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Larkspur and Other Poisonous Plants

BY
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Larkspur and Other Poisonous Plants.

BY GEO. H. GLOVER.

According to the last statistics, there are something over $50,000,000 invested in live stock in the State of Colorado. The old open range conditions still prevail to some extent, and many of the vexatious problems which have hampered this industry from its inception remain unsolved.

I deem it no presumption to say that there is no place on the face of the earth where the live stock industry flourishes less hampered by disease, contagious or otherwise, than in the salubrious climate of the arid west.

Not one of the great animal scourges that have decimated the herds of the Orient for centuries, and some of which have in the past reached our eastern shores, have ever found their way west of the Mississippi river, thanks to an eternal vigilance on the part of the Federal and State authorities. The loss we suffer is not great from any one specific cause, but in the aggregate become a heavy burden.

It has been estimated that the loss from poisoning of stock on the open range in the State of Montana is at least $100,000 annually. In this State it must be nearly or quite as great. The aggregate value of the animals actually lost does not, however, begin to represent the loss actually sustained by the industry because of the presence of a few species of poisonous weeds. In many sections of this State ranchers have given up in despair and been forced to abandon otherwise ideal ranges. The animal mortality, combined with the injury done to those animals not actually destroyed, have curtailed the profits until the owner at last is forced into bankruptcy and the ranges are abandoned.

Until the last few years no systematic effort has been made to investigate these poisonous plants of the western ranges. Their identity, poisonous nature, and remedy was simply a matter of common report among the stockmen.

In 1901 the U. S. Department of Agriculture sent two experts (Chesnut and Wilcox), to Montana to investigate the plant poisoning of stock in that State, and their report has been of inestimable value not only to the live stock industry of that State but to the whole country, more especially to the arid West. Other

bulletins from various State experiment stations, notably North Dakota, Idaho, Montana, have followed, and not only been of great practical benefit to the stockmen in identifying the most dangerous of these plants, but seems to have aroused the spirit of inquiry on the part of scientists for more extended research regarding them.

This bulletin is issued with the view of placing before the farmers and stockmen of the State a plain and concise statement, with illustrations, regarding larkspur and a few of our most common and most to be dreaded range plants.

Early in the spring of 1905 the Colorado Experiment Station undertook a co-operative experimental investigation of loco and larkspur with the Department of Agriculture. The work with loco weeds has been carried on throughout the summer and fall, with headquarters at Hugo, Colo., under the direct supervision of C. Dwight Marsh, of the U. S. Department of Agriculture, and the report will follow in due time.

Poison weeds in general throughout the State, with special reference to larkspur, has been the subject of special inquiry by the Experiment Station, at Fort Collins, and in this investigation has been ably assisted by the Bureau of Plant Industry, at Washington, by way of identification of plant, chemical analysis, determination of lethal dose, etc.

Out of the large number of plants known to be poisonous under certain conditions the two loco weeds known as white and purple loco, and several species of larkspur, have been singled out for special investigation at this time as they are held responsible for at least ninety per cent. of the loss in this State. While scattering reports come in from various sections of the State of loss which can be attributed only to camas, lupin, hemlock, and various others, in the great majority of cases it is from the loco weeds in the eastern half of the State and larkspur in the mountainous regions. Nearly every community of the State has been visited within the last year, and a fair knowledge of the most prevalent poisonous weeds obtained. In visiting various sections of the State, and by correspondence as well, I find that unless the plant under discussion is at hand there is no certainty that we both have the same plant in mind. There is no general agreement among stockmen themselves either as to the common names, identity, or symptoms from poisoning of even our most common poison weeds. White loco weed and rattle weed are spoken of as different plants; larkspur is commonly called aconite; death camas as wild onions, etc. I have corresponded with different parties with reference to the loss sustained from larkspur, and upon receiving the specimens found them to be something entirely different. This, however, simply causes some inconvenience. It does not present a serious

obstacle to their investigation, but incidentally furnishes an indisputable argument in favor of the necessity of educating the stockmen as to their identity in order that they may the more effectually avoid them.

In the realm of toxicology we are still groping in the dark, and our best scientists have laid down before many of the stupendous obstacles confronting them and acknowledge defeat. Here are some of the difficulties with which we have to contend:

1. *Some Plants Are Poisonous Only at Certain Stages of Growth.* The lupine (wild pea—horse beans), are found growing in almost every section of the State and in great abundance on the Western Slope, and in many places are cut for hay; they are poisonous only at the time of going to seed. Larkspur (*Delphinium*), is very deadly early in the spring, and loses its toxicity almost entirely at flowering time. The death camas (*Zygadenus venenosus*), growing from a poisonous bulb, is very deadly early in the season, but gradually becomes less harmful and dries up in July. Sorghum and kaffir corn, which became popular forage crops in the non-irrigable sections of eastern Colorado, have produced such disastrous results from feeding green at certain stages of growth that their cultivation has been generally abandoned. In Bulletin No. 37, of the Idaho Experiment Station, is found the following bearing upon this subject: "The roots of the wild parsnip or water hemlock, which are so virulent in the early spring, have been fed to cows in the late summer and early fall without ill effect. Another member of the same family, the hemlock water parsnip, has a root which is poisonous in the early spring, but harmless after midsummer, while the roots of another plant of the carrot family, poison hemlock, contain no trace of poison during March, April or May, although considerable quantities of the active principle coniin are present in the leaves and stems by May. Later in the season the roots also become dangerous."

2. *Unusual Conditions May Affect the Quantity of Poison in Plants.* In sorghum and Kaffir corn a stunted growth, resulting from arid conditions, is best suited for the development of prussic acid, the most powerful poison known. The poisoning by Johnson grass (a near relative of sorghum), is no doubt due to the same cause, as shown by Crawford and by Jeffries.

The common potato which belongs to the same genus as black nightshade, spreading nightshade, bitter sweet, and other dangerous plants, contains an active alkaloid solanine which develops in large quantities when potatoes become green from exposure to the sun. This is no doubt the cause of the sudden and mysterious death of horses in the vicinity of Greeley that had been turned into potato fields after digging time, many small potatoes having

been left on the surface exposed to the sun. The wilted leaves of the wild cherry are poisonous. In the eastern section of the State a scrubby cherry is found growing along the small streams and arroyas, and some loss in cattle has been reported. Several species of cherry are found growing abundantly along the ravines in the mountains.

3. *Poison Found in Different Parts of Plants.* Another discouraging feature in poisonous plant investigation is that the poison is not always found in the same part of the plant. In the case of wild hellebore, aconite, showy milkweed, thorn apple, and many others, the entire plant is poisonous. In wild parsnips the roots contain most of the poison. In lupines and yellow dock the seeds are dangerous. In potatoes the roots may be harmless and the tops poisonous. In the mountain laurel and wild cherry it is the leaves. In milkweeds the stems are said to be poisonous. In the crowfoot family it is found that the flowers are especially dangerous.

4. *Variations According to Season, Climate, Etc.* There are other serious difficulties to contend with in a systematic investigation of this subject. The danger of certain plants varies according to season, climate, character of soil, etc., from year to year. A dry season is generally favorable for the development of poison in most plants. A plant may be poisonous in one country and harmless in another. Jimson weed is more active in America than in Europe. Some plants become less poisonous by cultivation, such as wild hellebore and aconite. Where the plants contain poison in small quantity the native stock obtain a certain amount of immunity and will feed without harm on a range that will prove disastrous to other animals. The active principle may exist performed in the plant, which is generally the case, or it may be formed by the action of ferments during mastication and digestion.

5. *Some Animals More Susceptible Than Others.* Plants injurious to one species are harmless to others. The horse, mule, and goat eat poison ivy with impunity. Clover and alfalfa may cause a true intoxication, with bloating, under certain conditions, in ruminants; horses pasture upon the green plant without danger. Individuals of the same species show a wide divergence of susceptibility to poisons. As has been well said, "What is one man's meat is another man's poison." Poison ivy produces a violent inflammation of the skin on most persons. Some will escape and are apparently immune at one time, and equally as susceptible at another period of life.

Throughout the vegetable kingdom, from bacteria all the way up to the mighty oak, we find species of plants poisonous under certain conditions, but few of them poisonous under all conditions.

CONDITIONS UNDER WHICH POISONOUS PLANTS ARE EATEN.

Most poisonous plants are bitter and are avoided by animals. When confined to a certain range and not interfered with, they learn to avoid them, but are frequently poisoned while being moved from one locality to another. When an animal is hungry it will eat weeds that it would not otherwise touch. While driving the herd at the time of the roundup or to market they will be seen reaching for the tops of weeds that at other times would not be molested. It is a matter of common observation that the greatest amount of poisoning occurs under these conditions, and the reasons assigned are that animals when driven for some distance become ravenously hungry and have not time to make the same choice of forage plants as when at rest.

The time of greatest danger is during or immediately after a rain or snow storm in the spring months. Alfalfa, whether green or cured, is known to be much more dangerous for cattle and sheep when wet from rain or dew. This seems to be the case with some poisonous plants, especially larkspur. The explanation most commonly proposed for this phenomenon, however, is that when the ground is wet the roots are more readily pulled and eaten, and being much more poisonous, the danger is enhanced.

COMMON SALT AS A PREVENTIVE AND ALKALI AS A SUBSTITUTE.

There seems to be a diversity of opinion among stock raisers as to whether alkali, which is found in abundance in many sections of the State, is a complete substitute for common salt. There are several reputable stockmen on the Western Slope, whose success in business recommends their judgment, that have not salted their cattle for several years, and claim that in withholding the salt they lessen the liability to poisoning, and cattle at least do just as well without it. On the other hand, equally as responsible parties hold that, if salt is not supplied, the animals develop a taste for acrid plants, and thus the danger is increased.

While we have no definite information at hand bearing upon this subject, it would seem that from a physiological standpoint alkali, which is mostly sulfate of soda, sulfate of magnesium, and carbonate of soda, would in a measure take the place of common salt, which is chlorid of sodium, but could not entirely do so. The assumption that lack of salt in some form causes animals to more readily partake of noxious weeds seems entirely reasonable.

The drinking of alkali water is said to cause the death of cattle and sheep, with symptoms much like poisoning from larkspur. The reason for this assumption is due in a large measure to the fact that when animals are poisoned from various weeds they im-

mediately start for water and are found after death lying adjacent to water holes, springs, and accessible streams. In some places the springs of purest water have been fenced in, the owner erroneously believing the water to have poisoned his stock. For the reasons already assigned, the finding of a number of sick or dead animals within a few yards of a spring has frequently caused the owner to suspect his neighbor of having maliciously placed some violent poison in the spring.

PREVENTIVE MEASURES.

Prevention is better than cure. The all important question with the stockmen is how to prevent poisoning. The loss from this source, even though it be small, cuts directly into the profits. Remedies, no matter how efficacious, will only save a small percentage of them. As previously stated, poisoning is more likely to occur while they are being handled, but the aggregate loss will show that the great majority are simply found dead near a water hole adjacent to a patch of larkspur. There is no such thing as complete immunity from poisoning so long as animals are exposed to the weed. If the weed could in some way be eradicated, the problem would be solved. The possibility of displacing poisonous plants with forage plants has led to some experiments along this line by the Montana Experiment Station.* The forage plants tried were the smooth brome grass and the western wheat grass, or "blue joint." It will require several years to determine finally whether this is possible.

In the report of Chesnut and Wilcox, on "The Stock Poisoning Plants of Montana,"** is found the following:

> The short-awned brome grass (Bromus marginatus Nees), a native species, is spreading rapidly in a number of localities in various parts of the State. In some places this grass had already displaced all other native plants and occupied the ground completely. On a cattle ranch near Augusta it has invaded a timothy meadow and entirely killed out the timothy as far as it has spread. This brome grass produces a heavy crop of hay, and a few stockmen, having noticed its good properties, are preparing to save seed for sowing upon other parts of the ranges. Although work along this line extends over only three or four years, the outlook is promising, and it is perhaps not unreasonable to hope that by assisting the distribution of the brome grasses, blue joint, and other aggressive forage plants, the quantity of poisonous plants upon the range may be appreciably diminished.

This, however, were it to succeed, would take many years. Introducing forage plants to supplant others in their natural habitat, on the millions of acres in Colorado ranges is not sufficiently promising to warrant much hope of its consummation in many years to come, if ever.

The feasibility of grubbing out the weeds is worthy of more

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* Bulletins Nos. 15 and 45, Montana Experiment Station.
** Bulletins Nos. 20 and 24, U. S Department of Agriculture.

serious consideration. This I have advised in some cases where the plants were growing in a circumscribed area. It is rather surprising the amount of land that can be cleared by three or four men in a day. In one instance a patch of aconite covering possibly two acres that had been a source of trouble for several years was finally cleaned out in half a day by four men. Of course, where the plants are well distributed over a range of several thousand acres this would be impracticable and all but impossible. There are many instances, however, where the loss in one year would pay for the digging out of every plant. The results of observation and experiment are conclusive that the most dangerous period is in the early spring, and that the plants not only become unpalatable but cease to be dangerous at the flowering period. The most effective means of prevention is for the stockman to become thoroughly familiar with the different species of larkspur, and having located them, pasture the animals on non-infected ranges until the dangerous period is past. The time that they can be placed on larkspur pastures will depend upon the season and the altitude. At high elevations (9,000 to 11,000 feet) it would not be safe before about the 15th of July. West of Fort Collins, at an altitude of 5,500 feet, the stockmen feel quite safe by the 20th of June.

Poisonous Plants.

LARKSPUR. (*Delphinium.*)

There can be no question but that the several species of larkspur growing native in the mountainous districts of Colorado are a greater source of loss to the stockmen than all other weeds combined. While the larkspur is confined to the mountainous regions, it nevertheless holds true that in the aggregate mortality throughout the State from poisonous plants larkspur takes second place only to loco. We have no statistics at hand whereby we can estimate, with any degree of accuracy, the total loss, but judging from the reports of other western states and from information received from most every section of the State, it would seem that $40,000 annually is a conservative estimate.

There are four species of larkspur found growing abundantly in the middle and western portion of this State, and one found growing sparingly in the eastern plains section. Other species have been found in isolated places, but have not been especially accused of doing any harm, and their toxicity has not been proved. The four species found in the greatest abundance and named in the order of their importance, are purple larkspur, *Delphinium Nelsonii,* Greene; tall larkspur, *Delphinium elongatum,* (Rydb.); *D. Geyeri,* (Greene), and *D. Barbeyi,* (Huth). These all have the same characteristic flowers, and are found growing in the mountains at altitudes from 5,000 to 11,000 feet. The *D. Penardii* (Huth), has a white flower and may be seen growing adjacent to streams and in the arroyas on the plains as far east as the State line.

In June last this letter of inquiry was addressed to one thousand stockmen in the State, and a fairly liberal response was received.

Dear Sir:

The Experiment Station is conducting an investigation in connection with the U. S. Department of Agriculture, on the range plants of the State, poisonous to stock, and desires the benefit of your experience and observations on the subject. The information obtained will be collated and published and copies will be sent to all who have assisted with information and experience.

The Experiment Station will more particularly take up the question of larkspur and poison plants other than loco.

Please answer as many of the questions as you can, and forward the

blank promptly. Will you please send me samples of any plants you have reason to thing cause trouble, including the flower, if possible.

GEO. H. GLOVER,
Veterinarian.

COLORADO AGRICULTURAL EXPERIMENT STATION
FORT COLLINS, COLO.

LARKSPUR INVESTIGATION.

1. My name is.....
P. O. Address.....
2. I have had experience with.....on the
Kind of stock
range extending over.....years; on ranges as follows:
..... in the .....
Give location Foothills
.....at elevation of.....
3. I have lost.....attributed to eating
Kind of stock
larkspur.
4. The loss has been.....per cent annually from.....
years' experience.
5. The greatest loss of any one year was.....% which
was in....., year.....
State
6. Of those attacked.....% died (or better, state how many were attacked and how many died, giving size of herd).
7. What was your remedy for larkspur?.....
8. The most successful remedy has been.....
9. State what remedies or methods of treatment did not succeed.....
.....
10. Send samples of what you know as larkspur.
11. Do you believe larkspur to kill simply by bloat like alfalfa?.....
.....
Reasons .....
12. About what is the altitude of your pasture.....
13. About what time of year do you experience the greatest loss from larkspur? .....
14. About what kind of livestock has suffered most in your vicinity from this cause? .....
15. Do you believe lack of salt caused them to eat more of this plant than they would otherwise?.....
16. Do you believe that rain, snow, etc., aggravate the trouble?.....
.....
17. Are animals in poor condition more liable to be attacked than those in good condition?.....
18. Are they more liable to be attacked after or during a long drive?
.....

Name .....

P. O. .....

The response to this letter of inquiry was, in some respects, disappointing. Of those who were courteous enough to reply, 93 per cent had experienced loss from various poisonous weeds, ranging from one-half of one per cent. to sixty per cent. Seventy-five per cent. of those replying acknowledged that while they had lost animals from some kind of poisoning, yet they were not familiar with larkspur, and expressed a profound ignorance regarding the identity of the plants mentioned. All kinds of harmless weeds were sent to the Station, presuming them to be larkspur, or something equally as dangerous. Four expressed the opinion very emphatically that, while their ranges were infested with larkspur, yet they had suffered no inconvenience and did not expect to so long as the range was not overstocked and plenty of salt was provided .

In answer to question No. 4, the loss ranged from one to five per cent., covering a period of from one to twenty years. In question No. 5 the greatest loss in any one year ranged from one to sixty per cent. The latter being in case of a small herd being driven through the mountains where they came near being exterminated.

Of those attacked the report was that from five to one hundred per cent. died. The remedies suggested were as follows:

Bleeding from the ear-vein or under the tail.
Tapping through the side and allowing the gas to escape.
Turning the head uphill when down. Chasing the poisoned animals, and keeping them on the run.
Slitting the skin in the forehead and pouring in turpentine.
Tobacco, internally, in uncertain quantities.
Bacon, cut into small strips and forced down the throat.
Linseed oil given by drench.

Bleeding and tapping through the side appear to be the universal remedies, and most every answer contained an emphatic statement that animals could be saved by this treatment.

Of the specimens sent, about one-half proved to be larkspur. In answer to question No. 11, forty per cent. believed larkspur to kill by bloat, like alfalfa, and that if they could be tapped soon enough, would all recover. The altitude ranged all the way from 5,000 to 11,000 feet. There was general agreement that the early spring was the most dangerous period. A few had lost cattle and sheep in August, at high elevations. The greatest loss was reported in cattle; next in sheep, and a few reported loss of horses.

In answer to question No. 15, seventy-one per cent. replied in the negative, and the remaining twenty-nine per cent. were sure that lack of salt caused an abnormal appetite for noxious weeds. Practically all agreed that rain and snow, in some way, greatly aggravated the trouble.

In question No. 17, the answers were about equally divided between those who believed that condition of animals had nothing to do with the case, and those who were confident that poor animals were more susceptible and those who thought fat animals more liable. All the answers to No. 18 were in the affirmative except two.

The value of the information gained by this inquiry consists largely in the fact that it reveals in a measure the extent of the loss from these noxious herbs and lays bare before us evidence that the stockmen possess no reliable information regarding them or any other of the poisonous weeds. In one thing, however, they are all agreed, viz.: some poisonous plants are killing the animals from year to year and that it has become a heavy burden. Not knowing anything better, the old fashioned remedies, bleeding, bacon rinds, turpentine, etc., are tried, with indifferent results.

This is not surprising, however, when we come to consider that it is only within the last few years that this subject has received any attention at the hands of investigators, and even now very little reliable information can be had regarding the chemistry, physiology, or satisfactory antidotes for the many deadly plants inhabiting the western ranges.

Description, History, and Habitat. While there are several species of larkspur growing in the State, there are only two, the tall and the purple, found growing in sufficient quantities to warrant a serious consideration. They both have the characteristic spur shaped flower (cockspur), but in other respects differ widely. The tall (*Delphinium elongatum*) grows from one to five feet high, and has a pale blue flower. The leaves are broad and from two to six inches in diameter, and greatly resemble those of the wild geranium. It is found growing along the streams, in moist places, and upon the north side of mountains at an altitude up to 9,000 feet. From the middle of March to the 4th of July, according to altitude, is the dangerous period for this plant. The tall larkspur resembles the aconite (Monkshood), both in its general appearance and toxic effect upon animals. They should not be confused, however, if careful examination of the flower is made, the larkspur having an appendage in appearance like a cock's spur; while the aconite has a flower dark purple in color and with a top resembling a hood, hence the name monkshood. From the reports in other western states, especially Montana, it would seem that the purple larkspur, which is more generally eaten by sheep, is the more disastrous of the two. In this State it is quite the reverse. The tall larkspur is more abundant and the major part of the mortality is among cattle.

The purple larkspur rarely exceeds two feet in height. The

leaves appear on a long stem in the form of a cluster, are finely divided, and in appearance are very different from the large oval leaf of the species previously mentioned. The flowers have the same appearance, save in color, which varies from a deep blue to a dark rich purple. It grows at high altitudes. In the mountains west of the Roaring Fork it was found growing at 11,000 feet, and at lower altitudes had been seen in full bloom on the 20th of April. Very little damage had been reported from this plant after May 1st. As both species of larkspur do their damage before the flowering season, it is of the greatest importance that stockmen familiarize themselves with the appearance of this plant before bloom and assiduously avoid it.

Symptoms of Poisoning. The symptoms of larkspur poisoning are similar to those produced by aconite. The first thing noticed is a stiffness. The back appears to be arched and the legs are carried wide apart. There is usually some frothing at the mouth. The animal stumbles and falls, several times, and trembles violently. The throat is affected and there is persistent swallowing. Breathing is rapid and shallow. In severe cases violent convulsions come on, in one of which the animal finally dies.

Treatment. In cases where the bloating becomes extreme, we have not only the intoxication from the active poison in the plant to contend with, but the excessive accumulation of gas becomes a mechanical condition, which of itself hastens or may even become the principal factor in causing the death of the animal. The practice of tapping through the left side into the rumen for the purpose of allowing the gas to escape in extreme cases is good treatment and has no doubt been the means of saving many an animal. Every stockman should carry a trocar with him while riding the range during the spring months to use for this operation, and not be obliged to use the jack knife. The instrument can be purchased at hardware stores for one dollar or less. The results of using it in the case of bloat in cattle or sheep from any cause are usually perfectly satisfactory, and the animals will not shrink in condition as is usually the case from using a knife.

As previously stated, the most trouble occurs while the animals are being moved from place to place during the spring months. In most cases the man is alone and may have several poisoned at the same time. He is therefore poorly equipped to undertake any complex treatment. His treatment must be simple, effective, and done without delay. The practice of turning them so that they lie with the head up hill is to be commended, as it relieves the pressure on the lungs and heart from the distended bowels. Bleeding is uniformly recommended and practiced by the sheep herders and cow men. It is difficult to see how it can be of any benefit,

and experimentally it has not proved to be so. One gentleman from the Western Slope, who besides being a successful ranchman, was also a graduate physician, explains the beneficial results of bleeding as follows: "It relieves the passive congestion induced by the paralyzing effect of the poison upon the heart."

It is less than fifty years since bleeding was practiced on the lower animals as well as on the human, for every imaginable complaint, and it was considered uniformly efficacious. It has now been discontinued save in rare instances. It is a question whether the animals would not do just as well or better if left entirely alone. The principal effect of larkspur, like aconite, is to depress the heart action; therefore the animal should not be chased or excited.

It would be hard to conceive of a treatment more disastrous, in this case than tobacco. Its action would be much like the poison and disastrous in the extreme. The use of bacon would be absurd. Lard could be given in this case as it is in strychnine poisoning in dogs. Its value consists in mechanically retarding the absorption of the poison. The practice of slitting the forehead and pouring in turpentine is too absurd for serious consideration. This, along with many other absurdities practiced in the name of curative medicine, is to be looked upon as a relic of the superstitions of former days, and should, along with the magic of the witches mess pot, be relegated to the company of the empiricisms of a less enlightened age.

As shown in the account of experiments which follow, we have at least two remedies which possess real antidotal value. These cases of poisoning occur in almost every instance in mountain ranges, far removed from any immediate assistance, and under the worst conditions imaginable. The remedies, whatever they are, must be something that can be carried on horse back and easily and quickly given. As a chemical antidote, potassium permanganate and aluminum sulfate in equal parts in doses of from thirty to fifty grains (five to ten grains for sheep), dissolved in at least a pint of water, is given at one dose, by drench. This remedy, so highly recommended by Chesnut and Wilcox in their Montana investigation, has been repeatedly tried at this Station with most satisfactory results. I believe this remedy to be a practical one for the stockmen. When operating within easy access to water, the powders can be carried ready for solution and given without much delay. With slight inconvenience the solution can be carried ready for use. It is important to see that the powder is completely dissolved. It should then be given at one dose, exciting the animal as little as possible. A number of drugs have been tried experimentally upon sheep and rabbits, with the hope of finding something easy of application that would counteract the depressing effect

of the poison upon the heart and circulation. Most of them were disappointing in the extreme. Stimulants are indicated (alcohol, camphor, ammonia, strychnine, etc.,), and all are more or less beneficial. Glonoin (nitro-glycerine) injected hypodermically, revived the heart's action and abated the alarming symptoms for a time. This, however, did not appear to be a true physiological antidote.

Atropine, given in one half to one grain doses, hypodermically, gave satisfactory, and in some cases, astonishing results. Every stockman should keep on the ranch a hypodermic syringe for inoculating his calves against blackleg, and in this way become familiar with the use of the instrument. The atropine tablets can be secured at any drug store. A small vial of boiled water may be carried in the vest pocket and the remedy quickly prepared and given to a number of poisoned animals. The dose is one-half to one grain for cattle and horses and one-twentieth of a grain for sheep. I have no hesitancy in strongly recommending potassium permanganate, when used in the way indicated, as a chemical antidote, and the atropine as a physiological antidote. Either drug may be repeated, if necessary, in half an hour. In case these remedies are not at hand, any one of the following stimulants might be tried: Whiskey, in two-ounce doses, for cattle or horses; aromatic spirits of ammonia, two ounces well diluted with water, for cattle and horses. Spirits of camphor, one ounce. Fluid extract of belladonna, two drachms. Nitrous ether, two ounces. For sheep, give one-fourth the amount.

Results of Experiments. In accordance with an agreement entered into with the Department of Agriculture, whereby we were to conduct a co-operative investigation of loco, larkspur, and other poisonous plants, larkspur was gathered at intervals throughout the spring months. The first was gathered on April 26th, when it was about four inches high, and the last on June 12th, at which time the flower was in full bloom and the plants were beginning to dry up. It was dug with roots attached and after drying ten days, was sent in five pound packages to the Bureau of Plant Industry, U. S. Department of Agriculture.

On October 10th Doctor Crawford reported as follows:

"The method used in testing the physiological activity of plants was to weigh accurately five grams of the powdered plants, then extract this over night with twenty c. c. of water, and ten c. c. alcohol added mainly as a preservative. The following day the extraction with water and squeezing was continued until the fluid became colorless. The fluid was then evaporated to dryness in vacuo about 40° C., and the residue made up to 30 c. c. with water. Any number of c. c. would do as well. The alcohol was given off in vacuo.

PLATE I.*

Purple Larkspur, Young Plant.

(*Delphinium bicolor*)

Almost indistinguishable from *D. Nelsonii* of Colorado.

* All Plates, except Plate VIII., are from U. S. Dept. of Agriculture, Chesnut and Wilson Bulletin 26, Div. of Botany.

PLATE II.

Purple Larkspur in Flower.

(*Delphinium bicolor, D. Nelsonii* Greene)

PLATE III.

Tall Larkspur.

Shown as *D. glaucum* in Bull. 26, Div. of Botany, Dept. of Agriculture.
Much the same as *D. elongatum* of Colorado.

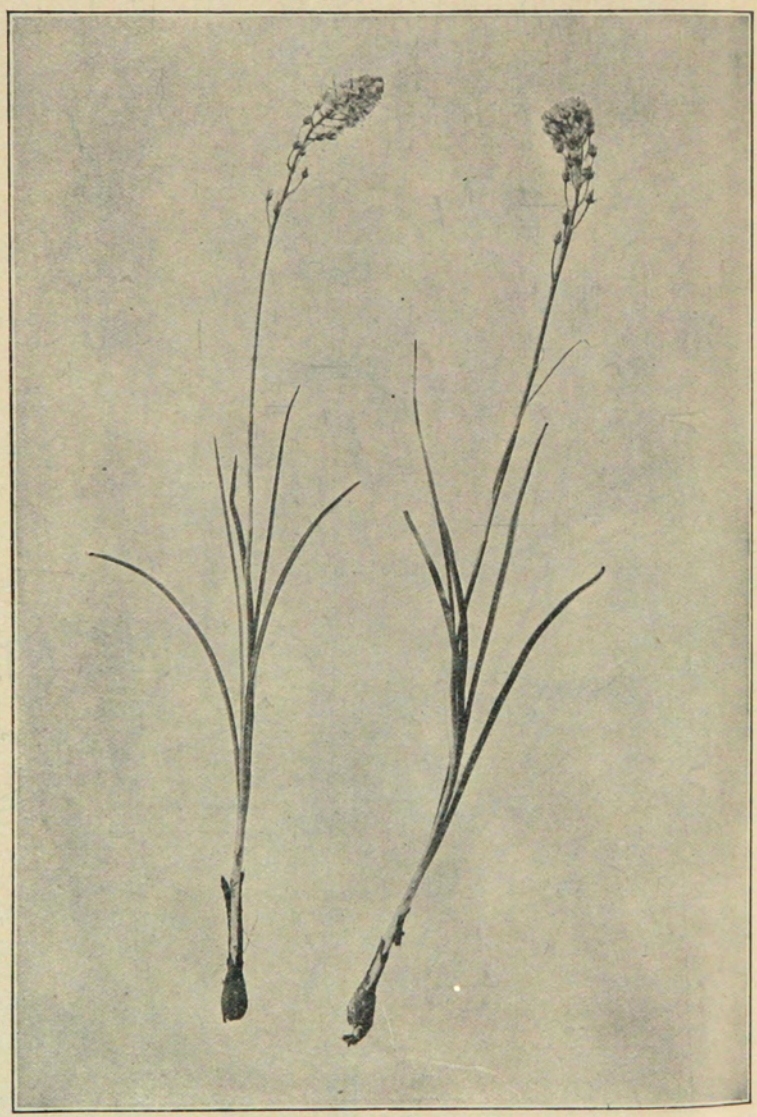

PLATE IV.

Death Camas

(*Zygadenus venenosus.*)

The First Batch Collected April 26th, 1905.

1 c. c. injected into a guinea pig (subcutaneously), weight 730 grams. Caused no disturbance.

3 c. c. in guinea pig, no symptoms.

6 c. c. in guinea. Killed.

6 c. c. injected into guinea pig, 285 grams, killed in 33 minutes.

4 c. c. injected into guinea pig, 352 grams, no symptoms.

Repeated:

5 c. c. killed guinea pig weighing 196 grams. Died in 55 minutes.

4 c. c. injected into guined pig, 299 grams. No symptoms.

Evidently lethal dose for this solution lay between 4 to 5 c. c.

Second Stage, Gathered May 16th, 1905.

Solution corresponding to 4 c. c. of No. 1 caused no symptoms in guinea pig weighing 445 grams, while 5.3 c.c. gilled one of 350 grams, but death was delayed longer than with extract of first stage.

Third Stage, Gathered in June, 1905.

Solution corresponding to 4 c. c. caused no symptoms in guinea pig weighing 376 grams.

5.3 c. c. caused no symptoms in guinea pig weighing 500 grams.

6.6 c. c. caused no symptoms in guinea pig weighing 480 grams.

Evidently lethal dose is much higher and the plant loses much of its activity in development.

This report is very conclusive in proving that the plant contains an active poison, and further in substantiating the claims of experienced observers that the plant loses much of its toxic properties as it approaches the flowering period.

Correspondence with those who have had wide experience with larkspur elicits the fact that animals often eat considerable quantities of the plant without injury. Rabbis lived for days on a on a spare diet of dried purple larkspur, but succumbed readily to the more tempting bait of the green.

It is not the purpose of this bulletin to give a detailed report of laboratory experiments. The results will be briefly summarized at the conclusion of this report. As proof, however, of the statements made regarding the difficulties of securing accurate knowledge of the toxic properties of plants under any and all conditions, the following experiment is interesting as well as instructive:

Seven and one-half grams of dried purple larkspur fed to each of three rabbits on April 20th. No results.

Seven and one-half grams of fresh purple larkspur from same patch fed April 25th to each of three rabbits. Two showed slight uneasiness, and one was bloated a little. One, showing less effect than the others, had eaten but three and one-half grams.

On May 1st a like quantity from the same patch was given to the same rabbits under similar conditions. Results, two died, and the other distressed.

On June 15th, the plants from the same source being in full bloom, but the leaves and stems dry, were fed to rabbits. Al-

though very hungry, they at first refused to eat, but later ate large quantities of it without any ill effects. The experiments with tall larkspur were equally as confusing. The fact that the plants at one period of growth gave negative results was no guaranty that it would not be dangerous at another. The tall larkspur growing luxuriantly on the college campus proved to be very active, physiologically, and furnished the best specimens for producing the physiological effects upon animals. In the experiments with antidotes this domesticated species was found to be very poisonous while in bloom in the middle of August.

Two other species, *D. Barbeyi*, (Huth) and *D. Geyeri* (Greene), found growing sparingly under conditions about the same as the species mentioned, were found to be poisonous. Their relative toxicity, however, was not considered, as they were not found in great abundance.

The several conclusions arrived at with reference to larkspur are as follows: First, at least eighteen species, and several varieties of larkspur, have been found growing in the State. Four growing in the greatest abundance are known to contain an active poison in sufficient quantities to be dangerous to live stock.

Second, death is produced as a result of the presence of an active poison, and not from "bloat," as many stockmen have claimed.

Third, the toxic principle of larkspur has not yet been determined for these species, but is probably delphinine and allied alkaloids present in other species that have not been fully studied.

Fourth, the plant loses its toxic qualities as it approaches the flowering season and finally becomes harmless.

Fifth, two species, because of their abundance, are doing most of the damage, *i. e.*, tall larkspur (*Delphinium elongatum*), and purple larkspur (*Delphinium Nelsonii.*)

Sixth, stockmen generally have little knowledge of the identity, poisonous nature, or satisfactory remedy for larkspur.

Seventh, considering the enormous loss and the fact that larkspur is usually found in circumscribed areas, it would seem feasible, in many localities at least, to undertake its eradication by the grubbing hoe.

Eighth, by avoiding the areas where larkspur abounds during the months of April, May, and June, the loss can be reduced to the minimum.

Ninth, in potassium permanganate and atropia sulphate, respectively, we have a chemical and physiological antidote of real practical value. Stimulants are indicated. Tapping should be done with trocar and canula high up on the left side, after first making slight incision on the skin with a knife. In case of extreme

distention this operation should not be delayed. The value of bleeding is questionable. All measures which tend to depress the animal, such as forcible exercise, tobacco, aconite, etc., are positively harmful. If on sloping ground, the head should be turned up the hill.

DEATH CAMAS. (*Zygadenus Venenosus,* Wats.)

Other names: Wild lobelia, poison camas, poison grass, wild onion, poison sego, mystery grass, wild leek, crow foot.

Description. As will be seen from the accompanying plate, this plant bears a strong resemblance to the wild onion. On account of its bulb it has also been mistaken for the prairie lilly or Indian sego. The bulb of the sego (*Calochortus*) is edible and has furnished food for travelers and generally eaten by the Indians. The wild onion is no doubt a harmless plant. Early in the season death camas looks like grass. It starts a little earlier than grass, and being more succulent and devoid of disagreeable odor or taste, is eaten freely.

Where Found. The plant is found growing in every county in the mountain districts of the State. It is not found in the eastern plains district. Its favorite habitat is along shallow ravines where there is slight seepage. It is often seen, however, growing singly and widely scattered over the high mesas and in shallow depressions commonly found in such places. It is not nearly so abundant nor so widely distributed as larkspur. The camas is much more abundant in the northern part of the State.

While the loss from camas is no doubt small as compared with larkspur, yet for several reasons it is to be looked upon as one of our most dangerous poison weeds. Stock on the range are usually thin in the spring and ravenously hungry for the first green forage that appears. Camas starts a little ahead of grass and is relished by all kinds of range stock. All parts of the plant are extremely poisonous and an animal does not need to eat a large quantity to become fatally poisoned.

In Bulletin No. 37, of the Idaho Experiment Station, is found the following:

"During the past year the tops were found by the Agricultural Department at Washington to contain a poisonous substance, one of the powerful veratrine alkaloids. The bulbs which have been reputed poisonous were not examined. A study of this part of the plant in the Chemical Laboratory of the Idaho Experiment Station showed the presence of at least three alkaloids similar to veratrine, the most important of which appeared to be related to violent poison hellebore, a single milligram, which is only one-fiftieth of a grain, killed a frog in two minutes. The dose of strychnine fatal to the frog is twice that amount, from which some idea of the intensely poisonous nature of the bulbs may be gathered."

Symptoms. The symptoms of poisoning by camas are characteristic. At first they appear to be excited, are unsteady

in their movements, breathe rapidly, stagger, and fall. They appear to be completely paralyzed, but in full possession of their senses. Spasms come on more or less severe according to the amount eaten. In mild cases only a slight stiffness of muscles is noticeable, and this soon disappears. In severe cases of poisoning the animal will lie flat on its side, unable to even raise the head, and death will be delayed for several hours.

Treatment. Chesnut and Wilcox experimented with several antidotes, among the most promising of which was potassium permanganate, given by the mouth, and strychnine, atropine, morphine, and caffeine, hypodermically. In their first report the potassium permanganate is found to be a valuable physiological antidote. The strychnine and atropine had little if any curative value. In further experiments with the active principle, these authors recommended caffeine diuretin.

The directions for giving the potassium permanganate as an antidote will be found in connection with the treatment for poisoning by larkspur.

WATER HEMLOCK. (*Cicuta occidentalis,* Greene.)

Other names: Wyoming water hemlock; cowbane; spotted cowbone; wild parsnip; snake weed; spotted parsley; death of man, etc.

Description. This plant is more commonly spoken of in Colorado as wild parsnip, and is confused with at least three other species, which it greatly resembles on account of the similarity in the umbrellalike expansion of the top.

It is often mistaken for the cultivated parsnip, which it resembles to some extent. It is not, as many have supposed, the cultivated parsnip gone wild. On the contrary, it is a distinct species and can be distinguished from the garden species by having a white flower. It arises from a bunch of thick tuber like roots, which when cut and pressed will yield a gummy secretion which contains the active poison. The seeds also contain the poison and the foliage early in the season.

Where Found. This plant abounds throughout the entire Rocky Mountain region. It is found in wet or swampy places, along streams, on ditch banks, and often invading the meadows. It is found growing on the plains east of the mountains, more sparingly but under similar conditions.

Symptoms. There is manifest symptoms of great pain; the animal performing much the same as when suffering from colic. This is followed by frenzy and spasms. The breathing is labored. There is frothing at the mouth and finally unconsciousness, the

PLATE V.

Wyoming Water Hemlock

(*Cicuta Occidentalis.*)

PLATE VI.

Lupine

(*Lupinus sericeus.*)

PLATE VII.

Aconite.

(*Aconitum columbianum.*)

PLATE VIII.

Rubber Plant

(*Hymenoxys floribunda.*)

animal dying in violent convulsions. In bad cases of poisoning the animal may die in fifteen minutes. In milder cases it may live for several hours or even days with symptoms less pronounced.

Treatment. The decomposed state of the bowels after death indicate that it is a violent, irritant poison. The remedy most available and effective to counteract this condition is melted lard, or linseed oil, morphine in three grain doses hypodermically, or laudanum in ounce doses to relieve pain are indicated. Chloral hydrate for the same purpose has been recommended, but being itself very irritating, should not be used.

LUPINES. (*Lupinus*)

Other names: Wild pea, wild bean, blue bean.

There are several species of the lupine, but they resemble one another so closely, that a person knowing one will have no difficulty in recognizing the others.

They belong to the pea family the same as the loco weeds, and the two have often been confused. The different species of lupine are found growing extensively in the central and western half of the State, by the road side, in the meadows, and on the mountain side. It is generally eaten throughout the season by all kinds of range animals and is cut extensively for hay. The poison is confined entirely to the seeds. It blooms about June 1st at an altitude of 6,000 feet. Most of the cases of poisoning observed in this State have been in sheep and from eating lupine seeds in hay. When the pods become ripe most of the seeds fall to the ground and the lupine hay may be fed with safety, and it makes a valuable forage crop. It is when the plants are cut a little green or during damp weather and the seeds are retained in the pods in large quantities that trouble occurs.

Symptoms. The symptoms are characteristic. In chronic poisining (*lupinosis*) there is a yellow appearance of the skin and mucous membranes. The urine is highly colored or bloody, depraved appetite, clammy mouth, and general appearance of unthriftiness. This chronic condition has been seen in horses of this State more than in other animals.

Sheep are very fond of the seeds, and where they are accessible, eat them in large quantities, producing the disease in the acute form. In the acute poisoning the animal rushes about in different directions in a state of frenzy. It finally falls in a fit, has violent spasms and dies, usually inside of two hours.

Treatment. In severe cases the violent symptoms come on so rapidly that it seems all but useless to try to save them. In less violent cases of poisoning melted lard, bacon grease, or linseed oil

are usually obtainable and might be given to advantage. Laudanum or morphine to counteract the nervous condition. Potassium permanganate as recommended for poisoning by larkspur promises the best results, but must be given early.

THE RUBBER PLANT. (*Hymenoxys floribunda,* (Gray) Cockerell.

During the summer and fall of 1895 severe losses among sheep were reported from Middle Park on account of this plant. It can not be considered as a truly poisonous plant for as far as we know it contains no active poisonous principle. When eaten in large quantities, however, it forms an indigestible rubbery mass, which obstructs the bowels.

POISONING BY ALKALI.

Because of lack of salt or great thirst, concentrated alkali water is often drank in large quantities, and with fatal results, especially by cattle. The symptoms are bloat, frothing at the mouth, and scours. Animals poisoned from either weeds or alkali are commonly found adjacent to water holes. This fact combined with the similarity of symptoms, makes it difficult or wellnigh impossible for the ordinary observer to determine the cause with certainty. Prevention would consist in salting the stock regularly, and being careful when they are first turned on the range to see that they do not have access to alkali water holes until they have become accustomed to the dilute form of the salts. Treatment would consist in tapping them through the left side with trocar or knife in case they become excessively bloated. Opium, oak bark, tannin, and aromatic sulphuric acid are indicated.

Synopsis of Symptoms and Treatment for Poison Weeds.

CATTLE.

Poisoned on Mountain Ranges.—Bloat, stiffness of legs, continuous swallowing, twitching of muscles, shallow breathing; in April, May, or June,—Larkspur.

Treatment.—Puncturing rumen when bloated; potassium per manganate by drench; atrophine hypodermically; stimulants of whiskey, ammonia, camphor.

Poisoned in a Field of Stunted Growth of Sorghum or Kaffir Corn.—Bellowing, staggering, breath has odor of almonds, suddden death; late in summer,—Prussic acid from eating the corn. No treatment.

Poisoned in Low Ground.—Convulsions, frothing, excessive urination, not many affected at one time; in the early spring and fall,—Wild parsnip.

Treatment.—Melted lard, linseed oil, laudanum, morphine.

Poisoned in Alkali Districts.—Bloat, diarrhoea, frothing, occurring usually in late summer or fall,—Alkali.

Treatment.—Tapping, linseed oil, opium, tannopine, aromatic sulphuric acid.

Poisoned in Open Range.—Emaciation, unsteady gait, involuntary rocking of the head, special sense disturbed, crazy when disturbed,—Loco.

Treatment.—Take them up and feed grain.

In Mountain Ranges.—Stumbling, weaving, stiffness in legs, paralysis, do not lose consciousness, usually a number affected,—Death Camas.

Treatment.—Potassium permanganate and aluminum sulfate dissolved in water.

HORSES.

In the Mountain Ranges.—Violent colic, frenzy, blindness, spasms, bloody urine; in the late summer or winter months, or from feeding lupine hay in seed,—Lupines.

Treatment.—Potassium permanganate, morphine, melted lard, linseed oil.

On the Farm.—Tardy breathing, fever, stupor, costiveness, stumbling, head pushed against wall, or hanging on manger,—Mouldy hay, fodder, potatoes, carrots, etc.

Treatment.—Salicylic acid., potassium iodide, creolin, internally; purgatives.

In Alkali Districts.—Bloating, scouring, frothing, sweating,weakness; (Alkali).

Treatment.—Tapping, laudanum, linseed oil, aromatic sulphuric acid, stimulants.

In low Pastures and Along Ditch Banks.—Great pain, frothing, frequent urination, spasms; occur in May or June, or in fall and winter when roots of hemlock have been plowed to the surface,—Water Hemlock.

Treatment.—Aloes, morphine in large doses, potassium permanganate, linseed oil.

SHEEP.

Mountain Ranges in August or Lupine Hay in Winter.—Crazy, running in every direction, convulsions, bloody urine,—Lupines.

Treatment.—Same as for cattle.

In Mountain Ranges.—Stiffness, stumbling, paralysis; do not lose consciousness; many affected; occurs in April, May, and June,—Death Camas.

Treatment.—The same as for cattle.

In Mountain Ranges.—Bloating, stiffness of front legs, convulsions, shallow breathing,—Larkspur.

Treatment.—Same as for cattle.

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