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THE COMMON GROUND SQUIRRELS OF CALIFORNIA.

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Two rodents in the State of California give the rancher more trouble than all the other animal pests combined, insects excepted. One, the pocket gopher (*Thomomys* sp.), feeds largely on the roots of plants and trees and hence is one of the worst pests of the garden and orchard. The other, the ground squirrel (*Citellus* sp., *Ammospermophilus* sp., *Callospermophilus* sp.) is especially destructive to grain, but it is also destructive to nuts and fruit. The established fact that the California ground squirrel is instrumental in spreading bubonic plague has made these animals of more than ordinary economic importance.

These two principal rodent pests are easily distinguished by their general appearance, size, habits, and burrows. The pocket gophers have very short ears, small eyes, short tails, and cheek pouches which open externally; they are relatively small (6 to 10 inches), largely nocturnal, and live almost entirely in their burrows. Ground squirrels have relatively large ears and eyes, longer tails, and the cheek pouches do not open externally; most of them are larger in size, diurnal, and forage for food above ground. The burrow of the pocket gopher can be distinguished by a mound of earth surrounding the entrance, and by the fact that the opening is nearly always kept plugged full of earth. The burrow of the ground squirrel on the other hand is usually open, with the excavated earth thrown out on one side of the entrance only. One or more runways lead away from the burrow.

According to Merriam,¹ the ground squirrels of California may be arranged in four groups: (a) the large, long-eared gray ground squirrel (subgenus *Otospermophilus*); (b) the small, short-eared, brownish species (genus *Citellus*); (c) the small, white-striped, antelope ground squirrel of the deserts (genus *Ammospermophilus*); (d) the golden-mantled ground squirrel of the mountains (genus *Callospermophilus*).

The "digger" ground squirrels (*Citellus* sp.), which belong to the subgenus *Otospermophilus*, are not only the most destructive, but are the disease carriers (Fig. 1). These ground squirrels usually live in colonies, their burrows often being connected for a considerable distance. Food in the shape of grain, seeds, and fruit is stored for the winter season. The call note is a single loud whistle. The warning note is a similar short whistle followed by two or three chattering trills. Young, numbering from five to ten, are usually born in March and April. This ground squirrel has been found infected with bubonic plague, and several cases of human plague have been traced to a bite

¹Merriam, C. Hart. 1909. California Ground Squirrels. Treas. Dept., Public Health Reports. vol. 23, no. 52, pp. 1-8.

of one of these animals. The real danger of the spread of infection lies in the dissemination of infected fleas. As has been shown by the recent campaign against these ground squirrels, carried on by the U. S. Public Health and Marine Hospital Service, eradication of this pest depends largely on persistent work of the individual.

This group of long-eared gray ground squirrels has a wide range, being found throughout the State. Several species and several varieties of each have been recognized. Each variety or subspecies occupies a fairly well-defined region of the State, so that they can usually be distinguished by the locality in which they are found. The northern coast form is known as the Douglas ground squirrel (*Citellus douglasi*); that of the interior valleys, as the California ground squirrel (*Citellus*

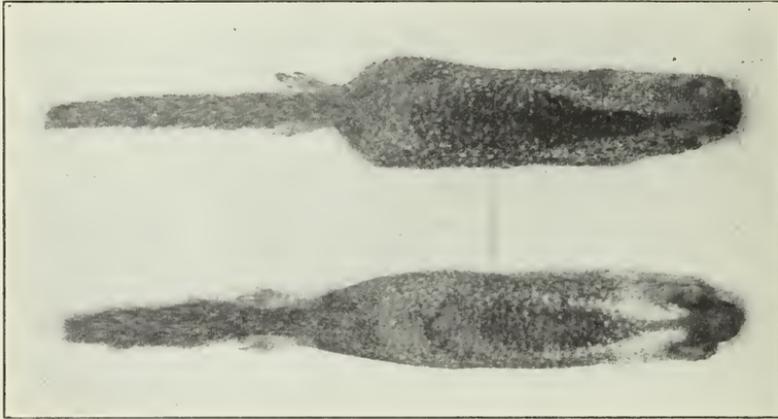


FIG. 1.—Two varieties of the common “digger” ground squirrel of California, found throughout the State. The squirrel above is the Douglas ground squirrel (*Citellus douglasi*), found along the coast north of San Francisco Bay; the one below is the California ground squirrel (*Citellus beecheyi beecheyi*), the common ground squirrel of the interior valleys and the carrier of bubonic plague.

beecheyi beecheyi); and that of southern California, as the Fisher ground squirrel (*Citellus beecheyi fisheri*).

In the extreme northeastern corner of the State and to some extent in the northern part, a smaller brown ground squirrel is found in abundance. It is known as the Oregon ground squirrel (*Citellus oregonus*). The ground squirrel of the desert is much smaller than the common “digger” squirrel and is striped. It is called the desert or round-tailed ground squirrel (*Citellus tereticaudus*). A small striped form belonging to another genus (*Ammospermophilus*) is found to a limited extent in the San Joaquin Valley, and a variety of the same species in the rocky places in the deserts and foothills bordering the deserts. These forms are known as the Nelson ground squirrel and the Antelope ground squirrel. Neither are abundant enough to be of great economic importance. Golden-mantled ground squirrels (*Callospermophilus* sp.), more often called red-headed chipmunks, are mountain species and seldom give trouble (Fig. 2).

CONTROL OF GROUND SQUIRRELS.

H. J. QUAYLE.

There are two methods of destroying ground squirrels: first, by means of poisoned grain, and, second, by the liberation of carbon bisulfid in their burrows. Which of the methods to be followed will depend upon the season, the poison grain method being more effective during the dry season, while the carbon bisulfid treatment will be more effective during the rainy season when there is sufficient soil moisture to prevent the general diffusion of the gas beyond the open burrows.

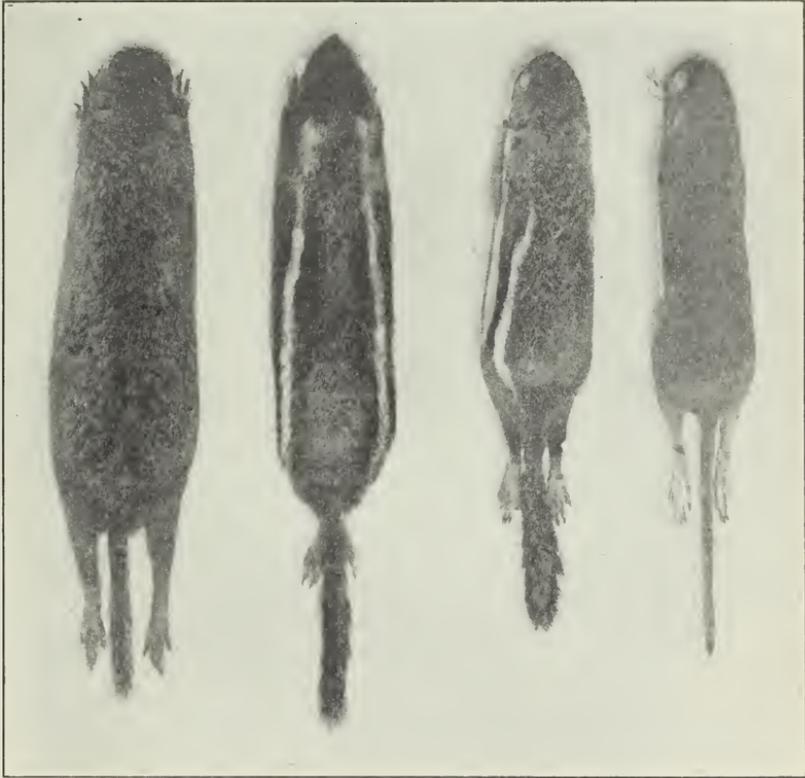


FIG.2.—Arranged from left to right are the ground squirrels of less economic importance in California, the Oregon ground squirrel (*Citellus oregonus*), golden-mantled ground squirrel (*Callospermophilus chrysodeirus*), Antelope ground squirrel (*Ammospermophilus leucurus*), and the desert, or round-tailed ground squirrel (*Citellus tereticaudus*).

Where ground squirrels are abundant over considerable areas, the simplest, most effective and least expensive way to destroy them is by the use of poisoned grain. Barley is the grain to be preferred, since it is more attractive to the squirrels and less likely to be eaten by birds.

The formula and method of preparation are as follows:

Clean barley	20	quarts.
Strychnia sulphate (ground or powdered)	1	ounce.
Saccharine	1	teaspoonful.
Gloss starch (ordinary laundry starch)	$\frac{1}{2}$	teacupful.
Water	$1\frac{1}{2}$	pints.

Dissolve the starch in a little cold water and add $1\frac{1}{2}$ pints of boiling water, making a rather thick solution. While hot, stir in the strychnine and mix until free from lumps; then add the saccharine and beat thoroughly. Pour in the poisoned starch over the barley and stir rapidly until the poison is evenly distributed; then allow the grain to dry. When dry it will keep indefinitely without deterioration.

By this method a coating of poison is formed on the outside of the grain, which acts much more quickly than if the grain is boiled or soaked in the poison. Squirrels are also readily killed by carrying such coated grain in their cheek pouches while storing food for future use.

PUTTING OUT THE POISON.

The poisoned grain should be scattered (not placed in heaps) on clean hard places about the colonies, the trails between the holes, along fences and roadsides and other places frequented by the squirrels. The time to apply it is during the dry season. If distributed just at the end of rainy season, late March or early April, it will destroy them during the breeding period, when one killed is equivalent to eight or nine later in the season. The poisoning may continue, however, throughout the summer and early fall. This poisoned grain as it is scattered about is not dangerous to stock, but is fatal to poultry.

COST.

The cost of preparing the material according to the formula given varies from about \$4.00 to \$4.75 per 100 pounds. One hundred pounds of the poisoned barley is sufficient to treat 200 or 300 acres. It may be distributed from horseback.

CARBON BISULFID.

A tablespoonful of crude carbon bisulfid is poured over a small ball of cotton waste, corn cob or other absorptive material and placed as far down the burrow as possible, and the hole is tamped in.

It is used to best advantage when the soil is wet. In wet soil the interspaces are filled with water and thus general diffusion of the gas through the soil is prevented.

Carbon bisulfid is a volatile liquid and rapidly loses its strength on exposure to air. It should therefore be kept in tight containers. It is also inflammable and explosive. It should be used only in burrows known to be inhabited by squirrels. The cost of crude carbon bisulfid is about 8 cents per pound in 50-pound carboys or drums.

The two methods described, poisoning and the carbon bisulfid treatment, may well supplement one another. Where the area is extensive the poison may first be used, because of its cheapness, and this followed in the proper season with the carbon bisulfid to clean up those that escape the poison.

Small areas may be freed from squirrels, but these are likely to be quickly reinfested again from the neighboring territory. It is often important, therefore, for the people of a district to unite in a coöperative campaign and free large areas from the squirrel pest.