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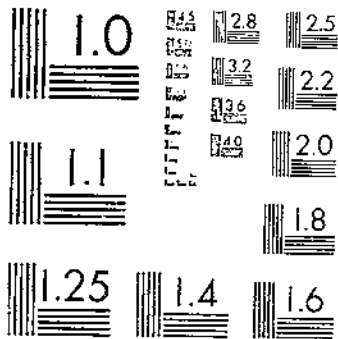
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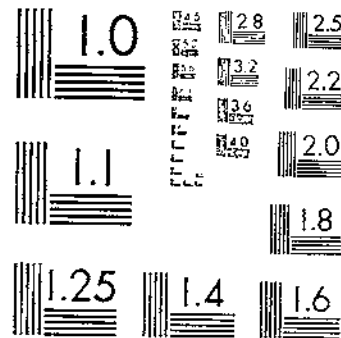
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UNITED STATES DEPARTMENT OF AGRICULTURE  
WASHINGTON, D. C.

ALPINE KALMIA (*KALMIA MICROPHYLLA*) AS  
A STOCK-POISONING PLANT

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OCT 11 1933

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PURPOSE OF INVESTIGATIONS

In the United States alpine kalmia (*Kalmia microphylla*) grows in restricted areas of the livestock ranges, where it has been suspected of having poisoned sheep and cattle. In order to determine its toxicity for these species of animals, as well as to compare the effects produced by it with those caused by other species of kalmia in previous investigations, feeding experiments were undertaken by the Salina (Utah) Experiment Station of the Bureau of Animal Industry.

REVIEW OF LITERATURE

The alpine kalmia (*Kalmia microphylla* (Hook.) Heller) and the bog kalmia (*K. polifolia* Wang.) are so closely related that botanists do not agree as to their being distinct species. Rydberg (13)<sup>1</sup> and Tidestrom (15) consider them distinct, but Jepson (11) classes *K. microphylla* as a varietal form of *K. polifolia*. A comparison of descriptions and of the plants themselves makes it appear probable that no distinct line of demarcation exists between the two but that the alpine kalmia is simply the high-altitude form of the bog kalmia.

Various common names have been applied, more or less indiscriminately, to these plants. Among them are: Dwarf kalmia, alpine bog kalmia, American laurel, swamp laurel, alpine laurel, pale laurel, pale American laurel, and calico bush.

<sup>1</sup> Italic numbers in parentheses refer to "Literature Cited," p. 9.

In a number of articles the bog kalmia and the alpine kalmia have been mentioned as being poisonous to livestock. In some instances it is obvious that the alpine plant has been referred to as *Kalmia polifolia*.

Davy (3) in 1902 suspected that *Kalmia polifolia* "may possibly prove poisonous to sheep as some of the eastern species of the genus are considered among the most dangerous of cattle poisons."

In 1911 Jepson (10, p. 312), in referring to *Kalmia polifolia*, says: "Alpine in the Sierra Nevada (*K. glauca* Ait.). Leaves probably poisonous to cattle." Although he does not mention the name *microphylla*, the description and range assigned make it evident that he had the alpine kalmia in mind.

In 1915 Hall and Yates (9) referred to *Kalmia polifolia* in California and stated: "It is one of our most poisonous plants, but fortunately grows in districts where there is but little stock raising."

The same plant (*Kalmia polifolia*) is included by Glover and Robbins (8) among the poisonous plants growing in Colorado. They say:

The plant grows in mountain bogs, seldom below 10,000 feet elevation \* \* \* Colorado stockmen generally know very little of swamp laurel as a poisonous plant. This is probably accounted for from the fact that it grows only on the very high ranges, where relatively few animals graze. It is much dreaded in some section, however.

It is of interest that Durrell and Glover (5) in a more recently published list of the poisonous plants of Colorado do not mention either the bog kalmia or the alpine form. Although *K. microphylla* apparently occurs in Colorado at elevations between 10,000 and 11,000 feet, Rydberg (13) does not mention *K. polifolia* as growing in this State.

In 1918 Baird (2, p. 67) says of *Kalmia polifolia* variety *microphylla*: "Pale American laurel. In swampy ground. A shrub about 6 inches high, poisonous to cattle. Corolla lavender, very attractive. In bloom on the north side of Squaw Meadow early in July."

In 1919 Fleming (6) fed *Kalmia microphylla* to 26 sheep and 10 calves and poisoned both classes of animals. From his experimental work he concluded: "From this it would seem that the plant varies in toxicity in different environments, and that there is a considerable seasonal change in the poison present."

In 1920 Fyles (7, p. 79) in Canada, concludes that because *Kalmia latifolia* and *K. angustifolia* are poisonous "no doubt, other species of kalmia, including the swamp or pale laurel (*Kalmia polifolia* Wang.), are equally injurious."

In 1922, Sifton (14, p. 89), also writing of Canadian plants, lists *Kalmia polifolia* as a poisonous plant and says it "grows across the continent except on the prairies. It is found on mountains and in cold bogs."

In 1925 Anderson (1, p. 147), another writer on Canadian plants, says of *Kalmia polifolia*: "The leaves are poisonous to animals."

In 1931 Dayton (4, p. 128) says of *Kalmia microphylla*: "Normally, livestock do not touch this species but instances are reported of sickness or even loss, especially among lambs admitted to high range too early in the spring."

## DESCRIPTION AND DISTRIBUTION OF THE PLANT

*Kalmia microphylla* (*K. polifolia microphylla*) is a low, branching shrub or bush, from 1 to 12 inches high, growing from an underground stem and belonging to the heath family, the Ericaceae. The leaves, which have short petioles, are nearly oval in outline, although, because of a tendency to roll along the edges, they often appear very



FIGURE 1.—General appearance of alpine kalmia (*Kalmia microphylla*). a, Seed pod or capsule.

narrow. They are from one fourth inch to nearly an inch in length, and are dark, shiny green above and whitish underneath. The flowers vary in color from pink to rose-purple. The general appearance of the plant is shown in figure 1. It is found growing in sphagnum swamps and in the western part of the United States at the higher altitudes usually between 10,000 and 12,000 feet, and ranges from central California north to Alaska and eastward to Colorado.

## EXPERIMENTAL PROCEDURE

Through cooperation with the Bureau of Plant Industry and the Forest Service of the United States Department of Agriculture, four lots of *Kalmia microphylla* were received at the Salina Experiment Station, located on the Fishlake National Forest, near Salina, Utah. Of these four lots, three were collected in Squaw Valley on the Tahoe National Forest in California. This is the "Squaw Meadow" area referred to by Baird (?). One lot was collected about August 1, 1927, one about September 1, 1929, and one in the early part of May 1931. In the summer of 1932, a fourth lot was collected on the Cascade National Forest in Oregon at a time when the plants were in bloom. The four collections, to a limited extent, have made it possible to compare the poisonous qualities of the alpine kalmia at different stages of growth and from two widely separated localities.

All the plant material used was dried before being shipped. In order to estimate, in terms of green plant, the doses fed to the different animals, an allowance was made for the loss in weight by the plants in drying. For this purpose 75 percent, approximately the normal moisture content of the green plants, was used. All dosages were then computed on a green-plant basis and as percentages of the animals' weights. The feedings were made by means of a veterinarian's balling gun. It required from 5 minutes to 1 hour to make them, depending largely on the quantity fed. Leaves alone were used, except that in several instances a few stem tips bearing buds and flowers were included. In these the proportion of stem tips was so small that for the purpose of comparison it was assumed that leaves alone were used. Owing to the physical difficulties of obtaining this plant from the high elevations where it grow, the limited available supply was fed chiefly to sheep and goats because of their smaller feed requirements. One steer was used. The feeding experiments are summarized in table 1.

TABLE 1.—Summary of experiments with the leaves of *Kalmia microphylla* fed to three species of livestock

Animal	Weight	Date of feeding	Dose as percent of animal's weight <sup>1</sup>	Approximate date plant was collected	Result
Cattle:	Pounds				
1112.....	765	Sept. 14, 1927.....	0.30	Aug. 1, 1927.....	Not sick.
Goat:					
2.....	92	Sept. 13, 1927.....	.30	do.....	Do.
17.....	68	Sept. 1, 1930.....	.40	Sept. 1, 1929.....	Do.
16.....	67	Sept. 13, 1930.....	.50	do.....	Symptoms.
Sheep:					
1005.....	96	Aug. 24, 1927.....	.40	Aug. 1, 1927.....	Do.
1009.....	79	Aug. 26, 1927.....	.30	do.....	Do.
1012.....	67	Aug. 29, 1927.....	.20	do.....	Not sick.
1013.....	67	Aug. 30, 1927.....	.50	do.....	Sick.
1027.....	82	Sept. 9, 1927.....	.60	do.....	Do.
1026.....	110	do.....	.25	do.....	Not sick.
1154.....	94	Sept. 1, 1930.....	.70	Sept. 1, 1929.....	Symptoms.
1100.....	84	Sept. 13, 1930.....	.40	do.....	Do.
1207.....	74	June 13, 1931.....	.30	May 1931.....	Not sick.
1200.....	129	June 16, 1931.....	.50	do.....	Sick.
1211.....	105	June 18, 1931.....	.70	do.....	Do.
1206.....	75	June 20, 1931.....	.82	do.....	Do.
1213.....	93	June 25, 1931.....	1.22	do.....	Do.
1216.....	88	July 1, 1931.....	1.50	do.....	Do.
1225.....	87	July 21, 1931.....	1.75	do.....	Do.
1162.....	118	Sept. 2, 1931.....	2	do.....	Very sick.
1240.....	107	Sept. 14, 1932.....	.50	summer 1932.....	Symptoms.
1225.....	114	Sept. 16, 1932.....	.75	do.....	Sick.
1238.....	92	Sept. 20, 1932.....	1	do.....	Do.

<sup>1</sup> Estimated as green plant.

## RESULTS OF EXPERIMENTAL FEEDING

## TYPICAL CASE OF SHEEP 1162

Between 9:30 and 10:30 a.m. on September 2, 1931, sheep 1162, a 2-year-old ewe, weighing 118 pounds, was fed with the balling gun 268 grams (9.45 ounces) of dry leaves of *Kalmia microphylla*. The plant material was collected by Leland S. Smith in the Truckee district on the Tahoe National Forest, in California, in May 1931 at a time when the plants were in bud and flower. Since an allowance of 75 percent was made for the loss in weight by the plant in drying, the quantity fed was considered as equivalent to 2 percent of the animal's weight, in terms of green leaves.

At 1:20 p.m., or 2 hours 50 minutes after the completion of the feeding, the sheep was salivating slightly, and frequent, uncontrolled swallowing movements of the throat and neck were noticed, showing that the animal was nauseated. A drooping of the ears indicated a mild depression. The symptoms of sickness gradually became more pronounced, and at 4:30 p.m. the respiration was 120 and deep and quick.

At 7 p.m. it was observed that there was a considerable quantity of green saliva around the animal's mouth and that she had recently vomited a little. The depression at that time was more pronounced than at 4:30 p.m. At 9 p.m. the vomiting, salivation, and depression were even more pronounced than at 7 p.m. The following morning, September 3, the animal was somewhat worse, and at 9:06 a.m. not only was she still salivating but a leg weakness had developed, causing her to stagger when she tried to walk. The respiration was fast, shallow, and irregular.

The weakness and nausea both continued to increase, and at 10:40 a.m. there were pronounced contractions of the abdominal muscles, accompanied with marked regurgitations. The sheep, however, actually vomited very little but managed to reswallow most of the regurgitated material. She grated her teeth and was much depressed, although able to stand. While out in the watering corral at 2:30 p.m. she spent most of her time lying down, although she was able to get to her feet. After exerting herself a little in attempting to run away from the observer, she fell and was unable to rise. A little dribbling of urine was noticed at the time. The animal remained lying down and unable to get up until at least 9 p.m. She was not observed during the greater part of the night. Throughout the afternoon the respiration had been fast, irregular, and somewhat labored.

Although the sheep was still weak on the morning of September 4, she had gained some strength and at 10:30 a.m. was able to get to her feet. However, she was still salivating and somewhat nauseated, and staggered when attempting to walk. She improved materially in strength during the day and ate some hay. The salivation continued and was still apparent on September 5, when she was grating her teeth more or less during the day. The last time this was noticed was at 4:30 p.m. on September 5.

On the morning of September 6, the animal appeared to have recovered completely. She was strong, there was no evidence of salivation, and she had eaten fairly well during the night. In this case the illness continued from 1:20 p.m., September 2, to about 4:30 p.m., September 5, or for more than 3 days.



## SYMPTOMS

The symptoms produced in sheep by *Kalmia microphylla* were the same as those which were observed in animals poisoned by *K. latifolia*, *K. angustifolia* (12), and related plants. In the mildest cases loss of appetite, salivation, depression, and some vomiting were observed. With more severe poisoning there was grating of the teeth and vomiting. In some instances the vomiting became so pronounced that large quantities of material were gotten rid of by the sheep. In other cases the vomiting was less pronounced, and weakness was the prominent effect noted. In some cases there was a mild weakness which caused the animals to stagger in walking. The very sick animal, no. 1162, was so weak as to be unable to stand for a time. No effect on the pulse or body temperature was noticed in most cases. A rise in temperature followed the feeding of two of the sheep. One of these, no. 1213, developed pneumonia, probably as a result of the feeding. This condition naturally was accompanied by a distinct rise in temperature and an increase in the pulse rate. A similar pneumonic condition has been observed in a number of sheep poisoned by other closely related plants. With two other sheep which otherwise showed no marked symptoms of illness there was an increase in the pulse rate. When the animals were so severely poisoned as to be classed as sick or very sick, the respiration was more or less interfered with, an effect that would naturally be accentuated by the vomiting. In some instances however, the respiratory effects did not appear to be associated with the vomiting. Sometimes the respiration was forced; at other times it was irregular, jerky, or shallow.

The symptoms observed in the one goat that was poisoned corresponded closely with those seen in the sheep.

## APPEARANCE OF SYMPTOMS AND DURATION OF ILLNESS

The periods between the feeding of *Kalmia microphylla* and the time symptoms were noticed, the duration of illness, together with the doses fed the different animals, are shown in table 2.

TABLE 2.—Time from feeding *Kalmia microphylla* to observed development of symptoms and duration of illness

Kind of animal and designation	Dose as percentage of animal's weight <sup>1</sup>	Time from end of feeding to observed appearance of symptoms		Duration of illness		
		Hrs.	Mins.	Days	Hrs.	Mins.
Goat 16.....	0.5	21	40			
Sheep:						
1000.....	.3	9	24	1	9	43
1005.....	.4	11	39		9	25
1190.....	.4	20	30		1	65
1013.....	.5	10	12	1	10	16
1200.....	.5	4	45		3	25
1240.....	.5	24	58	1	8	35
1027.....	.6	9	26	1	2	10
1164.....	.7	6	45		23	50
1211.....	.7	7	10		14	50
1225.....	.75	11	32	1	9	58
1206.....	.8	8	10	1	0	25
1238.....	1	2	55	2	7	6
1213.....	1.22	6		2	1	10
1216.....	1.6	8	35	1	9	57
1225.....	1.75	2	50	2	5	5
1162.....	2	2	50	3	3	0
Average for sheep.....		9	18	1	7	33

<sup>1</sup> Estimated as green plant.

Goat 16, which had been given a 0.5 percent dose, was found to be ill 21 hours 40 minutes after she was fed. Up to 20 hours no evidence of illness had been apparent. During the interval she was not observed.

For the 16 sheep that were poisoned the average time between feeding and the observed appearance of symptoms was approximately 9 hours. However, inasmuch as some of the sheep were found to be affected when they were first seen in the morning following the day they were fed, the interval was somewhat less than that given, as the animals were not observed during the night. The two longest periods were for sheep that were fed early in the forenoon, had not become sick up to the last time they were seen in the evening of the day of the feeding, but were found to be ill when first seen the following morning. One sheep fed at 7 a.m. had shown no evidence of illness at 9 p.m. the same day but was sick at 8 a.m. the next day.

For 8 sheep fed early in the day and found to be showing evidences of illness the same day the average time was 5 hours 10 minutes from feeding to the manifestation of illness. These sheep included all but one of those fed the heaviest doses. The shortest period, 2 hours 50 minutes, occurred with the two sheep given the largest feedings. There was a tendency for the period between feeding and illness to decrease as heavier doses were given. The longest periods followed 0.4 percent and 0.5 percent doses. Although symptoms of poisoning may develop within 3 hours after the *Kalmia macrophylla* has been eaten, they may not become apparent for 14 or more hours.

Goat 16 was sick for approximately 8½ hours after a 0.5 percent dose.

One sheep fed by Fleming (6) was "very sick, lying for 5 days in a stupor." At the Salina Experiment Station the average period of illness for the sheep was 7½ hours. The shortest time was approximately 2 hours, the animal having been given a 0.4 percent feeding. The longest period of sickness was 3 days, and occurred with the animal fed the largest dose. There was a tendency for the duration of illness to be longer as heavier feedings were given.

When the degree of sickness of the animals is taken into account, its duration corresponds fairly well with the results obtained for sheep which were fed *Kalmia latifolia* and *K. angustifolia* (12).

#### TOXIC AND LETHAL DOSES

Fleming (6) reported the poisoning of calves on as little as 9 ounces of *Kalmia macrophylla*. Other calves were poisoned on various quantities of the plant up to 2.5 pounds. All these animals recovered. He poisoned sheep on 1 ounce. Other sheep were given feedings varying from 2 to 10 ounces. Some were not poisoned, others became very ill. One sheep died after eating 8 ounces of the kalmia.

At the Salina station only one steer was fed the plant. He received 9 ounces, or a 0.3 percent dose, without effect.

Of three goats fed, one given a 0.5 percent dose was somewhat affected. As doses of 0.3 and 0.4 percent, respectively, were given to two other goats without effect, 0.5 percent would appear to be the minimum toxic dose for these animals.

Nineteen sheep were given doses of the plant. The smallest dose that affected an animal was 0.3 percent. This produced symptoms of poisoning in sheep 1009. The same dose, however, was given to

sheep 1207 without effect; therefore, 0.3 percent may be taken as a minimum toxic dose for sheep. Other doses of various sizes up to 2 percent were given to different sheep. Since none of the animals fed the plant were killed by it, the lethal dose was not determined; however, the 2 percent fed to sheep 1162 caused a very severe illness and it was thought to be almost a fatal quantity for that animal. The results of the feedings indicate that the plant was about as toxic as *K. latifolia* and considerably less toxic than *K. angustifolia* (12).

Although the data thus far obtained by the writer and other investigators are insufficient for the formation of other than general impressions it appears that sheep are slightly more susceptible to poisoning by this plant than either goats or cattle.

#### POISONOUS QUALITIES OF PLANT AS RELATED TO STAGE OF GROWTH AND REGION

The results of his experimental work led Fleming (6) to conclude that there might be differences in the poisonous qualities associated with the age of the plants and with the region in which they grew. In the experimental evidence here presented such variations were not apparent. Plants collected in the same area on the Tahoe National Forest at different seasons and plants collected on the Cascade National Forest were all of about the same degree of toxicity. The symptoms in the goat and all of the sheep that were poisoned were very similar.

#### SUMMARY

Alpine kalmia (*Kalmia microphylla*), a species closely related to bog kalmia (*K. polifolia*), has been suspected of poisoning cattle and sheep in the higher mountain ranges of the western part of the United States and in Canada.

The experiments' evidence obtained at the Salina Experiment Station, near Salina, Utah, shows that sheep may be affected by as little as 0.3 percent of their own weight of the green leaves, and that they may consume as much as 2 percent without being fatally poisoned.

Symptoms, which are principally weakness and nausea, accompanied with salivation and vomiting, may develop within less than 3 hours after a toxic dose has been eaten, or they may not be apparent for 14 hours or more. Poisoned animals may remain ill for more than 2 days and still recover.

Alpine kalmia is sufficiently poisonous to be a source of danger to sheep, goats, and cattle, sheep being the most susceptible. Experimental data strongly indicate that it is approximately equally poisonous at all stages of growth and in different localities.

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