for a population "greater than that of our whole country to-day" does not seem extravagant.

In comparison with such a possible development every other project or public work which the government is asked to undertake seems indeed insignificant. The dead and profitless deserts need only the magic touch of water to make arable lands that will afford farms and homes for the surplus people of our overcrowded Eastern cities, and for that endless procession of home-seekers filing through Castle Garden.

The national government, the owner of these arid lands, is the only power competent to carry this mighty enterprise to a successful conclusion, to divide the reclaimed lands into small farms for actual settlers and home-builders only, and to provide water for the settlers at a price sufficient merely to reimburse the cost of the work.

When the plans for irrigation suggested by President Roosevelt and Secretary Hitchcock are carried out, every section of this country will be benefited. The East and Middle West will find in that regenerated empire a market for machinery and manufactured products of every description; the South will find ready sale for the fabrics of her cotton looms; while the farmers of the reclaimed regions will send the cereal products of their acres across the Pacific to the swarming millions of the Orient. Viewed from every standpoint, the national irrigation movement is full of promise to the nation.

CHAPTER XV.

RECLAMATION ACT.

THE predictions made in the preceding paragraphs have been verified with almost startling rapidity. The people and Congress awoke at the call of the President and his assistants. The preparations and plans made through a decade reached fruition even more rapidly than had been hoped by the most sanguine of the advocates of national irrigation. The so-called Newlands Bill was taken up, modified by Congress, and finally became a law by the signature of the President on the 17th of June, 1902. This act set aside the proceeds from the disposal of public lands in the thirteen Western states and three territories. The money thus appropriated, amounting on June 30, 1905, to $27,770,815, is held as a fund to be drawn upon by the Secretary of the Interior for the survey and construction of irrigation works, the cost of which is to be returned to the fund in ten annual installments, to be paid by the owners of the lands benefited by the works. Operations under this law were immediately begun by the formation of what is known as the Reclamation Service, this being under, but not a part of, the Geological Survey,

the organization which for many years had been studying the water supply and topography of the arid regions and which was prepared to enter at once upon the more extensive and difficult work of actual reclamation.

The first operations were in the Salt River Valley in Arizona, where the people, in their anxiety to secure federal aid, had already taxed themselves and had raised funds for expenditure by the Geological Survey in getting ready such of the information as would be needed whenever the national agencies were ready to begin. At about the same time, work was begun in Nevada, where, through the far sight of Mr. Francis G. Newlands (then a representative — later a senator from Nevada), a large amount of definite information had already been accumulated and title secured to important reservoir sites. The needs and opportunities for reclamation in Arizona and Nevada were the most pressing of those in the entire arid West. Having put the work here in motion, the Reclamation Service next gave attention to other localities, and within four years from the time of the passage of the act construction had practically begun in each of the states and territories of the arid West where the conditions of land ownership were such that proper control could be had of the irrigable areas.

In the following paragraphs a brief outline is given of the principal work in hand. It would require another volume of the size of this ade-

quately to describe these works and to discuss the problems of construction, operation, and management which are confronting the agents of the government. The problems are difficult and vary in each locality; but it is confidently believed that, with the experience had and with the start already made, it will be practicable to overcome these difficulties in detail. The most important matter is to carry on the work under the general provisions of the law with such economy and effectiveness that the people of the country as a whole and the Congress will have continued confidence in the good management of the work and will be ready to assist whenever the need arises.

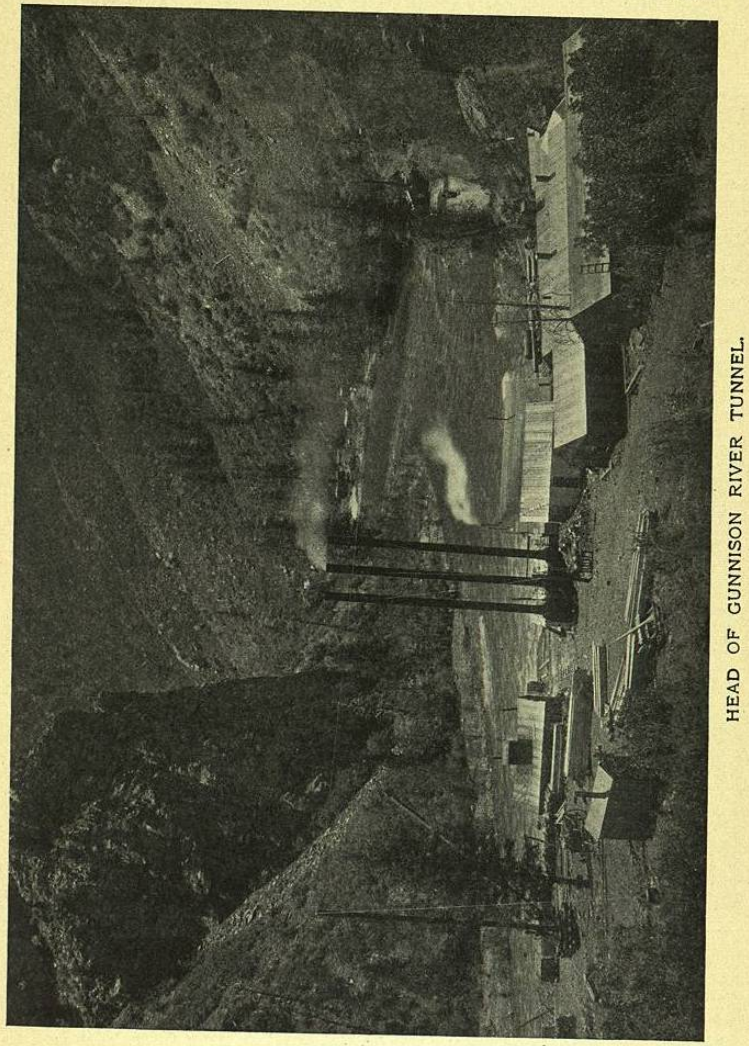
Arizona. — As noted in the description of this territory on page 307, the most notable opportunity for storing water is at the junction of Tonto Creek and Salt River. This is about 70 miles east of the city of Phœnix, where the structure known as the Roosevelt Dam is under construction with the object of storing the floods for a gravity supply of about 160,000 acres of land in the vicinity of Phœnix. A large amount of power will be developed at this point and utilized for pumping water from underground for an additional 20,000 or more acres. Nearly all of the land which will be irrigated is in private ownership and the prospect of an early supply of water has given this land, though desert in character, a large value. Twenty acres, or even less, of this valley land will, when carefully

cultivated, be sufficient for the support of a family.

California. — The principal operations in this state under the terms of the Reclamation Act are at the two extremes, the first on the lower reaches of Colorado River in the vicinity of Yuma, Arizona, the second on the Oregon border around the Klamath Lakes.

About 12 miles north of Yuma there is being built a low dam or weir, 4780 feet in length, extending across the Colorado River, for the purpose of raising the water about 12 feet and diverting it into canals, taken out on both sides of the river, irrigating fertile lowlands in California and Arizona down to the Mexican border. The climate and altitude are such that the most valuable semi-tropic crops can be produced, and under careful cultivation one or two acres, or possibly five acres, will be amply sufficient for the support of a family. The low alluvial lands along the river are protected by dikes, and the water is distributed over these lands through lateral ditches. It is expected that under careful management the products from this area will be fully as valuable, and will add as greatly to the prosperity of the state, as those from the valleys farther west in the vicinity of Los Angeles, as described on page 327.

Colorado. — In this state the principal work by the government is the tunnel nearly six miles in length leading from the part of Gunnison River



HEAD OF GUNNISON RIVER TUNNEL.

where it is in a narrow cañon, and extending under the high mountain mass to the broad valley of Uncompahgre River. A view of the heading of this tunnel is shown on Pl. LXIII. At this point is the power plant, the mouth of the tunnel being on the edge of the river at about the center of the picture. The tunnel starts in solid granite and ends on the valley side in soft shale, much of which is decomposed into clay. This soft material has been exceedingly treacherous, and it has been necessary to line the tunnel with timber, which in turn is embedded in concrete. A view of the timber lining before the concrete has been inserted is shown in Pl. LXIV.

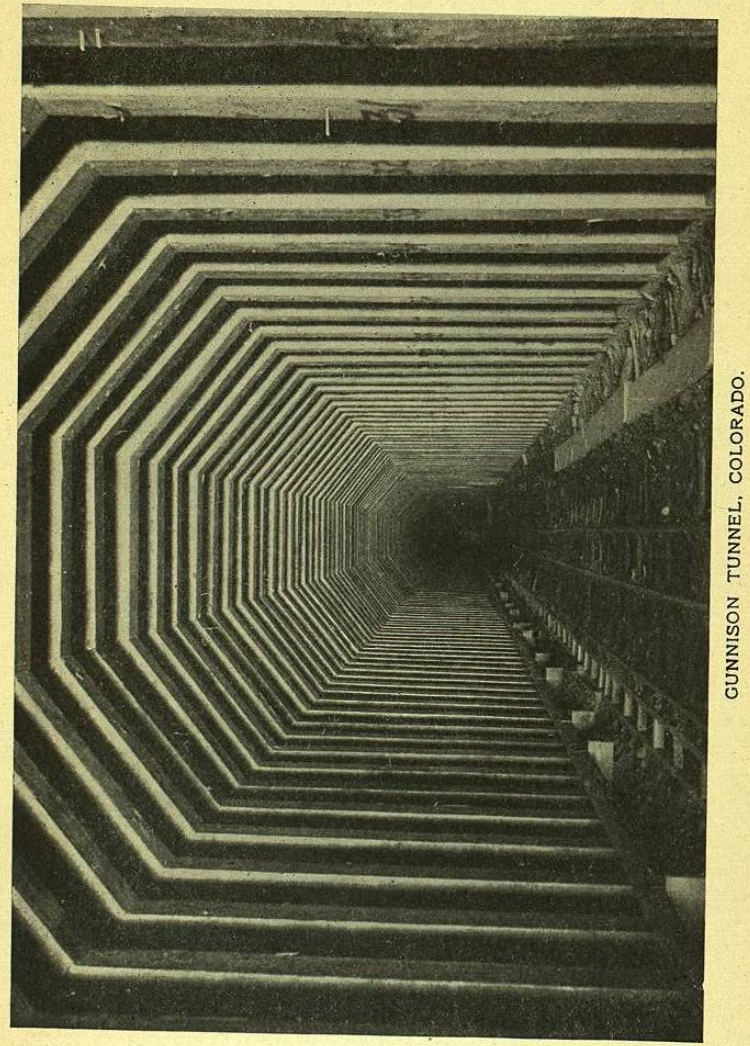
From this tunnel the water will be distributed by canals, taken out on both sides of the valley, watering about 90,000 acres of land, at an estimated cost of $30 per acre. This land is highly productive, the valley being already renowned for the excellent quality of apples, pears, peaches, and other fruit produced.

Idaho. — In southern Idaho, as noted on page 337, the chief interest centers around the use of the water of Snake River. The principal government works consist of a dam across this river and canals on each bank, taking water out on what is known as the Minidoka tract, a nearly level sage-brush-covered plain. The country is so flat that careful surveys were necessary in order to determine the direction of the slopes. The river has

been controlled by a great dam of loose rock with concrete core and the water taken out, mainly on the north side, to cover about 75,000 acres. The cost has been placed at $26 per acre. The land to be covered was at the beginning of the work all in public ownership, and the area has been subdivided into farm units of 40 or 80 acres. Settlement followed immediately upon the construction of the canals, and a number of towns sprang up with surprising rapidity. The rich desert soil is capable of producing, when watered, a vigorous growth of forage plants, fruit crops, and vegetables common to the temperate zone. Orchards of the hardier fruits flourish to perfection.

Kansas. — In the western part of this state large investments have been made, as noted on page 379, in the construction of gravity irrigation works; but these, as a rule, have been failures, owing to the diversion of water from the streams at points nearer their source. The sands or gravels which underlie the broad valleys are usually saturated with water, and it is practicable to pump some of this water to the surface with sufficient economy to utilize it in irrigation, particularly in the production of sugar beets.

The works of the government have been designed with reference to the possibility of bringing to the surface, by means of carefully planned pumps, some of the water which has been found to occur in large volumes in the valley of the Arkansas River.



GUNNISON TUNNEL, COLORADO.

A pumping plant has been begun in the vicinity of Garden City, Kansas, to supply upwards of 10,000 acres of valley or low-lying bench land. The soil, although very fertile, does not receive each year sufficient moisture from rainfall to give full-crop production, and it is believed that by having water at critical times the yield will be greatly increased.

Montana. — In Montana surveys and examinations have been made along the tributaries of the Yellowstone and the Missouri, especially on Milk River, an international stream, as described on page 340. The principal obstacle to development on this river has been that arising from shortage of water and complication of vested rights among the various claimants, most of whom have been unwilling or extremely slow in making any concessions for the general welfare. The difficulties also of securing an adjustment with Canada by which water might be brought from St. Mary River through Canadian territory have resulted in relatively slow progress. To the south, however, on Yellowstone River, the complications of vested water rights have not proved as destructive, owing to the fact that the water supply is large and the diversions have not yet reached the limit of supply. Construction has been taken up in the vicinity of Huntley, water being taken from the south side of Yellowstone River, upon about 30,000 acres of land, on what was formerly the northern part of the Crow Indian Reservation.