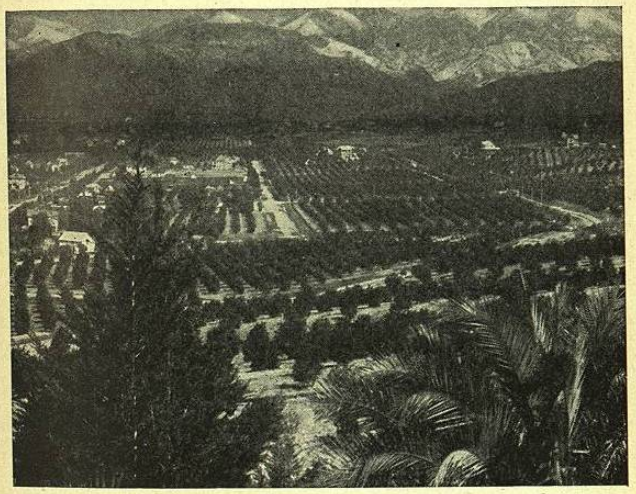
directly reversed as regards acreage, the grazing land having the greatest extent, and the irrigated land the least, with the maximum value per acre.

The forests of the arid region not only mark the greatest rainfall, but also indicate the locality from which come the principal streams. The head waters of nearly all of the rivers which give value to the lands are within forested regions (Pl. V.) It is commonly known that the forests to a certain extent protect, or even regulate, the flow of these streams, and it has been urged that the largest and best development of the country requires the conservation of the forests along the head waters.

Forest conservation is practicable, when joined with a proper cutting of the timber. Experience has shown that the removing of the mature or ripe trees, such as are best adapted for lumber, may improve the general conditions of the forests. Virgin forests finally reach a stage where decay balances growth, and it is clear that matured trees should be cut and utilized before they have lost their value, their place being given to the younger and thriftier growth previously retarded by the shade of the older trees. From the commercial standpoint trees have first value for lumber. Fortunately the proper use of the forests in producing lumber is not antagonistic to their preservation and to the perpetuation of favorable conditions of water supply.

A. FORESTS PARTLY DESTROYED (THE DRAINAGE FROM THIS IRRIGATING THE FIELDS SHOWN BELOW).



B. CULTIVATED FIELDS RECEIVING WATER FROM THE PARTLY FORESTED MOUNTAINS.

Public sentiment has been aroused to such an extent that steps have already been taken to preserve many of the forests of the head water streams of the West, primarily for the beneficial influence the leafy cover may have upon the river flow. The national government has set aside over 90,000,000 acres of the forests and adjacent woodlands, and efforts are being made to preserve all the remaining large bodies of public forests thus situated. This first step is being followed by an administration which will preserve the forests from their great enemy, fire, and will ensure a businesslike treatment of them, under which they will yield a revenue.

Protection and conservative management of the forest at the head waters of the streams will conserve the water supply, while the returns from timber sale and grazing privilege will more than pay the cost of management.

The accompanying small map (Fig. 9) exhibits the general distribution of the forests of the West, dark spots marking the mountains or highlands. On this map the black portions indicate the relative position of the areas upon which trees of commercial value are growing, or have recently grown; the areas surrounded by an irregular line indicate the wooded localities and lower mountains upon which are scattered trees whose size or condition is such that they are not suitable for lumber, although they have great value to the settler and

farmer in the way of furnishing cheap fuel and material for fence posts and for building cabins,

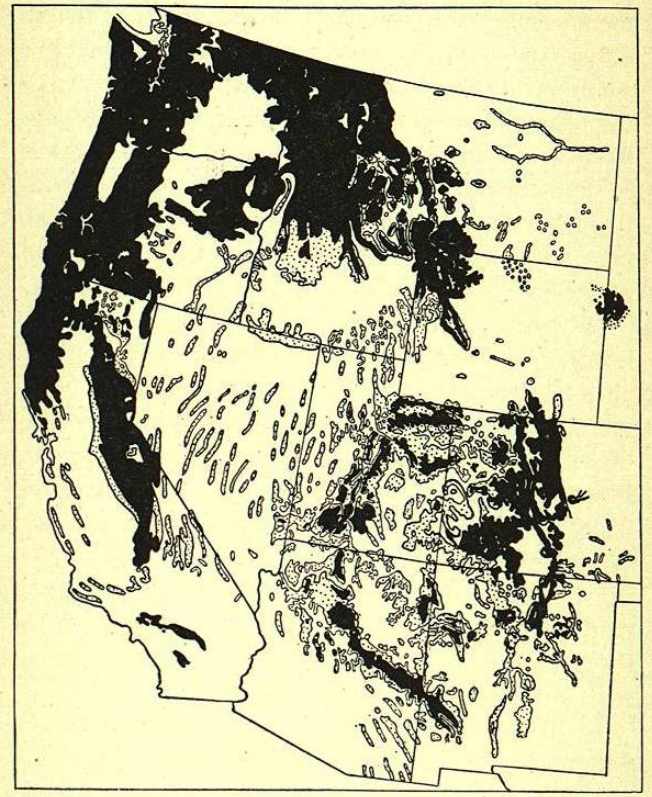


FIG. 9. — Forests and woodlands of the West.

corrals, and shelter for cattle. Much of the open woodland has been wisely included in forest reserves, since the trees, though scattered, are extremely valuable as protection cover.

The forest reserves already created do not by any means embrace all the public lands covered with valuable trees. Each reserve has been set aside for some specific purpose, particularly with reference to the protection of the head waters of streams used in irrigation. The relative location of these reserves is shown in Fig. 10, on page 34, in connection with the areas of arid land whose reclamation is now being undertaken by the government under the terms of the Reclamation Act of June 17, 1902.

On this map the spots in solid black indicate the location and extent of the lands which will probably be irrigated by the works built by the government with the proceeds of the disposal of public lands. These black spots are surrounded by an irregular outline, which indicates the area within which lands have been temporarily set aside for examination pending the final determination of the exact area to be watered. A glance at this little map shows the relative extent and importance of the forest reserves, and their size, as compared with the tracts which are being watered.

In the drawing have been included the areas within the Yellowstone, Rainier, and Yosemite national parks, although the control of these is distinct from that of the forest reserves proper. The care and protection of the forest reserves has, by Act of Congress approved February 1, 1905,

been transferred to the Department of Agriculture and a forest service created for their administration. This service now has entire jurisdiction and control of the cutting of timber and the grazing of sheep

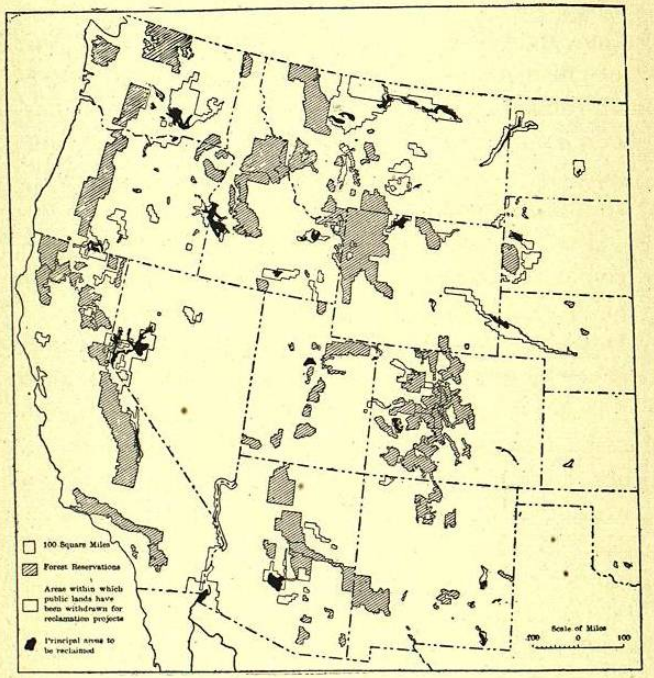


FIG. 10. — Relative position of the forest reserve and national irrigation projects.

and cattle; but does not have charge of the land titles, or matters pertaining to real estate ownership, or boundary surveys. The matters of title are left with the General Land Office, but the

conduct of the general survey of the regions within and adjacent to the reserves has been intrusted to the Geological Survey. Detailed topographic maps are being prepared, showing all elevations of the surface, the streams and their catchment areas, the extent of burns resulting from fires, the amount of cutting, and the location of roads, trails, houses, or cabins. Upon the topographic base thus prepared are also shown, by appropriate colors, the general character and commercial value of the standing timber.

Following the mapping of the forest reserves comes the systematic examination and preparation of working plans by the Forest Service of the Department of Agriculture. This bureau, which is working in close coöperation with the Geological Survey, examines the forests with great detail in respect to the character and condition of the timber, in order to obtain facts upon which to base working plans — that is, recommendations or outlines of methods to be pursued in the cutting and removal of the timber so as to yield the largest returns, and at the same time to leave the forest in condition to insure future revenue, and to increase the percentage of valuable trees. By an efficient protection from fire and by following carefully considered working plans, it is possible to enlarge the wooded areas upon the head waters of streams of the arid West, and to increase the beneficial effect, in regulating the flow of the streams upon

which the irrigators depend, thus serving a double purpose in assuring to the settler a never failing supply both of timber and of water.

GRAZING LANDS.

By far the greater portion of the arid West consists of open grazing lands. These vary in their covering of forage plants from the extremely scanty vegetation of the deserts up to the thick turf which is to be found within the mountain parks. The broad sandy deserts occasionally receive a downpour from the local storms or cloudbursts, and there springs up at once a scanty herbage, which, though apparently dry and woody, is nutritious and is eagerly sought by the cattle. On the less arid plains there are to be found every year a number of grasses and smaller plants or shrubs, which, drying under the intense heat, become in effect naturally cured hay, and which, though sparsely distributed, thus furnish sustenance for horses, cattle, and sheep.

As summer approaches and the heat upon the deserts and plains becomes intolerable, the herds and flocks gradually move up into the mountains, and find excellent grazing upon the broad slopes and open spaces within the forested areas; thus a considerable part of the land shown on the small map (Fig. 9) as wooded and forested is also of value for grazing. The interests of the cattle owner, and especially the sheep owner, and of the

forester are sometimes at variance, since the cattle, and more particularly the sheep, when the country has been overgrazed, browse upon the young herbage and prevent the growth of small trees; so it is often important to exclude sheep, and even cattle, from the forests in order that the trees may reproduce themselves. The extension of forest reserves has been frequently opposed by the sheep and cattle interests, and the administration of the reserves has been hampered by the demand for free grazing upon the public lands. This opposition has now ceased; moreover the policy of permitting grazing under regulation on the forest reserves has to a great extent done away with the opposition to them. The grazing fee where charged is small, drift or division fences are allowed under certain conditions, and special concessions are made to protect and assist home-builders or those who are trying to live upon the small farms near the reserves.

The sheep industry is one of the most important of the arid regions, and the profits are large, so that from a commercial standpoint it is highly important that the grazing lands extend as widely as possible, even into the forest reserves. Working plans for the forests have been prepared, such that, while preventing overgrazing, they will permit the use of the forests as a summer range with a minimum amount of injury to the young growth. A general plan has recently been adopted, which it is hoped will ulti-

mately satisfy the irrigators on the one hand, who are concerned in protecting their water supply, and the sheep owners on the other, who demand that their flocks shall graze wherever young plants can be found.

Forest protection and sheep grazing are not wholly incompatible, for there are certain forested areas where sheep have been and can be allowed to run without serious damage. The exclusion of sheep from the forest reserves should, where necessary, be brought about gradually, so as not to injure this important industry, and the conditions of each locality must be carefully considered before sheep and cattle are either excluded or permitted to graze. The tendency undoubtedly will be to restrict the wide range of the sheep and to bring the industry to the conditions prevailing in older, settled communities, where the sheep are fed through a considerable portion of the year upon improved pastures, or with forage raised by irrigation.

The approximate location and extent of the open or free grazing land are shown in the accompanying map (Fig. 11), the crossed lines indicating the lands where, for the most part, sheep, cattle, and horses graze freely. Some of this is in private ownership, particularly in western Nebraska and Kansas. Texas has been excluded, as the state has sold or leased nearly all of its grazing lands to large cattle owners and the range land is nearly all enclosed by fences. The scale of the map is too

small to exhibit deserts and mountain tops where no forage plants are found. The sketch emphasizes the fact that throughout nearly one-half of

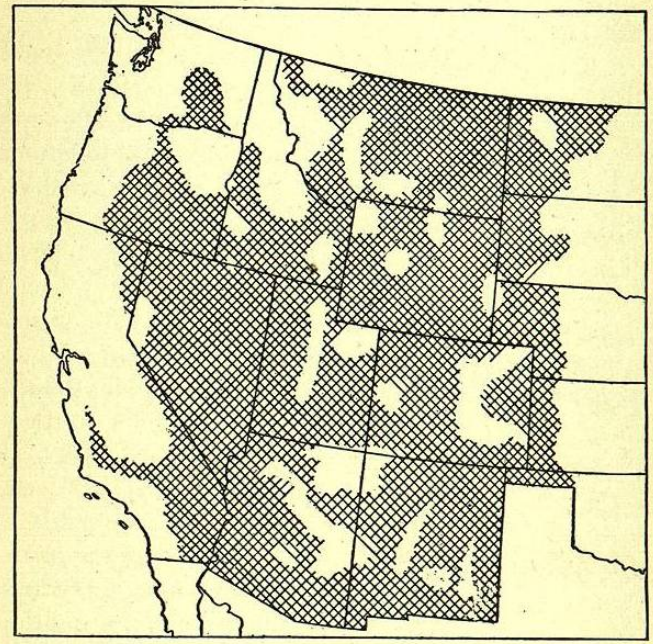


FIG. 11. — Approximate location and extent of the open range.

the United States grazing is the principal industry. Any plan of reclamation and utilization of the vast arid areas must take cognizance of this fact and be shaped accordingly.

Irrigation may be regarded from one standpoint

as an outgrowth or later development of the grazing industry, especially in the more northern part of the arid region. In the early days the sheep and cattle on the open ranges at the approach of cold weather were brought into the lower valleys or sought natural shelter. During severe winters the losses were very large, occasionally one-half of the stock dying during long-continued or extremely stormy weather. With the increase in the business and the overstocking of the ranges, the necessity of providing winter feed for the young or less vigorous animals became more evident, and at the home ranches small areas began to be irrigated in order to provide forage for the winter.

This process has continued to a greater and greater extent, until a balance has been reached between the available summer range and the winter food supply raised by irrigation; that is to say, a cattle owner can maintain as many animals as he can feed for two or three months with forage raised by irrigation, provided he can obtain sufficient range. If, however, his summer range is limited or is partly injured by the incursions of sheep, he may find it economical to reduce the amount of feed raised by artificial watering.

The tendency in the stock-raising business is toward an increase of small owners and decrease of great herds and flocks, owing to the competition for summer range and the necessity for providing an increased amount of winter feed. There is a

gradual evolution from stock raising toward what is sometimes known as stock farming; that is, the owner of a relatively small herd is tempted to put his irrigated land into other crops besides forage, or to raise an additional amount for sale in local markets. Thus, in the stock-raising districts there is a gradual development toward intensive farming.

Nearly every settler upon the public domain, even though intending ultimately to raise the ordinary farm crops and fruits, requires for a time a certain amount of grazing land. He must have a few draft animals and dairy cows, and, as a rule, finds it profitable to own a small herd of cattle or a band of sheep. He desires and needs the use of the public land in his vicinity, in order that he may herd his cattle near his home and bring them in each day or at frequent intervals.

Under existing law the settler who is making a home has no legal claim or right to the use of this public land other than the right possessed by every citizen of the country. Thus, there frequently occur acts which seem to the settler to be grossly unjust, in that cattle or sheep belonging to some non-resident individual, or to a wealthy corporation, may come upon the land in his vicinity and destroy all of the nutritious vegetation, leaving his own cattle to starve. Since the settler is trying to make a home and is paying taxes for the maintenance of law and order, he feels that he has a superior right to the use of the unoccupied land, at least

until the land is wanted for homes by other settlers, or until he is in position to raise by irrigation sufficient forage for his cattle. Thus the settler is often at war with the cattle and sheep owners, and many areas which might have been utilized for homes have been kept vacant through fear of depredations by the cattlemen or even as the result of open violence.

On the free range there are also controversies between rival live-stock owners, and particularly between the sheep owners and the cattlemen. The manner in which sheep are handled usually gives them a great advantage in the use of the open range, and as they feed much closer than cattle, if unrestricted they will drive the latter out. With the growth of the wool industry, the range devoted to cattle is being encroached upon, and many of the owners are disposing of their herds and going into the sheep business, finding it possible to make a living on the public lands by sheep grazing when not successful with cattle.

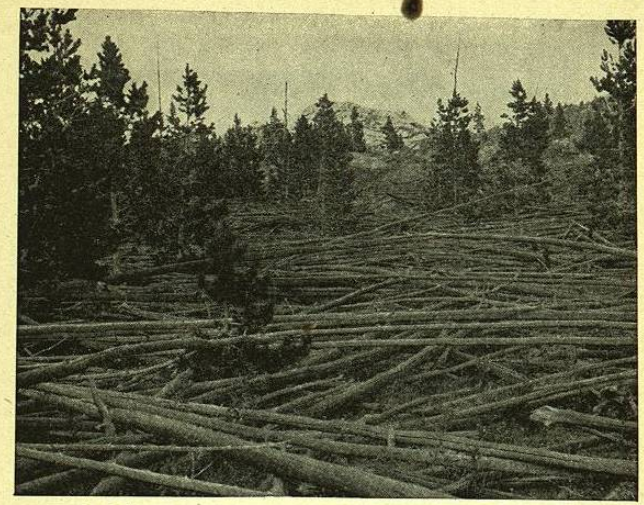
In many localities there has come about what may be termed an armed neutrality among the various interests concerned with the use of the public land. The settler and irrigator, having obtained a foothold, has been able by combining with his fellows, and by show of force at times, to secure for himself the use of certain pieces of public land for grazing. The cattle companies and larger owners have, as a rule, found it good policy not to encroach upon the settlers who are already

established, and have combined with these men to exclude sheep from the cattle range used by all in common. The sheep owners, after various conflicts and conferences, have agreed to abide within certain other ranges, and for a time at least peace has been assured and all have been fairly content.

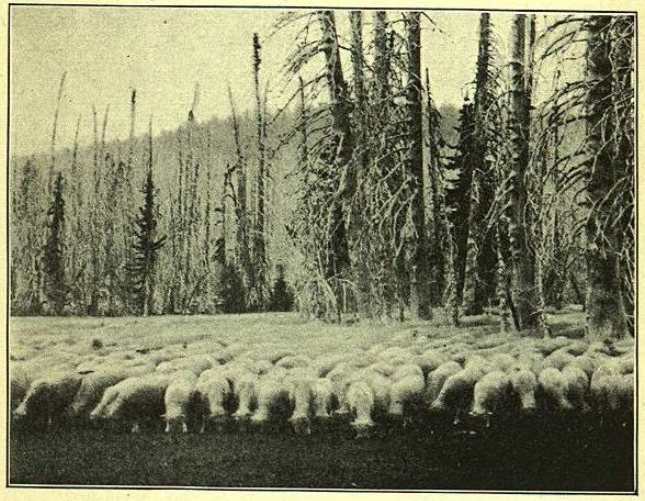
The condition just noted is an unstable one, likely to be upset at any moment by the gradually increasing herds of one or another of the parties to the mutual understanding, or by erratic bands of sheep. For example, by tacit consent a certain mountainous or hilly area may have been set aside for cattle grazing for the benefit of the inhabitants of a portion of a county. It has frequently happened that the owner of large bands of sheep in another state, learning that the grazing is good in this area, sends great bands (Pl. VI, *B*) aggregating fifty thousand or one hundred thousand sheep through this part of the country, travelling toward the mountains or market. Such hordes of sheep, progressing slowly, literally destroy all edible vegetation, devastate and ruin the land, and completely upset all local customs and privileges. Occasionally an inundation of this kind is resisted by force, and from time to time local newspapers have a brief item to the effect that an unknown sheep herder was found dead in a remote spot, or that bands of sheep have been dispersed or driven over cliffs by unknown persons.

With the uncertain conditions surrounding the use of the public lands, it is a natural consequence that practically all the farmers and irrigators of the arid region, as well as the stockmen, ask that there be accorded the grazing lands some definite treatment by which, pending complete or final settlement, temporary rights may be had to the use of the forage. It is highly essential for all concerned to be able to enjoy undisturbed possession from year to year of certain lands to be used for grazing purposes. For such a license the owners of the sheep, cattle, or horses are willing to pay a suitable compensation.

The necessity of restricting grazing on portions of the public domain has become apparent, particularly in Arizona, where in the southern part of the territory there are areas upon which the industry has practically exterminated itself. In one locality in the vicinity of Tucson, where formerly 20,000 head of cattle ranged, only a few hundred can now find subsistence. This is due to the fact that some years ago, when there was a decline in the value of cattle, the shipments were reduced and the herds multiplied. Then came a season when the drought was severe, the feed became scanty, and the starving cattle ate practically every living shrub, digging down even to the roots, so that plants and cattle perished together. The few cattle remaining have been sufficient to prevent the forage plants from spreading again, but where small areas have been



A. YOUNG FOREST GROWTH SUCCEEDING A FIRE.



B. SHEEP GRAZING IN THE FORESTS.

enclosed the native grasses have come back and are flourishing.

This natural recovery of the enclosed range has been demonstrated by the Agricultural Experiment Station of Arizona. A field of 350 acres has been fenced and carefully studied, the conditions of rainfall, moisture distribution, and plant reproduction being observed. It has been shown that the grasses, when protected, not only spread over the ground, but also serve to obstruct the rapid run-off of the water resulting from the sudden and capricious storms of the country. The vegetation causes a greater portion of this water to sink into the soil, where it is stored for future use by the plants.

The Papago Indians of the Southwest, living by crude methods of agriculture, have learned how to make use of the erratic water supply and have demonstrated the practicability of storing flood waters in the soil. Whenever it rains and the water runs down the little gullies near their lands, every man, woman, and child turns out in the storm and builds small dams, or levees, holding the water as far as possible on the series of hastily constructed low terraces. When the water sinks in, they at once plant corn upon the wet surface, and as a result the tribe is fat and happy during the next winter. Observation has shown that even as small an amount of rain as 0.1 inches will cause running water on lands denuded by excessive grazing. If, however, this water can be held back by