

WATER

FOR THIRTEEN CITIES

IN THE
METROPOLITAN WATER DISTRICT
OF SOUTHERN CALIFORNIA



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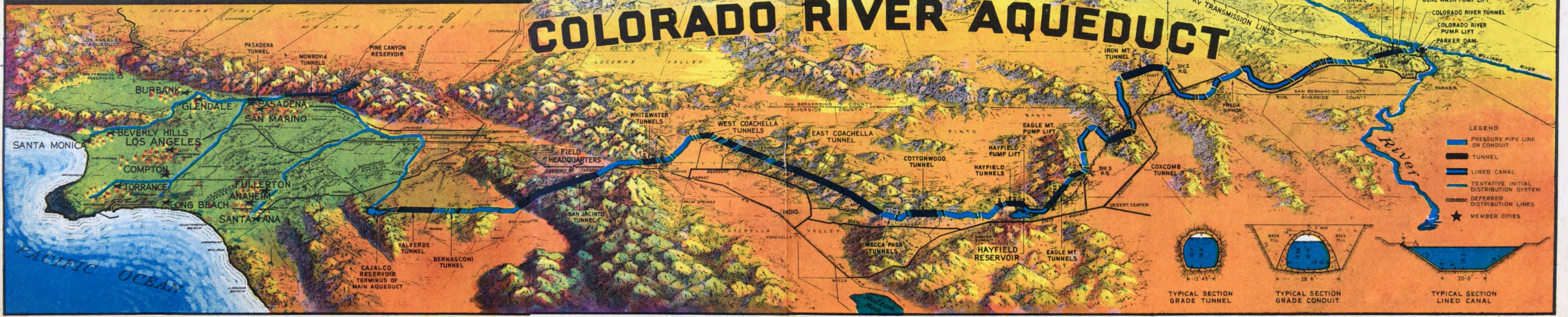


THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

NOW BUILDING THE
COLORADO RIVER AQUEDUCT

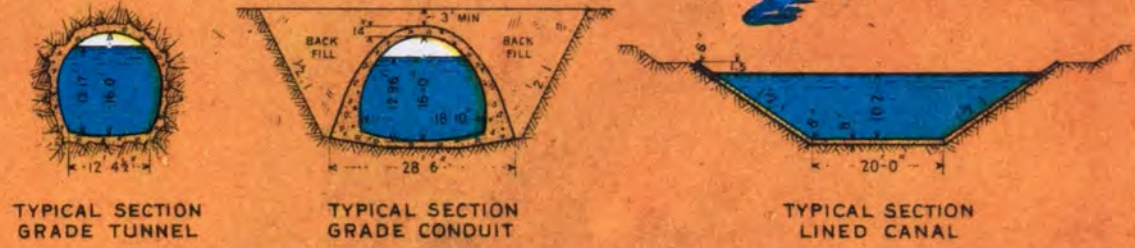
A Map of the Aqueduct route from the Colorado River to the Coastal Plain of
Southern California and the thirteen cities in the Metropolitan Water District

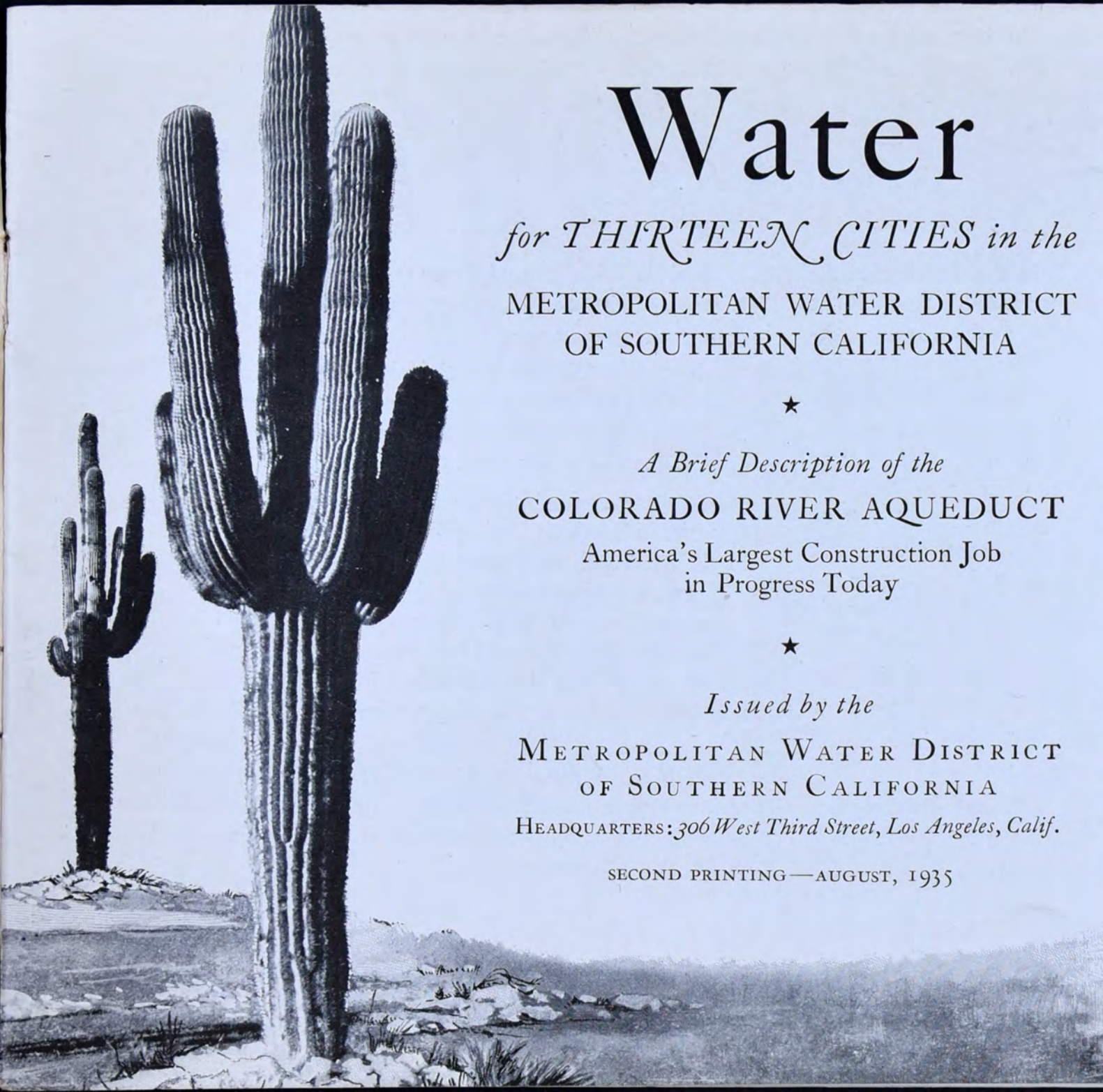
FRANK E. WEYMOUTH, GENERAL MANAGER AND CHIEF ENGINEER
HEADQUARTERS: 306 West Third Street, Los Angeles, California



COLORADO RIVER AQUEDUCT

- LEGEND
- PRESSURE PIPE LINE OR CONDUIT
 - TUNNEL
 - LINED CANAL
 - TENTATIVE INITIAL DISTRIBUTION SYSTEM
 - DEFERRED DISTRIBUTION LINES
 - MEMBER CITIES





Water

for THIRTEEN CITIES in the
METROPOLITAN WATER DISTRICT
OF SOUTHERN CALIFORNIA



A Brief Description of the
COLORADO RIVER AQUEDUCT

America's Largest Construction Job
in Progress Today



Issued by the
METROPOLITAN WATER DISTRICT
OF SOUTHERN CALIFORNIA
HEADQUARTERS: 306 West Third Street, Los Angeles, Calif.

SECOND PRINTING—AUGUST, 1935



Foreword

SOUTHERN CALIFORNIA is in the extreme southwest corner of the United States. It is a part of that vast region frequently described as the Great Southwest.

In common with every other part of the Southwest, Southern California is by nature a semiarid, desert country. For the newcomer it is difficult to understand how this can be. Coming to Southern California we see prosperous and growing cities, beautiful garden homes, rich orange groves and fertile farms. We see great quantities of water being used for industrial, agricultural and domestic purposes.

And, in addition, we see an organized program of continuing development.

We ask: How can these things be in a region which by nature is a desert country?

It is because the people of Southern California do not depend upon the vagaries of Nature for such a vital necessity of life as water. First, they have

utilized the underground water resources of this region—underground water supplies that accumulated slowly during past ages.

Next, the City of Los Angeles, 25 years ago, built an Aqueduct that tapped the snow waters of the High Sierras, 250 miles away, and brought in a golden flood of water from that source.

And today, Los Angeles and twelve other communities in Southern California are banded together in the Metropolitan Water District. They are engaged in the construction of the greatest domestic water supply system in the history of engineering—a giant Aqueduct that will bring an everlasting supply of water from the Colorado River to the communities included in the Metropolitan Water District.

It is the purpose of this booklet to tell briefly how this great Aqueduct is being built—and what it means to the present and future of the communities in the Water District.

Thirteen Cities and a River

*T*HE METROPOLITAN WATER DISTRICT of Southern California is a governmental division of the State of California. It was established in 1928 for the express purpose of financing, building and operating an Aqueduct from the Colorado River to cities in the District.

A Board of Directors governs the District, each city being represented by at least one director. The District's chief administrative officer is its General Manager and Chief Engineer. This man is Mr. Frank E. Weymouth.

Following are the cities which comprise the District:

ANAHEIM	SANTA MONICA
BEVERLY HILLS	LONG BEACH
BURBANK	PASADENA
COMPTON	SAN MARINO
FULLERTON	SANTA ANA
GLENDALE	TORRANCE
LOS ANGELES	



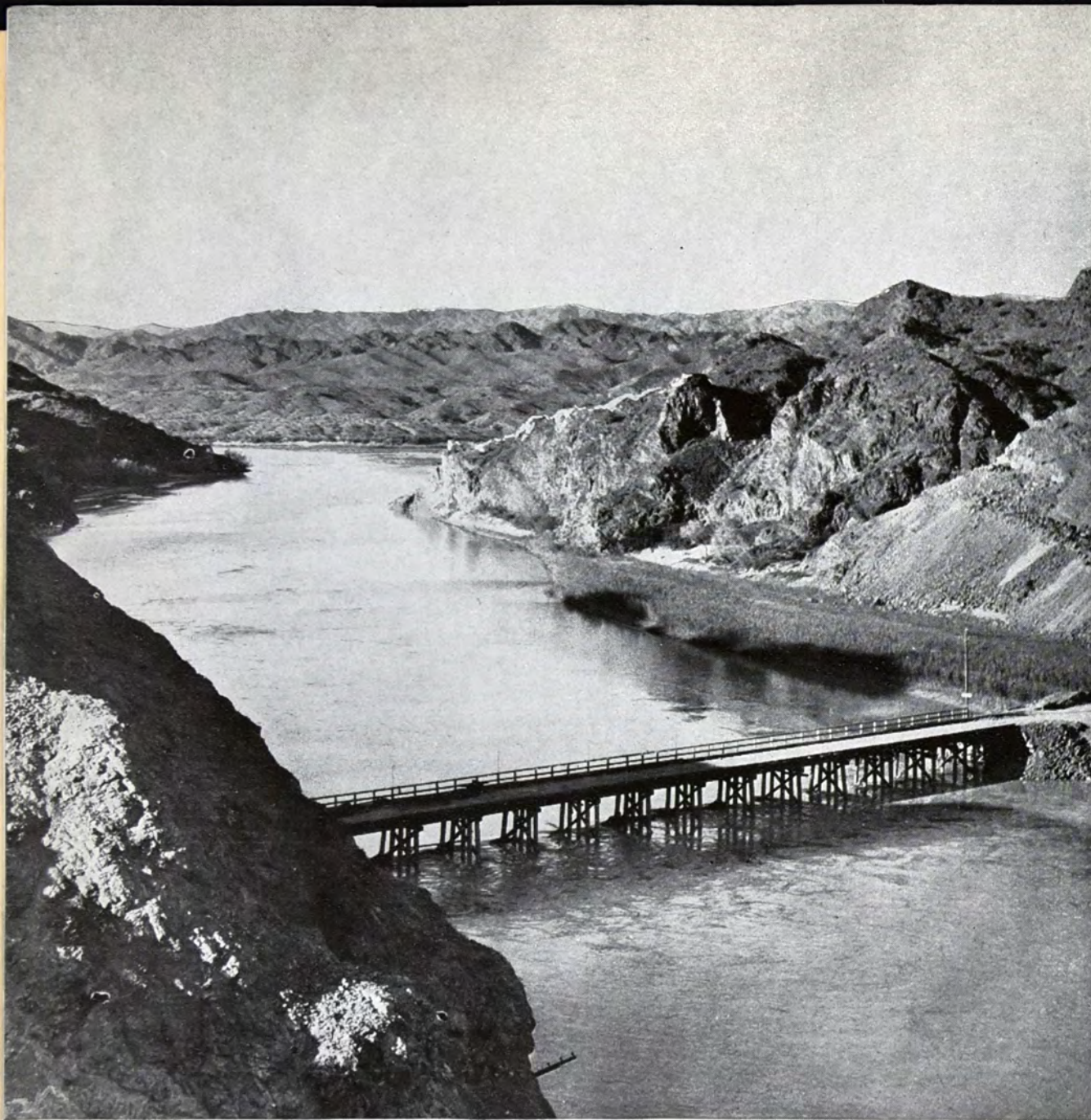
*Metropolitan Water District
Field Headquarters, Banning, Calif.*

Conquest of the Colorado

*M*ELTING SNOWS of the Rocky Mountains, covering a vast area of 245,000 square miles, is the water source of the Colorado River. This river flows through two countries, the United States and Mexico. Its watershed includes large portions of seven states. They are New Mexico, Colorado, Wyoming, Utah, Nevada, Arizona and California.

The annual flow of the Colorado River is sufficient to provide an abundant water supply for the cities and areas in the Southwest which economically may be served from this source. But for years most of its water has come down in annual floods, often devastating the regions along its lower reaches, and has wasted into the sea.

In 1928, Congress adopted an Act providing for the erection of a great dam in Boulder Canyon on the river. Boulder Dam recently has been completed. It will regulate the river's flood water and make this water available for use in Arizona, Nevada and California. A portion of the water conserved by Boulder Dam will be brought to the cities in the Metropolitan Water District through the Colorado River Aqueduct.



Colorado River near Aqueduct Intake, Parker Dam construction bridge in foreground.

Colorado River Aqueduct

CONSTRUCTION WORK on the Colorado River Aqueduct was started in December, 1932. It is scheduled to be completed and delivering water in December, 1938.

The Aqueduct is primarily a domestic water supply system—and not an irrigation project.

One billion gallons of water a day will be delivered by the Aqueduct to cities in the Metropolitan Water District. This new supply of water gives to the people residing in the Water District the assurance of a continuing development in homes, business and industry.

Water will be taken from the Colorado River by the Aqueduct, and delivered by a system of tunnels, canals and conduits to each city in the Water District. The Aqueduct has its intake at Parker Canyon, 155 miles below Boulder Dam and about 300 miles east of Los Angeles.

From its intake to its terminal storage reservoir, the main Aqueduct is 242 miles long; its initial distributing system to each District city is 150 miles long; a total of 392 miles.

By a wide margin, the Aqueduct is the largest construction job in progress in America today.



On the Big Job! A shovelful of the 45,000,000 cubic yards of Aqueduct material being excavated.



East Portal, Coxcomb tunnel, one of 29 hard rock tunnels totaling 92 miles in length on Aqueduct main line.

Financing

*A*QUEDUCT CONSTRUCTION WORK is being financed by a bond issue of \$220,000,000, voted by the citizens of the thirteen cities in the Metropolitan Water District on September 29, 1931. This bond issue was approved by the decisive majority of five to one.

Aqueduct bonds are now being sold, in blocks as required, to the Reconstruction Finance Corporation, at interest rates of 4 and 5 per cent. The R. F. C. had agreed to purchase up to \$89,500,000 in District bonds. A full construction program is going steadily forward.

The Public Works Administration also has purchased \$1,500,000 in Aqueduct bonds to finance early construction work on Parker Dam.

The R. F. C. has approved the Aqueduct as a self-liquidating project—a water supply system capable of paying all bond charges as well as operation and maintenance expenses out of water revenues. Careful studies indicate that such revenues may be realized on the basis of rates well within the average domestic water rate being charged in large American cities.

Years of Study

ENGINEERING STUDIES and surveys on the Colorado River Aqueduct were started in 1923 and continued for eight years before the District engineers made their final report and recommendations.

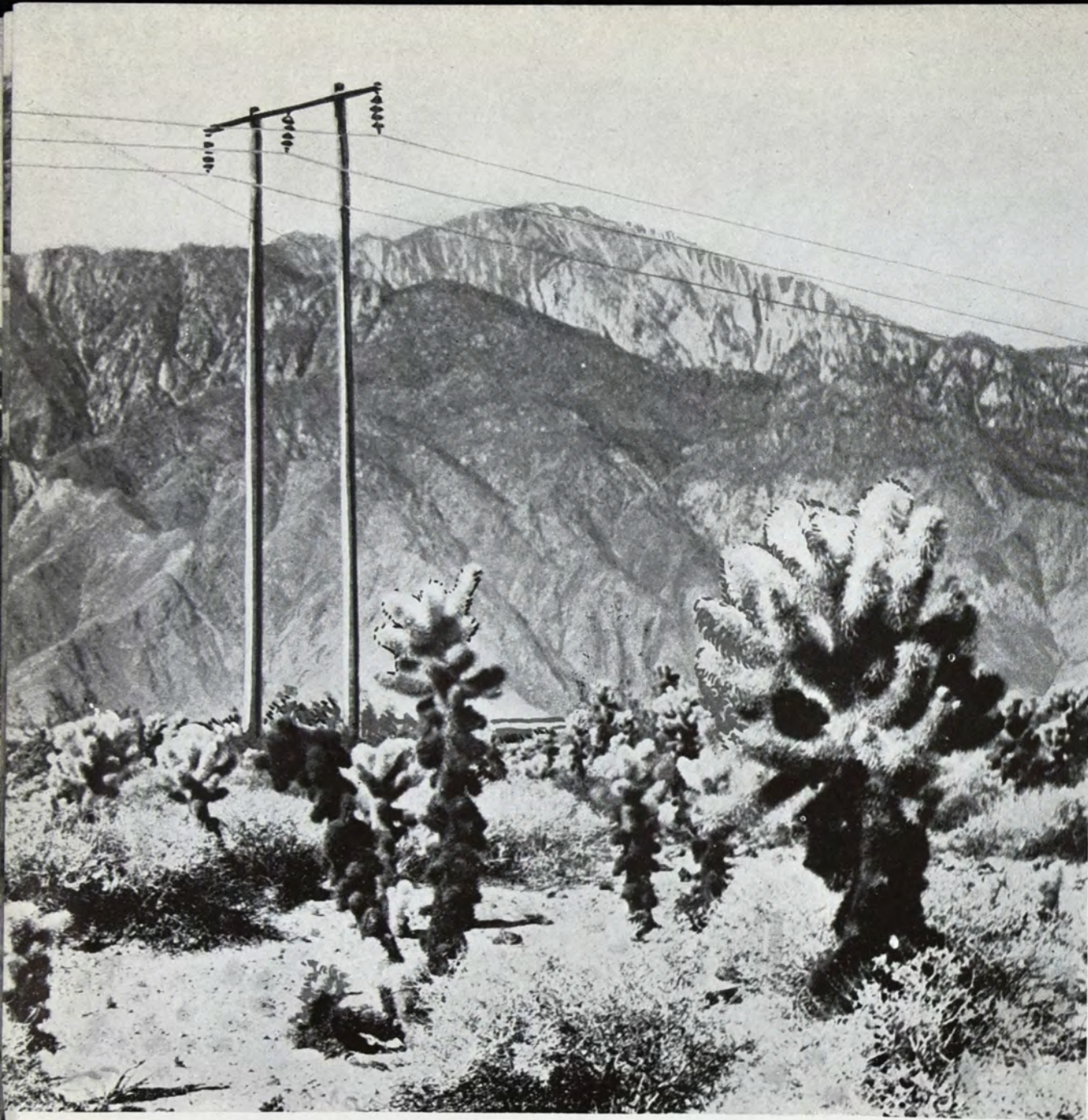
For several years these studies were conducted by the City of Los Angeles. In 1928 the Metropolitan Water District was organized, including Los Angeles and a number of other nearby cities. The District thereafter took over all studies and work on the great project.

The task confronting Aqueduct engineers was to find the best and most economical route for the Aqueduct. An area of 25,000 square miles of mountain and desert country was surveyed. More than one hundred different Aqueduct routes were considered.

Chief Engineer Frank E. Weymouth selected the so-called Parker route as the best, the safest and the most economical. This route was also approved by an engineering Board of Review composed of Thaddeus Merriman, New York City; A. J. Wiley, Boise, Idaho; Dr. Richard R. Lyman, Salt Lake City.



Aqueduct surveyors in desert region east of Mt. San Jacinto, shown in background.



Temporary power lines, 448 miles long, were built to carry electric energy to Aqueduct construction camps.

Water to Get Water

*B*ETWEEN the Colorado River and the cities which comprise the Metropolitan Water District lies a vast mountain and desert region.

Prior to the coming of Aqueduct construction forces, this region was virtually uninhabited. It had no roads, no water supply, no system of communication or transportation.

Metropolitan engineers located and drilled wells. They built 180 miles of water mains to deliver water to Aqueduct camps. Road builders constructed 150 miles of surfaced trunk highways, which give access by feeder roads to all points of operation. Workmen erected 448 miles of high voltage electric power lines for camp use and the operation of construction machinery. They built 1,060 circuit miles of telephone lines.

A 200-mile stretch of inaccessible mountain and desert country had been transformed into an area where an army of men are able to work efficiently and live comfortably.

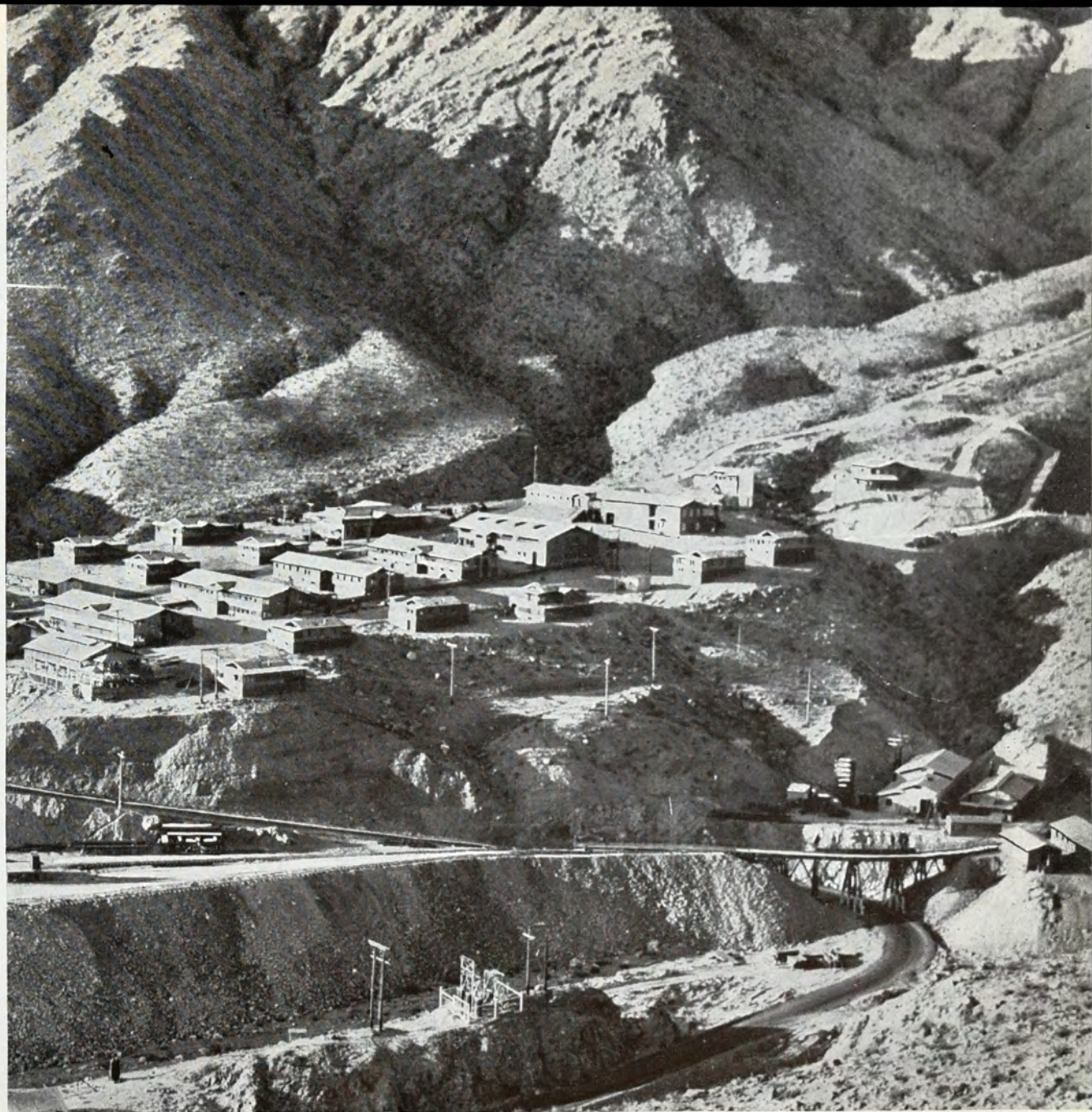
Jobs for an Army of Workers

*I*N *MAY*, 1935, an army of 6,500 men were employed directly on Aqueduct construction. In addition many thousands of other workmen were employed in shops and factories, manufacturing and handling the vast quantities of materials, equipment, and supplies being used on the big job.

During the next year Aqueduct employment will rapidly increase to a peak of from 9,000 to 11,000 men.

Only bona fide residents of the Metropolitan Water District are qualified for Aqueduct employment. Persons who have not resided for at least one year in the District cannot be employed on Aqueduct work.

Ideal living conditions prevail in Aqueduct construction camps. Generous meals of high quality are served the workmen. The men live in modern air-conditioned dormitories with every up-to-date convenience. The result is a high standard of efficiency and excellent construction progress.



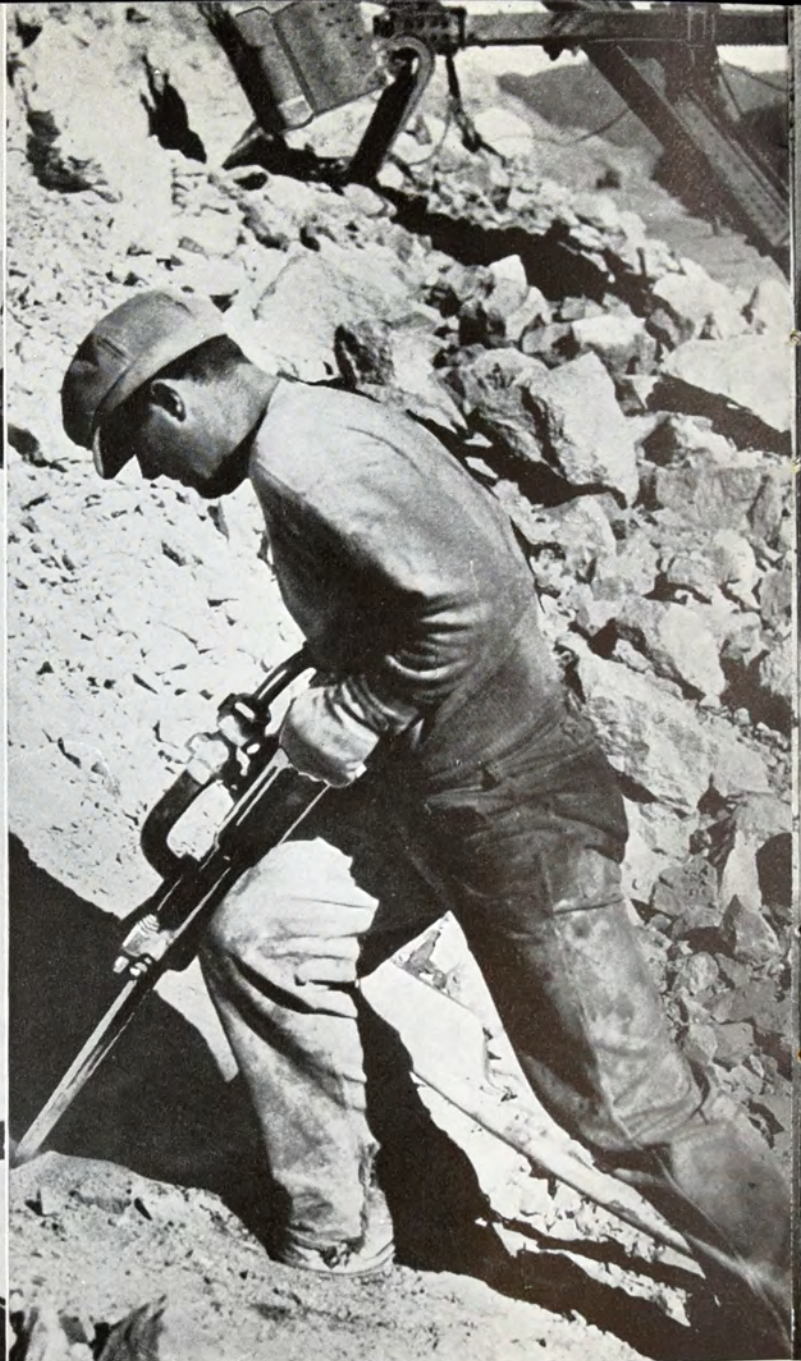
Berdoo Camp. Typical of the modern camps where men are housed and fed along 300-mile Aqueduct front.



*Drill runner in a hard
rock Aqueduct tunnel.*



*Steel form workman on
Aqueduct conduit section.*



*Jackhammer man on
Aqueduct rock section.*





*Mucking machine operator
in an Aqueduct tunnel.*

★



*Reinforcing steel workman on
an Aqueduct siphon section.*

★



*Welder in an Aqueduct
machine shop.*

★



On the way! Section of Aqueduct conduit under construction west of San Jacinto Mt.

How It Is Built

INCLUDED in the Aqueduct from the Intake to the cities in the District are:

29 tunnels, 16 feet in diameter. Total length 92 miles.

53 sections of covered concrete conduit, 16 feet high and 16 feet wide. Total length 55 miles.

98 sections of concrete lined canal, 20 feet wide at bottom and 12 feet deep. Total length 63 miles.

146 inverted siphons of various designs. Total length 29 miles.

5 reservoirs— Combined capacity 230,000 acre feet. 2 miles.

5 pumping stations. Total pump lift 1617 feet. 1 mile.

Distribution System

9 tunnels—Total length 15 miles.

System of steel and concrete conduits. Total length 135 miles.

When filled to capacity the Aqueduct will deliver one billion gallons of water daily to the cities in the District. All of its main sections are now being built for capacity of 1500 second feet, except most of the siphons which may economically be built initially for half capacity.

Progress of Work

*A*QUEDUCT WORK is being done by both the contract and force account methods. Forty-six miles of tunnels are being built by District forces. The balance of the work is being done by 22 general contracting firms. Sealed bids are received and contracts in all cases are awarded to the lowest responsible bidder.

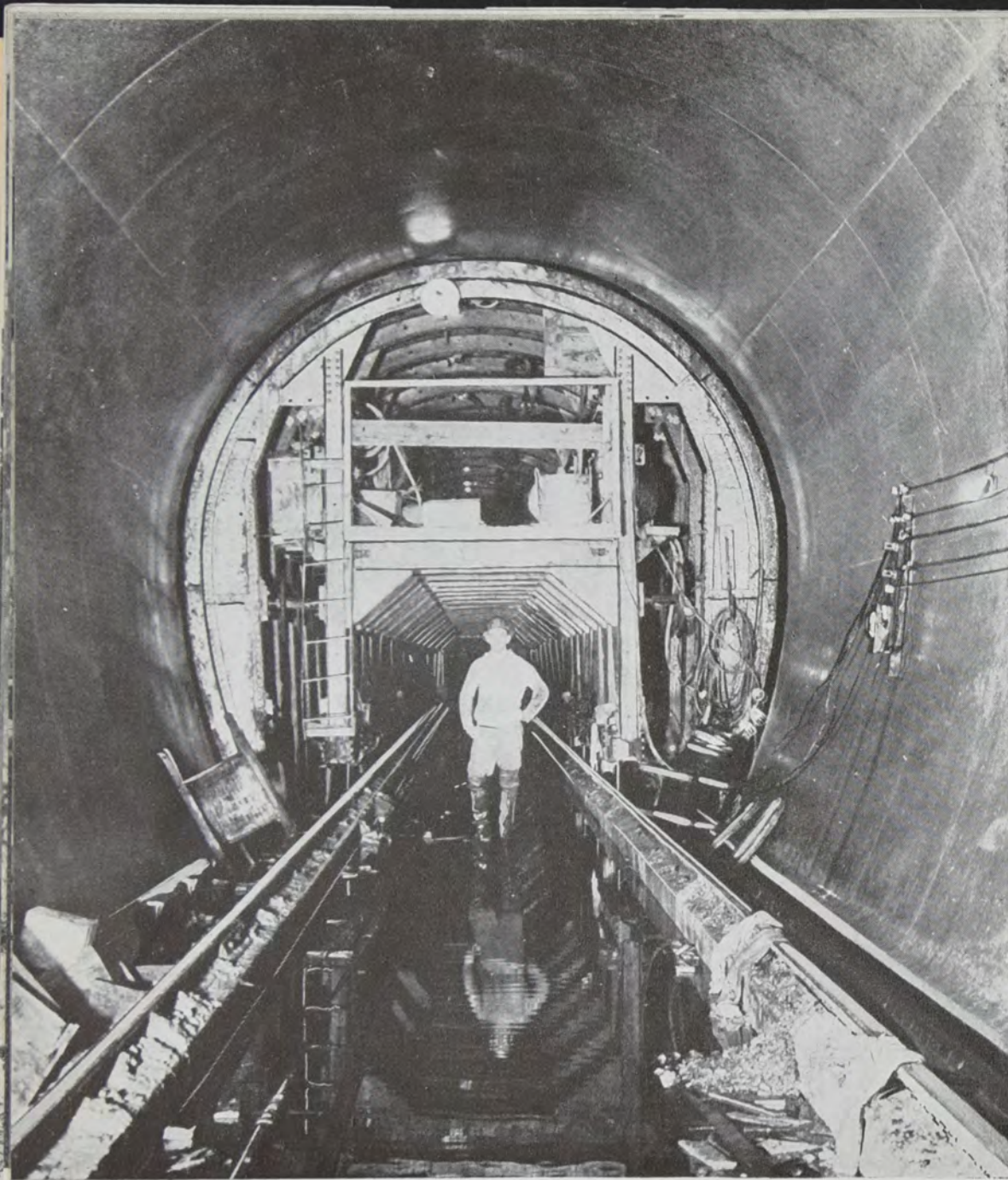
On June 1, 1935, 72 miles of tunnels had been excavated; nine miles of tunnels had been concrete lined. One hundred and fifty miles of canal, conduits and siphons were under construction, and fifteen miles had been excavated and concreted.

New records of speed in tunnel excavation have been established on the Aqueduct job. At the same time the District has enforced rigid safety regulations with the result that there has been maintained on this big job the lowest accident record for this class of work.

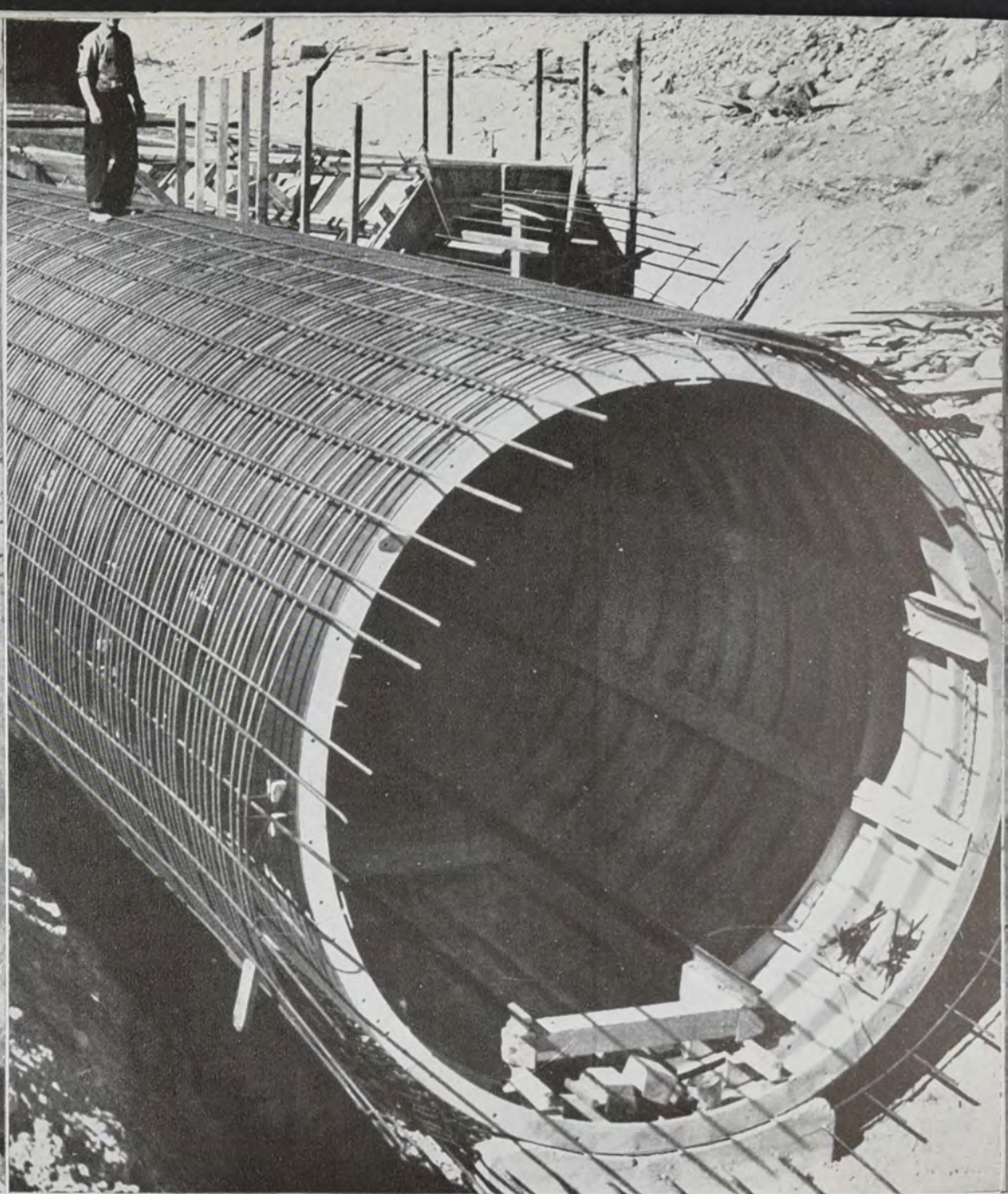
Aqueduct construction thus far is being done within the estimated cost. A bond issue of \$220,000,000 was voted to finance the work. The original cost estimates were \$218,800,000. In view of actual costs to date it is anticipated that savings will be effected which will materially reduce this cost.



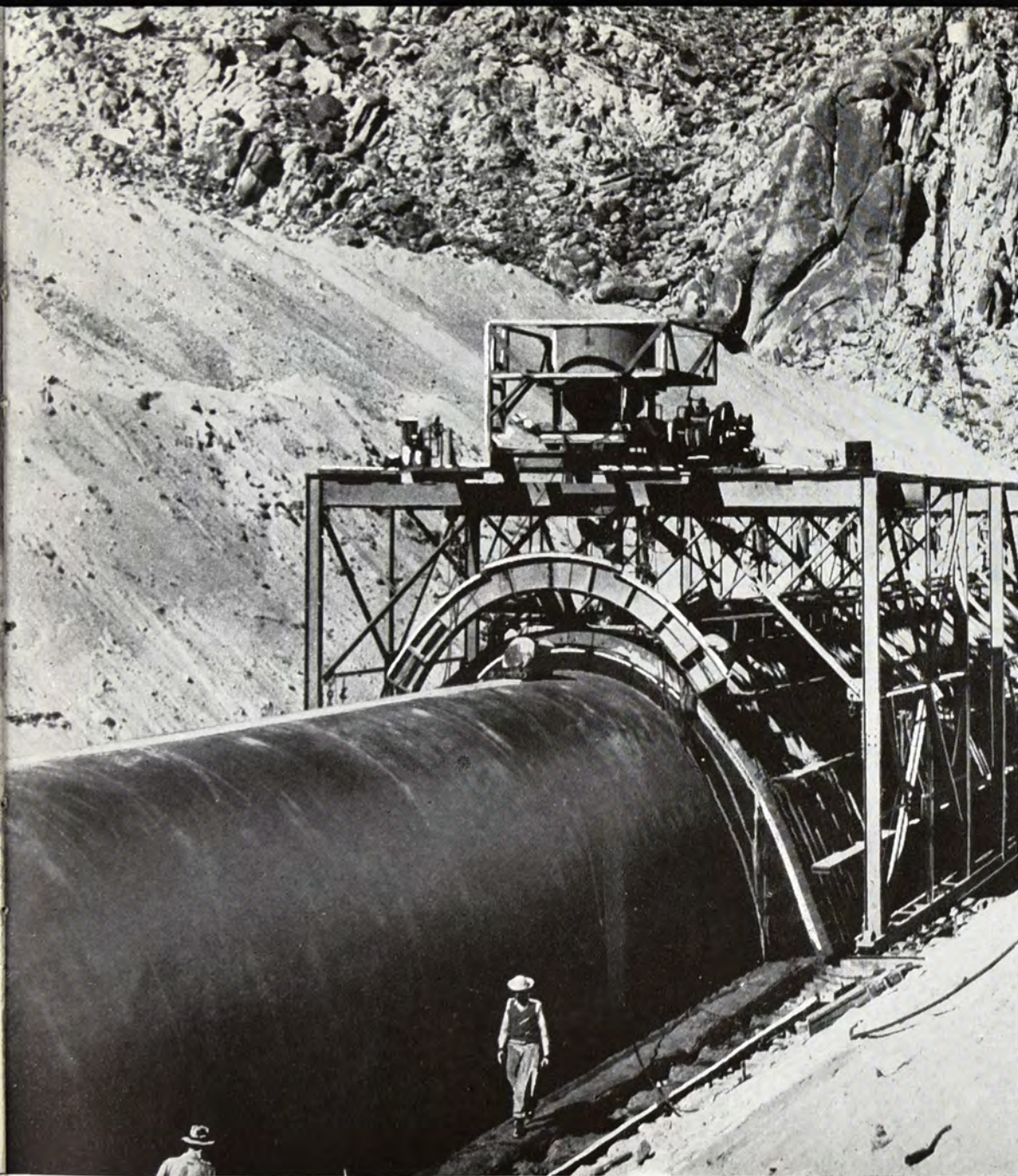
Pay day in an Aqueduct Camp. 6,500 workmen were on Aqueduct construction payrolls in early summer of 1935.



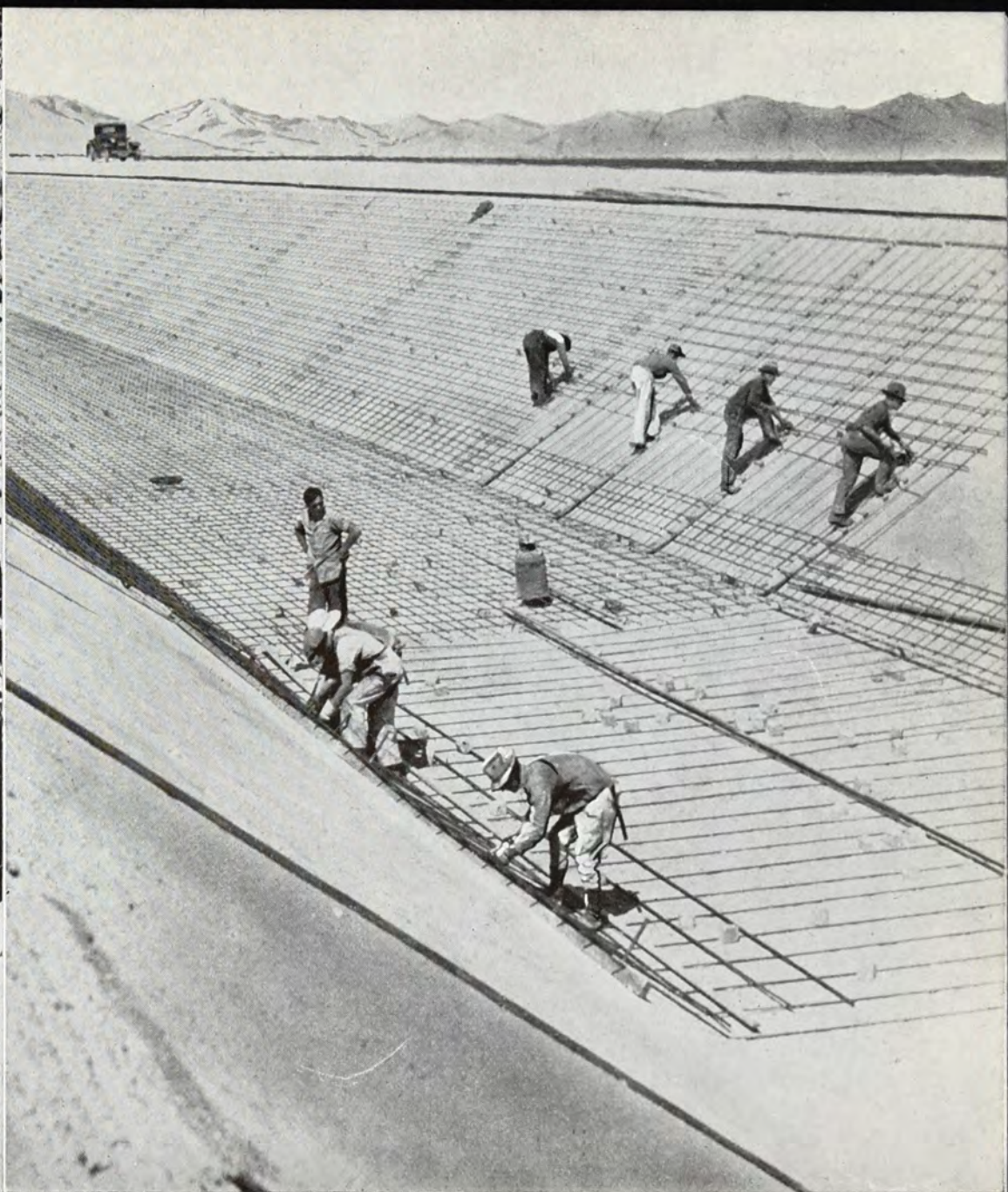
Aqueduct tunnel section being concrete lined. 92 miles of tunnels.



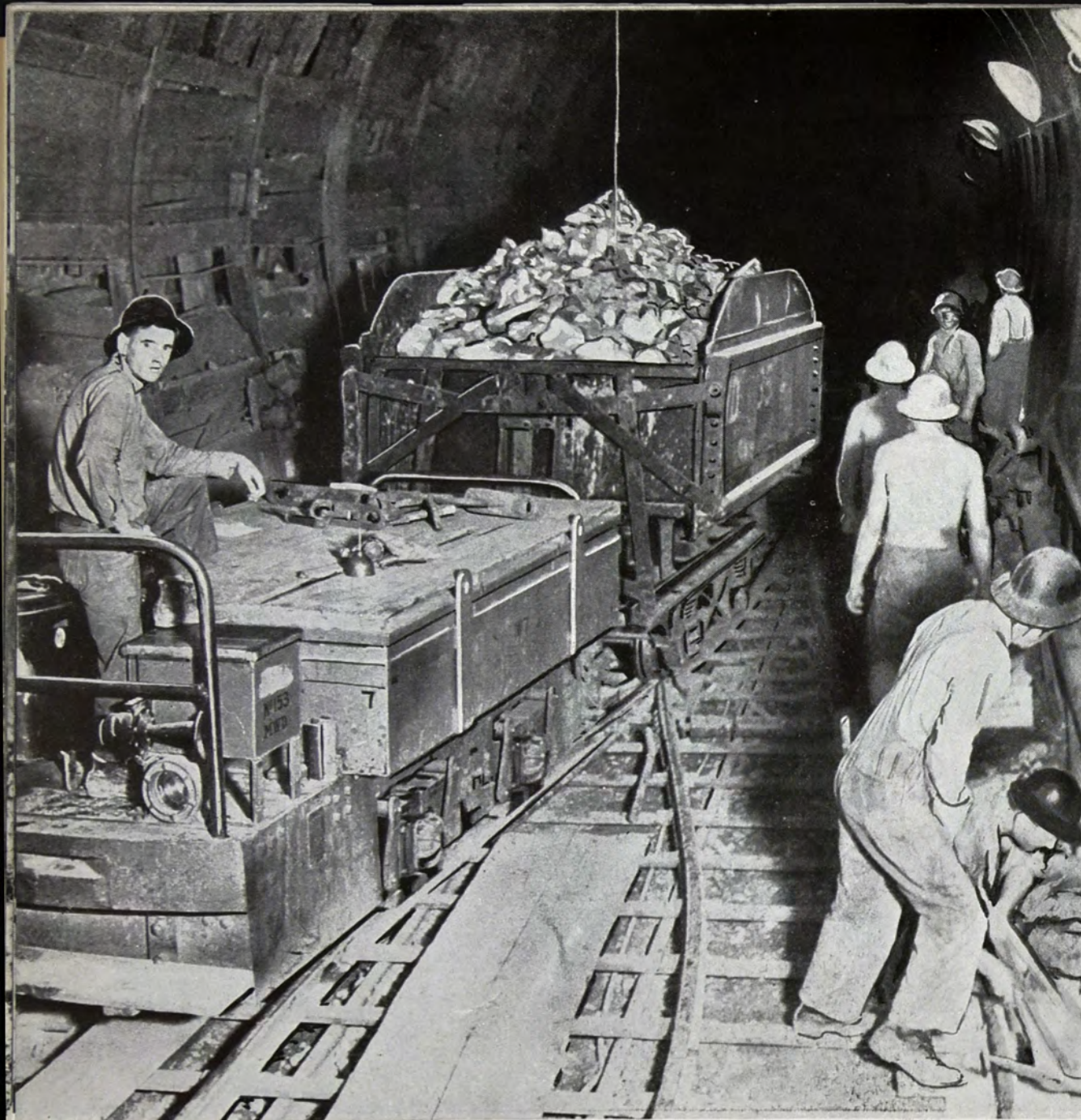
One barrel of an Aqueduct siphon section under construction. 29 miles of siphons.



Aqueduct conduit section, concrete pouring work in progress. 55 miles of conduit.



Aqueduct canal with reinforcing steel being placed. 63 miles of canals.



Electric locomotive emerging from an Aqueduct tunnel with loaded muck car.

A National Project

*B*ECAUSE of the vast quantities of materials and equipment required for the building of the Aqueduct, its benefits are national in their scope. Throughout the Middle West, East and South scores of factories, employing many thousands of workmen, have been engaged for more than two years in the manufacture of materials and machinery used on this job.

The estimated value of Aqueduct construction equipment and operating machinery is \$25,400,000.

AQUEDUCT QUANTITIES

Cement, enough to build a 14-foot highway from Los Angeles to New York	6,750,000 bbls.
Reinforcing steel	124,800 tons
Structural and plate steel	122,500 tons
Copper	6,000,000 lbs.
Lumber	55,000,000 bd. ft.
Material to be excavated	45,000,000 cu. yds.
Concrete to be placed	5,000,000 cu. yds.

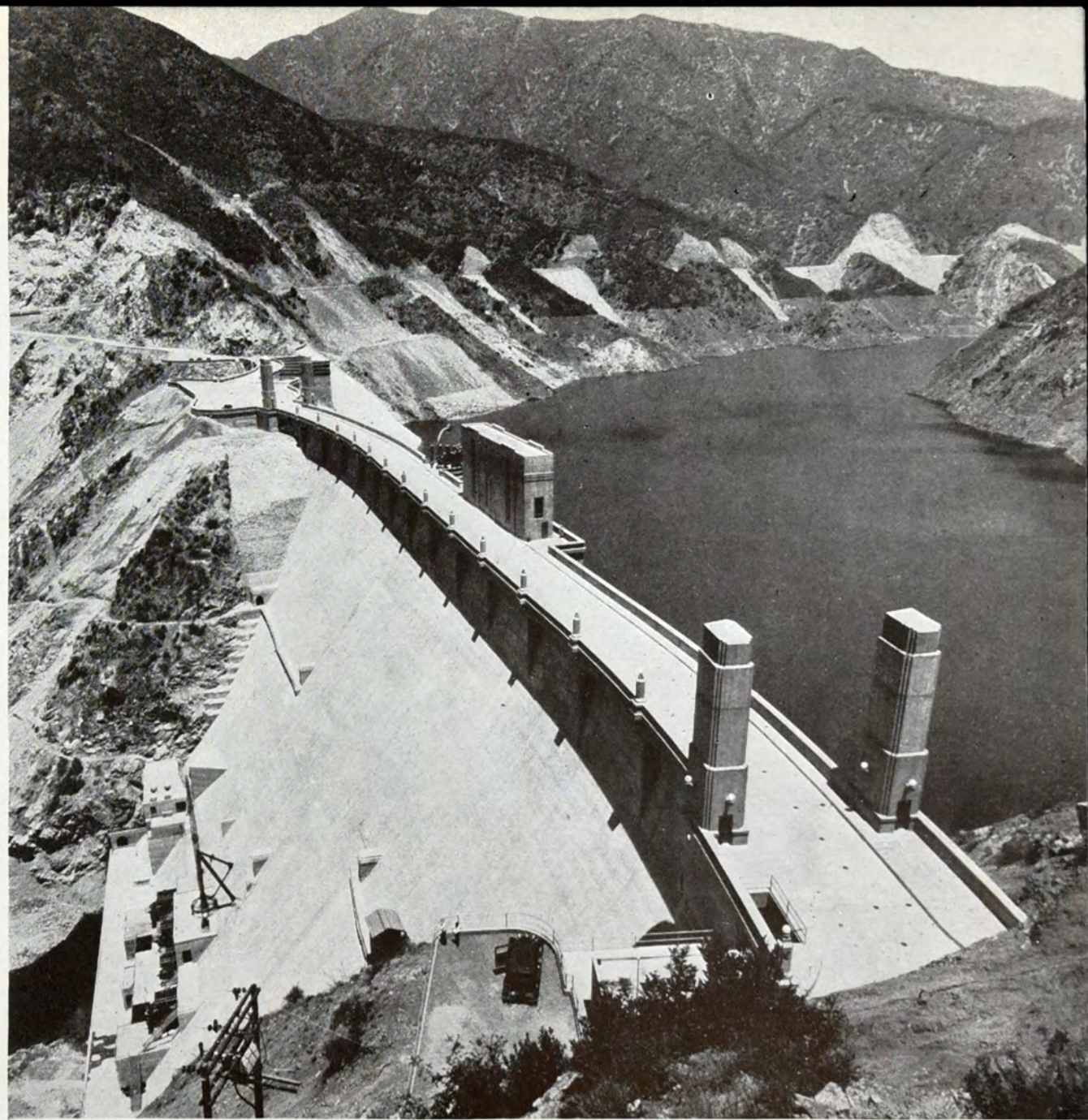
A Billion Gallons of Water

ONE BILLION GALLONS of water a day will be delivered to the cities and areas in the Metropolitan Water District. This is about equal to the amount now consumed in the metropolitan area of Southern California.

It has been necessary to bring in this large additional water supply because the natural rainfall of this region is not sufficient to meet the present and future requirements of developed areas. The average annual rainfall is 15 inches.

Each city or area in the Water District is entitled to its share of Aqueduct water. This share is fixed by the percentage of that city's financial responsibility in the District. For example, if a city represents 10 per cent of the total assessed valuation of the District and contributes 10 per cent to District expenses, that city is entitled to 10 per cent of the water.

Use of Colorado River Aqueduct water will be limited to cities and areas actually in the District. It is expected that a number of cities and developed areas not now in the District may join the District in the near future.



Morris Dam and reservoir which will serve as one of the storage reservoirs in the Aqueduct's distributing system.



Typical Aqueduct hard rock tunnel, 18 feet in diameter before being lined with concrete.

Aqueduct Tunnels

*O*NE HUNDRED AND SEVEN miles of tunnels are included in the Colorado River Aqueduct system. This represents the greatest tunnel job ever carried forward at one time in the history of engineering.

Ninety-two miles of tunnels on the main Aqueduct are excavated to a diameter of about 18 feet to be 16 feet when concrete lined; fifteen miles of tunnels are on the distributing system and are ten feet in diameter when lined.

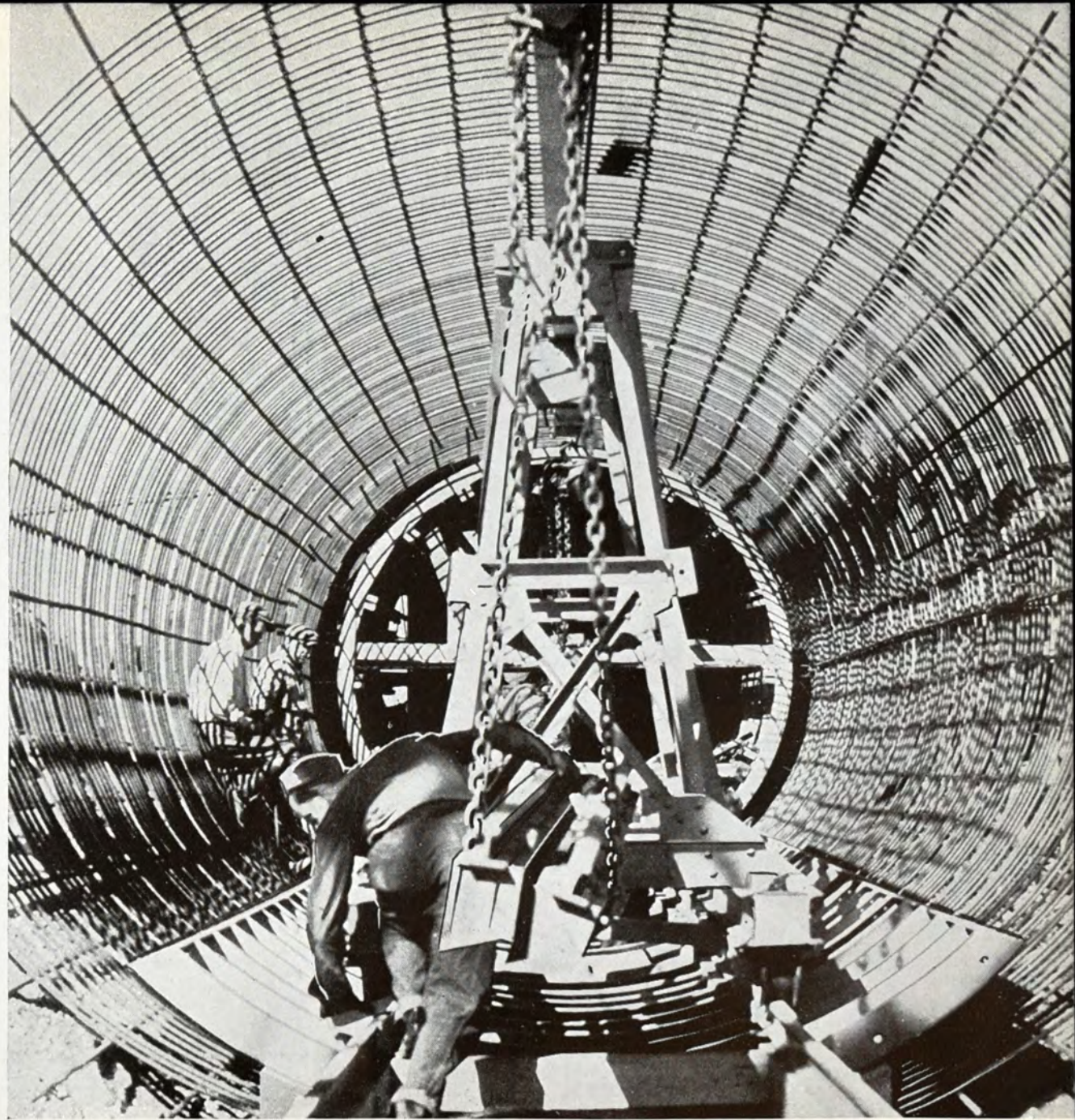
There are 29 separate tunnels on the main line. The longest is the East Coachella, 18 miles long and the longest tunnel of its kind in the world. Next is the San Jacinto, 12.8 miles long. By means of these tunnels the Aqueduct passes through the mountain barriers standing in its path.

Hard rock miners on the Aqueduct have established a new set of records for speed, efficiency and safety on tunnel excavation work.

During the peak period of tunnel construction four and a quarter miles of tunnel were excavated a month.

Aqueduct History

- OCT., 1923 Colorado River Aqueduct studies and surveys started by William Mulholland, then Chief Engineer of the Los Angeles Water Bureau.
- MAY, 1925 Citizens of Los Angeles voted \$2,000,000 in bonds to finance Aqueduct surveys and studies.
- DEC., 1928 The Metropolitan Water District of Southern California was established. It originally included Los Angeles and ten other cities.
- SEPT., 1931 Citizens of Metropolitan Water District voted \$220,000,000 Aqueduct bond issue by five to one majority.
- DEC., 1932 Construction work on Main Aqueduct line started.
- JUNE, 1935 Aqueduct in third year of construction and scheduled to be completed in 1938.



*Placing reinforcing steel on Fan Hill siphon,
one of 146 inverted siphons on Aqueduct.*



Boulder Canyon Dam site before Man tackled the job of harnessing the turbulent Colorado River at this point.

Boulder Canyon Dam

*B*OULDER DAM is located in a canyon section of the Colorado River, where the river forms the boundary line between Nevada and Arizona. It is about 200 miles below Grand Canyon and about 300 miles northeast of Los Angeles.

Boulder Dam is being built by the United States Government; the Aqueduct is being built by the thirteen cities which now comprise the Water District.

Boulder Dam depends upon the Aqueduct for a large portion of revenue which it will derive from the sale of hydroelectric power. This power will be purchased by the Metropolitan District to lift Aqueduct water over intervening mountain barriers.

The Metropolitan Water District also has a contract with the Federal Government for sufficient water storage behind Boulder Dam to produce a regulated flow of one million acre feet annually into the Aqueduct. This storage assures the District an ample supply of water for its Aqueduct even during extremely dry years.

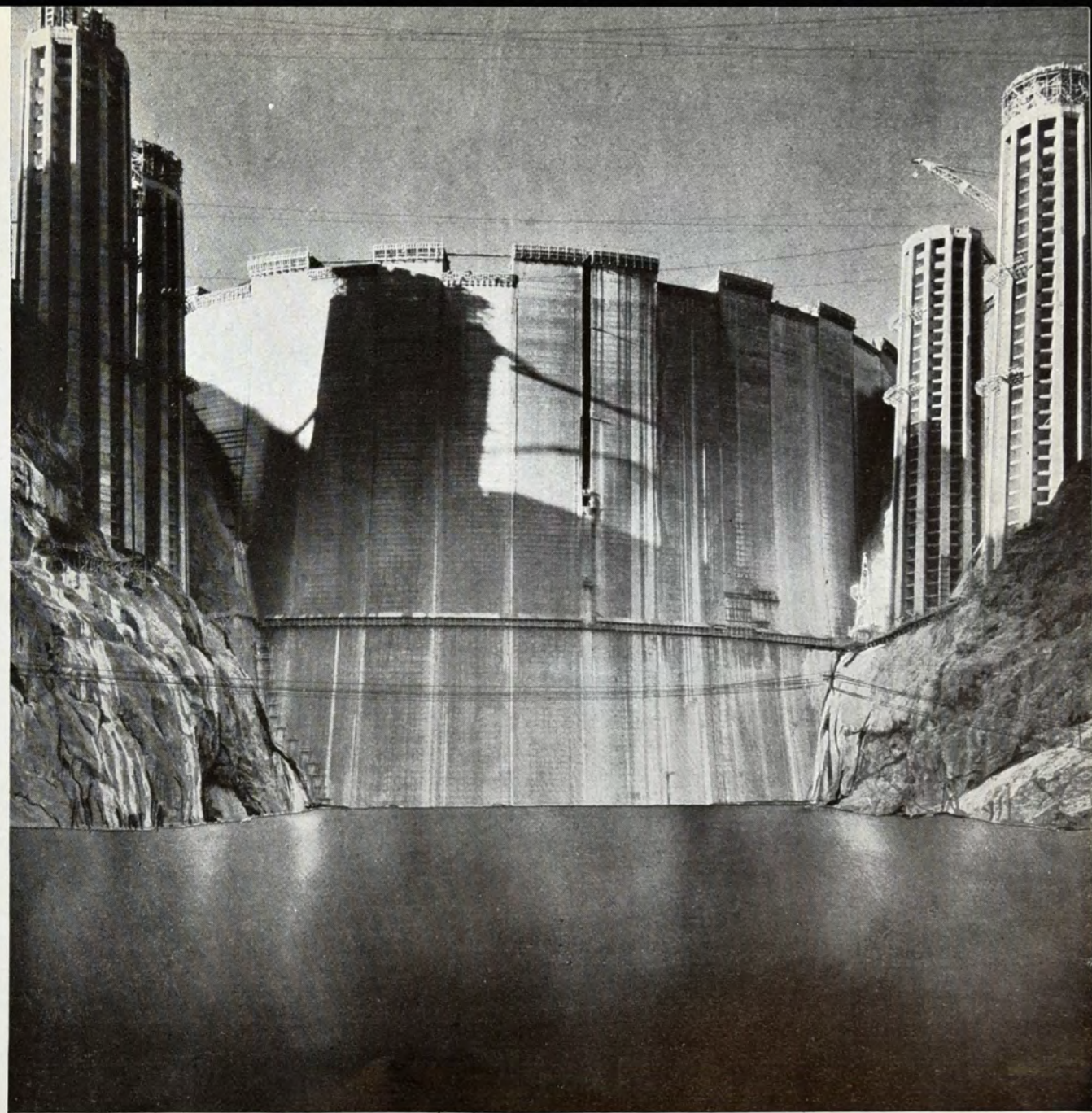
Facts About Boulder Dam

*B*OULDER DAM is the largest dam ever erected by the hand of Man.

Construction work was started in June, 1931, and the pouring of concrete on the Dam was completed in February, 1935. Work on the power plant is now in progress and scheduled to be completed in 1935.

Here are a few facts about the Dam:

Height of Dam, above bedrock	727 feet
Length of crest	950 feet
Width at bottom, up and down stream	650 feet
Cement required for Dam .	5,500,000 bbls.
Steel required for Dam . .	19,000,000 lbs.
Capacity of reservoir . . .	30,500,000 ac. ft.
Area of reservoir	145,000 acres
Length of reservoir lake .	115 miles
Installed capacity of power plant	1,200,000 h.p.
Continuous firm power output	662,000 h.p.



*Boulder Dam, now completed and storing water,
a part of which is available for the Aqueduct.*

The Metropolitan Water District of Southern California

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The Metropolitan Water District of Southern California

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GENERAL HEADQUARTERS

Los Angeles, Calif.

FIELD HEADQUARTERS

Banning, Calif.

Aqueduct Map

APPEARING on the inside cover of this booklet is a map which indicates the route of the Colorado River Aqueduct. It reveals how the Aqueduct will deliver water across mountain and desert country to each city in the Metropolitan Water District.

On this map we see the Boulder Dam built by the United States Government. We see the location of the great electric power transmission line that will deliver power from Boulder Dam to five pump-

ing plants along the Aqueduct. The power will raise Aqueduct water over mountain barriers.

Water from the Colorado River—a billion gallons a day—will be delivered to the cities in the Metropolitan Water District—and the cities which may later enter the District. How the Aqueduct will deliver this unfailing and abundant water supply to all parts of the Metropolitan Water District is graphically revealed on the map.

Aqueduct Distances

Boulder Dam to Parker Dam	155 miles	Longest Aqueduct Tunnel, East Coachella	18 miles
Aqueduct Intake to Cajalco Reservoir	242 miles	Second Longest Aqueduct Tunnel, San Jacinto	12.8 miles
Cajalco Reservoir to 13 District Cities (Initial Distributing System)	150 miles		



Booklet prepared by

DON J. KINSEY, *Assistant to the General Manager*

The Metropolitan Water District of Southern California

SECOND PRINTING—AUGUST, 1935