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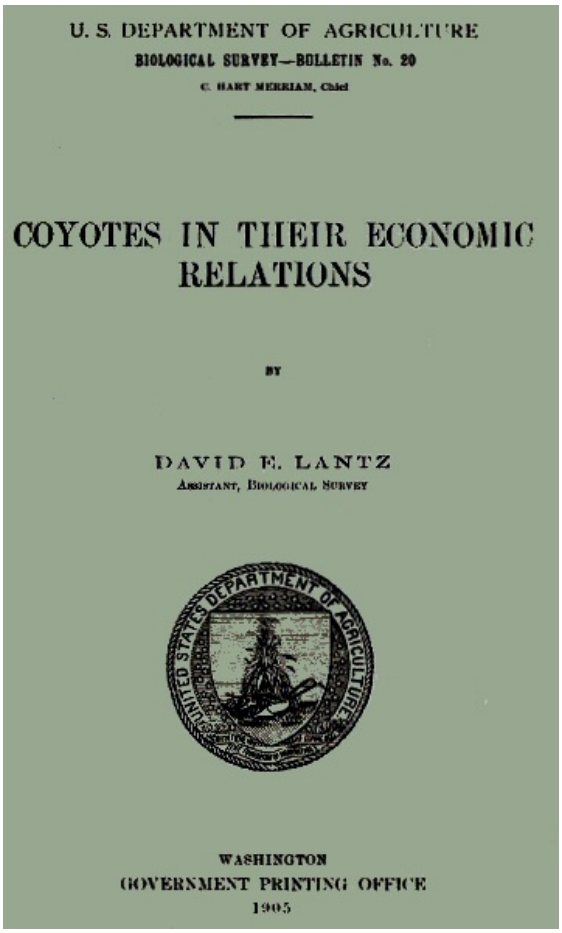

U.S. DEPARTMENT OF AGRICULTURE

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C. HART MERRIAM, Chief

COYOTES IN THEIR ECONOMIC RELATIONS

BY

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U. S. DEPARTMENT OF AGRICULTURE,
BIOLOGICAL SURVEY,
Washington, D. C., March 23, 1905.

SIR: I have the honor to transmit herewith for publication as Bulletin No. 20 of the Biological Survey a report on Coyotes in their Economic Relations, prepared by David E. Lantz, assistant. The subject is of immediate importance to the sheep industry of the West, where the wasteful method of sheep herding prevails. If in the range country sheep can be fenced with coyote-proof fencing at moderate cost, as seems probable, herding may be done away with and the sustaining capacity of the lands thereby greatly increased.

Respectfully,

C. HART MERRIAM,
Chief, Biological Survey,

HON. JAMES WILSON,
Secretary of Agriculture.

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COYOTES IN THEIR ECONOMIC RELATIONS

INTRODUCTION.

The small prairie wolves of the western and southwestern parts of North America are generally known by the Spanish name 'coyote.' This serves to distinguish them from the larger gray or dusky wolves that occur in many portions of the same range.

Intermediate in size between the foxes and the larger wolves, yet varying greatly in this respect with the different species, the coyotes are outwardly characterized by a sharp-pointed muzzle, upright ears, and a moderately long, bushy tail. The pelage is full, especially in winter. The usual color is a dirty gray, with more or less reddish tinge about the head, neck, and legs, and black hairs showing about the shoulders and on the back. The extent of the red and the black varies much with the different species.

Coyotes are generally distributed from the central Mississippi Valley to the Pacific coast and from Costa Rica on the south to the plains of the Athabasca on the north.[A] In this extensive range about a dozen species have been thus far recognized.[B] Four of these are restricted to Mexico and Central America. Of the eight forms that occur in the United States, it may be remarked that their ranges and relations to each other have not been fully determined. Much material is yet needed before anyone can write with exact knowledge of their distribution.

[A] Edward A. Preble informs the writer that the coyote has been captured at Fort Smith, northern Athabasca (60° north latitude), and on Nelson River in northeastern British Columbia (59° north latitude).

[B] The following is a list of the forms:

1. *Canis latrans* Say. Type from Council Bluffs, Iowa.
2. *C. nebracensis* Merriam. Type from Johnstown. Nebraska.
3. *C. lestes* Merriam. Type from Toyabe Mountains. Nevada.
4. *C. frustror* Woodhouse. Type from Fort Gibson, Indian Territory.
5. *C. mearnsi* Merriam. Type from Quitobaquita, Arizona.
6. *C. estor* Merriam. Type from San Juan River, Utah.
7. *C. cagottis* II. Smith. Type from Rio Frio, Mexico.
8. *C. ochropus* Escholtz. San Joaquin Valley, California.
9. *C. peninsulæ* Merriam. Type from Santa Anita. Lower California, Mexico.
10. *C. microdon* Merriam. Type from Mier. Tamaulipas. Mexico.
11. *C. vigilis* Merriam. Type from Manzanillo. Colima, Mexico.
12. *C. goldmani* Merriam. Type from San Vicente. Chiapas, Mexico.

A group in which there is so much variation in size must also present considerable diversity of habits. The larger forms, like *C. latrans*, are, of course, the more injurious to the live-stock interests. Smaller species, like *C. estor* and *microdon*, confine themselves in their food more to the smaller wild mammals and thus do much less damage. Yet it is not the intention in this preliminary bulletin to consider the species separately. Indeed, no such detailed study of their habits has yet been made. The present paper deals with the group as a whole, and is confined to a discussion of the economic relations of coyotes in general to our agricultural interests.

In the matter of fencing to protect sheep and poultry against coyote depredations, the

Biological Survey has made some preliminary investigations, and has formulated plans for more extensive experiments in the near future. In the meantime it is hoped that farmers and ranchmen throughout the West who have had personal experience of the efficiency of various forms of fence as a protection against coyotes and other wild animals will write the Biological Survey fully as to such experience.

ABUNDANCE OF COYOTES.

Coyotes are abundant in most parts of their range, except the extreme north and the more thickly populated regions where waste lands are scarce. It is, however, on the plains of the western part of the United States that they come most closely in contact with the advancing tide of settlement. The establishment of pioneer homes throughout the country has always resulted in restricting the numbers of the larger wolves, which have gradually become extinct over large areas in the eastern and middle parts of the United States where they were formerly abundant. Not so with the coyote. Except in a few thickly settled regions, it has thrived upon civilization and is practically as numerous as it was before settlements began. Indeed, in many parts of the West coyotes are said to be increasing in spite of a constant warfare against them.

The introduction of domestic birds and mammals has provided the coyotes with an additional food supply always available and entirely precluding any danger of starvation. Then, too, the animals are far too suspicious to be easily destroyed by the use of traps or poisons. Old hunters of the Plains have informed the writer that while it was comparatively easy to poison large numbers of the gray wolf, the coyote was not an easy victim and usually avoided both the baited traps and the poisoned buffalo carcasses.

The plains east of the Rocky Mountains and the higher plateaus of the Great Basin west of the mountains are especially adapted to the wants of the coyote. Cultivated areas are far apart: stock ranges are extensive; tall grasses, weeds, cactuses, and sagebrush afford excellent hiding places; rabbits, prairie dogs, ground squirrels, and other small animals are plentiful; and, when these natural resources of the country fail, sheep and young calves furnish abundant food.

In nearly all the Western States the efforts of ranchmen to destroy the coyote have been supplemented by laws authorizing the payment of bounties from public funds. Some of these laws have been in operation for a score of years or even more and, except locally, no diminution in the general numbers of the animals has resulted. In some parts of Mexico where the natives have for many years practiced systematic poisoning, the coyote is becoming rare, but in most sections of its range it is either increasing or no substantial decrease has been observed.

COYOTES IN KANSAS.

The State of Kansas, where settlements are comparatively old and where man's warfare against the coyote has been long continued, affords an excellent illustration of the animal's ability to maintain its numbers under seemingly adverse circumstances. Most of the counties of the State have for many years paid bounties for killing coyotes, and conditions have been reached where there is little fluctuation in the total amount paid from year to year. The returns of the animals killed for the fiscal twelve months from July 1, 1903, to June 30, 1904, show that nearly 20,000 scalps were presented for bounty in the State.

The following is a table, by counties, of the number of coyotes on which bounties were paid during the year above specified. Of the 11 missing counties, 10—Cherokee. Comanche. Finney. Grant, Haskell, Kearney, Morton, Seward, Stevens, and Wyandotte—paid no bounties, and 1, Doniphan, made no report. The bounty in all cases is $1 for each animal killed.

Number of coyotes on which bounties were paid in Kansas from July 1, 1903, to June 30. 1904.

County.	Number of coyotes.	County.	Number of coyotes.	County.	Number of coyotes.
Allen	73	Harper	44	Phillips	400
Anderson	129	Harvey	99	Pottawatomie	329
Atchison	48	Hodgeman	74	Pratt	242
Barber	633	Jackson	86	Rawlins	223
Barton	109	Jefferson	94	Reno	184
Bourbon	157	Jewell	106	Republic	52
Brown	70	Johnson	62	Rice	90
Butler	186	Kingman	257	Riley	206
Chase	343	Kiowa	477	Rooks	280
Chautauqua	451	Labette	137	Rush	144
Cheyenne	585	Lane	164	Russell	258
Clark	460	Leavenworth	56	Saline	186
Clay	104	Lincoln	105	Scott	193
Cloud	42	Linn	175	Sedgwick	223
Coffey	159	Logan	329	Shawnee	69

Cowley	325	Lyon	197	Sheridan	306
Crawford	51	Marion	166	Sherman	291
Decatur	240	Marshall	304	Smith	133
Dickinson	145	McPherson	210	Stafford	142
Douglas	99	Meade	224	Stanton	188
Edwards	290	Miami	96	Sumner	401
Elk	212	Mitchell	100	Thomas	185
Ellis	248	Montgomery	148	Trego	430
Ellsworth	193	Morris	176	Wabaunsee	170
Ford	500	Nemaha	58	Wallace	259
Franklin	152	Neosho	98	Washington	200
Geary	102	Ness	273	Wichita	307
Gove	355	Norton	227	Wilson	210
Graham	293	Osage	173	Woodson	115
Greeley[C]	117	Osborne	248		
Greenwood	336	Ottawa	61	Total	19,152
Hamilton	275	Pawnee	230		

[C] six months.

The experience in Kansas is not exceptional. It may be duplicated in a dozen other Western States and in some of the British provinces. It is probable that the united efforts of the people are keeping the coyotes in check, and that, were these efforts relaxed, the animals would be far more abundant; but the coyotes are still so menacing to certain interests that the subject requires careful investigation to determine what more may be done to improve present conditions.

GENERAL HABITS OF COYOTES.

The various forms of the coyote seem each to conform to particular faunal areas. They inhabit all the life zones, from the Lower Boreal, through the Transition, the Upper and Lower Sonoran, and the semi-arid parts of the Tropical. In the northern part of its range C. latrans has a migratory movement southward in winter and north ward in the spring, probably caused by the limited food supply of the northern wilds, and varying in degree with the severity of the seasons. A similar movement of other species in the western part of the United States from the higher mountain areas to the valleys has been noticed. In summer the mountain species range above timber line.

The coyotes are noted for their peculiar prolonged howling. A single animal is capable of a performance which impresses the uninformed hearer as the concert of a dozen, and when several join in the medley the resulting noise is indescribable. They are silent during the day, but may be heard at any time between sunset and sunrise.

Coyotes breed but once a year. The mating season is late in January or early in February. The period of gestation is probably that of the whole genus *Canis*, which is given by Owen as about sixty-three days. The young are produced in dens, and number from four to eight or even more. The dens are usually enlarged from those made by badgers or smaller animals and are often among rocks or in washed-out places along banks of streams. Probably at times they are made entirely by the coyotes. They are rarely far below the surface, but sometimes of considerable extent and with two or more openings. Little attempt is made to provide nests for the young. In the Central West these are born early in April and usually may be heard in the dens during May. In June they come out to play around the mouths of the burrows, which are finally deserted during July. By August 1, the young are left by the parents to shift for themselves.

In the earlier descriptions, the prairie wolves were usually said to hunt in packs. Lewis and Clark, Say. Richardson, and others so reported, but the Prince of Wied met them only singly. It is probable that they hunt in numbers only when the quarry is large, as in the ease of deer and antelope; but as many as three have been known to pursue a single jack rabbit.

FOOD HABITS OF COYOTES.

The food of coyotes has been a subject of investigation by the field naturalists of the Biological Survey, whenever opportunity offered. A number of stomach examinations have been made in the field: but trapped animals are often found with empty stomachs. In the case of a number of the species nothing definite is known of the food.

The stomachs examined contained mainly animal matter, but in two cases vegetable remains were found. One examined by Vernon Bailey contained a quantity of ripe cultivated plums: and William Lloyd found a coyote that had eaten mesquite beans. In northern Arizona Doctor Merriam saw a coyote eating a watermelon, and a correspondent al Russell, Kans., says that they sometimes cat ripe melons. In California they cat peaches, apricots, grapes, and other fruits. They cat also juniper berries, manzanita berries, and the fruit of the prickly pear (*Opuntia*).

Only one case of insect-eating has been observed by the Biological Survey. The same animal

that had eaten plums had in its stomach the remains of a large cricket (*Stenopelmatus fasciatus*).

Coyotes feed greedily upon all kinds of animal food. This ranges from the larger hoofed mammals to the smallest rodents, and includes also birds, reptiles, fish, and crustaceans. Three horned toads (*Phrynosoma*) were found in the stomach of a specimen killed June 3, 1898, in Big Smoky Valley. Nevada, by Vernon Bailey. On the low tropical coast of eastern Mexico and Texas members of the Biological Survey have often seen coyotes searching the beach for crabs, fish, and turtle eggs.

BENEFICIAL HABITS.

Among the mammals included in the food of the coyotes are many injurious species; and, so far as their food is confined to these, the animals are decidedly beneficial to the farming interests of the country. The destruction of rabbits, both large and small species, is of great advantage, especially on the plains and in the cultivated valleys, where their depredations are keenly felt by the settlers. The various species of jack rabbit have often been observed as included in the coyotes' fare, and the smaller rabbits are also habitually eaten. The coyotes usually catch the rabbits by lying in wait behind bushes and bunches of grass near their paths and pouncing upon them as they pass. Sometimes they have been known to hunt jack rabbits in company. While a single coyote would not be able to run down a jack rabbit, by hunting together, taking turns in the drive, and by taking advantage of the tendency of the hare to run in a circle, they are able to capture it. Eye witnesses to such a performance state that they do not fight over the division of the rabbit's carcass, but that all obtain a share. The constant warfare of many coyotes upon these rodents has much to do in keeping down the numbers; and the abundance of rabbits in some sections of the West has been largely attributed to a local decrease in the number of coyotes, caused by an unusual activity against them which had been stimulated by high bounties.

Prairie dogs (*Cynomys ludovicianus* and other species) are also a staple coyote food. The coyote captures them by hiding behind clumps of weeds or bunches of grass at some distance from the burrows. When the unsuspecting rodent, in feeding, approaches near enough, a few leaps enable the coyote to secure it. The grass in a prairie dog 'town' is usually cropped very short, and all tall-growing weeds are cut down. Sometimes a weed is permitted to grow to maturity on the cone-like mound sit the mouth of a burrow. Only three species of weeds have been seen so growing by the writer—the horse nettle (*Solanum rostratum*), the Mexican poppy (*Argemone*), and a Euphorbia (*Euphorbia marginata*). These afford shade to the animals, but do not obstruct the view. All other weeds, and even cultivated crops, are cut down to prevent the unseen approach of an enemy. When the cultivated crop is some rapid-growing or dense one which they can not clear away, they abandon the land rather than stay to be devoured.

But clearing the prairie dog town of weeds is not sufficient to baffle the coyote. In the absence of hiding places he takes to new methods of hunting. J. H. Gaut, of the Biological Survey, records his observations in a prairie dog town in New Mexico:

> The coyote started at one end of the town and ran at lightning speed in a straight line until he cut off one from its burrow. When the prairie dog saw that it could not get to its hole, it stopped and began to kick until the coyote caught it and killed it in very much the same way that a dog kills a rat.

Besides rabbits and prairie dogs, the food of the coyote is known to include the following mammals:

Rice rats (*Oryzomys*), kangaroo rats (*Dipodomys* and *Perodipus*), wood rats (*Neotoma*), ground squirrels (*Ammospermophilus*, *Callospermophilus*, and *Spermophilus*), woodchucks (*Marmota*), voles (*Microtus*), pocket gophers (*Thomomys*), chipmunks (*Eutamias*), and pocket mice (*Perognathus*). All of these are more or less harmful, and the coyote performs an important service in preying upon them. The service is not an occasional or a spasmodic one, but lasts throughout the year and throughout the life of the coyote. When the number of animals taking part in the work is considered, the enormous importance of its bearing in maintaining the 'balance of nature' becomes apparent.

The coyote is useful also as a scavenger. In the prairie country, especially in winter, it comes into towns at night searching for garbage thrown into the alleys. Here it finds remnants of meat from the table, offal from game, and similar prizes. When hungry it will reject no animal food, not even carrion. The slaughterhouses near the towns are favorite feeding places, and the animals are often shot there by moonlight. On the ranges they soon consume dead horses and cattle. Leaving the bones clean.

INJURIOUS HABITS.

Coyotes have been known to capture some of the wild animals that assist man in his warfare' against insects and rodent pests. Among them are the weasels. In August, 1903, a member of the Biological Survey met a coyote carrying a weasel in the Pecos River Mountains of New Mexico at an altitude of 11,600 feet. The coyote, frightened, dropped its prey and ran off. The various kinds of skunks also are probably captured and eaten.

GAME DESTROYED BY COYOTES.

Coyotes destroy considerable game. Birds that roost and nest on the ground are frequent

victims. Quail, grouse, and wild ducks are caught on the nest, and both birds and eggs are eaten. Wild ducks and geese, when wounded and unable to fly, may be found along the banks of streams and ponds, and the coyotes regularly patrol the shores in search of them. In Oklahoma I found fresh coyote tracks each morning on the grassy borders of a large artificial pond. Ducks resorted there in considerable flocks, and I several times found that they had been eaten by coyotes, as evidenced by tracks of the animals and feathers of the birds.

Like the larger wolves, the prairie wolf kills deer and antelope. In hunting these they always go in packs of two or more and take turns in the chase. They know that their prey runs in large circles, and at intervals individuals drop out of the pursuit and, crossing a chord of the circle, lie in wait until the quarry passes near them again. In this way the wolves keep fresh until the pursued animal is exhausted, but all of them are 'in at the death.' The present scarcity of these large game animals gives few opportunities for such chases, but on the plains they were formerly of frequent occurrence.

DEPREDATIONS ON FARM ANIMALS.

The coyote is widely and unfavorably known as a destroyer of domestic animals. Its depredations upon these indicate a marked change of habit since the first settlement of the West. Previously its food was restricted to the wild animals, including young buffalo, antelope, and deer. The destruction of the larger game by man may partly account for the change to farm animals as a diet, but it is probable that the quality of the introduced food had much to do with the coyote's preference for it.

The coyote kills hens, ducks, geese, and turkeys. Its usual method of capturing them in daytime is to lurk behind weeds or bushes until the fowls come within reach. Turkeys, which range far afield in search of grasshoppers and other insects, are frequent victims. At night the coyote captures poultry from the roost, provided the door of the henhouse is left open. A correspondent of the Biological Survey wrote from Rexburg, Idaho, that one neighbor had lost 60 chickens and another 30 in one night, taken by coyotes. Another correspondent, in Mayer, Ariz., writes:

> Have lost about 100 chickens by coyotes. With the exception of killing chickens, I believe them to be beneficial in keeping down the rabbit pest.

In approaching ranch buildings either by day or by night the coyote conies from the leeward side and with great caution. Once satisfied that no danger lurks in the shadows, it becomes exceedingly hold. George A. Coleman, formerly a member of the Biological Survey, wrote from London, Nemaha County, Nebr.:

> Depredations by wolves here upon henroosts and pigpens are of frequent occurrence. I have observed them several times. They come with a dash into the yard, take a chicken by the neck, and are gone before anyone can stop them. In the same way they visit the pigpens and take the young pigs away from the mother. In one instance they made way with eight 6-weeks-old pigs in one night. At another time two of them attacked a pig which would have weighed 75 pounds, and had they not been stopped by dog's would probably have killed it.

Few of the mammals of the farm are exempt from coyote raids. Even house cats, roaming far from home in search of rodents or birds, become victims. A correspondent of Forest and Stream, writing from Shirley Basin, Wyo., October 7, 1896, says:

> I live on a ranch, and we are somewhat troubled by field mice and mountain rats, and so we must keep cats. We have them, but we do not keep them long, because they are caught by coyotes. Within a few months I have lost four cats in this way.

The coyote has been known to kill the young of most farm animals—colts, calves, pigs, lambs, and goats. Colts are seldom killed, because the dam can usually protect them. Calves are taken only when the mother cow is feeding at a distance or has gone for water. The coyotes lie watching in the grass until this opportunity comes. Sometimes older animals are killed. Ranchmen in Oklahoma told the writer that in winter yearling cattle in good condition are sometimes killed by coyotes. To accomplish this two or more of them must hunt together, and get the victim separated from the herd.

Capt. P. M. Thorne, writing to the Biological Survey from Fort Lyon, Colo.. January 4, 1887, says:

> Old cattlemen who have lived here nearly all their lives agree in saying that the coyotes kill cattle, even full-grown ones. They say that they have seen them at their work, which is done in packs; they surround an animal and keep up a constant nipping at its legs until it falls from weakness and loss of blood.

In July. 1893, at Farmington, Utah, Vernon Bailey saw two coyotes chasing calves and yearlings about a pasture, evidently trying to separate one from the lot. He notes that in June. 1889, at St. Thomas, Nev., coyotes killed a hog that weighed about 100 pounds.

THE COYOTE'S RELATION TO THE SHEEP INDUSTRY.

The coyote is especially notorious as an enemy of the sheep industry. In many parts of the West sheep raising has greatly languished because of the depredations of wild animals upon the flocks. While some of the injury is caused by the larger wolves, mountain lions, bears, and lynxes,

the coyotes are by far the most formidable enemy. They are not only more abundant than the other animals mentioned, but they are present throughout the year, and their depredations are a steady drain upon the resources of the flock owner, comparable in extent to the losses caused by worthless dogs in many parts of the country.[D]

[D] In 1801 the loss from dogs was placed at $152,034 in Ohio and $200,000 in Missouri. (Sheep Industry in the United States. U. S. Dept of Agric, 1892.)

Dr. E. A. C. Foster, writing from Russell, Kans., in 1887, said:

> Of mammals, the prairie wolf is perhaps the most troublesome. It is constantly preying upon sheep and lambs; so much so that sheep can not be left alone without some of them falling a prey to this animal. Should the herder be absent or out of view, the wolf makes a dash into the flock and usually secures a lamb.

William Lloyd, writing from Paint Rock, Concho County, Tex., said:

> In January. 1886, coyotes killed over 30 sheep near Fort Stockton, and in March about 20 at Toyah, Tex.

Charles W. Richmond, in 1888, wrote to the Survey from Gallatin County. Mont., relating the following incident:

> While we were camped near Bozeman a flock of some 4,000 sheep were driven by, and night overtook them on some foothills south of Bozeman. During the night a flock of coyotes entered the ranks and the sheep stampeded. Many ran over some bluffs, and next morning sheep, dead and dying, were several feet deep at the foot of the bluffs. Nearly 500 were counted in the pile, and for several days afterwards sheep, with lacerated ears and torn flanks, wandered into barnyards in the vicinity. The total number lost must have been heavy.

In parts of the Southwest sheep growers have estimated their losses from wild animals as equal to 20 percent of the flock. The average loss reported from several States is 5 percent. In nearly all the States west of the Mississippi the industry has declined in the past two years, and one of the principal causes given is losses from coyotes. At present the industry thrives only in sections where the local conditions permit the herding of sheep in large flocks—a system highly injurious to the pasturage.

It is evident that the wealth of any State could be materially increased if it were possible everywhere to keep small flocks of sheep, Flocks increase rapidly under favorable conditions and good management, and the cost of keeping them is small when herders can be dispensed with. The double product, wool and million, usually places the profit of handling them above that of cuttle or horses. The gains also come oftener, since sheep mature in a year, while cattle and horse require three.

Vernon Bailey, chief field naturalist of the Biological Survey, writing from Seguin, Tex., under date of November 8, 1904, says:

> No sheep are kept in tins part of Texas, and in talking with several intelligent farmers I find that the reason invariably given is the abundance of coyotes. The region is occupied by small farms, mainly 80 to 500 acres, on which cotton, corn, sorghum, and vegetables are the principal crops. There are few if any large stock ranches, but each farm has its pastures for horses and cattle. These pastures are the wild land covered with scattered mosquito, post oak, and patches of chaparral and cactus. The native grasses are abundant and of excellent quality, and in this mild climate furnish good feed throughout the year. Many of the pastures are not half eaten down, and the dead and dry vegetation becomes a nuisance. After harvest cattle and horses are usually turned into cotton and grain fields, where they do good work in cleaning up grass and weeds in the field and along the borders. Still there is abundance of feed constantly going to waste, and a small flock of sheep could be kept with great profit and no expense on almost every farm.
>
> Fifty to two hundred sheep on a farm would at once make this part of Texas the most important woolgrowing section of the State. Other advantages to be gained would be keeping down the cactus and chaparral, which are inclined to spread and occupy much of the ground, keeping the edges of pastures and fields cleaned up so that they would not harbor a host of predaceous insects and rodents in close proximity to growing crops, and furnishing to the farmers and small towns a supply of fresh meat other than chicken. In this warm climate beef is rarely available, except in the larger towns. The advantages of introducing sheep into this part of the country are acknowledged by the farmers, and there seems to be no reason why it has not been done, except that coyotes are common, large, and fond of mutton.

Similar conditions prevail in many parts of the West and over large areas. While a dozen years ago the low price of wool was an important factor in causing farmers to abandon sheep raising, in recent years the prices have been excellent. Fine washed wool was quoted in the New York market February 6, 1905, at 32.35 cents per pound and in St. Louis on the same date at 40.41 cents per pound. The price of tub-washed wool at St. Louis was at no time during 1904 less than 30 cents per pound. Unwashed wool ranged from 15 to 31 cents during most of the year. Yet the number of sheep in the United States is now decreasing. Montana, with an area of 146,000 square miles, leads the States in the number of sheep kept, which is 5,638,957.[E] England, with an area of 50,867 square miles, has about five times as many as Montana. In Montana sheep are herded in immense flocks; in England every landowner and farmer keeps a small flock.

[E] Crop Reporter, U. S. Dept. Agric. February, 1905.

It is evident that the discouraging condition of the sheep industry in the United States is not

due to a lack of favorable climate nor to the absence of suitable pasturage. Neither is it due to low prices of wool and mutton. Indeed, in our markets mutton is coming to be more and more in favor, and this growing demand may be one of the causes for the present drain upon the flocks and the decrease in their numbers; but the chief discouragement of the industry undoubtedly lies in the depredations of worthless dogs and coyotes.

The dog question is a serious one, especially in thickly settled parts of the country, but the evil is best remedied by a resort to taxation. The tax on dogs should be sufficiently high to put most of the worthless ones out of existence.

MEANS OF DESTRUCTION.

The coyote problem is a serious one. Various methods of dealing with it have been in vogue since coyotes first began to like mutton. None of the methods have been entirely satisfactory, and some are signal failures. All of them combined have resulted in a partial check on the increase of coyotes in most parts of their range. Poison has probably killed the greatest number of adult animals, and in some parts of Mexico has almost destroyed some of the species, but no such success has attended its use in the United States.

POISONING.

Strychnine has always been a favorite weapon of hunters for wolf pelts and bounties. A half century ago hunters on the prairies killed the buffalo for its pelt, and added to their income by killing the wolves that followed the daily slaughter. A little strychnine inserted in the skinned carcass of a buffalo enabled them to secure many pelts of the gray wolf and occasionally one of the coyote; but not often the latter: he was regarded as much too shrewd to be taken by ordinary methods of poisoning. Resides, the pelt was small and not sufficiently valuable in comparison to warrant special efforts to secure it. Even in 1819 Thomas Say, who first gave a scientific name to a coyote, found this animal more abundant than the gray wolf.[F] Yet the number killed for their pelts has never been great.

[F] Long's Expedition to the Rocky Mountains, p. 168, 1823.

As an illustration of the coyote's shrewdness in avoiding poisoned bails, a farmer in Oklahoma gave the writer the following experience: After butchering some hogs he poisoned a hogskin and left it with other offal for a coyote that nightly prowled about his premises. In the morning everything but the poisoned skin had been cleared away. He left it two more nights, but it remained untouched. Thinking that the animal would not eat the poisoned bait, he buried it. That night the coyote dug up the pigskin and ate it, falling a victim to its deadly contents. Since then the farmer says he has never failed to poison coyotes when he buries the bait.

Another method of poisoning coyotes is to insert the strychnine in small chunks of meat that can be easily swallowed. Success by this method depends largely upon the condition of the animal as regards hunger, and may be helped by making what is known as a 'drag' in the neighborhood of the bait. A small animal—a bleeding dead rabbit is good—is dragged over the prairie and the morsels of bail left at intervals along the 'drag.' Two days previous to a general coyote hunt in Oklahoma a steer badly affected by 'lumpy jaw' was killed, opened, and left in the middle of the area to be hunted. During the first night coyotes howled all night in the vicinity of the carcass, but failed to touch it. The second day a hind quarter was separated from the carcass and dragged in a circuit of a mile or two, the drag coming hack to the carcass. During the following night the coyotes picked the bones of the carcass hare. Thus gorged with beef, they were in a condition favorable for their slaughter in the drive of the following day.

In the use of strychnine for wolves, the dry crystals of strychnia sulphate are generally preferred. They should be inserted in the bait with a knife blade, and the meat should be handled as little as possible. It should be remembered that if precautions are not taken there is a greater probability of killing dogs than wolves. The entire neighborhood should know of the intended attempt, and all valuable dogs should be confined until the operation is finished and uneaten baits disposed of.

TRAPPING.

Coyotes are not easily trapped. Some skill and a good knowledge of their habits are requisites for success. They travel in rather well-defined paths and usually hunt against the wind. Having a keen sense of smell, they easily detect the tracks of man, and if they have had previous experience of traps or guns they are suspicious of danger. In the wildest parts of the country remote from settlement they are more readily trapped. The chances for successful trapping decrease with their familiarity with man, so that there is little probability that the process will ever have much effect on their numbers.

The writer knows a Kansas trapper who is quite successful in capturing coyotes in a rather thickly settled part of that State. He steel traps and sets them along hedges in places where the animals are accustomed to pass through openings. No bait is used and the trap is partly concealed by dead leaves or grasses. He claims that both the direction of the wind and of the animal as it approaches the opening have much to do with the chance for success.

Field naturalists of the Biological Survey usually have experienced little difficulty in securing coyotes in traps. A No. 3 steel trap is generally used. A suitable place is selected along a narrow path or trail and the trap sunk in the ground level with the surface and concealed with fine grass, leaves, or other material that will harmonize with the surroundings. At the same time care is taken that the material used shall leave the jaws of the trap free to spring clear of the covering. – 20 –

The trap should be fastened to a bush or stake, or if these are not available, to a clog. For the last a pole lying on the ground is best, since it may be utilized without moving it or disturbing the surroundings. If the trap is anchored to a bush or small tree the chain must be securely fastened with snap or wire. A stout stake over which the ring will not slip, driven out of sight into the ground, is better. Every part of the trap and chain is covered, and the ground left in as natural and undisturbed condition as possible.

Any kind of fresh meat will do for bait—rabbits and other small rodents are often used, but larger baits seem to be more attractive. it is also of advantage after setting the trap to make a 'drag' of the bait for a quarter to a half mile, at the end of a rope from the saddle horn, and finally to fasten it to a bush or stake close to the trap, or cut it in bits and scatter all around the trap so that not all can be reached by the coyote without walking over the trap. The skill of the trapper and the situation of the trap will determine the best arrangement. The suspicion of the coyote is lessened apparently after following the bloody trail of a well-planned drag.

Before setting the traps many trappers rub their feet and hands on a skin or some strong-smelling meat or carcass to conceal the human odor. Oil of anise or rhodium is sometimes used for the same purpose. Any strong odor is likely to attract the attention of the coyote and allay suspicion. Care must be taken not to spit on the ground or kneel or throw down any clothing in the vicinity of the trap. A good plan is to set a line of traps and leave them for a day or two, and then go the rounds with a horse and drag, and bait the traps without dismounting.

HUNTING.

Many ranchmen find dogs an efficient help in guarding against coyote depredations. For this purpose the small varieties are useless, since the coyotes do not fear them. Beagles and larger foxhounds are too slow. Staghounds, Russian wolfhounds, greyhounds, and their crosses are to be preferred: and at least three are needed to successfully chase and safely kill a coyote. These dogs soon learn to hunt wolves, and are seldom known to harm sheep. Ranches on which they are kept are comparatively free from depredations of wild animals, while others within a few miles are by do means exempt. Of course, the keeping of these dogs on small farms would hardly be practicable. – 21 –

In the open country where there are few fences, hunting the coyote with horse and dogs is an exciting sport. Fox chasing, although less meritorious in purpose, may have some advantages as sport, because the quarry is not always in sight and the skill of the hounds is pitted against the cunning of the fox. In the chase of the wolf, as in coursing hares, the race is straight away and without cover; and when the quarry is overtaken the fight is won only because of the overpowering numbers of the pursuers. The ordinary greyhound can easily overtake a coyote, but is usually unable to kill it alone.

Coyote drives, in which an entire community engage, have become a popular feature of rural sport in some parts of the country. Such drives have been held in Kansas, Colorado. Idaho. Oklahoma, and Texas; but the methods employed depend largely on the local topography. The writer was present at the second annual wolf hunt which took place November 24, 1904, in the large Pasture Reserve near Chattanooga, Okla.

On Thanksgiving morning the weather was perfect, and a large number of people from the surrounding country collected in the village of Chattanooga. A little before noon the men who were to drive the wolves rode out of town and headed for their positions in the Pasture. As there were less than 150 men, the area covered by the drive was not so large as had been planned. The drivers were separated into three divisions. The south division, which was under the immediate charge of the commander of the hunt, Mr. J. W. Williams, proceeded about 7 miles south of Chattanooga. The eastern and the western divisions were under the charge of other captains and had their stations about 4 miles to the southeast and southwest of the town. The area covered by the drive was somewhat over 6 miles square.

On the north side were the spectators, occupying a position about a mile and a half from the town and extending over nearly 2 miles of front, from which the land sloped gently to the south. The spectators came from town in every sort of farm vehicle and numbered fully 500.

In front of the line of vehicles some 50 men on horseback held in reserve nearly 100 dogs, mostly greyhounds. Guns of all kinds were ruled out of the final 'round-up,' and only lariats, dogs, and clubs were permitted as weapons.

The line of spectators was formed at 1 o'clock, but it was fully an hour before the driving divisions were heard or seen. In the south a beautiful mirage occupied the distant valley a white sheet of water bordered by trees. It was on the surface of this mimic lake that we first saw the riders galloping by twos. Soon after we faintly heard their distant shouts; and when the shouts began to come clearer, the coyotes also came up the valley by ones and twos, and at length by threes and fours before the swiftly moving horsemen. – 22 –

When the first wolf was still a half mile distant, the dogs were released and riders and dogs dashed to the front to head off the animals. Hemmed in in front and rear, they broke to the right and to the left, and many made good their escape through the thinner lines of the east and the west divisions.

The sport was fast and furious for a short time, but when a little Later the dead and captured wolves were brought together in the town, they were found to number only eleven in all. Two of them were roped by cowboys during the drive and killed with pistols. Two were dragged to death at the end of lariats. Seven were caught by the dogs in the round-up, and two of these were brought in alive. Many escaped, but it is impossible to estimate the number.

Such hunts have considerable influence in decreasing the number of coyotes and also afford an agreeable break in the monotony of frontier life. Their purpose, however, is never admitted to be that of sport, but to kill coyotes.

BOUNTIES.

Activity in the warfare against the coyote has been considerably stimulated by the payment of bounties from the public treasury of the States and counties. Nearly all the States in which coyotes occur have been for years maintaining such bounty systems. In some parts of the West these are supplemented by rewards from stock associations or ranch owners. The bounties from public funds have ranged from 25 cents to $5 for each animal killed, but supplementary payments sometimes make them as high as $15.

The subject of bounties in general has been already discussed by Dr. T. S. Palmer, of the Biological Survey.[G] Doctor Palmer refers to the California coyote act of 1891, which was practically in force only eighteen months, but which cost the State $187,485. As the bounty was $5 per scalp, this represented the destruction of 37,493 coyotes. Kansas, with a county bounty of $1 per animal, succeeds in destroying about 20,000 each year. In addition to the bounty, the pelt of an adult coyote is worth from 50 cents to $1.50, according to its condition. However, most of the killing is accomplished in spring, when the female and her young are dug out of dens and the pelage of the adults is not in prime condition.

[G] Extermination of Noxious Animals by Bounties. Yearbook U. S. Dept of Agr., 1896, pp. 55-68.

Doctor Palmer rightly concludes that in practice bounties for the destruction of noxious animals, paid from public funds, are usually objectionable. Probably those on wolves and coyotes have been more nearly justified than those on any other animals. While it is certain that the larger wolves have greatly diminished in numbers under the system, forces far more potent than mere rewards have operated against them. Chief of these has been the encroachment of civilization. Coyotes have in some places held their ground under bounties, and possibly might have been held in check nearly as well under the operation of the same forces that helped to decimate the timber wolves. But the observed effect on the coyote of contact with settlements hardly justifies such a conclusion. That the bounties in some places have done effective work is undoubted; the question is as to whether the results have been commensurate with the expenditures. However, the principal objection to bounties is the ethical one, that they lead to fraudulent practices.

PROTECTION AGAINST COYOTES.

The discussion of the various means of destroying coyotes, and the evident futility, thus far, of all of them combined to completely check the increase of the species, leads naturally to the consideration of means of preventing their depredations. Could domestic animals be entirely protected, the coyotes would return to their original beneficial occupation as scavengers and destroyers of noxious rodents.

The plan that at once suggests itself is that of fencing against them. This means of protection from wild animals has been long in vogue in the Australian colonies and in South Africa. In Australia rabbits, dingoes, and some species of kangaroos are successfully kept out of pastures and crops by the use of wire nettings. In Cape Colony jackals, particularly the red jackal (*Canis mesomelas*), are a great hindrance to sheep and ostrich farming, and the success attending the use of wire netting in Australia led to the introduction of similar fencing into South Africa. The result has been highly gratifying. While the cost of the fencing is high, the advantages from its use have been regarded as more than compensating for the outlay. Mr. T. T. Hoole, president of the Upper Albany (Cape Colony) Farmer's Association, in a paper read at a meeting of that society[H] gives details of ten years' experience with jackal-proof fencing. Among its advantages to sheep growers he names:

1. Decreased cost of herding.
2. Increased value of the wool, about 3 cents per pound.
3. Increased number of lambs reared.
4. Increased value, owing to early maturity and condition of stock.
5. Less liability to contagion from scab.

6. Reduced death rate.

7. Additional security of the flock.

8. Improved condition of pasturage as against deterioration.

[H] Agr. Jour. Cape of Good Hope, vol. 25, pp. 560-563, 1904.

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The last item alone he regards as more than repaying the entire cost of erection. Under the system of herding on the open veldt it becomes necessary to protect from wild animals by driving the sheep to a kraal for the night. In the vicinity of the kraal the ground is soon trodden bare, and deep parallel paths are worn in the surface. In a few years the torrential rains wash the paths into what are called 'sluits'—similar to the 'arroyos' of our own Southwest.

In the western part of the United States the practice of keeping sheep in vast herds has resulted in much deterioration of the ranges, due to overcrowding, and the cost of herding has absorbed much of the profits of sheep raising. The process of withdrawing lands for homesteads and the various reservations has diminished the free range and increased the crowding, until flock owners for their own protection have been compelled to purchase lands for range purposes. The day of free pasturage on public lands is fast passing, and with private ownership of ranges, fencing must be resorted to to confine the flocks. The additional expenditure necessary to make the fences proof against coyotes would be inconsiderable when all the advantages are properly weighed.

INVESTIGATIONS CONCERNING COYOTE-PROOF FENCING.

The Biological Survey has undertaken an investigation of the feasibility of successfully fencing against the coyote. If a coyote-proof fence of sufficient cheapness and durability to be practicable can be brought into general use for pasturage, there is no reason why the sheep industry in the west should not be revived and greatly extended. If such a fence should at the same time prove efficient against dogs, the benefit would extend to the whole country and result in an enormous increase of the productive resources of our farms. A coyote-proof fence would prove valuable, even if its use were restricted to corrals and small pastures for ewes during the lambing season.

The writer, under instruction from the Chief of the Biological Survey, spent several weeks in the field during October and November, 1904, making such investigations as were possible during the limited time at his disposal. For the purpose of testing the ability of coyotes to pass over or through fences a unique experiment was made. The place selected was Chattanooga, Comanche County, Okla. South of the town lies the great Pasture Reserve, a large area practically without fences to interfere with the chasing of wolves. Since coyotes were abundant and the cowboys skilled in their chase, it was not difficult to procure the needed animals in an uninjured condition.

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The experiment was made with all the forms of fence that could possibly be obtained or built with the limited resources of a new country. A long lane was first built, with sides 7 feet high, made with poultry netting of a small mesh. Fourteen cross fences of heights from 30 to 66 inches and of various designs were built at intervals along the lane. They were arranged so that the coyotes, introduced at one end of the lane, should have presented to them gradually increasing difficulty in passing the fences. Two coyotes were released singly into the lane, and their progress and methods of passing the cross fences were carefully noted. One was badly frightened by the presence and noise of dogs and men, but the experiment with the other was not made in public.

The coyotes ran with their noses close to the ground and seemed to have no knowledge of jumping. Neither of them succeeded in getting over a fence more than 36 Inches in height. The method was one of climbing, assisted by the hind feet, rather than of jumping. All attempts to pass the obstructions began with efforts to get the muzzle through openings. If the entire head could be thrust through and there was enough room for the shoulders to spread out laterally, the whole wolf was able to follow. Both went through rectangular openings, 5 by 12 inches and 5 by 8 inches, but the larger animal failed to pass a mesh 5 by 6 inches. The smaller animal went through an opening 4 by 12 inches and another 5 by 6 inches. Had these openings been triangular in form the animal could not have passed through.

The following conclusions were drawn from the experiments:

1. Prairie coyotes will not willingly jump over a fence above 30 inches in height.

2. They will readily climb over fences built of horizontal rails or crossbars, especially in order to escape from captivity.

3. Barbed wires do not deter them from crawling through a fence to escape. Whether they would go through a closely built barbed wire fence to attack sheep or poultry is still an open question.

4. Woven wire fences should have meshes, when rectangular, less than 6 by 6 inches to keep out coyotes. For such fences triangular meshes are much better than square ones.

5. In fencing against coyotes with woven fences care must be used to see that there are no

openings at the ground through which the animals can force themselves, since they are more likely to crawl under a fence than jump over it.

In the experiments the animals, under some excitement, were attempting to escape from confinement. In the judgment of the writer, the experiments are insufficient to determine what a coyote would do if the conditions were reversed and, impelled only by the stimulus of hunger, he were attempting to enter an inclosure built of these fences. The barriers would surely be far more formidable. Experiments with certain types of fence, with sheep inclosed within them, and in a country with wolves as plentiful as they are at Chattanooga, would be far more conclusive in establishing a safe basis for practical recommendations to farmers.

The writer interviewed a number of farmers in Kansas who have had experience with poultry and farm animals in coyote-infested country. Several of them had for some years been using for corrals and small pastures woven wire fences, and had found those from 57 to 60 inches high entirely coyote-proof. These fences have triangular meshes and are of sufficient weight to be suitable for all kinds of stock. Such a fence, if set with the lower edge on the ground and anchored down where necessary, can safely be recommended as coyote-proof. Their cost, however, is possibly too great to bring them into general use for sheep pastures. Where land is valuable and pastures of the best, they will prove economical, for they have the merit of being both dog-proof and coyote-proof. Dogs, both large and small, that by chance get inside the inclosures are unable to get out, and have to be let out by the gate.

Between these rather expensive fences and the cheapest form that may be found efficient many grades may exist. In experiments to determine the efficiency of any form it is necessary to consider the familiarity of the animals with fences in general. In a new country a very simple fence might be ample at first to keep out wolves, but ultimately would prove insufficient.

Mr. T. T. Hoole, of Cape Colony, Africa, in the paper already quoted, gives the following experience in determining upon a jackal-proof fence:

> My first importation of 2 foot 6 inch netting served its purpose for a year or more, when I found the jackals as troublesome as over. The addition of a single barbed wire assisted for a time: but after some years of experience and comparing notes. I found that nothing short of a 3-foot netting and four barbed wires would be effective. I have given the above particulars of my experience as a warning to the inexperienced, that half measures are simply a waste of money and that badly erected fences, although effective for a time, will end in disappointment and failure.

Mr. Hoole has 18 miles of the fence just described, while a neighboring stockman has 45 miles built. The cost, including labor, when built of the host material—sneezewood posts and kangaroo netting—was estimated at £106 per mile—about $500. This fence was designed for ostriches, cattle, springboks, and sheep: a fence intended for sheep alone could be built for less. Materials and labor are both much more expensive than in the United States. A fence similar to that described by Mr. Hoole could be built in most parts of the West for about $200 to $250 per mile.

A writer in the Nor' West Farmer states that when he first began sheep raising in Manitoba a 2-strand barbed wire fence was a complete barrier to the coyotes, but that in less than two years they became used to it and would go under or between the wires without hesitation. More strands were added without effect, until a woven wire fence was adopted, which proved satisfactory.

In South Africa three types of fence have been in use for protection against jackals, and each has advocates among the farmers. The cheapest is built of strands of barbed wire placed close together and stayed at intervals by light strips of wood fastened to the wires by staples. In the second form the staying is done by light, smooth wire woven in by machinery, involving more labor in the building. The third type is that recommended by Mr. Hoole. It is more expensive, but seems always to have stood the test of experience. The others have not always been satisfactory, but their advocates claim that the fault has been in construction and not in design. The jackals have entered the inclosures through openings at the ground.

Mr. J. H. Clarke, of Laytonville, Mendocino County. Cal., has for several years succeeded in fencing coyotes from his sheep range. In a letter to the Chief of the Biological Survey, dated March 1, 1905, he describes the fence and relates his experience:

> The fence, inclosing nearly 4,000 acres, consists of redwood pickets 6 feet long driven into the ground 1 foot and leaving spaces or cracks not over 4 inches wide; posts 8 feet long and driven 2 feet, projecting 1 foot above the pickets; two barbed wires stapled to the posts 5 inches above the pickets and the same distance apart. These should be on the outside of the posts. The pickets are driven evenly by using a slat as a guide at the bottom and a line at the top. One barbed wire is placed at the bottom on the outside to prevent digging. The pickets are fastened to a No. 9 cable wire with a No. 13 wrapping wire. The posts are set 12 feet apart, or less, according to the surface—at top and bottom of each rise or indentation.
>
> Where gulches or small streams are crossed boxes and gates are put in. Where larger streams are encountered a dam is first put in and the gate so swung as to rest on or against the dam head in the dry season.
>
> The cost of construction varied from $320 to $400 per mile. Galvanized wire was used, and of the barbed the thickest-set four-pointed wire obtainable. If four-point wire could be had, with sharp points set not over 2 inches apart, the top wire might be dispensed with.
>
> While this fence was begun in 1897, it was net finished until three years ago. It was partly

> experimental at first, and at the end of the second year only that portion of the range used for lambing was inclosed with a coyote-proof fence. We do not know that a coyote has ever scaled or jumped it. A very large coyote that got in through an accidentally 'propped' floodgate, though chased by dogs all day, could not be made to jump out, even when cornered. Considering the steep, wild, and broken nature of the country, with several 'slides' in the fence that could not be avoided when building, and which move and displace the fence during hard storms, it is net surprising that a few coyotes have gotten in. Fortunately, partition fences have aided in the capture of those before much damage was done. Two obstacles are encountered in keeping up this fence—trespassers, who cut or break a picket to get through, and slides.
>
> Coyotes are very persistent, and when they see young lambs on the opposite side will follow the fence for miles, trying to find a hole. * * * None have gotten in this season.
>
> When we began to fence against them the coyotes wore literally driving sheep out of the country. * * * Horses and cattle have taken their places, but return less than half the profit sheep did prior to the coyote's inroads. Excessive rains in winter and irregularity of landscape preclude the practicability of close herding. With us it was either abandon sheep or fence the pest out. Fortunately we adopted the latter.

While the fence used by Mr. Clarke is expensive, the complete success of his experiment is of much interest. In most parts of the West woven wire would be cheaper than pickets and would require less labor in its erection. Where the land is as uneven as that just described, the use of woven wire may be impracticable.

Mr. D. W. Hilderbrand, of California, who has built coyote fences for ranchmen in the San Joaquin Valley, recommends a 3-inch mesh woven wire fence 36 to 40 inches in height, with two barbed wires on top, 5½ inches apart, and one at the bottom. He recommends that the posts be set 20 to 30 feet apart.

From data now available it seems reasonably certain that a fence constructed of woven wire with a triangular mesh not over 6 inches across, and of a height of 28 to 42 inches, supplemented by two or three tightly stretched barbed wires, would prove to be coyote-proof. It is difficult to make exact estimates of the cost. Woven fences differ in weight, price, and durability, and freight charges on materials depend on the distance from distributing points. The cost of posts and labor varies much. An estimate based on so many variable factors is of little value, but an average of $200 per mile would probably allow the use of the best materials.

Further experiments with wire fences will be made by the Biological Survey in cooperation with sheep growers in the West, and the results will be given to the public as early as practicable. The matter is one of great economic importance, and the Survey will welcome correspondence with persons interested in the subject.

Transcriber's Note

The total number of coyotes in the table on page 10 was changed to match the sum of the numbers in the table. Cover image was produced from an image made available on The Internet Archive and placed in the Public Domain.

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