BULLETIN 382-A JUNE 1944

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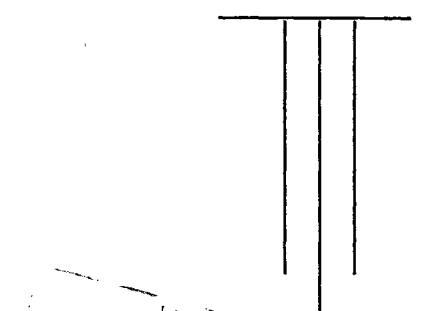

EXTENSION SERVICE
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Published and distributed in furtherance of the Acts of May 8 and June 30, 1914, by the Colorado State College, Extension Service, F. A. Anderson, Director, and U. S. Department of Agriculture cooperating.

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Selenium Poisoning of Livestock

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For many years horses, cattle, and sheep in certain regions of the West have developed what has been called "alkali disease" or "blind staggers." It is now believed that these diseases are caused by eating plants that contain selenium, one of the rare chemical elements. Records as early as 1860 report the disease in cavalry horses at Fort Rundale in what is now South Dakota, and, throughout parts of that state, Nebraska, Wyoming, and Colorado the disease has appeared during the years. It was at one time confused with loco and also frequently blamed on the water supply.

In 1931, a preliminary survey of the alkali disease was made in Nebraska, South Dakota, and eastern Wyoming. The toxicity of the plants in this region seemed to be correlated with soil from Pierre shale. It was suggested that selenium be looked for in these soils and plants and in 1933, selenium was found in the plants growing on these soils and also in the soil itself. A number of species of plants are able to absorb selenium from the soil and are poisonous to the animals that eat them.

Alkali disease in horses, cattle, and sheep is expressed by a depressed growth rate and loss of hair, especially the mane and tail in the case of horses. The hoofs develop abnormally and in severe poisoning the old hoofs slough off. In the more acute cases of selenium poisoning, the animals walk aimlessly; their vision is apparently impaired, as they walk into fences and other obstructions. The digestive system is believed to be inactive, the appetite is depraved, and the animal sometimes chews on fence rails, pieces of bone, or any metallic object. Finally, paralysis results; the animal grinds its teeth and drools from the mouth. Schoening observed the more chronic conditions as they appeared in horses and cattle. He mentions the abnormal growth of the hoofs, with the formation of deep rings. There is considerable stiffness and emaciation of the animal. Anemia occurred in animals experimentally fed selenium.

In poultry, selenium poisoning prevents about 75 percent of the eggs from hatching. The hatched chicks are greasy looking, often abnormal, and frequently live only a few hours.

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Autopsies of poisoned animals reveal lesions of the liver and erosions are found in the articular surfaces. The conditions described may prevail for several months, or even years, although the poisoned animals may recover when placed on good feed. Dr. O. A. Beath of the Wyoming Experiment Station, describes a "delayed action" in which animals may not show symptoms for several months while eating selenium plants, then suddenly a break down occurs and death follows in 1 to 5 days.

Generally two types of the disease are recognized, the "alkali disease" and the "blind staggers." It is now believed that these are the same disease and that the alkali disease is the less acute form, characterized by abnormal hoof growth, sloughing of hoofs, and loss of hair. The blind staggers is the more acute form, which results in death in a short time with no loss of hair or hoofs. The pathology of both diseases is alike.

Selenium is one of the so-called rare elements, chemically related to sulfur. It occurs in certain soils and rock formations of the western states. Its distribution is not uniform, however, either in the surface of the soil or deeper. Sandy soils contain less as it is more easily washed out. Seleniferous soils are derived mostly from shales of the Cretaceous geologic period. Steele, Pierre, and Niobrara formations contain relatively high percentages of selenium. Surveys by the Bureau of Chemistry and Soils, United States Department of Agriculture (USDA Tech. Buls. 482, 530, 601 and 783) indicate that selenium-bearing soils exist in these Colorado counties: Yuma, Lincoln, Larimer, Las Animas, Logan, Adams, Otero, Grand, Routt, Moffat, Mesa, Rio Blanco, Garfield, El Paso, Gunnison, Ouray, San Miguel, Delta, Prowers, Kiowa, Bent, Pueblo, Crowley, Washington, Fremont, and Huerfano. While the extent of the area indicated may appear alarming, the amount of selenium present, in most cases, is very small.

Numerous plants are able to absorb selenium from the soil and accumulate it in their tissues. Some plants growing in soil containing a few parts per million of selenium may accumulate as much as 1000 to 1200 parts per million. Plants experimentally grown in soil high in selenium turn white, however, in nature, the plants remain green and from their looks cannot be distinguished. The odor of these plants is distinctive, however. If an indicator plant, such as milkvetch, is crushed in the hand a peculiar sulfurous odor is noticeable if the plant contains selenium.

In the plant, selenium is thought to be associated with the proteins of the plant in organic combination. Application of sulfur to the soil seems to reduce the amount of selenium a plant may absorb. In field tests, however, this has not prevented plants from taking up some selenium and accumulating it. There is quite a difference in the ability of plants to accumulate this element. Molybdenum and tellurium are sometimes found in plants associated with selenium but their toxicity appears to be independent from the selenium but may add to the poisonous properties of some plants.

Plants known to have the ability to accumulate selenium are the following:

Two-grooved milkvetch	*Astragalus bisulcatus* (Fig. 1)
Timber milkvetch	*Astragalus convallarius*
Salt-bush	*Atriplex argentea*
Salt-bush	*Atriplex canescens*
Shadscale	*Atriplex canescens*
	Atriplex confertifolia
Nuttals salt-bush	*Atriplex Nuttallii*
Winterfat	*Eurotia lanata*
Stickleaf	*Mentzelia dicapetala* (Fig. 2)
Spurge	*Euphorbia lanata*
Princesplume	*Stanleya bipinnata* (Fig. 3)
Yellow bean	*Thermopsis divaricarpa*
Arrowgrass	*Triglochin maritima*
Gumweed	*Grindelia squarrosa*
Poverty weed	*Iva axillaris*
Wild aster	*Aster commutatus*
Woody aster	*Aster xylorrhiza* (Fig. 4)
Wild aster	*Aster hebeclaudus*

Of these plants, the two-grooved milkvetch is one of the best indicators of the presence of selenium. In addition, 12 other species of *Astragalus* have been found to contain selenium, as have cultivated grains and vegetables in some regions. These plants vary in ability to absorb selenium; *Astragalus bisulcatus* being highest with 8840 p.p.m. Dr. Beath of the Wyoming Experiment Station, states that certain plants are selenium converters. They absorb selenium readily and convert it to a more soluble form which is easily absorbed by other plants when the converter plant dies down into the soil.

Ordinary crops generally absorb little or no selenium in Colorado. In Wyoming, it was found that alfalfa, for instance, absorbed no selenium or only a few parts per million, even on selenium-bearing shales. Other plants, as winterfat, are variable in their behavior, sometimes taking up fairly large amounts and again little or none. Buffalo grass, grama grass, bluestem, and needle grasses contain relatively small quantities of selenium. Grain and vegetable foods have been shown to contain selenium. Analyses by different workers testing plants from soils rich in selenium, give parts per million for various crops as follows:

Cabbage	100	Spinach	315
Turnips	25	Young wheat	470
Wheat	5 to 31	Young barley	45
Rye	5	Young corn	275
Mustard	1240		

The stockman should learn to recognize the more common selenium-bearing plants and avoid feeding them if he lives in a selenium district.

As to treatment, the South Dakota Experiment Station has found that certain proteins, such as linseed meal, are protective against selenium poisoning. They also have found that giving small amounts of arsenic in food, water, or salt (about 5 to 10 parts per million) is effective in treating the disease.

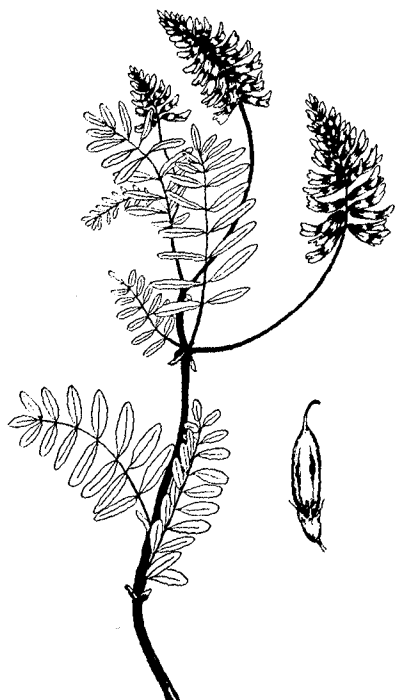

Fig. 1. Milkvetch

Fig. 2. Stickleaf

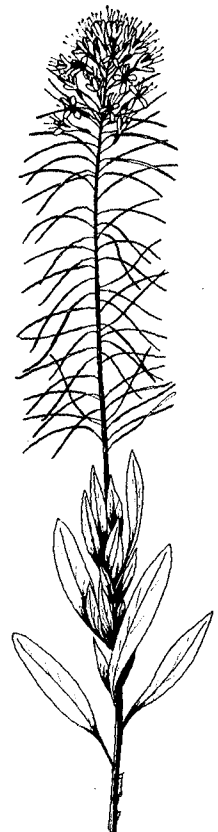

Fig. 3. Princesplume

Fig. 4. Woody aster