WOODY ASTER
(Xylorrhiza Parryi Gray)

Wyoming Experiment Station
LARAMIE, WYOMING.

PRELIMINARY BULLETIN, NO. 88
APRIL, 1911

BY THE VETERINARIAN AND RESEARCH CHEMIST

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EXPERIMENT STATION, Laramie, Wyo.
Wyoming Agricultural Experiment Station

UNIVERSITY OF WYOMING

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Woody Aster.

INTRODUCTION.

During the past several years thousands of sheep have died in Wyoming through what is supposed to have been the eating of poisonous plants on the range. For the last two or three seasons the losses have occurred, in many instances, in localities where previous losses had been noted, and where a certain plant that later came to be suspected as poisonous was found in enormous numbers. Several different plants have at times been suspected by stock owners, and until very recently the private opinion of those who have ranged stock was the only evidence on which one could base a conclusion as to the nature of the trouble. Under these conditions very little has as yet been done in the way of determining the plant or plants involved, the symptoms produced, etc., all of which must receive careful attention before it will be possible to deal with the question satisfactorily.

The importance of this problem to the stockmen of Wyoming can hardly be over-estimated. Some idea of the values involved may be gained by considering the estimates made by owners as to their individual losses while in the business; and on this basis these losses reach the high average of 14.6%. In terms of the last assessment valuation of sheep in Wyoming, this means an annual loss of more than $3,000,000. Sheepmen who have followed the business for the past ten years estimate that of the total losses noted, 60-70% have been caused by poisonous plants, and the remainder by coyotes.

The attention of this Station was definitely directed to this question by calls for investigation at Casper, Medicine Bow,
Wyoming Experiment Station.

and elsewhere during the seasons of 1907 and 1908. As a result of the trips to these places the Station Botanist suspected a plant commonly known as Woody Aster, which was very abundant in those areas designated by the sheepmen as "Poison Patches." It is interesting to note in this connection that sheep commonly refuse to eat this plant on the range when other forage is available, and that poisoning usually occurs either when the hungry animals are driven, after shearing, directly across the Aster patches, or where, for some reason, immediately after a rain or snow storm they purposely eat it. It is under one of these conditions that the most severe losses have occurred. In support of the last statement several observations by the field men engaged in this investigation during the season of 1910 are important. The facts cited were gathered near Medicine Bow, and are as follows:

On May 16, a slight rain and snow-fall occurred and the day following S. W. Johnson lost ten or twelve sheep in the Aster locality. No deaths had been reported in this flock for some time previous.

On June 1 it rained in the hills where a band of Mackeag Bros. sheep were pasturing and was followed by a loss of forty-five out of sixteen hundred.

June 16, following a rain storm, Mr. Wright lost quite a few young sheep (exact number not reported) after pasturing about Woody Aster.

May 28 it rained heavily during the night, and the following morning Mr. Bowles' sheep were grazed over an Aster patch with the result that one hundred and sixty were down by noon. The band was moved immediately and under treatment by Mr. Eakins of our camp only twelve of the affected died.

The investigation of this question presents several difficulties. To start with, the popular opinion seems to be that only those plants which produce death are entitled to be regarded as poisonous, in which case the behavior of many others that cause serious detriment to the health of an animal would be
overlooked, or at least not brought to the attention of the person sent by the Station to investigate the supposed poisoning. It has also been noted, in Press Bulletin No. 10, by the Botanist of this Station, that previous to the season of 1910 Woody Aster has almost invariably been infected with a fungus (*Puccinia xylorrhizae*), the poisonous character of which must next be studied. It should be stated, however, that extracts made from portions of the Aster practically free from this fungus were shown to be poisonous, from which it follows that the Aster and the fungus must be investigated separately. Finally, one must not lose sight of the fact that treatment of a case of poisoning from this source is often impossible because of the rapidity of the action of the active constituents. The poison is so active that sheepmen have estimated that more than 90% of the animals affected die.

This bulletin sums up the data so far collected in connection with the work on Woody Aster. Besides a statement of the losses that have been noted and attributed to the poisonous action of the plant or its fungus, this publication includes such a description of the plant and its surroundings, by the Botanist, that it is expected to serve as a definite warning to herders to avoid the Aster patches. Meanwhile, the investigation is being continued with a view to isolating and studying the active constituents of the plant, and determining the specific characteristics of the fungus.

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**PLANT DESCRIPTION AND COMMENTS BY PROF. AVEN NELSON.**

**The Woody Aster.**

(*Xylorrhiza Parryi* Gray.)

"Suspicion was first directed to the Woody Aster in the summer of 1909 by the writer in Press Bulletin No. 10 from this station, sent out under the title "A PLANT UNDER SUSPICION—Avoid the Aster Patches." This bulletin gave very briefly a small part of the circumstantial evidence which
had been accumulating from repeated observation upon the plant in those localities in which sheep losses were annually occurring.

"The plant in question, which may be called the 'Woody Aster,' does not occur throughout the State as a whole, but is confined to certain districts characterized by a gumbo clay
soil, more or less intermixed with gravel and containing more or less of alkali and other salts. It is a soil in which only the various kinds of alkali-loving plants, such as pig weeds, salt-bushes, grease-woods, and this Aster thrive. A fact of interest in this connection is that this particular plant is not only confined to this type of soil, but Wyoming is the center of its distribution. Perhaps more singular yet is the fact that the Aster is almost invariably, more or less infected with a fungus (*Puccinia xylorrhizae*). If it should prove to be true that the malady is due to the eating of the Aster then it may be the Aster, itself, that is the source of the trouble, but the chances are rather better that the specific poisonous qualities are due to the fungus.

**DESCRIPTION OF THE PLANT.**

“Somewhat hoary with a thin, loose, villous tomentum; stems several from the woody crowns, 1-2 dm. high; leaves spatulate-linear, cuspidate, 3-5 cm. long; peduncles solitary; involucral bracts oblong-lanceolate, long-acuminate, cinerous-pubescent; rays numerous, white, 10-14 mm. long; achenes white-villous.

“To those who are familiar with the range I think it will be possible to describe the plant so that it can be recognized. It need only be looked for upon gumbo clays, usually on gentle slopes or sometimes on ridges. Often these conditions are met with in the neighborhood of temporary ponds or lakes where the sheep are watered. The plant has a strong woody root, more or less branched just at the surface of the ground. From these woody crowns, tufts of short branches spring. These bear green, narrow leaves, one or two inches long, the whole tuft becoming at length several inches high and finally producing in June, a considerable number of large white daisy-like flowers with a yellow center. If the leaves be examined it will be found that they usually bear a considerable number of yellowish or brownish spots, caused by the fungus previously mentioned.
Wyoming Experiment Station.

View of open range around the Station camp, showing the profuse and general growth of the Aster.
Woody Aster.

“Rather careful examination of the plants in the districts where the sheep losses have occurred has failed to reveal any other plant that may reasonably be suspected unless perchance it might be one of the Vetches (Astragalus Grayi). This Legume, strangely enough, is also largely confined to soil of the same character as that on which the Aster grows, and these two plants often grow somewhat intermingled. Like the Aster, again, this particular species of Vetch scarcely occurs at all outside of the saline gumbo-clays of Wyoming. The other vegetation in these particular localities, as already mentioned, belongs in the Pigweed family (Chenopodiaceae), the chief representatives being the various kinds of Salt-bushes. There is, of course, no reason for suspecting any member of this family and some of the species are accounted, as is well known, most valuable forage plants.”

The time when the foliage first appears will vary with each year. The Medicine Bow camp was established May 1 (1910) and the plant had already leaved out. Again, the time of blossoming is a matter of weather conditions. Last season being an unusually dry one, more so than has been experienced during at least the twenty years preceding, the Aster dried up before blossoming to any great extent. Of those that flowered the first were noted May 27. These features may, as stated, have to do with the decreased losses of 1910, since poisonous plants vary in activity according to their stage of growth. Beginning June 10 the plant was observed to be drying up and becoming a yellowish brown in color. Shortly after this the sheep began eating the Aster freely, showing that when withered it becomes not only more palatable, but inactive.

So far as it is known, sheep are the only species susceptible to poisoning by the Woody Aster, and of these the greatest losses are reported in old pregnant ewes in early spring and in lambs late in summer. This is readily understood. Toxicologists have long known that a poisonous drug
varies in its action according to age and sex, and that young animals are not more susceptible because of their lesser body weight, but for the same reason that females are more responsive to the drug; that they possess a greater or more sensitive nerve organization. Also, in the spring we experience more wet weather and the plants are resultingingly more active as well as more inviting in appearance. Overcrowding of the range at this time urges the consumption particularly of the greener, more advanced vegetation over the less matured grasses.

At Medicine Bow the greatest losses naturally occur after shearing, when the fasted sheep are of necessity driven across patches of the Aster plant. The sheep, having little time to choose their food and urged by hunger, grasp the plants most attainable, i.e., the Aster, since its ranker growth allows it to outstrip and stand above the natural grasses. It is at this time, also, the flowering period of the plant or just previous to it, that the leaves of poisonous plants are considered to be the most active. There can be no doubt but that wet weather favors poisoning by the Aster, just as its toxicity is affected by various stages of its growth, but at present we can only theorize as to the reason.

PUCCINIA.

That fungi of various kinds are known to be poisonous furnished one reason for suspicion towards the Woody Aster, which has been almost invariably infected, and markedly so, by the Puccinia xylorrhizae. The past season furnished an exception, the plants appearing virtually fungus-free. This scarcity of the Puccinia in 1910 may be further reason for the decrease in losses last year, but since at least one of the three extracts tried out, which were prepared from these fungus-free plants, was very potent it is evident that this parasitic growth cannot be entirely responsible.

The occurrence of the fungus on the Aster is a factor of importance in this problem. Even though it might not pos-
Puccinia xylorrhizae.
Normally Parasitic Upon Aster.
s ess poisonous activity of its own, it is conceivable that the Aster may be sufficiently nitrogenous so that the numerous fungi may occasion a chemical change in the material similar to ptomain production by bacteria in the decomposition of foods of animal origin.

**OUTLINE OF EXPERIMENT METHODS.**

In carrying out the work of determining the character of the Woody Aster, it was decided to so outline the investigation that it would approximate as nearly as possible range conditions. Medicine Bow was selected as the most feasible point, since it was nearest to the Station of any locality where heavy losses had occurred and where the plant grew in abundance.

In the feeding experiments range sheep of the usual mixed breeding and of different sex, class and age were used. In each lot we maintained one old ewe with lamb, one young ewe, one old wether, and one young wether.

Movable feeding pens were erected on the Aster patch and on each transfer to a new position all vegetation other than the Aster was carefully cleaned out.

As the Aster gives off a pronounced and extremely disagreeable odor as well as possessing, while in a growing stage, a bitter taste, the sheep exhibited aversion towards eating it except under the spur of hunger. For this reason they were kept in the feeding pen as long as their condition would permit without their becoming weakened to the point of increased susceptibility. When necessary animals were removed from these poison squads and placed in a reserve pen while substitutes from the reserve lot replaced them in the feeding pen.

Twenty-four to thirty-six hours before being placed in the poison squads the animals were purged with castor oil and fasted in order to eliminate all material present from the alimentary tract.
The reserve pen was located upon Aster-free ground and the sheep fed upon native hay. Field notes were taken of the weather changes, of the growth of the Aster, twice daily of the temperatures and condition of the poison squads, as well as of any losses experienced by surrounding sheep men.

As often as feasible autopsies were made of the losses in nearby bands for the purpose of identifying when possible any plants present in the ingesta of a suspicious character. This feature was especially looked to in cases seemingly due to poisoning. Too often, however, the contents of the rumen were in a state of such complete digestion as to render recognition of any plant difficult, if not impossible. In various instances, nevertheless, salt-sage, Woody Aster, and grasses were observed.

These autopsies likewise held interest in the support or elimination they afforded of the various theories advanced as to the cause of sheep losses.

Among the parasites detected was of course, the common sheep tick (*Melophagus Ovinus*), the *Oestrus Ovis* larva (grub), in several cases, all old sheep; and the *Taenia Fimbriata* (the most common species of tape worm of sheep) in the gall bladder of one sheep.

The list of diseases observed follows:

Caseous lymphadenitis (pseudo-tuberculosis in sheep).
One case of pustular dermatitis (inflammation of skin); localized anterior to mammae:
Cholelithiasis (biliary calculi) in one instance.
Agalactia (absence of milk secretion) in one of the experiment sheep.
Myiasis (parasitic disease) of frontal sinuses.
Catarrhal vaginitis (inflammation of vagina) with purulent metritis (inflammation of womb) in one other.

The majority of deaths were probably due to consumption of the Woody Aster, as the lesions found in post mortem were usually similar in character in every respect to those
presented by sheep poisoned by the plant or extract of the plant in the experiment pens.

**FEEDING PEN LOSSES.**

Although purged, and fasted for a day, before placing in the feeding pens, the sheep persistently refrained from eating the growing plant other than in a few instances. After nibbling of it slightly they would exhibit considerable lassitude and dejection and thereafter avoid it entirely.

A young ewe, taken from the reserve and penned May 22, ate of the Aster somewhat on the 23rd and again on the 24th and on the morning of the 25th was found dead.

An old wether, placed in the feeding pen May 31, after the usual preparation, avoided eating the plant for a time, but finally ate of it freely, dying June 2.

In an attempt to counteract this refusal of the animals to eat the growing plant and at the same time determine the value of the plant for the chemists' work when cut and dried during the growing state, we tried feeding the Aster which had been so prepared.

A young ewe and an old wether, both freshly penned June 11, were given small amounts of the dried plant on the 15th. They were allowed to eat as freely of it as they wished on the 16th and 17th, and they did seem to relish it more than had been the case with the growing plant. On the 17th the young ewe died, while the old wether was in a dying condition that evening, which terminated during the night.

The rapid withering of the Aster at this time checked further feeding tests, and the season's field work was concluded with a trial of the three extracts which had been prepared.
Woody Aster.

View of one of the feeding pens on the Medicine Box Aster patch.
PREPARATION OF EXTRACTS USED.

The extracts used in the tests described in this bulletin were prepared as follows:

No. 1.
Woody Aster tops* (everything above ground) .......... 10 oz.
Glycerin ............................................... 10 oz.
Sulphuric acid, sp. gr. 1.84 ........................ 0.6 oz.
Water, enough to make .............................. 4 lbs.

One ounce of extract No. 1 equivalent to 0.15-0z. of plant.

The acid was mixed with the water, and in the resulting liquid the chopped tops were macerated for twenty-four hours. The mixture was then strained through muslin, the remaining liquid pressed out of the residue, and the total liquid then neutralized with sodium bicarbonate. The resulting solution was filtered, and the glycerin added to the filtrate.

No. 2. Woody Aster tops ...................... 25 oz.
Glycerin ............................................... 10 oz.
Sulphuric Acid (1.84) ........................... 1.5 oz.
Water, enough to make .............................. 4 lbs.

One ounce of extract No. 2 equivalent to 0.75— oz. of plant.

This was prepared in exactly the same way as No. 1, with the exception that the acid extract was evaporated to one-half its original volume before being neutralized. The finished product was therefore about twice as concentrated as the formula would indicate.

No. 3 (b).
Woody Aster tops ...................... 8 oz.
Alcohol, 50% .............................. 50 fld. oz.

One ounce of extract No. 3 (b) equivalent to 0.8 oz. of plant.

This was allowed to stand for several days at room temperature, and was then filtered through paper. The filtrate

*This material had been collected but a day or two and was practically green.
was next evaporated under reduced pressure to a volume of eight fluid ounces, and to this two fluid ounces of alcohol was added.

**EXTRACT NO. 1.**

**Old Ewe No. 1—Squad 2.**

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<th>Date</th>
<th>Time</th>
<th>Temperature</th>
<th>Pulse</th>
<th>Respiration</th>
<th>Method of Administration and Amounts</th>
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<td>June 17, 1910</td>
<td>9 a.m.</td>
<td>102.0</td>
<td></td>
<td></td>
<td>Per Or. 6 oz.</td>
</tr>
<tr>
<td></td>
<td>11 a.m.</td>
<td>102.3</td>
<td>40</td>
<td>16</td>
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<td></td>
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<td>5 p.m.</td>
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<td>20</td>
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<tr>
<td>June 18, 1910</td>
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<td>19</td>
<td>6 oz.</td>
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**Young Wether—No. 2. Squad 2.**

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<td>62</td>
<td>20</td>
<td>Per Or. 6 oz.</td>
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<td>June 18, 1910</td>
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<td>6 oz.</td>
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<td>56</td>
<td>42</td>
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**EXTRACT NO. 2.**

**Young Ewe—No. 1. Squad 2.**

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<td>25</td>
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<tr>
<td></td>
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<td>56</td>
<td>25</td>
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<td>101.8</td>
<td>59</td>
<td>24</td>
<td>6 oz.</td>
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<td>64</td>
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<td>103.4</td>
<td>68</td>
<td>152</td>
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<td></td>
<td>1 p.m.</td>
<td>103.5</td>
<td>79</td>
<td>160</td>
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<td>3 p.m.</td>
<td>103.0</td>
<td>70</td>
<td>115</td>
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</table>
Wyoming Experiment Station.

**EXTRACT NO. 3 B.**

*Young Ewe Fresh from Reserve.*

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<th>Pulse</th>
<th>Respiration</th>
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<td>June 22, 1910</td>
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<td>78</td>
<td>45</td>
<td>Per Orem. 16 oz.</td>
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<td>10 a.m.</td>
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<td>152-160</td>
<td>33-50</td>
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<td></td>
<td>12 m.</td>
<td>101.8</td>
<td>144</td>
<td>160-180</td>
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<tr>
<td></td>
<td>2 p.m.</td>
<td>Dead</td>
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</tbody>
</table>

Following administration of the extract the ewe exhibited great depression, defecated frequently, internal pain, shallow breathing, harsh respiratory murmur, tympany, injected conjunctiva, and rapid wiry pulse. Skin corneal reflexes, and pupil remained normal.

**Lamb No. 1. Squad 2.**

<table>
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<th>Temperature</th>
<th>Pulse</th>
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<td>80</td>
<td>67</td>
<td>Per Orem. 6 oz.</td>
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<td>10 a.m.</td>
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<td>285</td>
<td>210-270</td>
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<tr>
<td></td>
<td>Nystagmus</td>
<td></td>
<td></td>
<td>facial muscles</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12 m.</td>
<td>tetric convulsions of facial muscles</td>
<td></td>
<td>288</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 p.m.</td>
<td>Dying, respiration too fast to count</td>
<td></td>
<td>8 oz.</td>
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<tr>
<td></td>
<td>3 p.m.</td>
<td>Dead</td>
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</table>

**CONCLUSIONS REGARDING EXTRACTS.**

A sufficient amount of the three extracts had not been prepared to permit of a second trial of Extracts Nos. 1 and 2, but in considering the small amount of plant equivalent to an ounce of the extract it seems probable that they are active and that the lack of definite results, in their use, was due to too small doses administered. It may be, however, that these water extracts are not potent. These are some of the features to be determined during the coming season.

**SYMPTOMS OF ASTER POISONING.**

Weakness of locomotory muscles with prostration; later weakness extends to the muscles of the neck. Temperature about 103 to 104.5. Pulse very rapid and weak, 92 to over 300. Respirations dyspneic (labored) with mucous rales.

Tympany (bloat) is generally pronounced. Abdominal pain, evidenced by groaning.
Woody Aster.

Diuresis (increased secretion of urine). Froth, often sanguinous (bloody), from the air passages.

The mucous membranes vary from anaemic (bloodless) to cyanotic (bluish).

The stools are soft, with mucous, to very soft.

Pupils are sometimes noticeably dilated.

Cerebral symptoms present in a few instances.

Before death complete prostration and apparent unconsciousness.

Course.—Varies from a few hours to three or four days, according to the amount of plant ingested and the condition of the plant.

Treatment.—Co-operation with most of the sheepmen in the vicinity gave H. S. Eakins, field man in charge of the camp, considerable opportunity for trying out experimental treatments.

Tapping was not productive of very good results; some relief, however, being afforded by escape of some of the gas.

Stimulants and carminatives or anti-ferments were chiefly indicated.

AUTOPSIES.

Rumen: Fermentation producing a frothy mass with a small amount of flatus.

Omasum: Slight inflammation with some desquamation (shedding) of epithelium of mucous folds or leaves.

Intestines: Slight enteritis (inflammation of intestine).

Colitis (inflammation of colon) and proctitis (inflammation of rectum) sometimes present.

Liver: Passive congestion. Cloudy swelling with focal necrosis (death).

Spleen: Congested.

Pancreas: Slight congestion.

Lymph Glands: Congested.

Kidneys: Acute nephritis—albuminoid degeneration.

Bladder: Generally full, with some cystitis (inflammation).
Lungs: Badly congested (passive), with edema (dropsical swelling) and itis (inflammation). Pleuritic (from pleura) effusion (pouring out of fluid).

Trachea and air passages: Injected.

Heart: Hydro-pericardium (fluid in heart sac); petechia (blood spots) of myocardium (heart muscle) with myocarditis (inflammation of).

Brain: Occasionally slight cerebritis; veins injected.

Peritoneum: Itis; effusion.

Tissues were preserved from all post-mortems; sectioned and studied for the determination of the pathological changes resulting from Aster poisoning. The definite facts obtained from their study will be incorporated in the results obtained from a continuance of the work.

SUMMARY.

1. The Woody Aster has been proven to be poisonous to sheep.

2. The Woody Aster grows only on alkalied gumbo-clay soils, and but for the one recorded season, is always heavily infested with the fungus, Puccinia xylorrhizac. The presence of the fungus may add to the poisonous character of the plant.

3. Ninety to one hundred per cent of the animals affected die.

4. Aster poisoning is characterized by lassitude, difficult respiration, muscular weakness, bloat, and final prostration.

5. Duration of illness, from a few hours to several days.

6. Anatomical Diagnosis. Gastro-enteritis due to fermentation of ingesta acting as an irritant. General passive congestion due to weak and impeded heart action; and, in part perhaps, by reason of diaphragmatic pressure on lungs produced by tympany. Albuminoid degeneration of liver and kidney due to precipitation of proteids by toxin or toxins.

7. Treatment. Purely symptomatic and none uniformly successful. Administration of stimulants in small doses as tr. opii., alcohol, and ether; carminatives, gentian, nux vomica, and ginger; anti-ferments, eucamphol.