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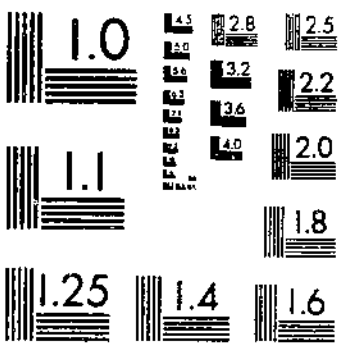

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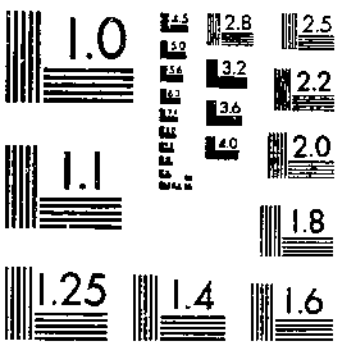

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TECHNICAL BULLETIN No. 113 JUNE, 1929

UNITED STATES DEPARTMENT OF AGRICULTURE
WASHINGTON, D. C.

ARROW GRASS (TRIGLOCHIN MARITIMA) AS A STOCK-POISONING PLANT

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REVIEW OF LITERATURE

Very few statements have been published in regard to the poisonous properties of arrow grass, *Triglochin maritima*. The first published statement seems to have been by Greshoff in 1908 (*8*),[1] in which he stated that he had found in the plant from 0.02 to 0.06 per cent of hydrocyanic acid.

Blanksma in 1913 (*5*) reported several analyses in which he found amounts of hydrocyanic acid varying from 0.0016 to 0.056 per cent.

The Department of Agriculture files show that C. E. Bessey, of the University of Nebraska, in May, 1902, stated in conversation that the plant was suspected by a farmer of killing three of his cows and poisoning others. A doctor had stated that it affected the nervous system, the animals going into convulsions. Doctor Bessey said that it had been reported before as being poisonous in northwestern Nebraska.

Beath (*2*) in the Thirtieth Annual Report of the Wyoming Agricultural Experiment Station, in 1920, reported that laboratory tests showed that the plant was highly toxic when extracts were introduced intravenously into rabbits. No poisonous symptoms were observed when it was fed in a green condition to cattle.

[1] Italic numbers in parentheses refer to "Literature cited," p. 13.

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In the Report of the Work and Expenditures of the Agricultural Experiment Stations, 1920 (*12*), is the statement that at the Nevada experiment station hydrocyanic acid had been found in arrow grass.

Fleming, in 1920 (*6*), in the Annual Report of the Board of Control for the Agricultural Experiment Station of Nevada, said that sheep had been killed by the fresh plant by a dose of from 1½ to 2½ pounds, while when air-dried material was used the lethal dose was from 2¼ to 8 ounces. Cattle were not affected by the green plant, but a yearling calf was killed by 8 ounces of air-dried material.

In 1920 Fleming, Peterson, Miller, Wright, and Louck (*7*) published a bulletin entitled "Arrow Grass, a New Stock-Poisoning Plant." This bulletin reported in considerable detail a series of feeding experiments showing the poisonous properties of the plant and giving the dosage. The bulletin will be referred to later in the discussion of the experiments made at the Salina experiment station, near Salina, Utah.

In the Report of the Work and Expenditures of the Agricultural Experiment Stations, 1921 (*13, p. 103*) is a statement in regard to the Nevada experiment station to the effect that "arrow grass * * * was found to contain a hydrocyanic glucosid, of which the dried plant yielded 0.25 per cent of its weight."

Beath, in 1921 (*3*), in the Thirty-first Annual Report of the Wyoming Agricultural Experiment Station, reported that hydrocyanic-acid determinations of green and dried plants had been made but did not give data. Experiments with cattle had negative results. Beath (*4*), in 1921, made a general statement in regard to the poisonous properties and distribution of arrow grass.

Lawrence, in 1922 (*9*), referred to the Nevada experiment.

Woodcock, in 1925 (*15, p. 117*), simply made the statement that "when dry and eaten in large amounts, fatal to animals."

Pammel, in 1920 (*10*), reviewed the bulletin of Fleming and coauthors.

Alexander, in 1925 (*1*), stated that the plant was poisonous, evidently basing his remarks on experiments carried on at the Nevada station.

The foregoing references cover the published literature on the poisonous properties of arrow grass. The subject was brought to the attention of the bureau's office of poisonous plants through R. J. Becraft, of the Utah Agricultural Experiment Station, who stated that County Agent Howard Welch, of Provo, had written to him that a considerable loss of cattle occurred each year in the meadows near Utah Lake. Professor Becraft suggested that an investigation might be desirable. A trip was made September 29, 1924, to Goshen, Utah, the locality where this poisoning occurred. It was found that the plant grew in the hayfields at the south end of Utah Lake, being found in abundance in strips through the damper parts of the fields. All the losses in this region had been confined to cattle. There were no reports of the poisoning of horses.

After the hay is cut, the plant grows up rapidly and is more prominent than the second growth of the other grasses. Poisoning occurs at this stage. It was the opinion of the people there that only small quantities were necessary for poisoning. They stated that death followed very quickly after symptoms appeared. The plant is

gathered and stacked with the hay and fed through the winter; no cases of poisoning had ever been known from the use of this hay.

In the summer of 1925 Forest Ranger D. H. Williams, of Emery, Utah, brought to the attention of the Salina experiment station the fact that a number of dairy cows had died in the neighborhood of Emery, apparently from eating arrow grass. A trip was made to Emery, and the localities where the plant grew were examined. It was found to grow in considerable abundance in seepage places, and reports in the neighborhood indicated that there had been considerable losses from the plant.

While the work of Fleming and coauthors (7) had demonstrated very clearly the poisonous properties of the plant, their results did not give very clearly the dosage, and the report in their paper that the dried plant was very much more toxic than the green plant was not in accord with the statements made by the Utah stockmen. Because of these facts and because of the local demand for further study of the plant, it seemed desirable to make a number of feeding tests to clear up the doubtful points. On this account the experiments were undertaken which form the subject of this bulletin.

DESCRIPTION OF THE PLANT[2]

Triglochin maritima L. is a perennial, erect herb, growing from 6 inches to 2½ feet in height. The slender, green, fleshy leaves arise from a sheathed base, the bases of the old leaves often persisting. The leaves are shorter than the flowering stem and are half round in cross section. The flower spikes are slender, the rounded stalk naked below, and the numerous flowers are smooth, small, greenish, and inconspicuous; the sepals and petals are alike, six in number, are oblong in form, are spreading, and soon wither and disappear; the stamens are six in number, and the anthers are oval without stalks; the pods are oblong; one-fourth inch long, usually split into six divisions from the bottom up, leaving a triangular stem.

The plant is commonly known as "arrow grass," but other common names are "goose grass" and "sour grass."

It is found in North America in salt marshes near the coast from Labrador to New Jersey and from Alaska to southern California. It also occurs in many places in the interior (particularly from the Great Plains westward), usually in saline or alkaline soil about lakes and streams. It grows in clumps and patches, which are hard to distinguish before flowering time from the accompanying grasses and sedges, although its half-round leaves are different from the leaves of those plants. It is often found in large areas and occurs in considerable quantity in the hay cut in the low-lying meadows, as is the case at the south end of Utah Lake in Utah. The plant is also found in Europe, Asia, and northern Africa. When a quantity of the green plant is crushed there is evolved a very distinct odor of hydrocyanic acid.

Figure 1 shows the form of the plant when in fruit and Figure 2 shows a patch of the plants growing in a seepage area.

[2] The description of the plant was prepared by W. W. Eggleston, Bureau of Plant Industry.

FIGURE 1.—Arrow grass (*Triglochin maritima*), showing form of mature plant in fruit

EXPERIMENTAL WORK

Experimental work with cattle and sheep was carried on at the Salina experiment station and at Goshen, Utah, in the summers of 1925 and 1926. The material used in 1925 was gathered from seepage

FIGURE 2.—Arrow grass (*Triglochin maritima*). Mature plants growing in a seepage area

areas near Emery, Utah; that used in 1926 was obtained in the region near the south end of Utah Lake, at Goshen, where the plant grows in profusion, covering many acres. Table 1 gives a summary of the experimental work.

TABLE 1.—*Summary of feeding experiments with Triglochin maritima, 1925 and 1926*

Animal		Date of feeding	Method of feeding	Part of plant used	Approximate loss in drying	Plant given per 100 pounds of animal weight [1]	Place and date of plant collection	Result	Remarks
Designation	Weight								
Cattle					*Per cent*	*Pounds*			
No.	*Pounds*								
1058	600	Aug. 31, 1925	With hay	Leaves of mature plant	6	1.49	Emery, Utah, Aug. 29, 1925	No effect	Plant partly dry.
1106	280	Aug. 25, 1926	In feed box	Leaves, stems, buds, and fruit		1.5	Goshen, Utah, Aug. 25, 1926	Slight effect	Green plant, eaten in 6 hours 25 minutes.
1107	250	do	Balling gun	do		1.5	do	Very sick	Green plant, fed in 31 minutes.
1076	780	Aug. 26, 1926	In feed box	do		1.5	Goshen, Utah, Aug. 24, 1926	No effect	Green plant, eaten in 8 hours 30 minutes.
1108	325	do	Balling gun	do		1.7	Goshen, Utah, Aug. 26, 1926	Death	Green plant, fed in 34 minutes.
1089	860	Aug. 27, 1926	In feed box	do		.63	Goshen, Utah, Aug. 24, 1926	No effect	Green plant, eaten in 40 minutes.
1106	280	do	Balling gun	do		1	Goshen, Utah, Aug. 27, 1926	Very sick	Green plant, fed in 17 minutes.
1076	780	Aug. 28, 1926	In feed box	do		1.5	do	No effect	Green plant, eaten in 7 hours 15 minutes.
Sheep									
No.									
904	79.5	Aug. 30, 1925	Balling gun	Leaves of mature plant	3	2.66	Emery, Utah, Aug. 29, 1925	do	Plant partly dry.
898	82.5	Sept. 1, 1925	do	do	8.45	2.512	do	Death	Do.
886	73	Sept. 16, 1925	do	do	.75	2	do	No effect	Air-dried plant.
952	96	Aug. 26, 1926	do	Leaves, stems, buds, and fruit		2	Goshen, Utah, Aug. 24, 1926	Death	Green plant.
960	129.5	do	do	do		1	do	No effect	Do.
958	98	Aug. 29, 1926	do	do		1.25	Goshen Utah, Aug. 27, 1926	Sick	Do.
960	129.5	Aug. 31, 1926	do	do	1.45	1.33	Goshen, Utah, Aug. 28, 1926	Slight effect	Plant partly dry.
951	83	Sept. 1, 1926	do	do	4.3	1.56	do	do	Do.
972	69	Sept. 3, 1926	do	do	4.6	2.09	do	do	Do.
959	71.5	Sept. 9, 1926	do	do	81.8	3.04	Goshen, Utah, Aug. 26–28, 1926	do	Do.
946	83.5	Sept. 10, 1926	do	do	81.2	4.25	do	do	Do.
951	83	Setp. 14, 1926	do	do	83	6.18	do	do	Do.
970	105	Sept. 16, 1926	do	do	84	3.93	do	No effect	Air-dried plant.
988	84.5	Sept. 20, 1926	do	do	84	5	do	Slight effect	Do.

[1] Estimated as green plant.

TYPICAL CASE OF CATTLE 1107

Cattle 1107 was a bull calf in good, healthy condition, weighing 250 pounds at the time of the experiment.

August 25, 1926, from 3.12 to 3.43 p. m., he was given, with balling gun, 3.75 pounds of finely ground green plant, which had been collected immediately before the experiment. This quantity was equivalent to a 1.5 per cent dose of the animal's weight. At 3.35 p. m. he was restless, repeatedly lying down and getting up. At 3.50 p. m. the respiration was 100, pulse 120, and temperature 105° F. The pulse was weak but regular. At 3.57 p. m. he was staggering in a manner reminding one of a drunken man. Figure 3 illustrates the posture of the animal at that stage of poisoning, when he was leaning against the fence to support himself. At 4.01 p. m. he was down, resting his nose on the ground, and at 4.09 p. m. was in a semicomatose condition. At 4.11 p. m. his respiration was labored and noisy. At 4.47 p. m. and at 5.45 p. m. he bellowed as if in pain or extreme discomfort. During this time the pulse and respiration remained rapid, and the temperature was normal. His eyes occasionally twitched, his eyelids moved in a jerking way, and his eyes sometimes were rolled up so as to show only the whites. At 5.52 p. m. the reflex of the eyes had disappeared. There was more or less trembling, and from that time until 7.34 p. m. there were repeated spasms. The respiration was gasping, he occasionally bellowed, and the pulse remained high, although the rate of respiration was slower. At 7.43 p. m. he attempted, without success, to get up. At 10 p. m. the animal rose and walked about the pen, being able to keep on his feet, although he was so weak that he staggered. At 11 p. m. he was lying down and breathing much more easily. The respiration at 11.05 p. m. was 16. He had eaten a small quantity of hay. There was still a quivering of the muscles of the hips and shoulders, and occasionally violent trembling.

FIGURE 3.—Cattle 1107 at 3.57 p. m., August 25. Because of weakness and consequent difficulty in standing, he leaned against the corral fence

At 12.05 a. m., August 26, he was still lying as at 11 o'clock, and the trembling and twitching of the muscles still continued. At 1.08 a. m. the trembling had disappeared. At 2.14 a. m. the pulse was 80, and the respiration 14, both being practically normal. At 6.20 a. m. he was up and walking about the corral and appeared bright, but was rather quiet. At this time his recovery was considered practically complete.

TYPICAL CASE OF SHEEP 898

Sheep 898 was a yearling ewe weighing 82.5 pounds, and was in good condition at the time of the experiment, September 1, 1925. In two feedings, between 1.44 and 2.34 p. m., she was given by balling gun wilted leaves of *Triglochin maritima*, the quantity being 2.5 per cent of her weight, estimated as green plant. At the end of the second feeding she lay down and by 2.45 p. m. was very sick, the most noticeable symptom being the very deep respiration.

At 2.46 p. m. the temperature was 100.8° F., pulse 172, and respiration 76. The pulse was weak and the respiration not only fast but deep. At this time she was lying with the nose resting on the ground.

At 3.05 p. m. the temperature was 99.2° F., pulse 120, and respiration 60. The respiration, as before, was very deep and regular, with occasional deep breathing. The respiration was so labored that the breathing shook the whole body.

At 3.17 p. m. the respiration became more spasmodic, and some of the time she threw her head with the respiration. The mouth and eye mucous membranes at this time were almost bloodless.

At 3.20 p. m. tremors passed over the whole body, and she kicked spasmodically.

At 3.24 p. m. in a muscular spasm the head was thrown back in an opisthotonos position, and she went over on the right side. From then until 3.33 there was a series of spasms, some rather violent, followed by a period of less labored breathing, the respiration gradually slowing up until 3.41 p. m., when the animal died.

The autopsy, made 20 minutes after death, showed little in the way of marked pathological conditions. There were a few petechiae near the apex of the heart, and it was noted that the blood was very dark.

DISCUSSION AND GENERAL CONCLUSIONS

SYMPTOMS

In some cases, as in two of the cattle, the first symptom of poisoning was restlessness, indicating discomfort of the animal. In all cases there was an abnormally rapid pulse and, in all but two, rapid respiration. In one of the cattle this rapid rate of pulse and respiration was accompanied by a higher temperature. Higher temperature, however, does not seem to be characteristic of poisoning by this plant. In animals which were only slightly affected rapid respiration and rapid pulse were the only symptoms noted. In those that were more severely poisoned there was staggering, followed by more or less complete prostration, and coma in the worst cases. Both before and after falling there was twitching of the muscles and in some cases trembling of the whole body. There was distinct dyspnea, the respiration becoming labored and noisy. Two of the cattle when down bellowed repeatedly, as if in extreme discomfort. In the worst cases there were frequent convulsions, which were accompanied in two of the sheep with opisthotonos. In one of the cattle, No. 1107, which recovered, there was a distinct odor of hydrocyanic acid in the breath, which was so marked as to be noticed in all parts of the pen in which the animal was confined.

In cattle 1108, which died, there was an odor of hydrocyanic acid in the lungs. This odor was not perceived in any of the poisoned sheep. In the fatal cases death was produced by respiratory paralysis. It will be noticed that these symptoms, as just described, are those that are typical of hydrocyanic-acid poisoning. Figure 4 shows cattle 1106 when down and unable to rise.

AUTOPSY FINDINGS

The autopsies on the three animals that died showed, as would be expected, no distinctive lesions, with the possible exception that in two of them it was noted that the blood was unusually dark.

MICROSCOPIC CHANGES IN TISSUES

A microscopic study of the samples of tissues from the animals fatally poisoned by *Triglochin maritima* revealed very little injury that can be ascribed to the plant, and such injury was found in relatively few organs. The conclusions are based largely on the study of tissues from cattle 1108 and sheep 898. Sheep 952 had a chronic lung disturbance that made it unsafe to draw conclusions from evidence of minor disturbances in the other organs of this animal. They were, however, of interest so far as they conformed to the changes found in the other two cases.

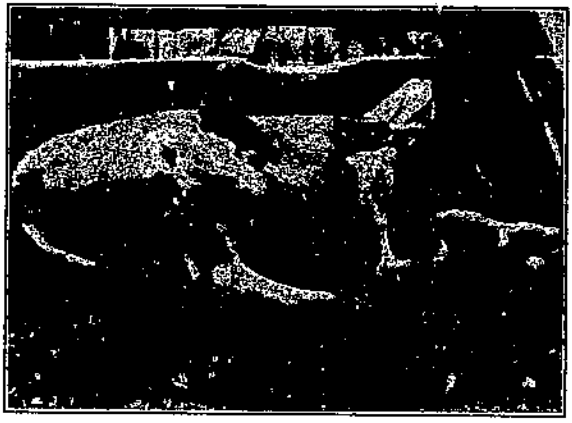

FIGURE 4.—Cattle 1106 at 2.38 p. m., August 27, when down and unable to rise

In the kidneys there was evidence of irritation which had resulted in a mild swelling and the early stages of granular degeneration in the epithelial cells of the convoluted tubules. In the liver there was apparently a slight injury to some of the hepatic cells. This had led to the beginnings of cloudy swelling or parenchymatous degeneration, especially in the cells bordering on or nearest the central and sublobular veins and along the portal canals. In addition, there were evidences of a mild, capillary congestion in the lungs and in the walls of the left ventricle of the heart. The presence of unusual quantities of hematogenous pigment in various places was suggestive of the degeneration and destruction of many red blood corpuscles.

TOXIC AND LETHAL DOSAGE OF GREEN PLANT

In the preliminary experiments, made in 1925, one head of cattle and three of sheep were used. Of these, only one, sheep 898, was affected, and this died on a dosage of 2.5 per cent of animal weight

of green plant. In this feeding leaves of the mature plant were used which had lost 8.45 per cent of weight by evaporation. Sheep 886 was not affected by a dosage of 2 per cent estimated as green, the actual material fed having lost 75 per cent of weight. Cattle 1058 was not affected by 1.49 per cent; the material used had lost 6 per cent in weight, but the feeding was spread over several hours.

In the experiments of 1926 the material used was young, second-growth plants gathered from a field after the harvesting of hay. These plants when air-dried lost 84 per cent in weight.

In 1926 seven experimental feedings were given to cattle. In all these experiments fresh plant was used, including leaves, stems, buds, and fruit.

Table 1 shows a minimum toxic dosage of 1 per cent of animal weight and a lethal dose of 1.7 per cent. As cattle 1106 was made "very sick" by 1 per cent, it may be assumed that the actual minimum dose, given by balling gun, is somewhat less. It is to be noticed, too, that of the animals given the plant in the feed box, only one was affected, No. 1106, which showed symptoms on 1.5 per cent eaten in 6 hours and 25 minutes.

The experiments with cattle show very clearly that the toxic dose is decidedly affected by the time spent by the animal in eating the plant. Cattle 1106 showed only "slight effect" on a 1.5 per cent dose taken in 6 hours and 25 minutes, while it was made "very sick" by 1 per cent taken in 17 minutes. Cattle 1107 was made "very sick" by the same dosage, 1.5 per cent, received in 31 minutes, while cattle 1076, on August 26, received 1.5 per cent in 8 hours and 30 minutes, with no effect, and again, on August 28, received the same dosage in 7 hours and 15 minutes with the same result. It is evident that cattle grazing in a field where there is some arrow grass with an abundance of other forage may take a considerable quantity of the arrow grass in the course of a day's feeding, with no ill effect. If, on the other hand, there is a scarcity of other forage, enough of the arrow grass may be eaten in a short time by a hungry animal to produce intoxication.

Eleven sheep were subjects of experiment in 1926, and all were fed by balling gun. Three of them, Nos. 952, 960, and 958, received green plant. The result was as follows:

Sheep 952 received 2 per cent of its weight and died.
Sheep 958 received 1.25 per cent of its weight and was sick.
Sheep 960 received 1 per cent of its weight and was not affected.

Comparing only the animals fed by balling gun, these experiments indicate that:

The minimum toxic dose for cattle is something less than 1 per cent.
The minimum lethal dose for cattle is about 1.7 per cent.
The minimum toxic dose for sheep is about 1.25 per cent.
The minimum lethal dose for sheep is about 2 per cent.

Apparently cattle are somewhat more susceptible than sheep.

The figures of Fleming and coauthors (*7, p. 12*) reduced to percentages of weight would give a minimum toxic and lethal dose for sheep, in terms of green leaves, of 1.87 per cent. This does not differ materially from the dosage obtained by the present authors when the nature of such work conducted under the different conditions is considered. Fleming and coauthors got no results from feeding

green leaves to cattle, although they used a dosage as high as 4.46 per cent.

TOXICITY OF DRY PLANT

The experiments with sheep in 1926, in which dry or partly dry material was used, gave very interesting results. As is shown in the summary, sheep 960, which received plant that had lost 1.45 per cent by evaporation, showed only slight symptoms on 1.33 per cent of its weight (the plant being estimated as green), although sheep 958 was distinctly sick on 1.25 per cent of green plant. In the succeeding experiments as the loss of moisture increased, the dosage to produce symptoms increased, until in the cases of sheep 951 and sheep 988, which were given the plant that had lost 83 and 84 per cent, respectively, the dosages of 6.18 and 5 per cent produced only slight effect.

It seems clear that the plant in drying loses much of its toxic property. In this connection it may be noted that the people in Goshen, Utah, who have had long experience with the effect of the plant on cattle, state that they have never known cases of poisoning to result from eating the plant in hay. A personal examination by the authors showed the presence of considerable quantities of arrow grass in some of the stacks.

These results from the use of dried material are very different from those reported by Fleming and coauthors (*7, p. 12, 13*). They report that they have poisoned sheep repeatedly on dry plant with a minimum dosage of 0.74 per cent of animal weight, the plant being estimated as green, and that a calf was killed by dry plant on a dosage of 1.6 per cent reduced to a green basis. They call attention to the risk involved in using hay containing arrow grass.

No explanation for this difference in results with dry plant is offered.

DURATION OF SICKNESS

Table 2 gives the time from the first symptom noted to the last. The actual duration of sickness was in most cases somewhat longer. Although the first symptom noted gives rather definitely the beginning of sickness, in most cases complete recovery probably came an appreciable time after the last noted symptom.

TABLE 2.—*Duration of sickness*

Animal	Time sick	Animal	Time sick
Cattle No.—	*Hrs. min.*	Sheep No.—Continued.	*Hrs. min.*
1107	10 29	960	6 27
1108	2 [1] 7	951 (Sept. 1)	1 22
1106 (Aug. 25)	5 52	972	3 10
1106 (Aug. 27)	5 3	959	5 35
Sheep No.—		948	1 5
898	1 [1] 8	951 (Sept. 14)	15
952	1 [1] 6	988	1 14
958	6 4		

[1] To death.

The maximum time of illness was in the case of cattle 1107, 10 hours and 29 minutes, while the minimum was shown by sheep 951 in the experiment of September 14 and was 15 minutes. The two

sheep that died were sick the same length of time, 1 hour and 6 minutes, while cattle 1108, which was fatally poisoned, lived 2 hours and 7 minutes. Of the three cattle, which were sick and recovered, the average period of sickness was 7 hours and 8 minutes, while the average of the sheep that recovered was 3 hours and 9 minutes. Taking the animals as a whole, the sickness lasted for a comparatively short period, and there did not appear to be any long-continued effects from poisoning from this plant. Complete recovery comes in a very short period.

TIME FROM FEEDING TO APPEARANCE OF SYMPTOMS

Table 3 shows the time from the conclusion of feeding until the appearance of the first symptom. The first experiment with cattle 1106, on August 25, is omitted from this table, since the symptoms appeared during the process of feeding.

TABLE 3.—*Interval elapsing between feeding and the development of symptoms*

Animal	Time of first symptom	Animal	Time of first symptom
Cattle No.—	*Minutes*	Sheep No.—Continued.	*Minutes*
1107	2	960 (Aug. 31)	23
1108	1	951	24
1106 (Aug. 27)	7	972	60
Sheep No.—		959	14
898	(1)	946	5
952	8	951	24
958	16	938	14

[1] Immediately.

The shortest interval before the appearance of symptoms was in the case of sheep 898, which was sick immediately after the feeding. Cattle 1108 was practically in the same class, as it was sick in one minute, while cattle 1107 was sick in two minutes. The longest time which elapsed was in sheep 972, in which symptoms appeared one hour after the feeding. The average of all these cases was 15 minutes. It is evident that in all cases of poisoning by this plant the symptoms of poisoning occurred in a very short time after the feeding.

The average time for cattle, 3⅓ minutes, is much less than that for sheep, which was 18⅘ minutes. Two factors may be considered as accounting for this difference, at least in part, one the apparently greater susceptibility of cattle and the other the fact that all the cattle were fed on green plant, whereas many of the sheep received plant which was partly or wholly dried.

REMEDIES

The action of the poison is so rapid and violent that little reliance can be placed on any remedy. However, a number of remedies have been suggested. Among them are hydrogen peroxide, potassium permanganate, cobalt nitrate, and glucose. Atropine may be given to stimulate the respiration.

Perhaps special mention should be made of the possible efficiency of the administration of glucose. It is known that glucose will combine with hydrocyanic acid and destroy its poisonous properties. Violle (*14*) reviews preceding work on this subject, work which included the use of glucose as a prophylactic in experiments with guinea pigs, and gives an account of similar successful experiments with rabbits. He shows that glucose is effective as a prophylactic when given intravenously and intraperitoneally, and to a less degree when given by the mouth. He suggests the use of glucose as a prophylactic for men who are exposed to the fumes of hydrocyanic acid in industrial occupations.

In this connection Saint-Rat (*11*) makes an interesting explanation of the failure of the attempt by Yousoupoff to poison Rasputin by port wine and cake with "crème rose" in both of which cyanide of potassium had been placed. Rasputin drank the wine and ate the cakes without any harmful result. Saint-Rat shows that the glucose of the wine and the lactose of the "crème rose" would be sufficient to neutralize the effect of the hydrocyanic acid.

No experiments have been made to test the possibility of using glucose successfully for animals already showing symptoms of poisoning. It seems probable, however, that some beneficial results could be expected from its use. Inasmuch as glucose in the form of corn sirup is readily obtainable, it would seem worth while to try its effect.

SUMMARY

Arrow grass, *Triglochin maritima*, is a widely distributed plant, growing in alkaline places in Europe, Asia, northern Africa, and North America, which has toxic properties caused by the production of hydrocyanic acid.

The plant has been the cause of considerable losses of cattle. The symptoms and dosage are described; these indicate that cattle are somewhat more susceptible to its effects than sheep.

To produce poisoning the toxic dose must be eaten in a short period of time. Cattle, in the presence of other forage, may eat considerable arrow grass with no harm, but when grazing on poor pasture may eat enough in a short time to produce intoxication or death. The sickness comes on very quickly, lasts a comparatively short time, and in cases of recovery has no permanent effect.

The air-dried plant used in the experimental work gradually lost most of its toxicity in drying. It is therefore inferred that stock losses result only from eating the green plant and that there is no danger from hay containing arrow grass.

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