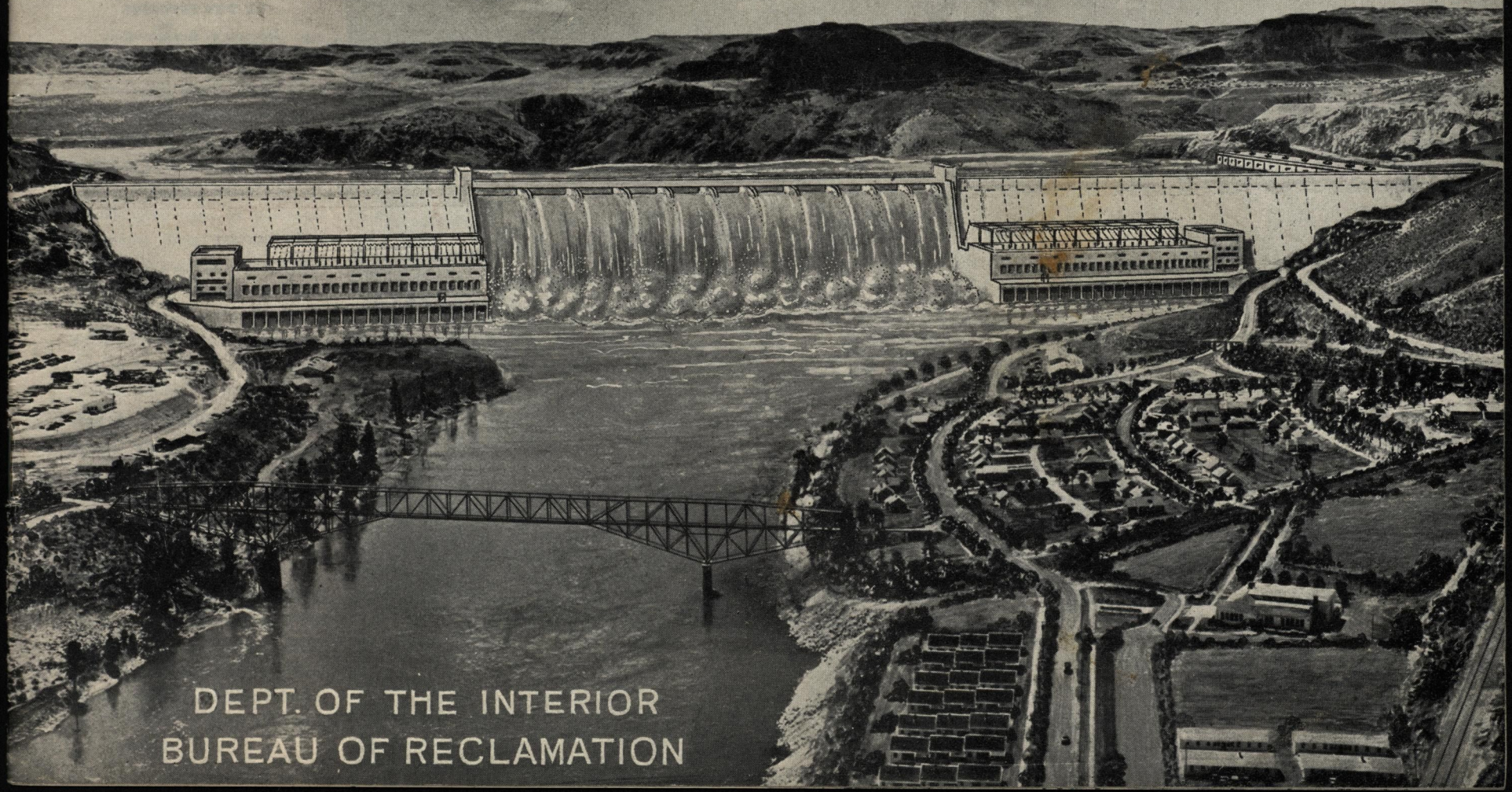
COLUMBIA BASIN PROJECT

GRAND COULEE DAM



DEPT. OF THE INTERIOR
BUREAU OF RECLAMATION

UNITED STATES DEPARTMENT OF THE INTERIOR

Bureau of Reclamation

NIGHT AND DAY work proceeds on the gigantic Grand Coulee Dam. As light as day are the workings shown here with a myriad of flood lights replacing the sun. In the distance is Mason City, the contractors electrified camp, on the east side of the river. The permanent government city, Coulee Dam, is the cluster of lights in the extreme left distance.

THE GRAND COULEE DAM and The Columbia Basin Reclamation Project

THE Columbia River in Washington and the large body of semiarid but exceedingly fertile lands of the Big Bend country adjacent thereto—together constitute the Columbia Basin project.

Rising in the Canadian Rockies and crossing the international border into the State of Washington near its northeast corner, the Columbia River, the second largest in this country in point of run-off, then flows for 750 miles through this State and along its southern border to the Pacific Ocean. On its way it falls 1,300 feet and earns for itself the distinction of being by far the largest river in the United States in point of potential power, susceptible of economic development.

IRRIGABLE AREA

Adjacent to this river in central Washington is a tract of 1,200,000 acres of what has been designated many times as the finest body of undeveloped land in the world. Unproductive and of little value in its present arid state, this land when irrigated will produce a great variety of agricultural, horticultural, livestock, dairy, and poultry products in abundance and it will provide homes, employment, and business for a vast agrarian

An early air view of dam site and Mason City (left Foreground) and Coulee Dam, the camps

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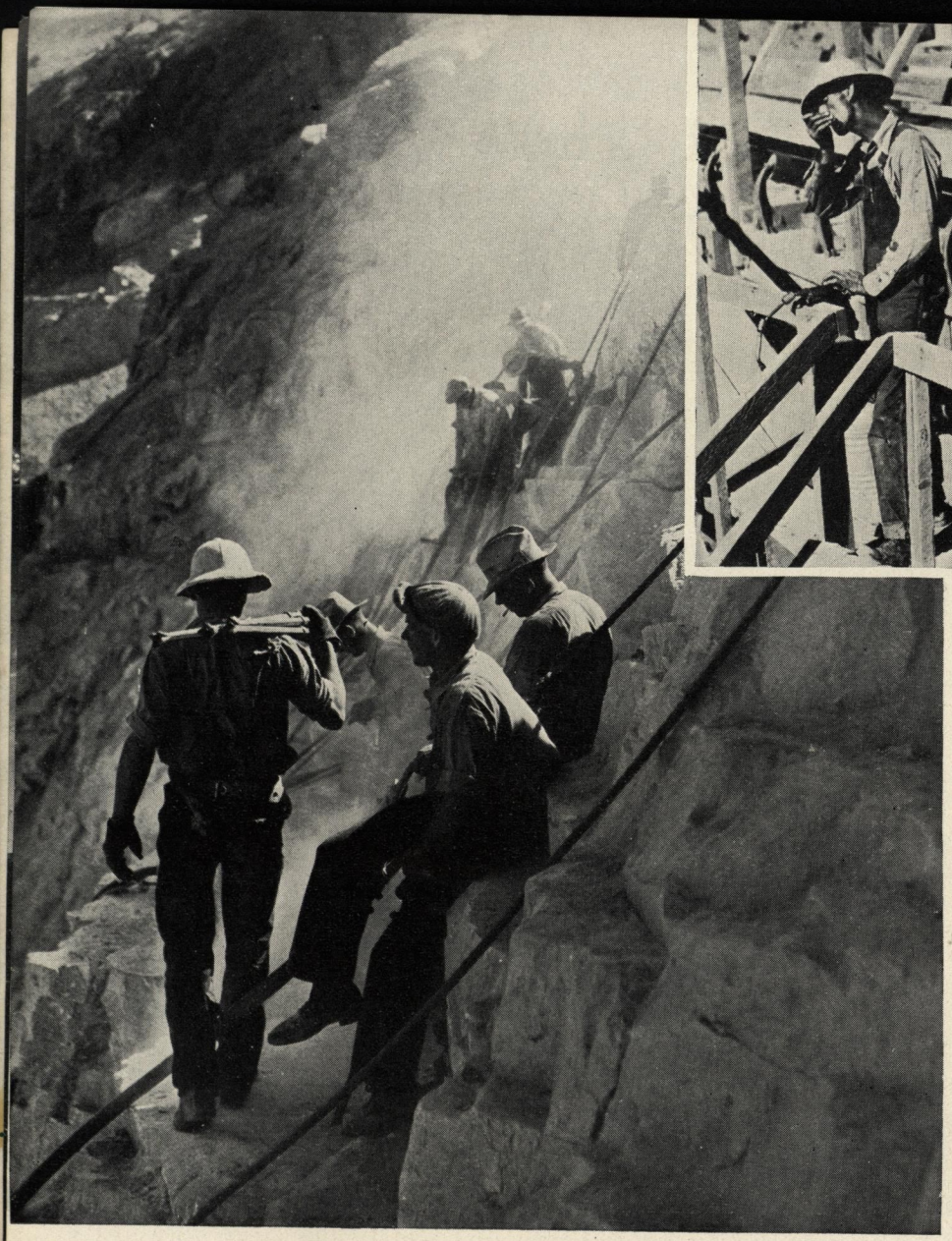
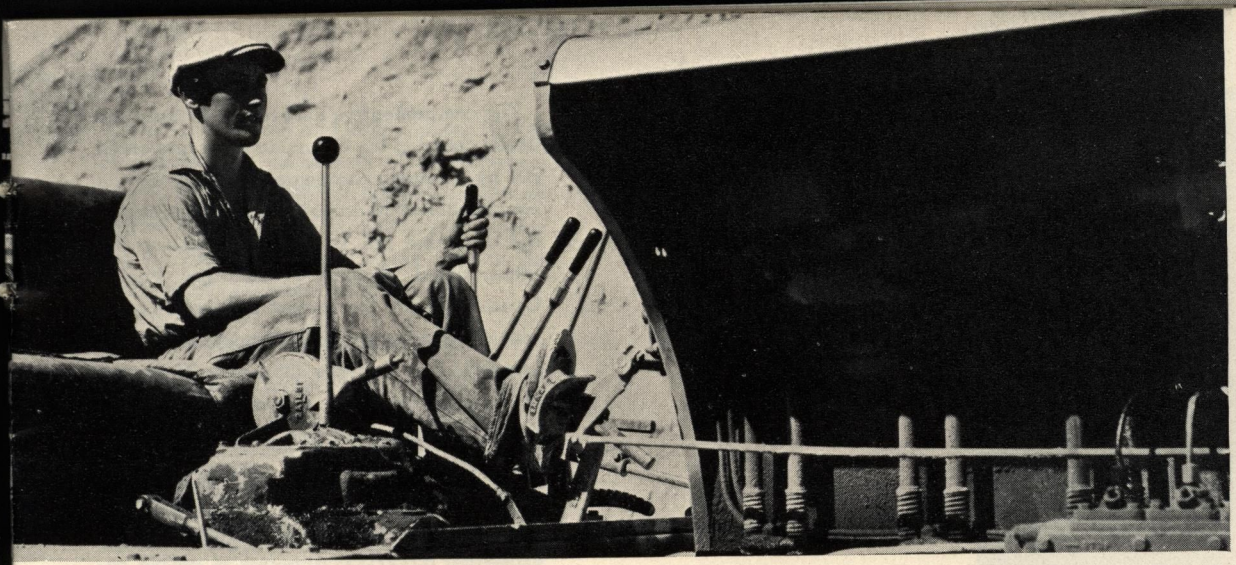


MACHINERY AND MEN are constructing the great Grand Coulee Dam. The pay roll at the dam site has grown steadily as work progressed, until in the Spring of 1936 more than 4,500 men were employed. At left are men stripping the western cliffs, working on a ledge about 500 feet above the river. Above is a close-up view of the great conveyor belt which has removed 13,000,000 cubic yards of material to Rattlesnake Canyon.

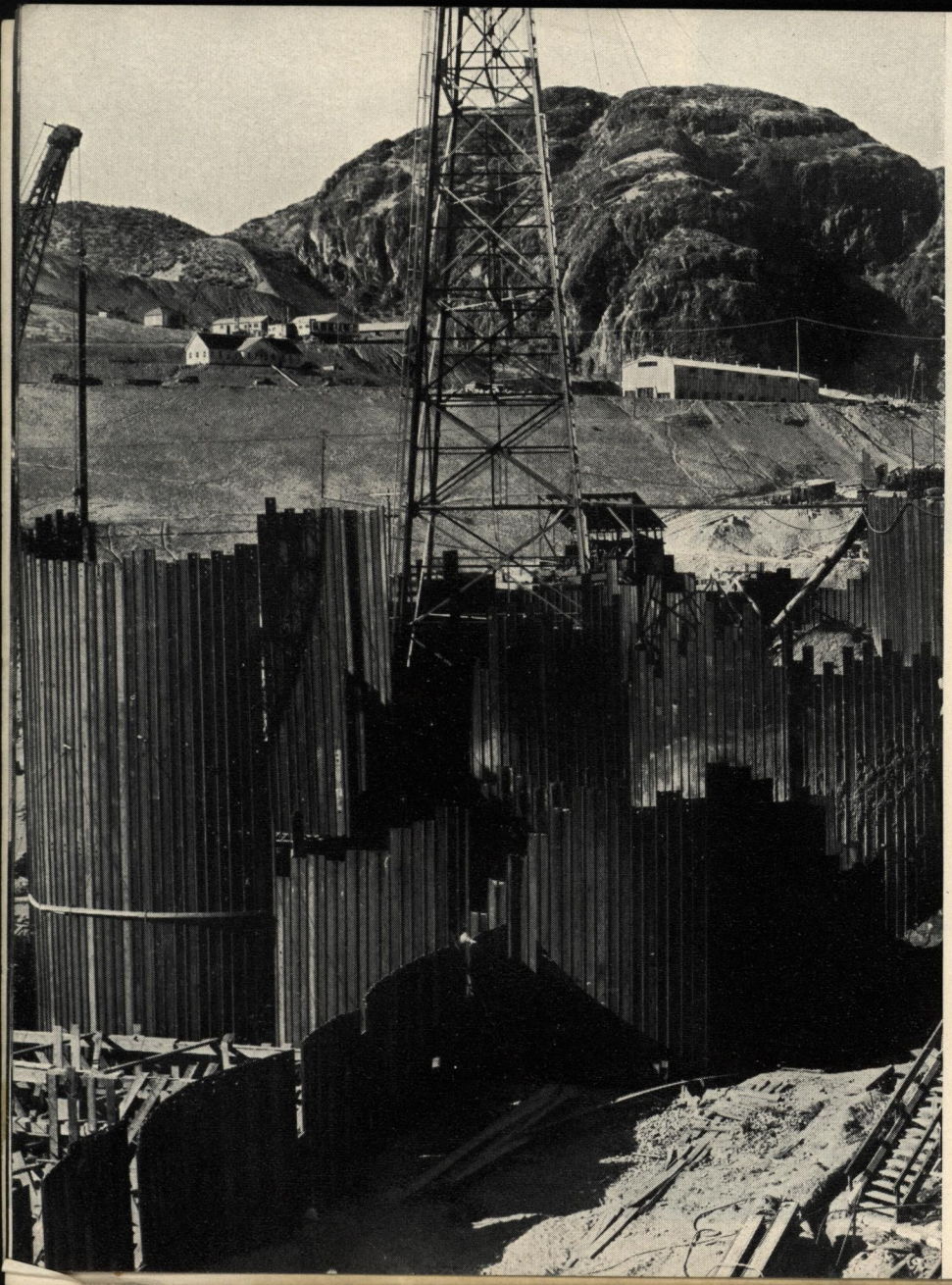
and urban population. The combination of these great resources—water, power, and land—for the creation of the Columbia Basin Project has been the goal of the people of Washington for 30 years and more. Many plans have been evolved and investigated through the years by engineers and economists of the State of Washington, the Army and the Bureau of Reclamation. The result is that the pumping plan, as opposed to the earlier gravity plan, is generally accepted as the better. The Bureau of Reclamation is proceeding with its detailed surveys on the basis of the so-called pumping plan.

The principal features of this plan include the Grand Coulee Dam for raising the water surface of the Columbia River 355 feet, thereby creating a usable storage capacity of more than 5,000,000 acre-feet; the power plant for the generation of 1,890,000 kilowatts of electrical energy for irrigation pumping and com-



mercial use; the pumping plant for raising 16,000 cubic feet of water per second a vertical distance of 280 feet into the Grand Coulee; the Grand Coulee Reservoir, with a usable capacity of 340,000 acre-feet, to regulate the flow of irrigation water to the project lands and permit the use of secondary power for pumping purposes; and the distribution system consisting of the East and West Main Canals, secondary pumping stations and laterals for conveying water to 1,200,000 acres of land. Although Congress by the passage of the rivers and harbors bill, approved August 20, 1935, authorized the construction, operation, and maintenance of the Grand Coulee Dam and necessary canals, structures, and other incidental works, funds have been made available so far only for surveys of the irrigable area and the construction of the foundation for the Grand Coulee Dam and power plant, a brief description of which will follow.

THE GREAT tractors at work at the dam site require skillful handling (above) of the complicated controls. At right is a workman piloting into place a strip of steel, which now forms a stave in the barrellike cell of the western cofferdam. Pile drivers hammered the piling home. Men and their machines caged the river between cofferdams, dug out the silt and clay of centuries to lay bare the bedrock, trimmed up the rock walls of the canyon, and now are busy placing the concrete of the dam itself.



CELLS OF STEEL make up the cofferdam, in construction of which 13,000 tons of steel sheet piling was used. Here are a cluster of cells in the west excavation which mark the toe of the dam.

The comprehensive long-range plan for the development of the Columbia River as worked out by the Army engineers contemplated the construction of 10 dams to utilize 92 percent of the available fall in the river between the International Boundary and the Pacific Ocean. By far the largest and most important of these is the Grand Coulee Dam. It is largest in that it utilizes 355 feet or 27 percent of the total available fall and includes an hydroelectric installation of 1,890,000 kilowatts capacity, which is larger than any existing development in the world. It is most important in that it creates a storage reservoir exceeding 5,000,000 acre-feet of usable capacity at the highest possible point on the river in the United States and affords the most feasible and practicable means of diverting the waters of the Columbia River out of its canyon and on to any considerable area of arid land.

The Grand Coulee Dam is located in the solid granite canyon of the Columbia River just below the point where the river once was diverted temporarily from its normal channel by an advancing glacier and forced to cut a new channel. The new channel, now high and dry, known as the Grand Coulee, 52 miles long, 600 to 800 feet deep, and 2 to 5 miles wide. As the glacier receded, the Columbia returned to its normal channel and left the Grand Coulee with its bottom 600 feet above the ordinary water level of the river. Following the clue given by the forces of Nature, it is now proposed to raise the water level of the river 355 feet by the construction of the

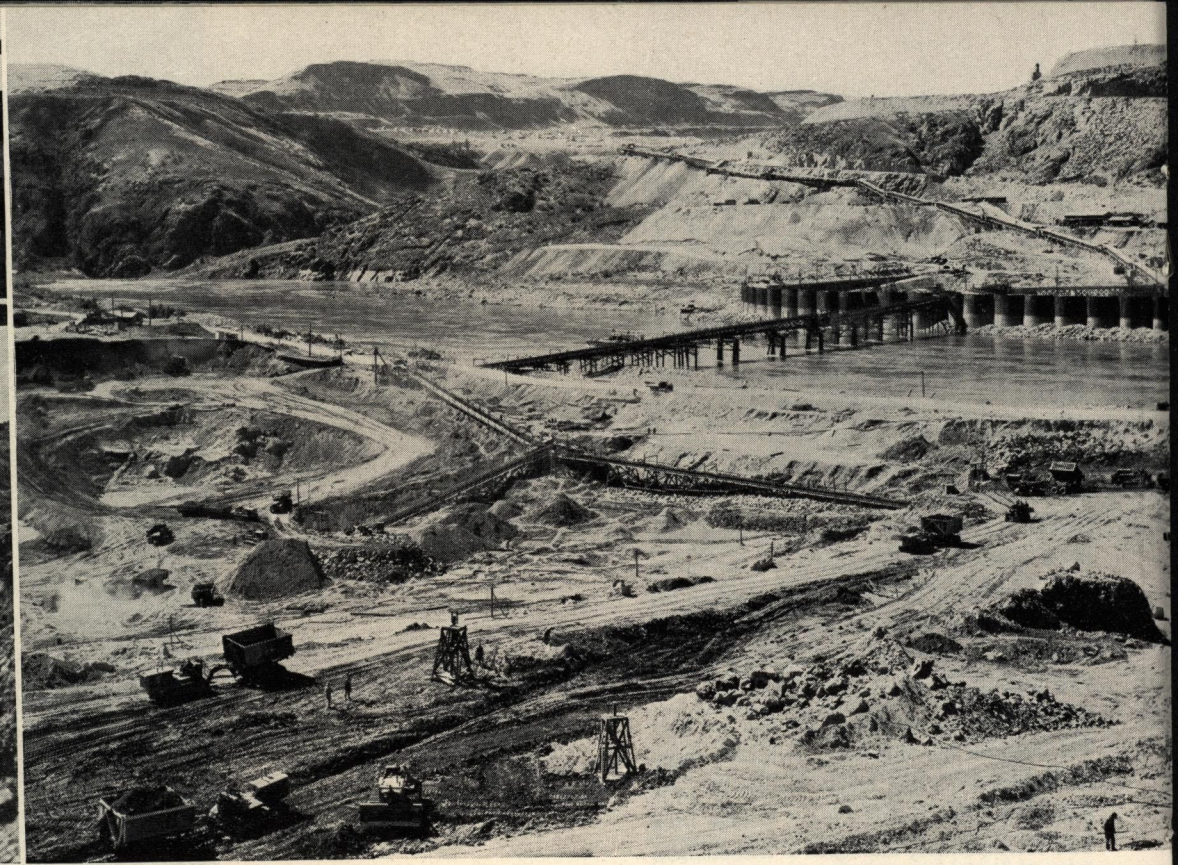
Grand Coulee Dam and then to pump 16,000 second-feet, or one-seventh of the average flow of the river, 280 feet higher and Grand Coulee will be used in regulating and supplying the life-giving waters of the river to the lands of the Columbia Basin project.

GRAND COULEE THE "KEY"

The Grand Coulee Dam is the "key" structure in the comprehensive plan for the development of the Columbia River. The importance arises from the fact that it will create a reservoir extending to the Canadian border, a distance of 151 miles, thereby adding a corresponding amount to the navigable inland waters of the State, and providing the master store of water for regulating the flow to other dams to be constructed in the system. The release of the stored waters from this reservoir during periods of low flow not only will increase the minimum navigable channel depths by 2 feet below Bonneville Dam and by 4.5 feet below Grand Coulee Dam with corresponding increases at intermediate points, but it also will double the amount of firm power that can be developed at the six power sites on the Columbia River between Grand Coulee Dam and the point where the Snake River joins the Columbia, and will increase by 50 percent the firm power that can be generated at the various sites, including Bonneville, below that junction.

In order properly to visualize what follows let us digress a moment for a brief description of the Grand Coulee Dam and power plant.

BLASTING dynamite strips the west abutment to the firm granite. Always spectacular, blasting operations were a major attraction at the dam site during early stages of construction.

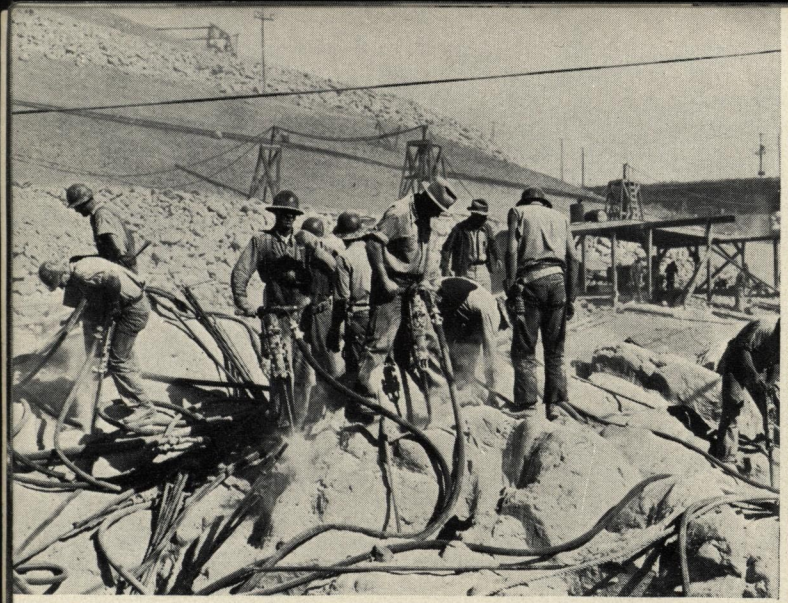


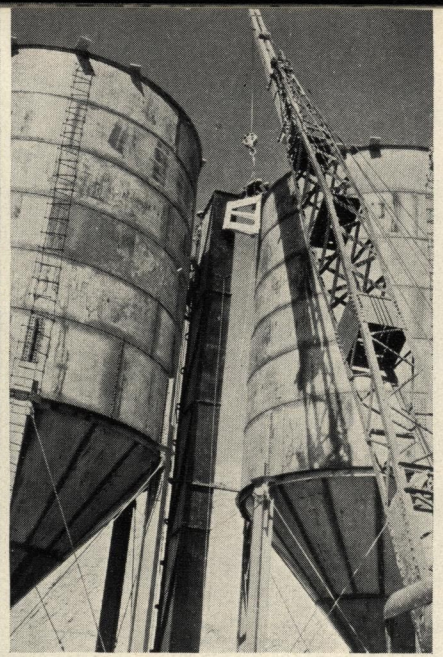
A UNIQUE FEATURE of the construction of Grand Coulee Dam was the use of belt conveyors in removal of the material overlying bedrock at the site. In 13 months approximately 10,000,000 cubic yards of earth and clay were removed to Rattlesnake Canyon 1¼ miles away from and 500 feet above the excavations on the west and east banks of the river. The principal conveyor had a belt 60 inches wide. It was fed by a network of smaller belt systems, one of which extended across the river. At top speed 1.30 tons of material was dumped each second in the spoil pile in Rattlesnake Canyon. The conveyor proved so successful that a similar system now brings the sand and gravel to the mixing plant.

The dam will be 4,300 feet long, 550 feet high above the lowest bed rock and 500 feet thick at the base. It will have a spillway 1,650 feet long capable of handling a 1-million-second-foot flood. The volume of concrete required will be 11,000,000 cubic yards or two and one-half times that required for the Boulder Dam. The power installation symetrically placed on each side of the spillway, which will be in the center of the dam will amount

to 1,980,000 kilowatts, of which 800,000 kilowatts will be for the generation of firm continuous power and the balance for secondary power for irrigation pumping and for standby service. Present contracts call for the completion of the foundation for the dam and power house to an average elevation about 50 feet above low water and involves among other things, the excavation of 15,000,000 cubic yards of earth and rock and

THE CONVEYOR system at Grand Coulee Dam was the largest ever put into service. In these pictures the earth can be followed from pit to pile. At the right are seen tractors dumping material into a feeder hopper. It was strained through a grill and stones more than 13 inches in diameter were removed, to be hauled away by truck. A pile of such rock is in the foreground. A belt loaded with clay is seen next. A single belt carried the material only a small part of its journey, each segment lifting it to a hopper a few feet higher than the hopper at which it received its load. Electricity was used to propel the belts. In the center is a view of the entire system, which can be traced from the feeders in the east excavation, across the river and up the canyon bank to Rattlesnake Canyon in the distance. At the extreme left is the stacker shooting the material onto the spoil bank in Rattlesnake Canyon.





DOWN TO BEDROCK. At left above is a crew of jackhammers at work smoothing the bedrock of the west excavation for commencement of the pouring of concrete. Below is a view of the east abutment, with the granite exposed. Above are storage silos where cement is kept.

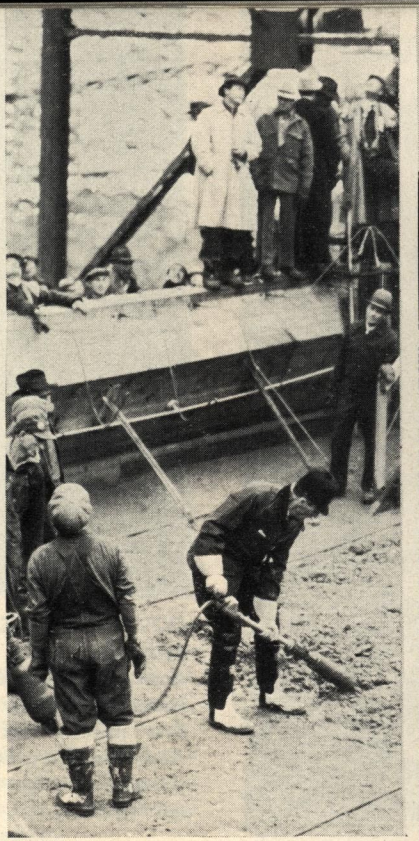
the placing of 4,200,000 cubic yards of concrete. The cost of this work including camp, railroad, highway, right-of-way, materials, etc., will be about $60,000,000. The cost of the completed structure is estimated at $186,000,000, and the irrigation features of the project at $208,000,000 making a total capital outlay for the ultimate project of $394,000,000, but the maximum investment in the project is estimated at around $260,000,000, depending upon how rapidly the irrigation features are developed and how soon the power revenues may become sufficient to take care of the cost of future construction

POWER MARKET

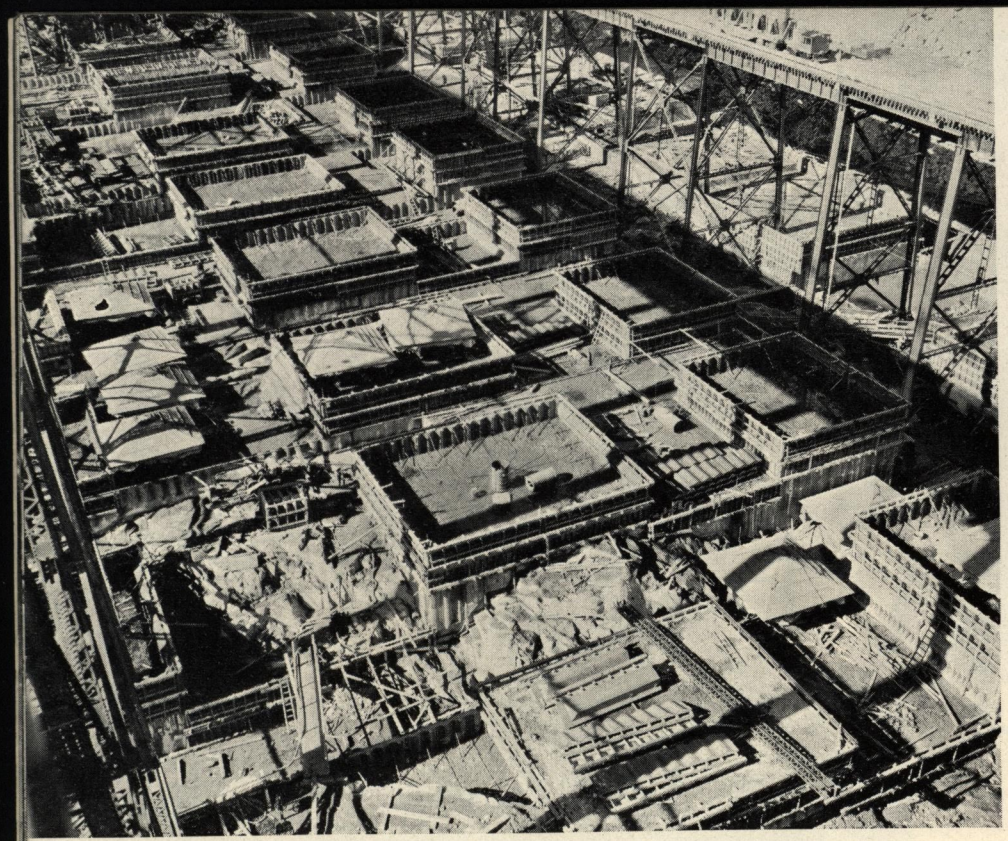
An important factor in the feasibility of this project as a whole is the market that may be available for the power that is to be produced at the Grand Coulee Dam. The market area in which this power may be absorbed includes the area within a radius of 300 miles of the dam and includes all of the State of Washington, the northern part of Oregon, the northern part of Idaho, and the western part of Montana.

During the 10-year period ending with 1930, the requirements for power in the territory described as constituting the power market area increased at an average rate of 9.5 percent per year, compounded annually. The installed generating capacity of power plants serving the territory in 1930 amounted to 1,145,000 kilowatts and during that year

there was generated 4,029,000,000 kilowatt-hours by those plants. The effect of the depression was to suspend for about 4 years the normal growth of the power market. Production fell off after 1930 and reached a minimum in 1933, but during 1934 returned to the 1930 maximum and in 1935 resumed its former rate of increase, with the result that the production that year substantially exceeded all previous records. If we may judge the future by the past, there is every reason to believe that the rate of increase in power production for the 10-year period prior to 1930, amounting to 9.5 percent compounded annually, will continue. But if we assume that the rate of increase starts off at but 8 percent compounded annually and decreases uniformly to 4 percent during the next 30 years, and if we assume further that Grand Coulee will absorb only one-half of the increase after its completion, leaving the other half to Bonneville and other new developments, all of the Grand Coulee commercial power will be absorbed by the market in 15 years. And if the commercial power can be sold at 2¼ mills at Grand Coulee, equivalent to 3 mills on the coast, the cost of the Grand Coulee Dam and power plant, with interest at 4 percent, can be liquidated in 50 years with a surplus of $144,500,000 available for the partial liquidation of the irrigation investment or other purposes, and after the 50th year, the annual surplus would amount to $15,000,000. The cost for operation and maintenance



C. D. MARTIN, Governor of Washington, above, is tamping the first pour of concrete which he dumped in the west excavation December 6, 1935. At right is a view of the concrete mixing plant on the west side and early pours. New pours were heated to prevent freezing during a cold snap in February 1936.



COVERING THE ROCK is among the most difficult jobs in connection with pouring a dam. Forms must be fit on uneven surfaces. At left is a view of the first forms. A few patches of bedrock remain visible. Above is the great central tower of the suspension bridge of the sand and gravel conveyor.

of the irrigation project, including the cost of power for pumping, is estimated at $2.60 per acre annually. The construction charge, if the irrigation development is deferred until the power income substantially exceeds the annual cost of power development, may not exceed $2.50 per acre a year.

POWER NOW WANTED

Conditions in the power-market area tributary to Grand Coulee at this time are illustrated by the fact that both Portland and western Montana are calling for power from the Washington Water Power Co. to which the company is responding to the extent of its ability, while Tacoma is feeding into Seattle all the power that its interconnecting systems will handle.

It is not contemplated, of course, that the power plant will be constructed to its full capacity in the first instance; but rather that the units will be added progressively as required to meet the demand for power. Like-

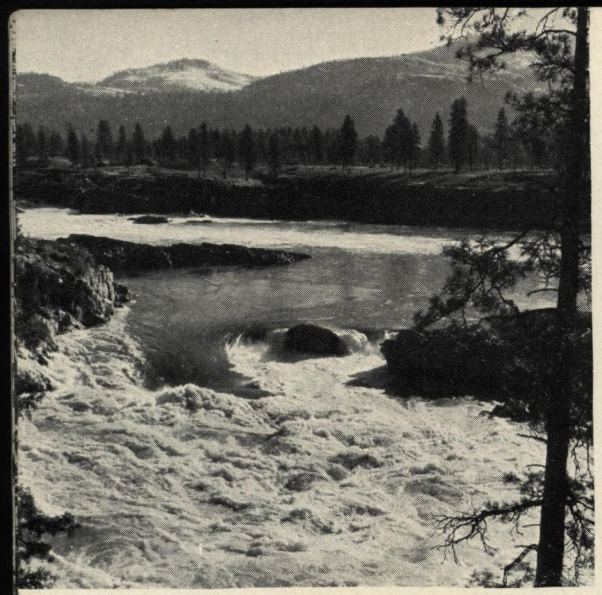
WESTMIX PLANT, where the concrete to be poured in the western excavation is mixed, has a daily capacity of 6,000 cubic yards. At the right is a view of the plant and the placing trestles with their cranes. Above is a view of block 40, where pouring started very early, taken from the cofferdam.

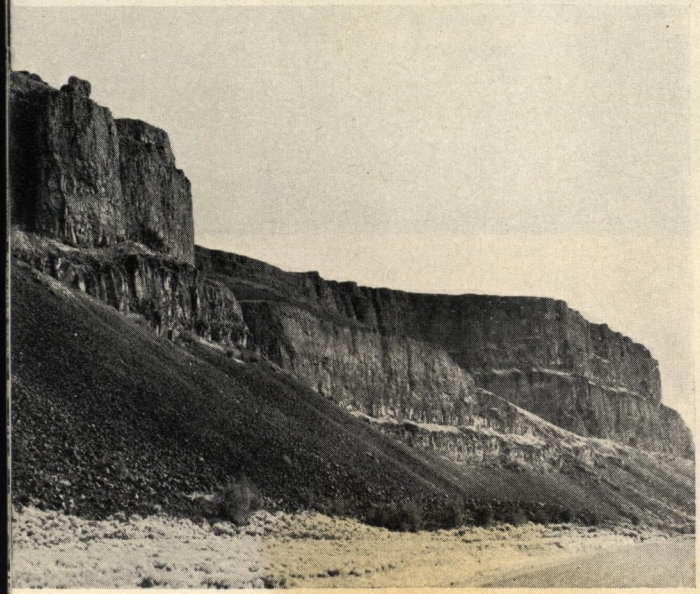
wise the development of the irrigation features should be made to conform to the demand for the land. The development would be progressive to meet the growing requirements of the country. And so now, after 30 years of planning and consideration by engineers and economists of the State, the Army, and the Bureau of Reclamation, the Bureau is starting on a program of construction that takes its proper place in a well-considered comprehensive plan for a long-time progressive development of a most valuable natural resource in the land and water constituting the Columbia Basin project.

BENEFITS

Now what may be said of the benefits that may accrue from a project of this kind?

From the standpoint of the present, employment is given to about 5,000 men who with their families constitute a population of more than 10,000 people living at the dam site, while thousands of others are working through-





out the State in cement mills, in lumber mills, in steel fabricating plants, in various factories, for the public utilities and on the farms producing, marketing, and transporting the material used in construction and the food, clothing, and other necessities for the workmen and their families, while back east of the Mississippi practically 50 percent of the money so far spent has gone for steel sheet piling, rubber belt conveyors, power shovels, tractors, buggies, sand and gravel plant, concrete plant, trucks, automobiles, tools and other untold items of plant and equipment materials and supplies and transportation of same—money directed into the regular established channels of industry and supplying work for thousands of persons at employment of their own choosing and at prevailing wages.

For the future, low power rates should reduce the burden of the heavy users of power particularly those engaged in pumping for

FINE WATER in great quantities pours over the rapids of the Columbia River, waiting to be diverted to make the dry basin lands flourish. The ultimate project contemplates using Grand Coulee, ancient glacial river bed, as a diversion channel and storage reservoir. Lower left is steamboat rock, in Grand Coulee; upper right, a typical Coulee wall; and lower right, the amazing falls of the dry river.

irrigation and should attract new industries particularly those requiring large blocks of power. And as the irrigable lands are reclaimed, thousands of small farms should be established not for the purpose of one-crop farming to raise products of which there may already be a surplus, but for the purpose of establishing farm homes with such surroundings that families may live there in comfort largely from the products of their own farms under diversified farming methods that will also permit the marketing of sufficient products to meet the running expenses.

It has been the experience in the past that for every family on an irrigated farm there is also one in the towns that are developed on the project to serve the farming districts and still another in the more distant cities and towns engaged in the manufacturing and transportation of things that the farmer must buy. Benefits that flow from the construction of an irrigation project, such as this will be in the future, are far-reaching indeed.

DRY-FARMING tragedies like those shown in the upper pictures dot the 1,200,000 acres of rich but dry lands in the Columbia Basin project. The peaches and hops, pictured below, were grown on the Yakima Federal reclamation project, across the river from the Columbia Basin lands. Irrigation will duplicate them on this project.


INDEX MAP
SCALE OF MILES
CANADA
FERRY
STEVENS
PEND OREILLE
LINCOLN
SPOKANE
CHELAN
DOUGLAS
GRANT
ADAMS
WHITMAN
KITTITAS
YAKIMA
FRANKLIN
BENTON
KLICKITAT
COLUMBIA
GARFIELD
WALLA WALLA
WASHINGTON
OREGON
IDAHO
Republic
Colville
Fruitland
Barry
Waterville
Wenatchee
Ephrata
Almira
Odair
Coulee
Davenport
Spokane
Ritzville
Colfax
Ellensburg
Yakima
Prosser
Pasco
Dayton
Pomeroy
Walla Walla
GRAND COULEE DAM
NORTH DAM
SOUTH DAM
U. S. CONSTRUCTION RAILROAD
COLUMBIA RIVER
Lake Chelan
Entiat River
Sanpoil River
Colville River
Spokane River
Snake River
Crab Creek
Cow Creek
Palouse River
Yakima River
Naches River
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Toppenish Creek
Yakima Indian Reservation
U.S. 97
U.S. 10
U.S. 395
U.S. 195
U.S. 410
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NORTHERN PACIFIC
GREAT NORTHERN
UNION PACIFIC
SEATTLE
PORTLAND
OLYMPIA
YAKIMA PROJECT
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COLUMBIA BASIN PROJECT
UMATILLA PROJECT
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GRAND COULEE DAM
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1936
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