but it usually grows where the soil is too alkaline for the profitable production of farm crops. These areas are commonly used for pasture or for wild hay. If the plants are scattered, pull the bulbs immediately after a rain, or dig each plant with a spade or fork. Gather all the bulbs and burn them.

Jimson Weed

Datura stramonium

Jimson weed was established in America at the founding of the Jamestown colony, from which it gets its name. It has been spread inland and across the continent by planting it as a garden flower. Animals may develop a peculiar craving for this weed, sometimes owing to salt deficiency. It is a common plant, found in hog lots, pastures, waste places, along roadsides, rivers, and edges of fields. It is one of the most noxious weeds in the Root River Valley, where the river overflows its banks almost every spring and spreads the seeds over thousands of

acres of land. Jimson weed has been used in medicine for centuries, and for a long time before that it was known to be poisonous to man. A number of deaths have occurred from it in recent years, especially among children. The flower is showy and, unsuspectingly, children play with it, putting it in their mouths, chewing the leaves, or eating the seed. All parts of the plant are poisonous, and only a few seeds will bring fatal results.

Toxicology. Jimson weed contains hyoscyamine and hyoscyne, both poisonous alkaloids. Animals are poisoned by eating it either in hay or in a green state. The plant has a bitter taste and animals will generally avoid it except when forced to eat it or at certain times when, for unknown reasons, they crave it. When it is cured in hay, much of the bitter taste is lost and, owing to this loss of repellent taste, poisoning occurs more frequently from hay than when the plant is green.

Symptoms. The symptoms of poisoning arise soon after eating and follow the same course in all cases. The order is extreme thirst, nervous confusion, blindness, convulsions, and then death.

General Appearance. Jimson weed is an annual growing 1 to 5 feet tall. The stem is stiff, grooved, and upright in form, with strongly forked branches. The leaves are alternate, 3 to 8 inches long and 1 to 4 inches wide, smooth and thin, darker on the upper than on the lower side, and strongly veined throughout. The leaf edge is irregularly lobed, with five or more points. The flowers are white, trumpet shaped, 2 to 4 inches long, and borne singly in the forks of the branches. The seed capsule is large, spiny, about 2 inches long, and four-celled, each cell containing many dark brown, wrinkled seeds.

Control. Pull or cut before any of the seed capsules are near maturity. Any type of cultivation will bring this plant under control. The leaves and seeds when properly cured can be sold on the drug market, and will probably pay for the cost of eradication.

Jimson Weed

Datura stramonium



White Snakeroot

Eupatorium urticaefolium

White snakeroot occurs extensively in woods and damp, shaded pastures in Minnesota. Among the early settlers of the Middle West, considerable argument was raised over the toxic properties of this plant. Some of the farmers said it was deadly poisonous while others insisted that the plant was totally harmless. It is now an established fact that the plant is very poisonous in certain localities, while in other places it is comparatively harmless. It affects humans and animals alike. When animals feed upon this plant they develop a condition called "trembles." When people drink the milk or eat the meat or butter from animals so affected, a disease known as "milk sickness" develops. This disease is characterized by frequent violent vomiting, and it sometimes upsets the digestive system so severely that death results. Many of the early pioneers died from this disease. It is estimated that white snakeroot causes 90 per cent of all livestock poisoning in Indiana.

Toxicology. White snakeroot, both in the green and cured state, is poisonous to sheep, cattle, horses, and pigs. This plant grows throughout the eastern half of Minnesota, being most abundant in the area of Aitkin and Crow Wing counties. It grows in any wooded area of the state where it can get sufficient shade and moisture. Fortunately, it is not as troublesome here as in other states. There is some evidence that animals raised in white snakeroot sections build up resistance against toxic substances of this plant. They also learn not to graze upon it. A number of the cattle that were shipped from the western drouth area into northern Minnesota for grazing during the summer of 1934 died shortly after their arrival. White snakeroot was probably responsible for a large number of these fatalities. It contains a poisonous alcohol, tremetol.

Symptoms. The following symptoms are characteristic of white snakeroot

poisoning in livestock: listlessness and slow motion; constipation; trembling and arched back; joints stiff, falling down and showing no inclination to rise; foul breath; death from exhaustion.

General Appearance. White snakeroot is a perennial 2 to 3 feet high. The stems are smooth and slender, with spreading branches. The leaves are borne opposite, and are smooth, thin, oval, and pointed. The leaf blades vary from 1 inch long at the top to 6 inches long and 3½ inches wide toward the base with sharp, coarsely toothed edges. The flower heads are small and white, and are borne on short branches in broad, compact clusters to a width of 3 inches.

Control. Pulling the plant, grubbing, and continued deep hoeing throughout the growing season are the only practical methods of control, as this plant naturally grows in wooded areas where cultivation is not possible. Chemicals are not recommended because of the hazards of fire and damage to trees.

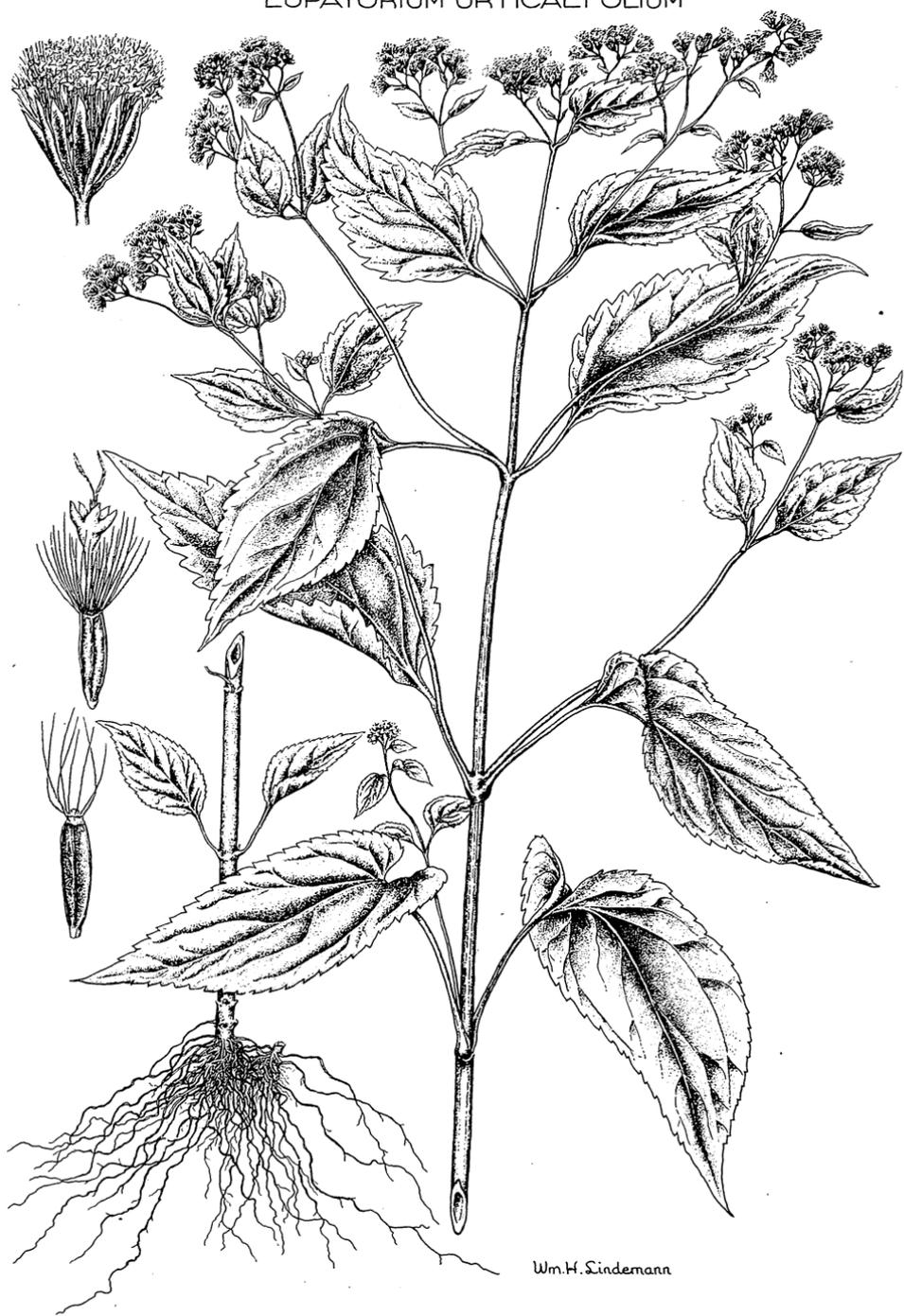
Water Hemlock

Cicuta maculata

Water hemlock, or poison hemlock, is found throughout the state. It prefers a very wet or marshy environment, and is most common beside springs, in wet bogs, and along lakes and streams.

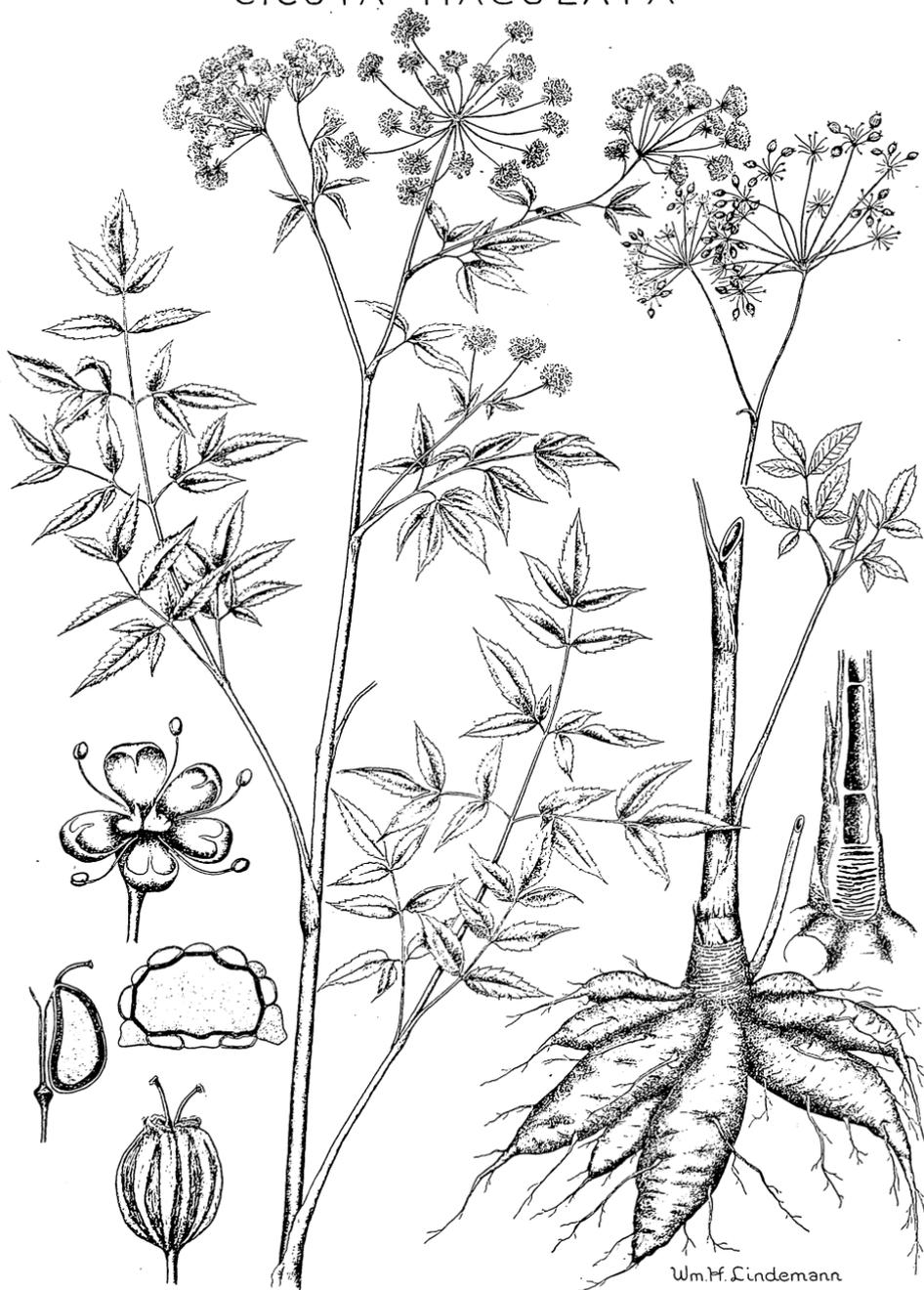
Toxicology. Few plants have as long a history of known poisonous qualities as the water hemlock. Probably no other plant is as directly responsible for as many human deaths. It is undoubtedly the most poisonous plant of Minnesota, as it contains the alkaloid coniine and a resinous substance, cicutoxin. There is some controversy as to the poisonous stages and poisonous parts of this plant, but it is advisable to assume that all parts of the plant are deadly poisonous in all their stages of growth and at all times of the year. Cows have been poisoned by eating hay that contained seedlings of water hem-

WHITE SNAKEROOT
EUPATORIUM URTICAEFOLIUM



Wm. H. Sindemann

WATER HEMLOCK
CICUTA MACULATA



Wm. H. Lindemann

lock. People have been poisoned by drinking water through the hollow stem. Children are often poisoned by using the stem for a whistle or for other purposes. The root is the most poisonous part of the plant; a small piece of it can kill a cow. Its effects are fatal to all farm animals—death generally ensues within a few hours.

Symptoms. The symptoms of poisoning are not definite, but ordinarily the animal first froths at the mouth, then exhibits severe pains in different parts of the body. Convulsions follow, becoming more violent until the animal dies in an exhausted condition. An autopsy usually shows more of the following complications, any one of which can cause death: congestion of the brain, lungs, or heart and congestion or paralysis of the nervous system. Evidence of hemorrhage is often found because the poison prevents the blood from clotting. Very little can be done after the animal has eaten the plant, for there is no successful treatment known for hemlock poisoning. Lard or raw linseed oil in the form of a drench is sometimes beneficial. When potassium permanganate is given early, it may be of some aid. Veterinarians recommend the use of sedatives to relieve the pain and to quiet the animal.

General Appearance. A perennial growing 2 to 5 feet tall, the water hemlock branches to a width of 2 feet or more. The leaves are compound; the leaflets are small, the majority being 1 inch long and $\frac{3}{8}$ inch wide, pointed, with definite toothed edges. The flowers are small, white, and are borne in umbels, with the flower head flat and spreading to a width of 2 to 3 inches. The hollow stem grows from a root-stalk to which is attached a group of tuberous roots 1 to 4 inches long and $\frac{1}{2}$ to $1\frac{1}{2}$ inches wide. By cutting the rootstalk lengthwise many crosswise chambers divided by pithy walls are visible. This will not be found in other members of this family, and is one of the easiest methods of identification.

Control. Dig the plant out by the root. This is easily done because the soil where the plant grows is soft and easily worked.

Black Cherry

Prunus serotina

The black cherry is one of the most valuable hardwood trees of Minnesota. It is used primarily for making high-grade furniture and for ornamental woodwork. There are several species of cherries in Minnesota. Choke cherry (*Prunus virginiana*) is common in all parts of the state, but the trees are not large and never develop into dense stands. The black cherry is scattered throughout Minnesota, except in the extreme northeastern portion. Heavy forest stands are found in the southeastern part, primarily in Houston and Winona counties. The propagation of black cherry should never be curtailed, although it sometimes produces poisoning in livestock. No cases of poisoning should occur if precautions are taken in pasturing woodlands. The black cherry is the most toxic of all the cherries in the state, but all of our cherries will cause hydrocyanic acid poisoning in livestock if the leaves are eaten when wilted.

Toxicology. Deaths from cherry poisoning usually occur after wind or hail storms when branches have been broken or entire trees blown down. When the leaves are wilted, poisoning occurs; the green fresh leaves are not poisonous. Laboratory analysis has shown that if the leaves contain the minute amount of 0.02 per cent of hydrocyanic acid, 5 pounds of the leaves will kill a mature horse, and only $1\frac{1}{2}$ pounds will kill a sheep. Death usually comes suddenly after a sufficient amount has been eaten.

Symptoms. The first symptoms of poisoning are hurried respiration, giddiness, and slow pulse. Later the limbs stiffen and the animal has noticeable difficulty in breathing. The pupils of

BLACK CHERRY
PRUNUS SEROTINA



the eyes dilate, the animal becomes unconscious, has frantic convulsions, and develops total paralysis of the body just preceding death. General paralysis is not always present. Death results from paralysis of the respiratory muscles.

General Appearance. The black cherry is a large tree, 30 to 60 feet high, with a bole 1 to 3 feet in diameter. The bark on the trunk is dark brown, very rough, and peels off in large flakes as the tree matures. The bark of young branches and twigs is reddish brown with definite white marks upon it. These marks (lenticels) are crosswise on the young trunks, branches, or twigs. The leaf is oblong, 1 to 1½ inches wide and 2 to 5 inches long, tapering to a point at the end. It has a definite toothed edge; the upper side is smooth and glossy, but the lower side is rough and hairy along the veins and midrib.

Control. It is advisable to check woodland pastures following hard storms to see that there are no broken trees or branches available for the livestock to graze upon. Cherry trees killed by drouth, disease, insects, stripped bark, or any other cause while the leaves are still green may have wilted leaves poisonous to livestock.

Porcupine Grass

Stipa spartea

Porcupine grass is a tall, native bunch grass of the western part of Minnesota and of the tall bunch grass region of the great plains area. Other common names are: needle grass, prairie needles, spear grass, weather grass, and auger seed grass. In South Dakota, it is called wild oats. It still persists in soil that has never been plowed or put under cultivation. In the early days it provided much of the native prairie hay and pasture and still does in some places. When used for hay, it is allowed to ripen so that the seeds drop to the soil and thus are not in the harvested hay. This avoids to

some extent the injury to livestock caused by the long, sharp-pointed seeds. The food value of the ripe hay is much reduced. It produces about the largest yield of hay of any grasses where it grows.

Injury. The injurious nature of the plant to livestock is due to the needle-sharp, basal point of the seed, which may injure the mouths of animals eating it or grazing on other plants among it. The mouth injury may prevent the animals from eating properly. In hay, these seeds may get into the eyes of cattle. Sheep appear to be the most seriously injured of all livestock. In addition to mouth and eye injury, the long sharp seeds catch in thick wool and penetrate the bodies of the sheep, causing unthriftiness, infections, and death. These seeds may be picked up by the sheep while grazing when the seeds are falling from the grass heads, while lying on the ground, or from hay and bedding. There are large annual losses of sheep from this cause; shippers refuse to buy from regions where porcupine grass is known to cause difficulty.

General Appearance. Porcupine grass grows to a height of 3 to 4 feet in clumps of a dozen or more stems from a single root system. It starts to grow early in the season and by the first of June is 2 to 3 feet tall and beginning to head out. Its seeds ripen in July and soon fall to the ground. The heads are made up of a few single-flowered spikelets. Striking characteristics of the spikelets are the long empty glumes, and the tough, flowering glumes which have a sharp basal attachment, covered with numerous bristles that serve as barbs, and a very long awn. When green or wet, this awn is straight and about 4 to 5 inches long. Upon drying it bends about 2 inches below the tip and the remaining 3 inches twist up tightly into a spiral. On becoming wet the spiral unwinds. This gives a back and forth boring motion which causes the seed to penetrate the soil and cover or plant it.

PORCUPINE GRASS
STIPA SPARTEA



Control. Porcupine grass is readily killed by cultivation. This may not be advisable where the grass is a staple hay and pasture plant and where wind erosion is apt to follow cultivation. In these cases, the plants should be pastured closely or mowed frequently enough to prevent seeds from developing to the troublesome stage. Waiting to cut it for hay until all the seeds have fallen is often practiced, but by that time much of the value of the grass for hay is lost due to hardening of the leaves and stems and the change of starch, sugar, and proteins into indigestible materials.

Other Poisonous Plants

Most crop plants are not poisonous in any stage of growth. Yet it must be remembered that if hungry livestock on short pasture are allowed to break through fences into lush forage they may overeat and become so gorged that the usual digestive processes are slow, and the ingested material may cause bloating. Bloating is unpredictable, because it depends upon the condition of the animals, the kind of plants, the stage of growth, and the types of fungi and bacteria that are ingested with the forage. Actually poisonous substances can be produced in the digestive tract by fungi and bacteria when animals are gorged with green forage. Such tendency from dry hay is seldom seen. In changing from dry pasture to lush forage it is always best to allow only partial grazing at first to avoid overeating. The sowing of grasses, especially brome, with alfalfa tends to reduce the dangers of bloat. The rough grasses stimulate the normal belching process. This is not true of alfalfa alone.

Of the crop plants that may poison livestock, Sudan grass pasture is most likely to cause trouble at certain times and under certain conditions. Hungry animals should not be turned into it. They should be carefully watched and

not allowed to feed fully the first time that they graze. However, it is a productive, succulent, and nutritious grass that can be used with good results by the livestock farmer if the following precautions are observed. Do not pasture Sudan grass until it is nearly a foot tall. If drouth or frost occurs, exercise greater caution in pasturing, for it is after such injury that hydrocyanic acid may form. Second growth Sudan grass is more dangerous than the first growth. Horses and sheep are less susceptible to poisoning than cattle. Hogs can be safely pastured on it.

Other plants that occasionally cause livestock poisoning include sorghum, flax, sweet clover, and some algae—the small, free-floating or submerged green plants sometimes found in stagnant pools or shallow lakes in July and August, when the weather is warm and the water is low. Sorghum and flax may produce prussic or hydrocyanic acid poisoning. Sweet clover hay at times causes fatal hemorrhages. Algae, when sucked in with water, have been the definite cause of livestock poisoning in several instances in this state. These three types of poisoning are known as cyanide, sweet clover, and water bloom.

There are several farm plants that may cause cyanide poisoning, among these being choke cherry, sorghum, and flax, in addition to black cherry, arrow grass, and Sudan grass. The conditions under which each appears to be poisonous varies to some extent. One lot may be poisonous while that growing under different soil and weather conditions may not. Even the physical condition of the animals, the stage of growth, and the kind of associated feed eaten may influence the effect. Hydrocyanic acid is present in the normal growth of these plants in combination as glucosides. Drouth, frost, bruising, trampling, wilting, mowing, etc., may induce the formation of hydrocyanic acid from its combinations. The quantity of acid produced may vary with the stage of

growth and growing conditions. Plants on poor soil low in nitrogen contain less than those on good soil. Plants in the northern United States appear more troublesome than those in the South. Dried plants are less troublesome than those that are wilted, because the hydrocyanic acid is volatile and evaporates. The amount of hydrocyanic acid an animal can tolerate varies with its size and somewhat with its species.

Flaxseed is not harmful if heated, as in pressing for linseed oil. Some feeds such as alfalfa hay and linseed cake retard the production of the hydrocyanic acid. Cattle being fed grain and corn are less liable to be poisoned than others on pasture alone. Flax screenings in feed are apt to be very poisonous, especially if the seeds screened out are not fully ripened. At best, they should never be used unless mixed in very small amounts with very starchy feeds such as ground corn.

Fresh choke cherry leaves may not cause poisoning, but wilted leaves are dangerous. Wilted frosted plants are liable to be dangerous, but when well dried they are safe.

Sweet clover hay has caused considerable loss of livestock, especially cattle. The poison appears to be associated with spoiling, due to poor drying and perhaps poor stacking. Musty parts either on top or in the butts of stacks of sweet clover hay should not be fed—at least not for more than one week at any time. Cattle less than four years old are most commonly affected. Sheep are less susceptible. The eating of musty sweet clover hay reduces the ability of the blood to form clots when the animal is injured, resulting in bleeding to death. This has most commonly followed castration, parturition, and dehorning. When fed over a period of a month or more, the blood diffuses out of the veins into the body cavity and the muscles. Swelling of the muscles may suddenly appear and indicate

an imminent danger. The affected animal bleeds to death internally. The only remedy is to be sure that the sweet clover hay is well cured and stored, and that all moldy or musty parts are discarded.

Water bloom is commonly seen in ponds and shallow stagnant lakes during the hot dry weather of July and August. The green color is usually due to small floating forms of plants called blue-green algae. Several species have been found to be poisonous to horses, cattle, sheep, and other farm animals. Most of these float near or on the surface so that animals drinking the water suck in large amounts of them. Sometimes the concentrations of algae in one place or along a shore are increased by a steady wind from one direction, thus multiplying the hazard in that spot. Serious illness or even death may occur a short time after livestock have drunk water containing these algae. A change in the direction of wind might relieve the problem in that area and transport it to another place along the pond or lake. A very dangerous time is apt to follow a heavy frost or freeze in late summer.

Control of the problem is largely a matter of fencing off water covered with this green scum. In some cases it can be quickly relieved by treating the water with copper sulfate at the rate of 3 pounds per million gallons of water, from time to time. This is done by calculating the amount of water, putting the required amount of the copper sulfate into a cloth sack, and dragging it through the water behind a boat, until it is all dissolved. This is apt to be injurious to other water plants and fish life and should be carefully done. The chemical should be well distributed to prevent too high a concentration in any one place. Repeat this when necessary. The above concentration of copper sulfate in the water will not injure animals drinking it.