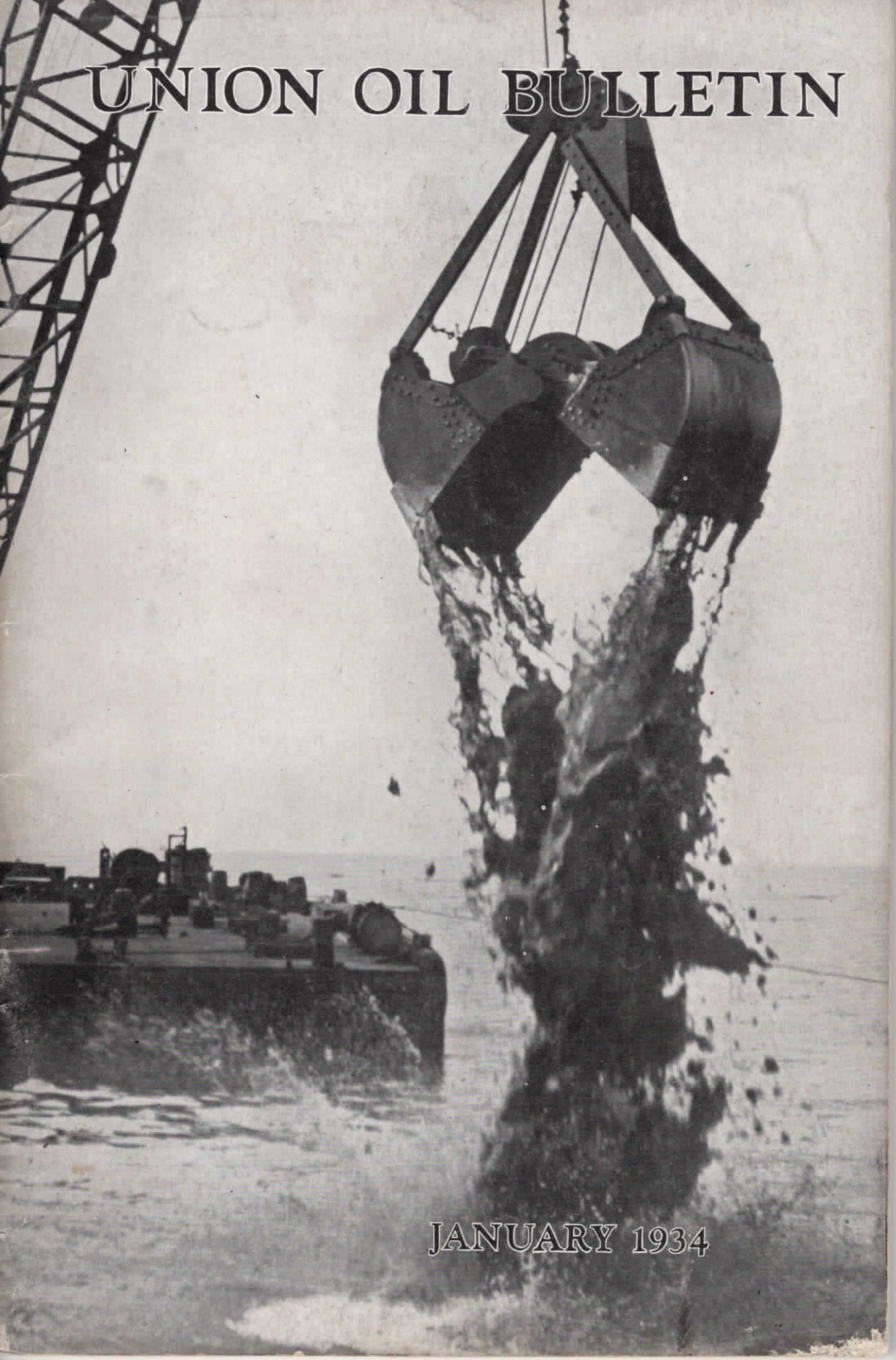
UNION OIL BULLETIN



JANUARY 1934

From these rising columns of steel will be suspended the longest bridge span ever built. The north pier of the Golden Gate Bridge, of which they are a part, will measure 846 feet from the base of the foundation to the top of the superstructure.

UNION OIL BULLETIN

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EDITOR'S NOTE: In order to present a comprehensive picture of the major public works and construction projects serviced by Union Oil Company during 1933, the Bulletins of November and December have been combined in this first issue of the new year.

Union's Contribution to 1934—A New Motor Oil

THE outstanding event of 1933, as far as the Union Oil Company is concerned, was the announcement, in November, that a new solvent-extraction process had been developed by the Research and Development departments for the production of a lubrication oil from Western crudes that will be superior to any oil, Eastern or Western, now marketed.

The outstanding event of 1934 will be its introduction to Pacific Coast motorists.

While it will be some months before the oil will be produced commercially in the million dollar plant now being erected at the Oleum refinery, a considerable quantity has been refined, for test purposes, in a miniature plant erected at the Los Angeles refinery, where all of the original research work has been done. From these tests, made over a long period of time, in the laboratory and on the road, the virtues of the oil have been determined beyond question.

At this time we cannot—for obvious reasons—go into detail concerning the new oil, nor its process of manufacture. It can be said, however, that the process by which it will be made represents the greatest refining achievement in the past quarter-century, as far as the manufacture of petroleum products in the West is concerned.

In the production of the new oil (for which employees have been asked to suggest a name) crude lubricating distillate, obtained as a result of vacuum distillation of crude oil, is mixed with a special solvent which has the power to dissolve the highly

desirable portions of the oil, but which rejects oils of low quality. The superior oil thus produced is then subjected to "propane dewaxing," which removes all wax, asphaltic and other undesirable residue.

It can be said of the product of this triple refinement that it will possess the following virtues:

An unusually high resistance to oxidation which will maintain the oil at maximum efficiency during the period of its service.

A high viscosity index, giving the oil a flat viscosity slope comparable to the best lubricants now on the market.

Low carbon residue.

Low consumption.

Used in proper grades it will increase gasoline mileage.

The development of the process used in the manufacture of the new oil covers a period of several years. Dr. D. R. Merrill, manager of research, and Dr. Ulric B. Bray, research supervisor, are credited with conducting a greater portion of the original research work that led to its discovery. Others in the Research Department participated. Dr. Merrill has been identified with the research work of the Union Oil Company since 1921. Dr. Bray, a native of Georgia, and for two years a Research Council Fellow at the California Institute of Technology, has been a member of Union's Research Department since August, 1928.

L. G. Metcalf, manager of refineries, and Earl W. Gard, development engineer, are largely responsible for successfully transforming the research discoveries from the laboratory to the commercial production stage.

Philip Subkow, patent counsel, has personally followed each step in the development of the new process, with the result that a large number of patent applications have been filed to protect it.

Public Works Projects of 1933

IN SPITE of the fact that the United States touched the bottom of the economic depression in 1933, the year witnessed the continuance and starting of the greatest group of public works ever undertaken on the Pacific Coast at one time. To help its readers visualize their scope, The Bulletin, in this issue, presents a review of the major western projects to which the people of the nation and various interested states have dedicated their resources, and in which the Union Oil Company is playing a part by supplying petroleum products to the contractors who are doing the actual construction work.

Following are some of the projects with which the company has been and now is identified:

Metropolitan Water District aqueduct—To cost $220,000,000—The greatest aqueduct of all-time.

San Francisco-Oakland Bay bridge—8¼ miles long—Three times the size of the present world's longest bridge.

Boulder (Hoover) Dam—The peer of all dams—Now in the third year of its construction.

Grand Coulee Dam in Eastern Washington on which preliminary work is now being done—The power phase of which alone will cost $60,000,000.

Madden Dam, Panama Canal Zone, and its twenty saddle dams to control the flood waters of the Chagres River and regulate the year-'round supply of water going into Gatun Lake.

And a host of lesser projects, such as, Pine Canyon Dam, built by the city of Pasadena and destined to become part of the Metropolitan Water District aqueduct; San Gabriel Dam No. 2, built by Los Angeles County; Santa Monica breakwater; and several hundred miles of state and county highways built throughout the Pacific Coast states.

The San Francisco-Oakland Bay Bridge as conceived by the artist, picturing San Francisco in the background.

Bridging San Francisco Bay

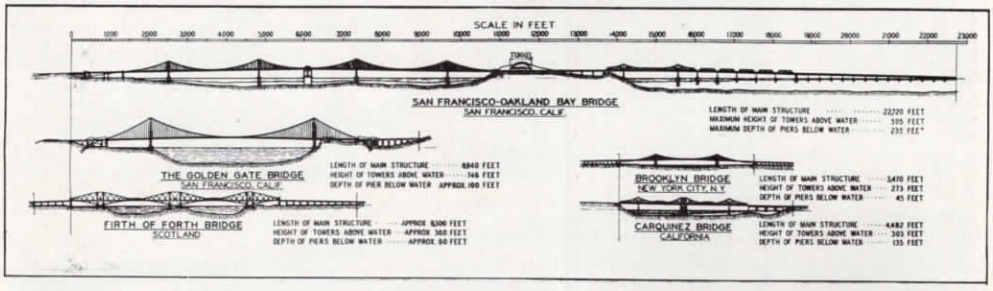
HISTORIANS, chronicling the outstanding engineering achievements of the early half of the 20th Century, are certain to include the building of two San Francisco Bay bridges, both now under construction and both started within recent months. One will span the bay between San Francisco and Oakland, a distance of 8¼ miles, and the other the Golden Gate. The former will be three times as long as the present world's largest bridge, the Firth of Forth Bridge of Scotland, and will cost $71,000,000 to complete. The latter will be more than a mile long, and its center span of 4200 feet will be 700 feet longer than the famous George Washington Memorial Bridge at New York, the greatest single span built to date. It will cost approximately $33,000,000.

Like Boulder Dam, the Metropolitan Water District Aqueduct and other great projects now underway on the Pacific Coast, these two bridges symbolize a new era of courage and progress born of the depression. They are a tribute to the citizenry, as well as the engineer and the builder.

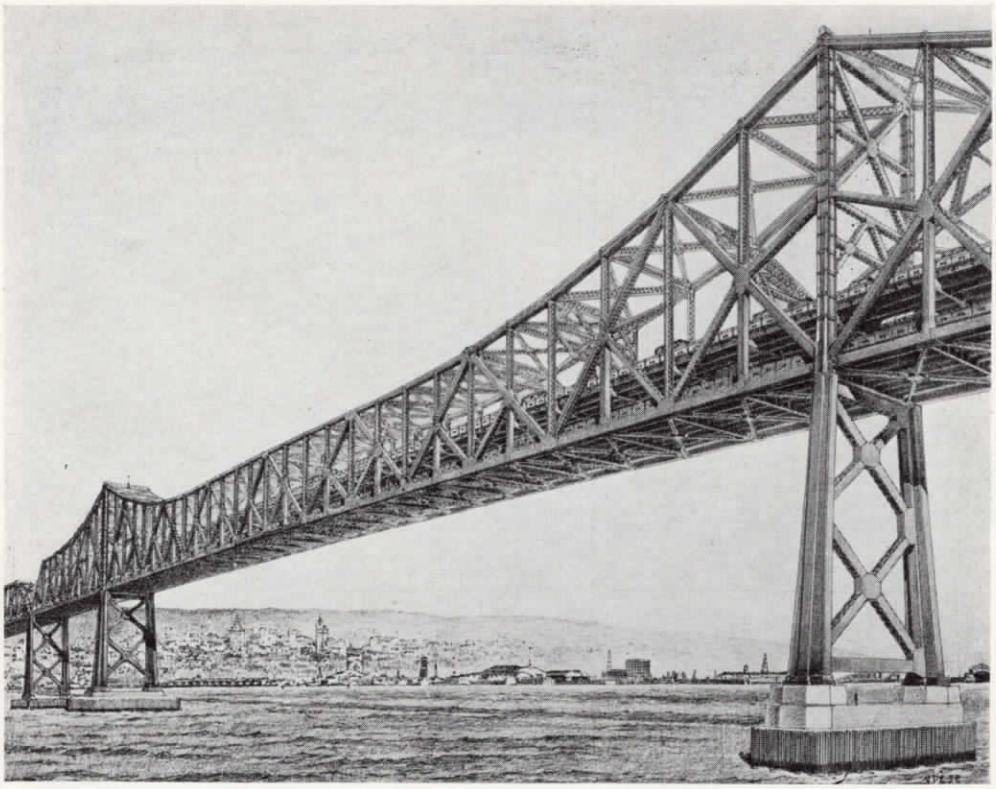
Because of the area covered it will be some time before either of the bridge projects take shape in the eyes of the layman, regardless of how imposing an individual unit may appear on close inspection. Approaches, anchorages and foundations are under construction on both bridges, but it is difficult to stand at either anchorage of the Golden Gate Bridge, even with the steel superstructure rising from the massive concrete base of the north pier on the Marin County side of the gate, and visualize the three-quarter-mile-span of steel cables and girders swung into place over the harbor entrance. It is equally difficult for one to stand on the San Francisco water front and mentally picture the completed bridge rising from the series of tiny artificially created islands now dotting the bay between San Francisco and Yerba Buena (Goat) Island, the center link in the bay-spanning project, and between the Island and Oakland shore line.

To know that it is to be done is sufficient, however, to enable one to appreciate the importance of these tiny islands, which assume impressive proportions when viewed from the vantage point of a power boat. They are found on such inspection to consist of temporary wharfs, caissons and barges, each being a complete operating unit in itself. They mark the points at which the foundations for the piers are being built.

When completed these piers will be the gigantics of a gigantic structure. They will vary in size, depending on their location. The foundations of the Westbay piers, those located between Yerba Buena Island and San Francisco, will range in depth from 200 to 235 feet below the surface of the water. The towers to be erected on these piers, and from which the bridge



Comparison of the length of the San Francisco Bay bridge with other outstanding bridges of the world.



One of the cantilever spans of the Eastbay crossing, as completed by the artist, showing Oakland in the background.

will be suspended, will extend above the foundations from 465 to 505 feet. The combined height of concrete foundation and tower will be approximately 700 feet, or a height greater than a 70-story skyscraper.

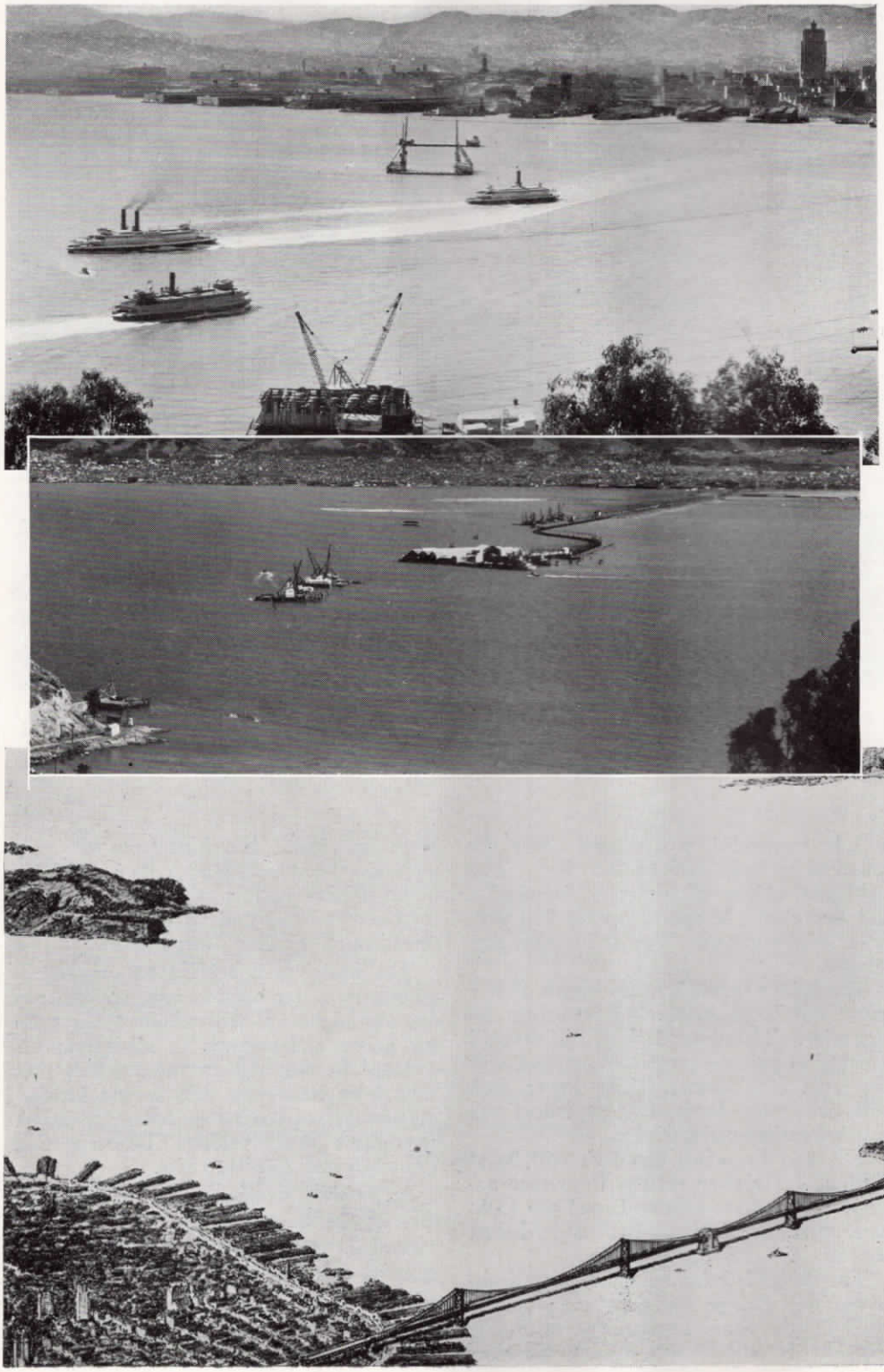
The bridge throughout its length of 8¼ miles will be a double-deck structure 58 feet wide. The upper deck will be devoted entirely to passenger automobiles and will carry six cars abreast. The lower deck will carry three lanes of heavy trucks and two interurban car tracks.

The San Francisco approach will be at Fifth and Harrison streets, if present announced plans are followed, and the Oakland approach will be at 37th and Market streets.

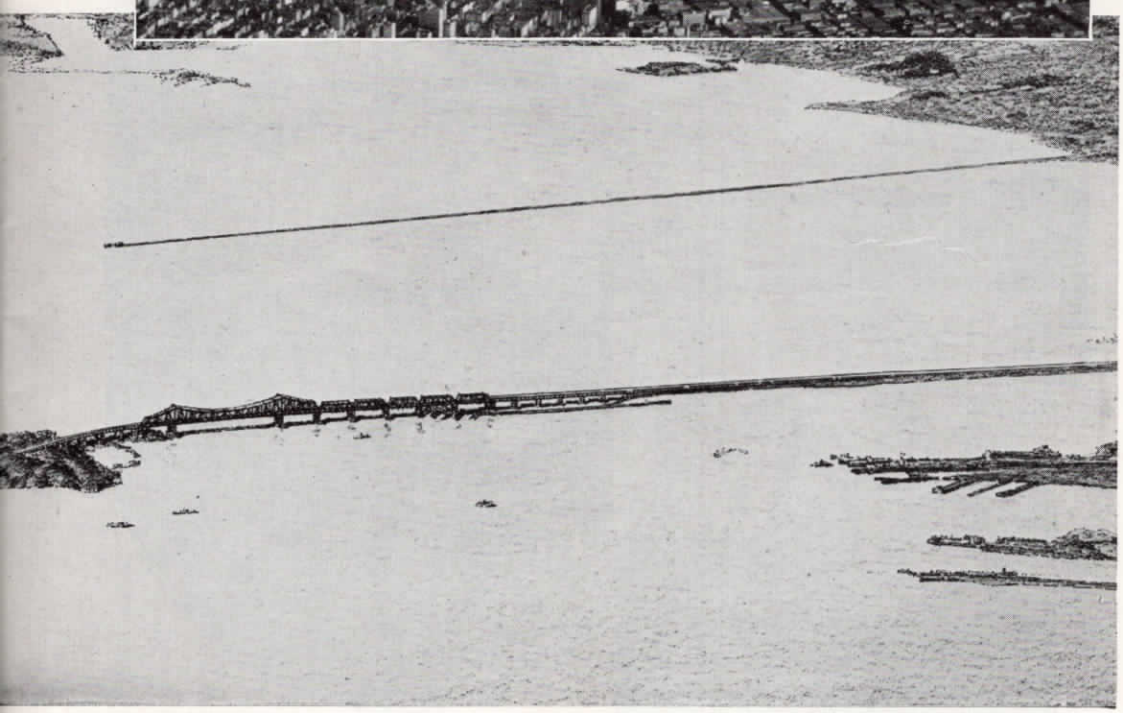
The bridge is being built under the California Toll Bridge Authority and is supervised by the State Department of Public Works. It will become part of the state highway system. Revenues from tolls will maintain the structure after its completion. Sixty million dollars of the $70,000,000 total cost is being underwritten by the Reconstruction Finance Corporation.

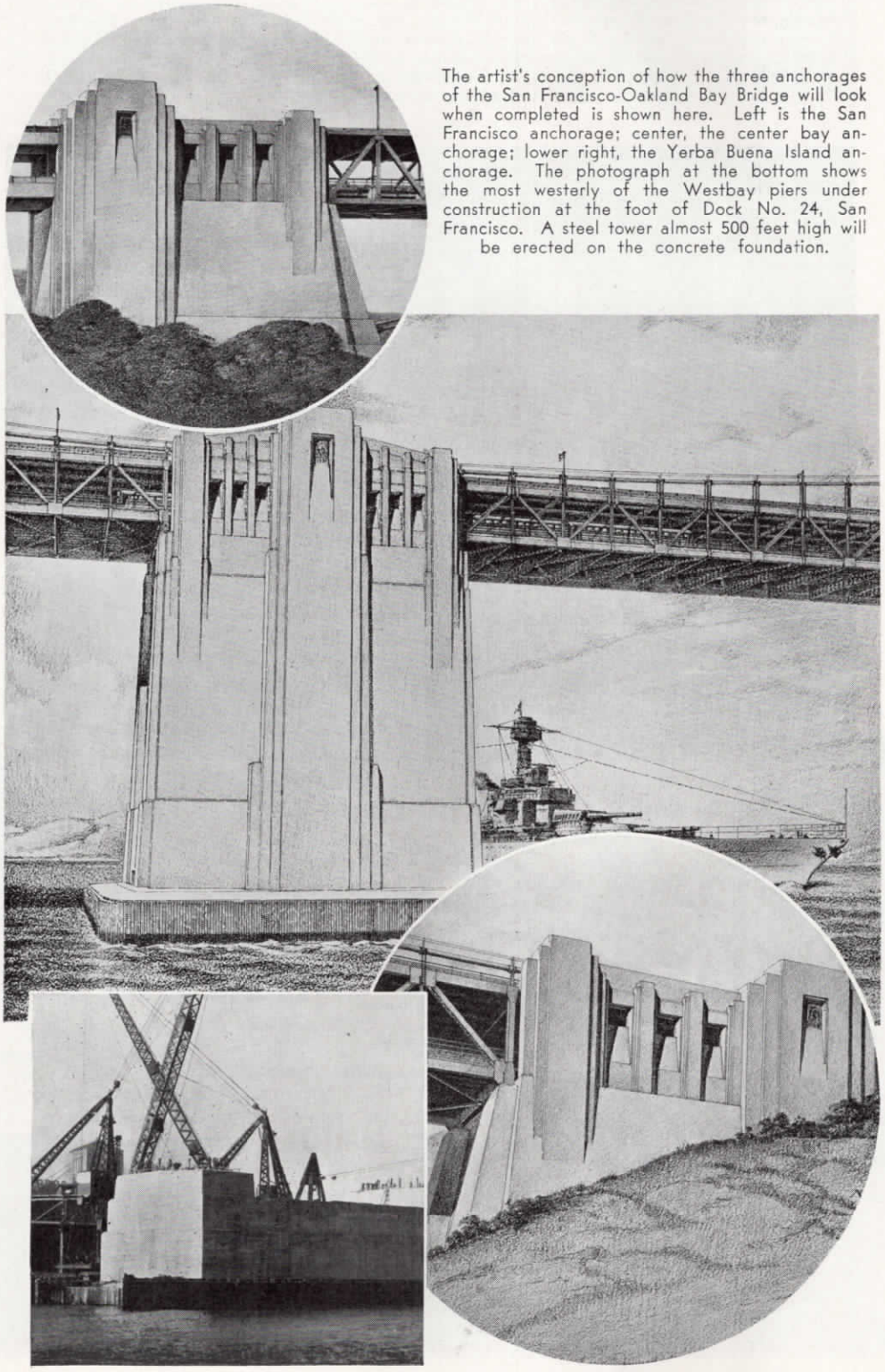
The bridge will replace an existing 5-mile ferry water barrier, and will be open day and night. It will eliminate the present delays and hazards to navigation occasioned by fog and storms, hazards that have been increasing due to the increasing number of boats required to transport commuters and vehicles between San Francisco and Eastbay cities.

Automobile traffic across the bay in spite of the ferry handicap has rapidly increased in recent years. In 1915 only 364,000 vehicles crossed the bay. By 1930 the ferries carried 4,500,000 vehicles in which were 10,500,000 passengers, averaging 2.3 passengers per car, and,



San Francisco-Oakland Bay Bridge views. Below is one from the air, copyrighted by Gabriel Moulin, showing approximate location of bridge. Top, page 6, looking toward San Francisco from Yerba Buena Island. A pier caisson is shown in the foreground, and location of other piers is marked in center of the bay. Center, looking toward Oakland from the Island, showing work in progress on piers. At the bottom is an aerial view drawing of the bridge as it will appear when completed.





The artist's conception of how the three anchorages of the San Francisco-Oakland Bay Bridge will look when completed is shown here. Left is the San Francisco anchorage; center, the center bay anchorage; lower right, the Yerba Buena Island anchorage. The photograph at the bottom shows the most westerly of the Westbay piers under construction at the foot of Dock No. 24, San Francisco. A steel tower almost 500 feet high will be erected on the concrete foundation.

also, 35,000,000 commuters. Conservative estimates indicate that by 1937 when the bridge is completed, the traffic will have increased to 8,000,000 vehicles.

At present approximately 50,000 persons cross San Francisco Bay twice each day. A great majority of these are commuters traveling from their homes in the Eastbay cities to places of business in San Francisco, or vice versa. The inter-dependence of the two sections, San Francisco and the Eastbay cities, is such as to require extensive and rapid movement of passengers and commodities across the bay.

When the bridge is completed it is estimated it will save vehicular traffic approximately 30 minutes in crossing the bay over the present ferry system. The time saved by interurban traffic is estimated at 20 minutes.

The structural steel for the bridge, consisting of 152,000 tons; cable wire, 18,000 tons, and reinforcing steel, 17,000 tons, represents 6.7 per cent of the total steel output in the United States for the year 1933.

More than 1,000,000 cubic yards of concrete will be used in the approaches, anchorages and piers; 1,300,000 barrels of cement and 30,000,000 board feet of lumber. The initial paint requirements alone will be 200,000 gallons. The lumber that will be used would be sufficient to build 3,000 five-room homes.

The upper deck of the bridge will have a traffic capacity of 24,000,000 automobiles a year and the lower deck a truck capacity of 6,000,000, giving the bridge a total vehicular capacity of 30,000,000 per year.

The interurban tracks will be able to carry 50,000,000 train passengers per year.

The upper deck is designed to carry a continuous congested load of twelve and one-half-ton vehicles, with occasional maximum of 15-ton vehicles.

The lower deck is designed for a maximum of 40-ton vehicles and 70-ton interurban cars.

Estimated Traffic

Year	Vehicles	Passengers Vehicular	Interurban
1937	8,000,000	16,000,000	35,640,000
1943	10,000,000	20,000,000	36,600,000
1950	12,600,000	25,000,000	40,000,000

The bridge costs are itemized as follows:

The entire project	$71,600,000
The bridge proper	55,000,000
Interurban installation	10,000,000
Approaches	6,600,000

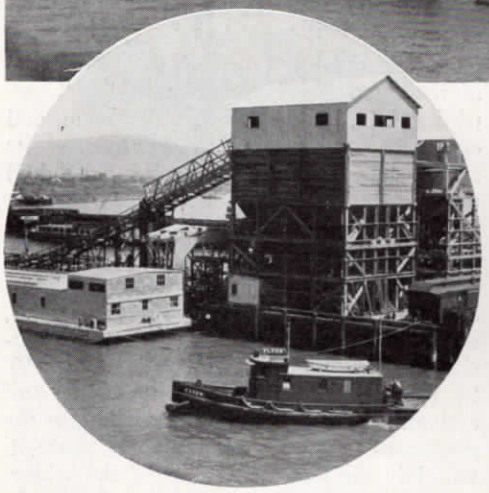
To speed the work, and also because different conditions are being encountered at the East and Westbay crossings, piers for the bridge are being constructed under two separate contracts. The Westbay piers, between San Francisco and Yerba Buena Island, are being built by the Tansbay Construction Company, and the Eastbay piers, between Yerba Buena Island and Oakland by Bridge Builders, Inc. Included in the latter organization are some of the companies identified with Six Companies, Inc., builders of Boulder Dam, and extensive users of Union products. The steel work of the bridge is being handled under still another contract.

The Westbay bridge crossing will be 10,450 feet long. It will be of the suspension type construction. The east end will be anchored on Yerba Buena Island, the other at San Francisco. A center anchorage, consisting of a concrete pier 92 by 192 feet in area at the water line and extending more than 200 feet below the surface of the water and 298 feet above it, will join the two main spans of the bridge, each of which will be 2310 feet long. In addition to the concrete pier anchorage there will be four other piers all of which will be founded on solid rock on the bottom of the bay.

The cables supporting the suspension bridge will be 28 inches in diameter and will consist of 37 strands containing a total of 17,464 wires. These cables will be anchored in San Francisco in a giant block of concrete containing 68,000 cubic yards of cement and aggregate, and will be anchored on Yerba Buena Island in tunnels driven into solid rock and made fast by steel eyebars set in concrete. The pull on each cable will be about 37,000,000 pounds, both live and dead loads.

The Yerba Buena Island crossing will consist of a double-deck tunnel 540 feet long, 76 feet wide by 58 feet high, providing for the same type of vehicular traffic on the upper and lower decks as is carried by the bridge. The tunnel will be lined with bright surfaced steel and will be the largest bore tunnel in the world.

The Eastbay crossing, between Yerba



Concrete mixing barges of the Henry J. Kaiser Company along side the Southern Pacific wharf where aggregate and cement are stored. Each barge is a complete mixing plant, its machinery electrically driven. When towed along side the location where the concrete is required its mixing machines are started and a continuous supply delivered by conveyor belts to the forms. Each barge has a capacity of 280 cubic yards. The Kaiser Company is supplying concrete for all piers and anchorages for the San Francisco-Oakland Bay Bridge. Union products are being used throughout. The tugs which tow the barges are operated by the Harbor Tug & Barge Company, also an extensive user of Union products.

Buena Island and Oakland, will consist of one cantilever span 1400 feet long; five simple spans each of more than 500 feet in length and a mole supported by concrete and wood piles. This bridge will parallel, slightly to the north, the present Key Route Mole. It will continue double-deck to the toll plaza near the Oakland shore, where the bridge approach will widen out to prevent congestion.

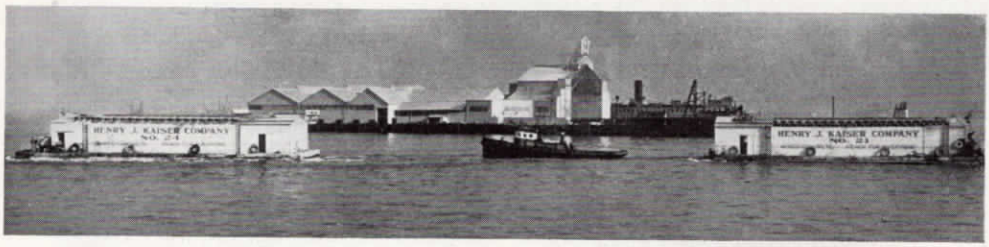
The clearance of the Eastbay crossing will be 185 feet above the water. The bridge over the West Bay will be more than 200 feet above the surface of the water.

The main automobile entrance to the bridge in San Francisco will be one block wide between Harrison and Bryant Streets on Fifth. Another automobile entrance to the bridge will be located at Clementina and First Streets.

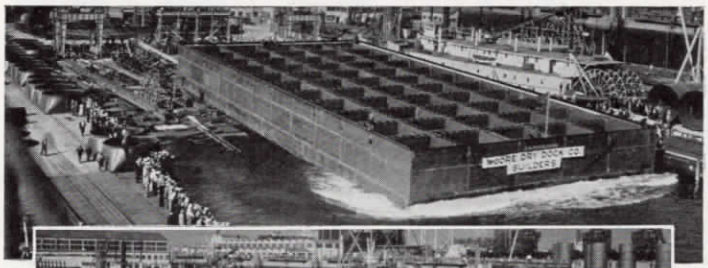
The truck entrance and exist from the lower deck of the bridge will be located on Harrison Street between Rincon and Sterling Streets.

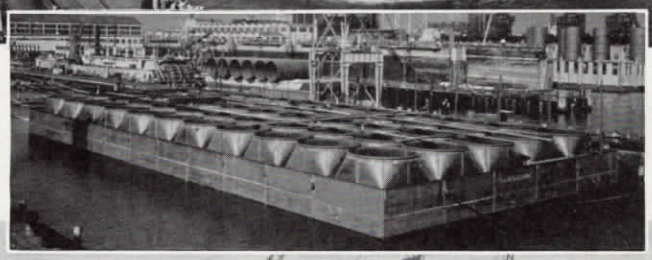
An interurban car loop will encircle a section between Harrison and Market Streets.

An additional exit for upper deck automobile traffic will be provided at Harrison and Fremont Streets. Present uncompleted streets in the neighborhood of the ap-

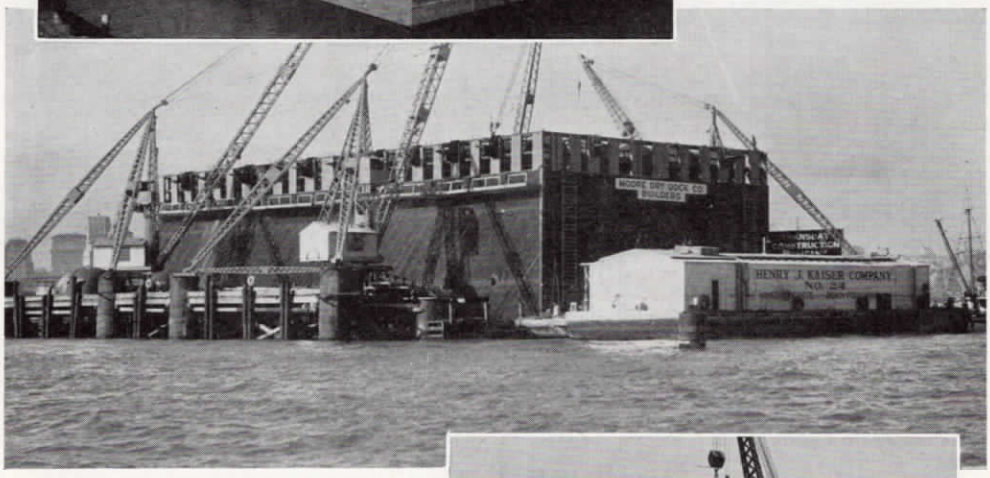


Henry J. Kaiser Company concrete mixing barges being towed to Eastbay crossing piers

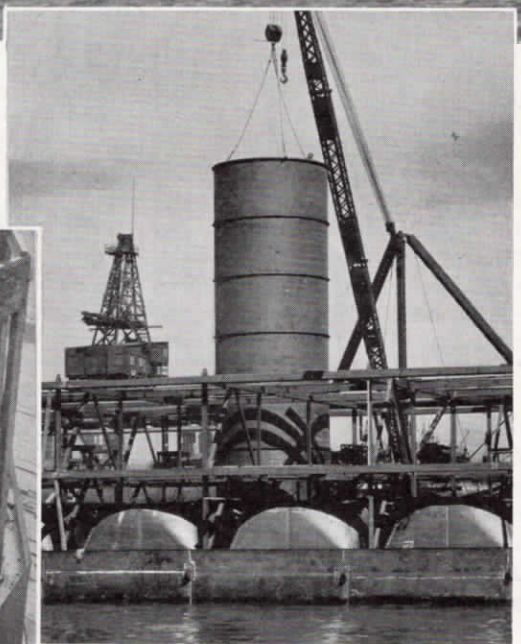


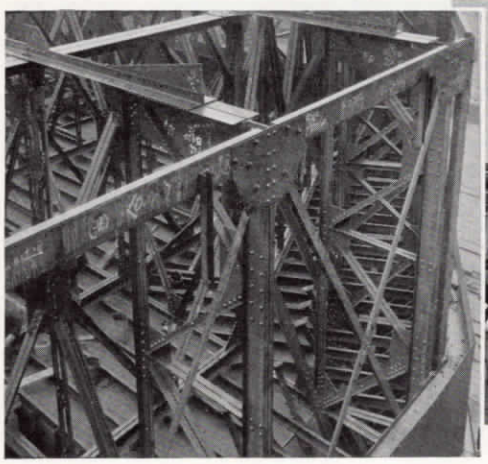


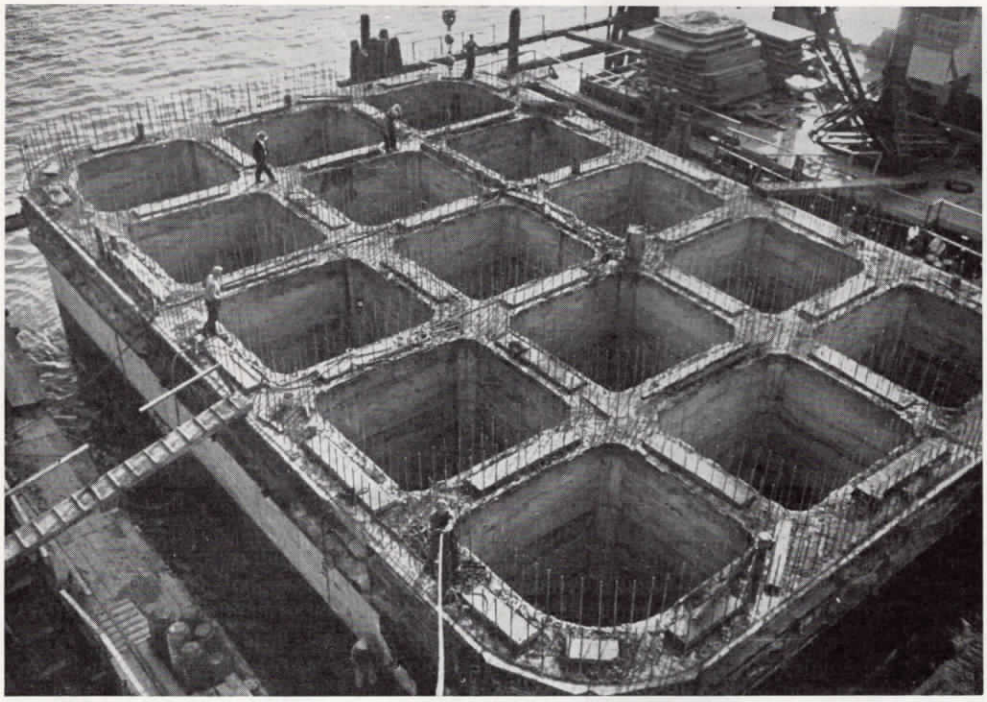
The caisson—without it the bridge could not be built. Top, left, launching bridge's largest caisson at Moore Dry Dock Company's plant, Oakland. It contains 55 dredging wells, each 15 feet square. Center, left, same caisson with adapter sections in place. Lower, right, lowering first of steel tube columns into place in adapter sections. The tubes are 15 feet in diameter and 69 feet high. Lower, left, steel framework inside caisson.



Above, the caisson in place, its sides calked like a ship, ready to be lowered in bay for the foundation of center anchorage. The Kaiser Company's concrete mixing barge is along side ready to pour first concrete into caisson.







One of the Eastbay piers in an advanced stage of construction. By operating dredgers through the 15 dredging wells—each approximately 13 ft. 6 in. square—pictured in the above photograph, the floor of the bay is excavated beneath the caisson to permit the pier to sink deeper into the bed of the bay. Piers of this type start with a caisson, equipped with four cutting edges. After being towed into place it is lowered to the floor of the bay by pouring concrete—reinforced as shown here—around the dredging well, a section being poured at a time. Once on the bottom of the bay dredging is started through the dredging wells, the area beneath the caisson being excavated to a fairly uniform depth, the weight of the caisson and concrete causing the cutting edges to knife their way through the earth and rock when it has been properly weakened. Each time the pier is lowered in this way a new section of concrete is poured until the desired depth is reached. Then a further excavation (not sufficient to cause the caisson to sink lower) is made and the excavation and bottom portion of the pier is filled with concrete. The next step is the capping of the pier preparatory to erecting the steel super-structure.

proaches will be cut to provide many routes to the bridge.

The toll plaza will be located just off the Oakland shore, east of the place where the lower deck is forked to permit the upper deck to come down to the same level.

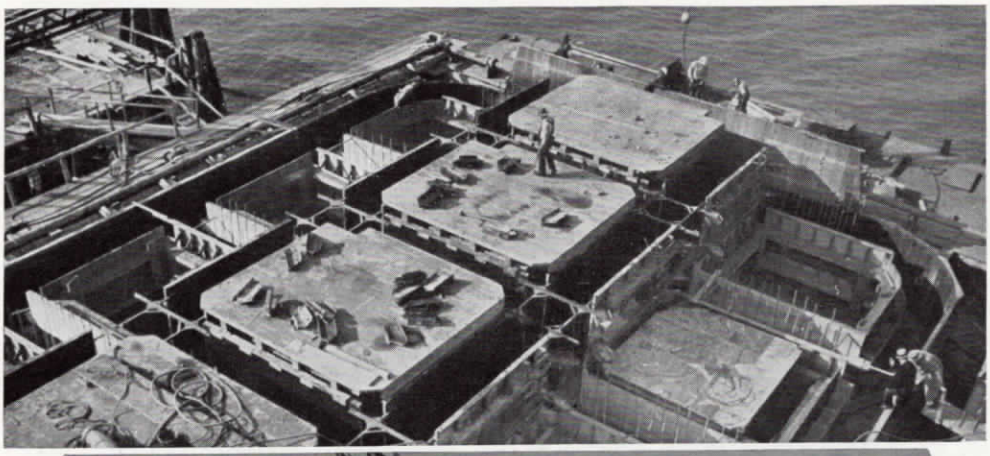
The bridge will tap Berkeley traffic with an approach located at the foot of Ashby Avenue.

Oakland traffic will be provided with a broad approach with an entrance width of one city block between Thirty-seventh and Thirty-eighth Streets at Market.

Alameda traffic will be provided with an approach terminating at Seventh and Cypress Streets.

The construction of the piers constitutes one of the highly interesting phases of the project, and starts, not at the site of the bridge, as the layman might expect, but in the plant of the Moore Dry Dock Company of Oakland (another Union Oil customer), where the caissons for the piers are being built. These caissons are striking steel structures in themselves. Those used on the Westbay piers are the largest ever built, the one for the anchor pier being 92 feet wide and 197 feet long. At the time it was launched at the site of the pier it had been built up to a height of 77 feet six inches.

The caisson is built up in sections, starting with four cutting edges, which perform a highly important mission when the floor of the bay is reached. After the cut-



Another Eastbay crossing pier, partially completed. Forms are being put in place to pour a section of re-inforced concrete. In the circle are shown the temporary wharfs constructed to facilitate building operations. The Key Route Mole is in the background. At the right, one of the concrete forms is being lowered in place with the aid of a crane. This is one of the piers being built by Bridge Builders, Inc.

ting edges are launched the superstructure of welded steel framework is erected on top of them. This framework consists of steel columns and beams similar to that for a six-story steel frame building.

The interior of the caisson is of a cellu-

Pier for one of the truss spans under construction. It is being built within an area inclosed by sheet steel piling. Wooden piles, driven to a depth of 40 feet below the water, form the foundation. At the left, a pile driver is shown in operation. Activities in connection with preparations to pour concrete on top of piles are pictured in the other photographs.

lar construction. The cells, or dredging wells, as they are called, are formed on the bottom cutting edge by 15-foot square openings. To these openings are attached adaptor sections 6 feet 6 inches high, 15 feet square on the bottom and 15 feet in diameter at the upper end. As the caisson is built up new sections of steel tubes, 15 feet in diameter are added and welded into place, until the necessary height is reached.

Fifty-five dredging wells were provided for in the caisson for the anchor pier. The cellular sections are called dredging wells, as it is through them that the mud and rock on the bottom of the bay are dredged out.

The outside wall of the caisson is protected with 10 inch by 12 inch vertical planking bolted to the steel frame, over which is laid 4 inch by 12 inch creosoted diagonal sheating. These timbers are calked in ship plank fashion, using oakum and cement to make them absolutely watertight.

Upon the arrival of the caisson at the site where it is to be launched, the areas within the outer walls and around the dredging wells are filled with concrete. Additional sections are added as the caisson settles into place. Once on the bottom, the dredging starts, the clam shell buckets operating through the cellular dredging wells. As the mud and rock are removed from beneath the caisson, the weight of the steel and concrete, aided by the cutting edges, causes it to settle to the bottom of the excavation. As each successive depth is reached a new section is added to the caisson and concrete poured around the dredging wells to the height of the new section. This process continues until the desired bedrock is reached. In the Westbay, it is approximately 100 feet below the present bottom.

After the caisson is built to the required height all outside cylinders (dredging wells) are filled with concrete, the space between the outer walls and between all cylinders having been filled with concrete during the sinking process.

The above procedure, while applying directly to the Westbay piers, applies, with variations, to the sinking of the caissons and pouring of the concrete for the piers that will support the cantilever and other spans of the Eastbay crossing.

The piers for the mole on the Eastbay crossing present a much easier construction problem. Sheet steel piling is first sunk in the bay around the area in which the pier is to be built and wooden piles driven to a depth of about 40 feet below the surface of the water, the depth varying several feet. A 5-foot layer of gravel is then poured around the piles and 16 feet of concrete on top of the gravel. To this is anchored a reinforced concrete block on which the mole superstructure will be erected.

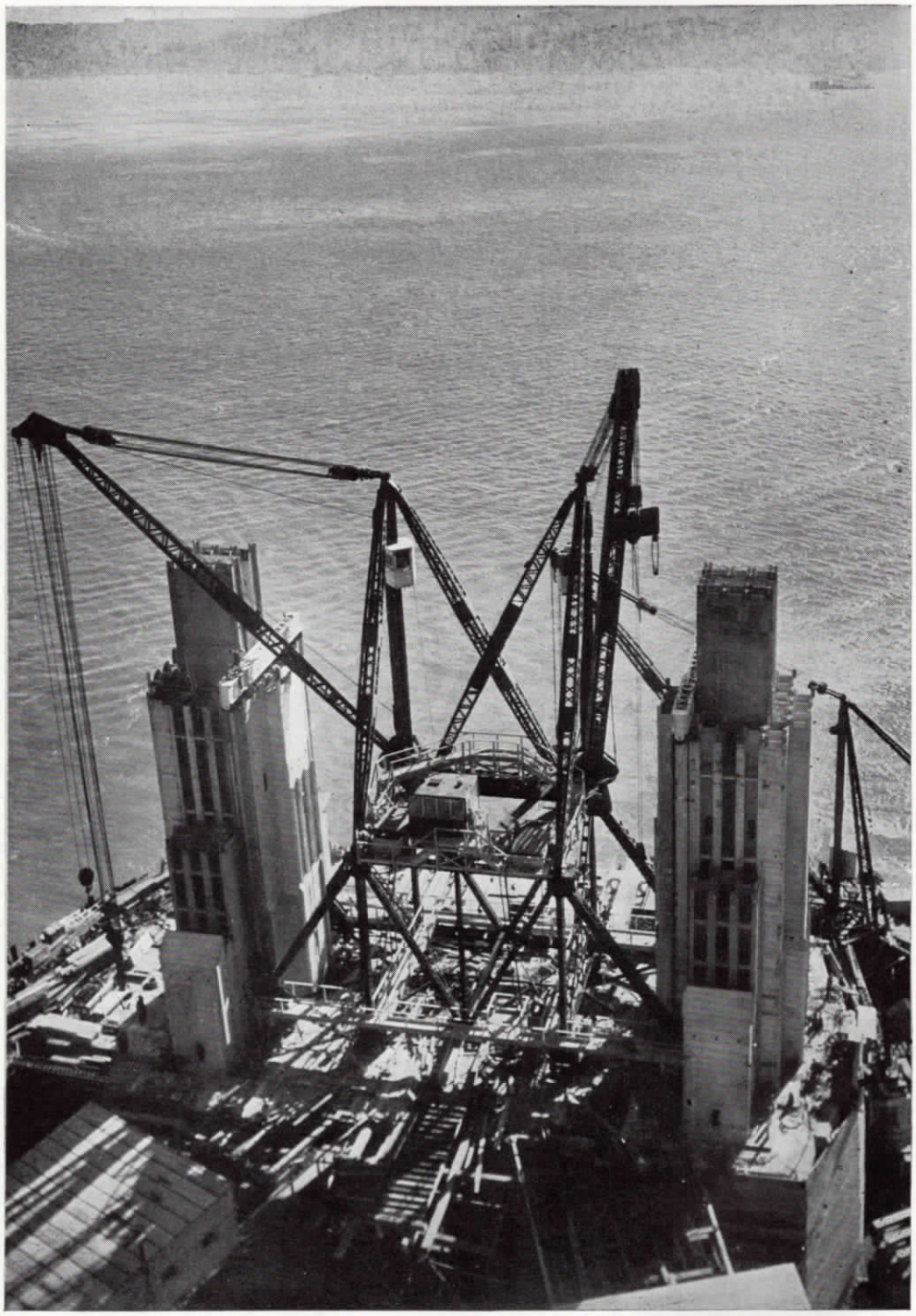
About 2000 men are now employed on the entire project and this number is expected to reach a peak of 12,300, with the average at approximately 6,500. Some 5,000 men are being given employment in factories manufacturing materials for the bridge. Most of the men employed on the bridge are skilled workers.

Golden Gate Bridge

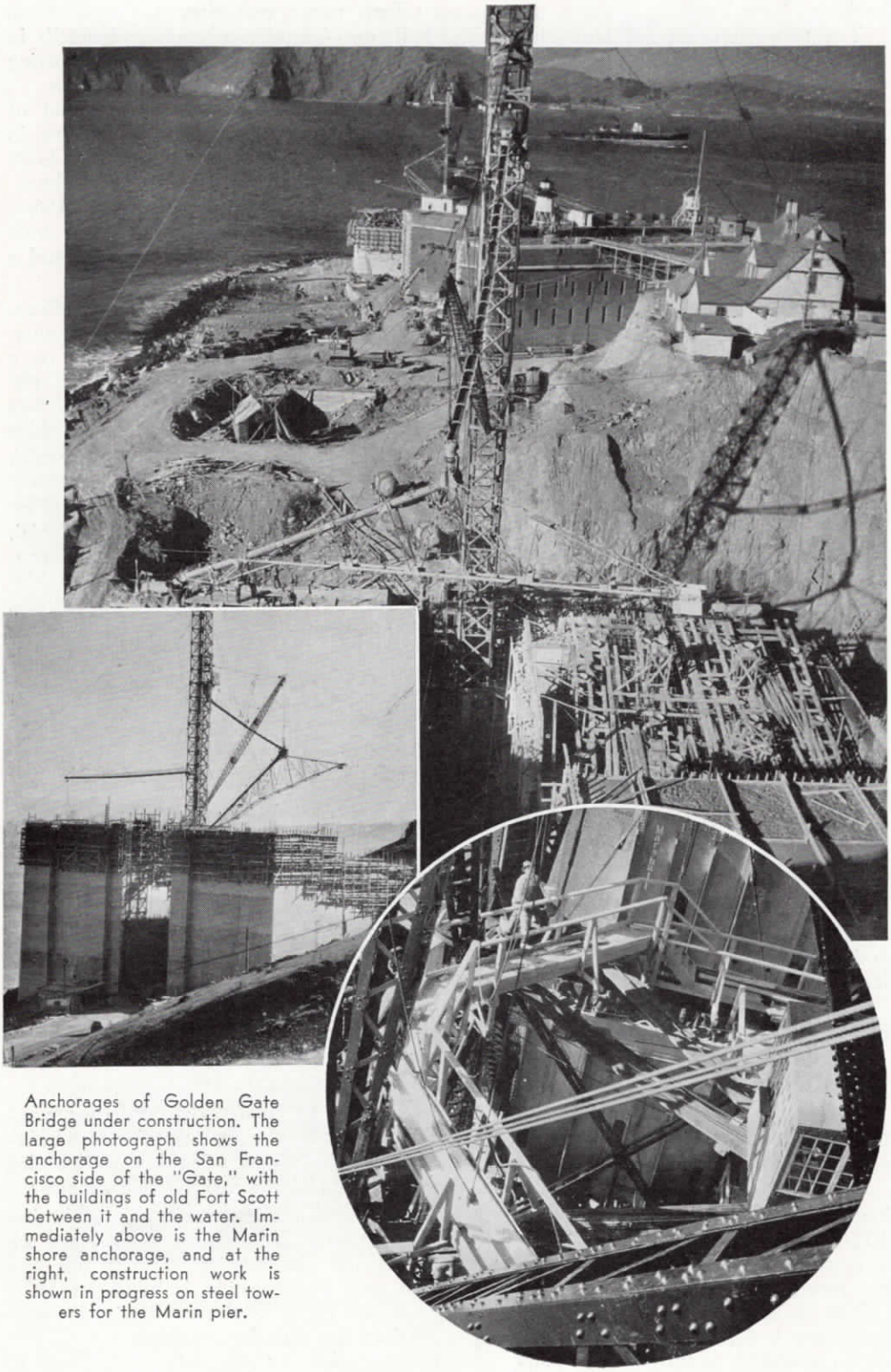
STARTED January 5, 1933, the Golden Gate bridge is now approximately 10 per cent completed. It is scheduled to be ready for use three year hence, January, 1937. When completed it will be the second largest bridge in the world, the San Francisco-Oakland Bay Bridge ranking first. In many respects it is a far more spectacular bridge than the one across the bay. It is the only bridge ever authorized to be built across the extreme outer mouth of a major ocean harbor.

Summarized briefly the outstanding facts concerning the bridge are these:

It has the longest single clear span in the world, 4200 feet long, four-fifths of a mile, three times the length of the Brooklyn Bridge in New York, and 700 feet longer than the greatest span ever built, the famous George Washington Memorial



Looking down on the columns of steel that will rise to a height of 746 feet from the concrete base to form the Marin shore pier of the Golden Gate Bridge. The total height of the pier and tower will be 846 feet. In the distance is the San Francisco side of the bridge. The wharf extending from the shore marks the site of the San Francisco pier. A single span, 4200 feet long, will bridge the intervening expanse of water.



Anchorages of Golden Gate Bridge under construction. The large photograph shows the anchorage on the San Francisco side of the "Gate," with the buildings of old Fort Scott between it and the water. Immediately above is the Marin shore anchorage, and at the right, construction work is shown in progress on steel towers for the Marin pier.

bridge at New York.

The two side spans are 1125 feet each, as against 550 and 610 feet respectively for the George Washington Bridge.

Thus the bridge proper has a total length of 6450 feet, or one and one-fifth miles, as against 4660 feet for the George Washington Bridge.

The towers are 121 feet wide at the bottom and 746 feet above mean high water, the highest and largest bridge towers in the world, extending more than 150 feet above those of the George Washington Bridge. (Measured from the base of the San Francisco pier the total height is 846 feet.)

The minimum vertical clearance at center is 220 feet above mean high water, 100 feet greater than the clearance of the Brooklyn Bridge, 20 feet more than the clearance of George Washington Bridge.

The total bridge width is 90 feet, divided into a 60-foot roadway, with 6 lanes of vehicular traffic and 2 ten and one-half foot clear width sidewalks.

The grand total length, including the two approach roads, or from Waldo Point in Marin County to the Marina Gate of the Presidio in San Francisco, all embraced within the project, is 7 miles.

The two main cables are thirty-six and one-half inches in diameter each and 7660 feet long between anchorages. The cable sag at center is 475 feet.

The total possible live load supported by the two main cables is 25,400,000 pounds corresponding to the bridge roadway packed, curb to curb, with vehicles and both sidewalks fully loaded, for full length of the span.

The load supporting capacity of the two cables is 430,000,000 pounds, 2.6 times the maximum load.

The pull on each cable at the anchorages is 63,000,000 pounds and the counteracting resistance capacity of the anchorage blocks is 126,000,000 pounds.

The vertical load on each pier at the base, including the concrete pier shafts, is 400,000,000 pounds, yet the load on each square foot of the supporting rock does not exceed the established standard units.

The horizontal wind force at each tower top is 1,900,00 pounds, corresponding to a velocity of 90 miles per hour.

Each tower comprises two steel posts, built up of a series of rectangular cells in groups, the number of cells tapering from 97 at the bottom to 19 at the top.

There will be 723,000 square feet of concrete roadway and sidewalk paving in the bridge proper and another 273,000 square feet in the Presidio steel viaduct.

The steel arch over old Fort Point, clearing it by 95 feet, will have 4 arch ribs, with a clear span of 319 feet and a height of 200 feet.

Adjoining the arch on the San Francisco side and the bridge end on the other, will be 1650 feet of steel viaducts on a curve, with a maximum height of 190 feet and deck widths of 84 and 68 feet respectively, which connect the bridge proper with the toll area and the approach roads.

There will be two viaducts in the Presidio approach, one of steel 95 feet high and 1078 feet long and the other of concrete 2911 feet long.

It will have the greatest steel tonnage of any single span but one in the world—100,000 tons—including cables, sufficient to load a freight train 20 miles long.

Each cable will weigh 11,000 tons and contain 27,572 separate wires, two-tenths of an inch in diameter.

The steel in its two towers alone will be more than the steel in the entire Quebec Bridge—one of the world's greatest bridges.

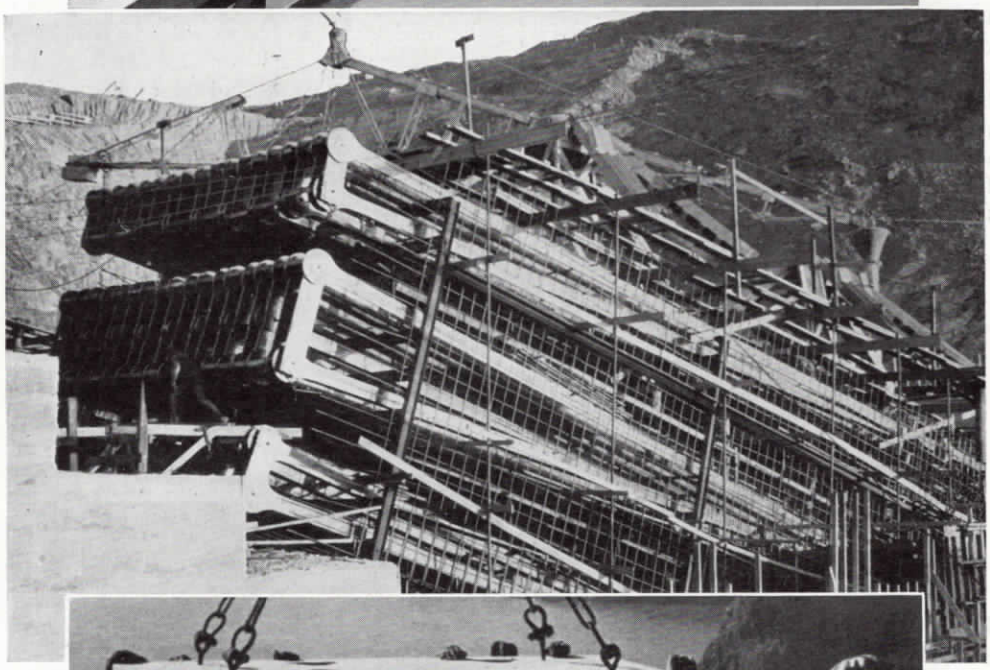
The San Francisco pier will be the largest ever built, 90x185 feet, with a base area of 16,650 square feet, carried 25 feet into the rock ledge of the bay bed, and with a total height of 144 feet.

The total concrete in the piers, fender and anchorages will be 254,690 cubic yards, enough to build a solid shaft of concrete 25 feet square and 2 miles high.

The toll terminal will have 16 gateways and 12 toll booths, and contain the administration buildings, the fire and police equipment and the maintenance depots.

The total traffic capacity of the bridge will be over 283,000 machines every 24 hours, but the earning capacity for the first year of operation is based on 5870 machines every 24 hours—less than one-fortieth the capacity provided.

The structural conception as a whole is



Lowering steel plate into place on Marin shore pier of the Golden Gate Bridge. Center, south anchorage tie-beams for cables from which the world's longest bridge span will be suspended. Each cable will weigh 11,000 tons and contain 27,572 separate wires, each two-tenths of an inch in diameter. Top, applying a protective coating of paint to the bridge steelwork.

adjusted to its scenic environment and is being carried out in full symmetry longitudinally and transversely.

The bridge is perhaps the first in which the importance of the new motif of stepped-off towers has been recognized and applied.

The bridge is also the first in which the network of transverse bracing between the tower posts is eliminated and the towers portal-braced throughout, making the tower effect that of a majestic doorway.

The San Francisco pier is the first bridge pier to be built in the open sea under new methods specially devised, and chief among which is a unique steel and concrete cofferdam 115 feet in height, built in place, section by section, 30 feet thick at bottom, with its top 15 feet above water, remaining in place as a permanent fender to enclose the pier and protect it from possible impact of passing ships.

The piers proper are huge concrete monoliths, carried out architecturally to match the accentuated vertical lines of the tower posts and the structure as a whole.

The bridge will incorporate modern lighting effects as a major element of design. The cables will be outlined in lights their entire length and the towers floodlighted, making the electrical display at night a brilliant and impressive spectacle. The towers will be surmounted by aerial beacons and provision has been made for possible utilization of these towers for radio broadcasting.

The bridge will have a regular United States lighthouse station—probably the first of its kind in the world. It will have a complete independent telephone, fire and police telegraph system, and every modern device for efficient operation. including a travelling platform below the deck for inspection, painting and maintenance, motor-driven, and extending the full width of the bridge, insuring maximum vigilance in the care of the structure.

Santa Monica Breakwater

At a cost of approximately one-half million dollars, a rock-fill type breakwater is now being flung across the entrance to Santa Monica, Calif., harbor to provide moorage space for several hundred yachts and small private boats, furnish a huge promenade, and grant additional shelter to the port.

The wall, containing 220,000 tons of rock, will have a base 102 feet thick, a height of 37 feet, a top width of 10 feet, and a height of 10 feet above mean low tide. It will extend north and south for a distance of 2268 feet from the end of the present municipal pier.

Rock for the fill is procured from Catalina island and transported to the site by barge and tugboat. Eleven barges are in the service of the Puget Sound Dredging Company to perform this work. Two sizes of rock are used on the breakwater, a class "A" type ranging from 1 to 10 tons each for foundation material and class "B" rock of ten tons or more for the surface or armour rock. The latter is placed by means of a derrick barge built for the job.

Mooring space inside the barrier will be available upon its completion and when tide conditions have been accurately determined. Plans are already under way for erection of clubhouse and building of more than 100 berths.

Union Oil Company is furnishing diesel fuel oils, lubricants, greases, and other products to both Puget Sound Dredging Company and Standard Dredging Company, sub-contractor on the job. Upon completion of the breakwater, Union Oil Company will install a floating marine service station from which all types of craft may be serviced.

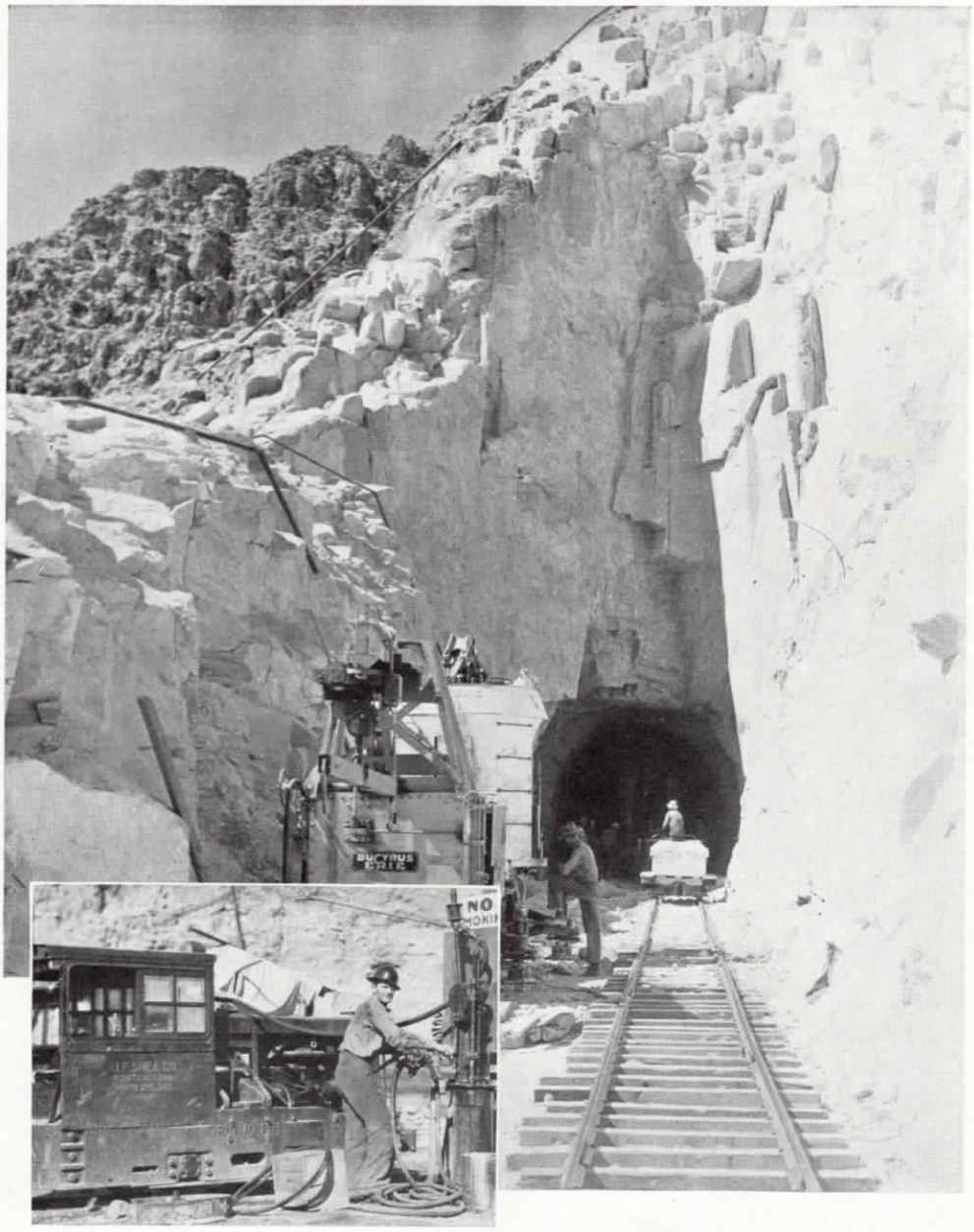
Santa Monica breakwater under construction and as it will appear when completed. The artist's picturization of the breakwater is drawn on a Spence aerial photograph of the bay. Extension of the pier is shown at the top and construction of the sea wall, below.

Boring through 13 miles of granite in the San Jacinto tunnel as dramatically sketched by Charles H. Owens and reproduced through the courtesy of Los Angeles Times.

Building World's Greatest Aqueduct

SCATTERED along a serpentine line of 241 miles, that starts at Parker damsite, Arizona-California, cuts through mountain ranges, knifes arrow-like over burning expanses of desert, skirts barren peaks, and traverses fertile valleys to its terminal point at Cajalco reservoir, 60 miles from Los Angeles, a force of several thousand men are today piecing together what is to become the longest aqueduct ever built—the quarter-billion-dollar project of the Metropolitan Water District of Southern California. Launched March, 1933, after years of study and 10 years of actual survey work and preparation of recommendations and specifications, the aqueduct in the past nine months has become the largest single development enterprise in the West.

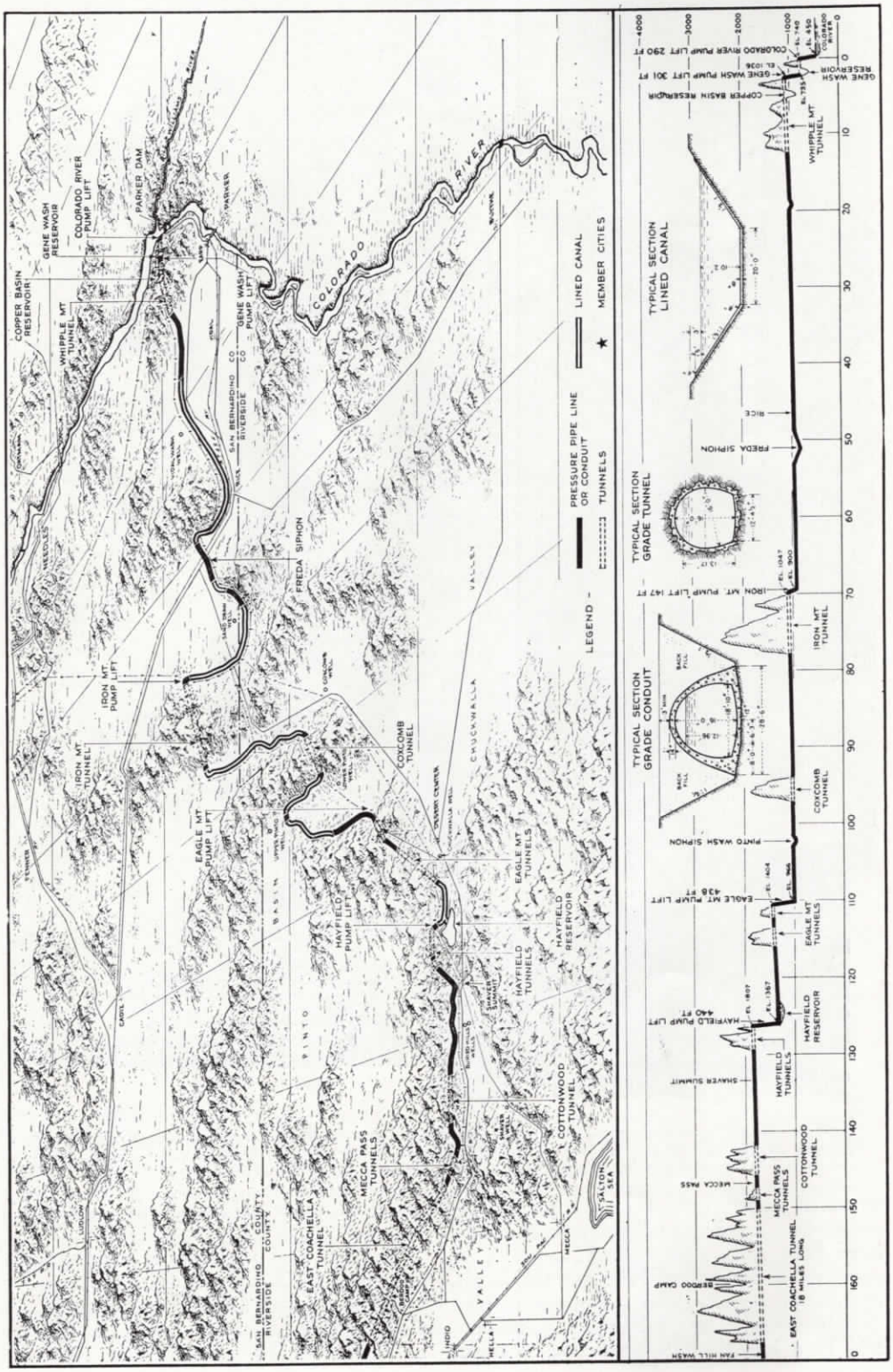
More than 4000 men are now employed, with additions at the rate of 200 monthly constantly being made. Thirty-one con-



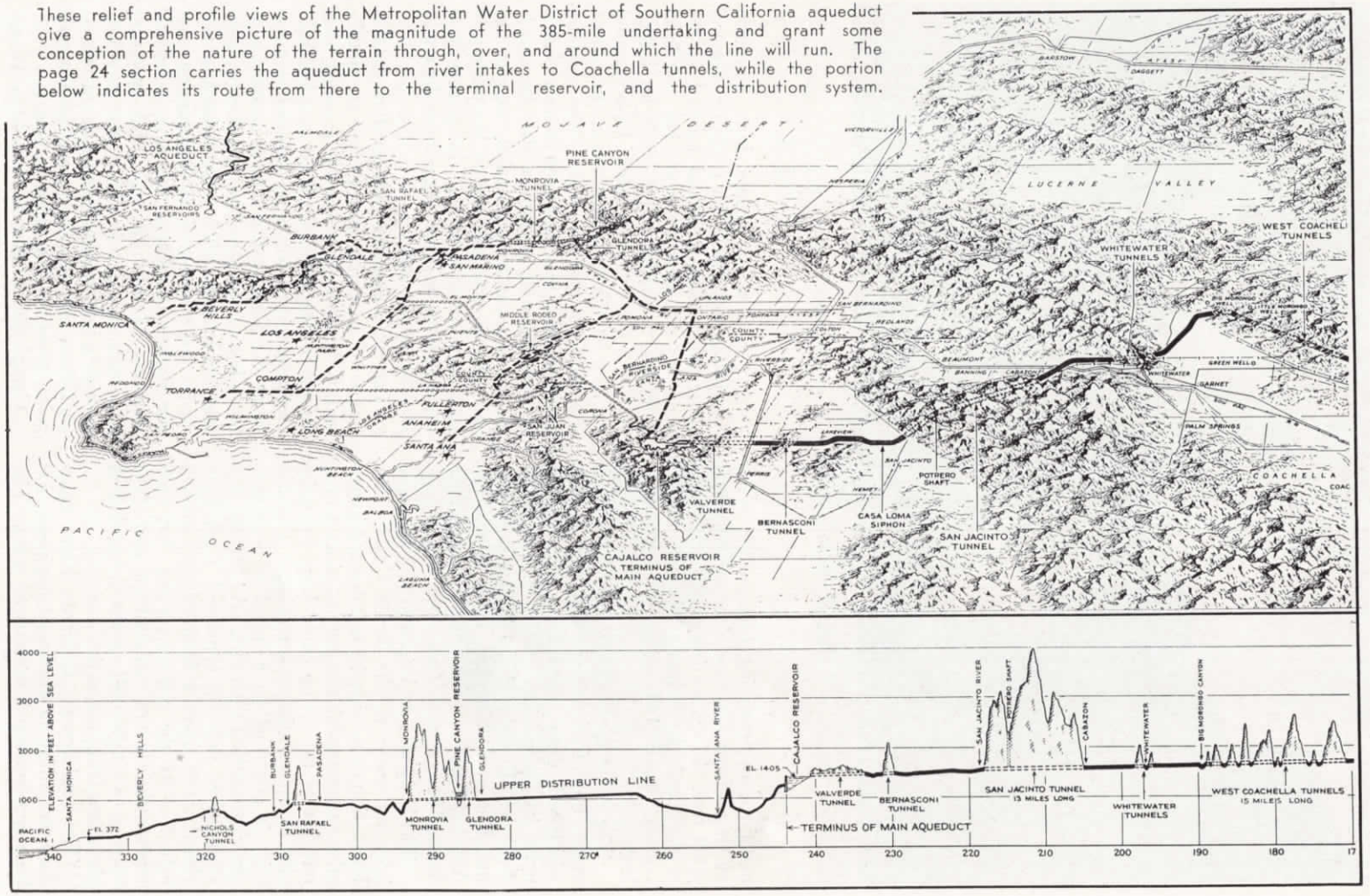
Adit to Coxcomb tunnel, showing granite formation through which tunnel is being driven. Lower picture at the left shows fueling of gasoline-powered dinky engine used by J. F. Shea Company to haul muck cars from interior of tunnel to dump spur.

struction camps have been set up to accommodate workers and equipment; roads have been laid, power lines installed, a complete water system built to provide all centers of activity with adequate supply. By December 1, last, 6.28 miles of tunnels had been bored, 1279 fet of shafts sunk, and 1.82 miles of access adits (tunnels) driven.

The job is as varied as it is prodigious, embracing in its completion the erection of a 280-foot dam across the Colorado 15 miles above Parker, Ariz., to divert a portion of the river's flow into the


COPPER BASIN RESERVOIR
GENE WASH RESERVOIR
COLORADO RIVER PUMP LIFT
PARKER DAM
WHIPPLE MT TUNNEL
GENE WASH PUMP LIFT
COLORADO RIVER
IRON MT PUMP LIFT
IRON MT TUNNEL
EAGLE MT PUMP LIFT
HAYFIELD PUMP LIFT
COVE TUNNEL
FREDA SIPHON
MECCA PASS TUNNELS
EAST COACHELLA TUNNEL
COTTONWOOD TUNNEL
HAYFIELD TUNNELS
HAYFIELD RESERVOIR
EAGLE MT TUNNELS
SALTON SEA
LEGEND
PRESSURE PIPE LINE OR CONDUIT
TUNNELS
LINED CANAL
MEMBER CITIES
TYPICAL SECTION GRADE CONDUIT
TYPICAL SECTION GRADE TUNNEL
TYPICAL SECTION LINED CANAL
COPPER BASIN RESERVOIR
COLORADO RIVER PUMP LIFT 290 FT
GENE WASH PUMP LIFT 301 FT
GENE WASH RESERVOIR
WHIPPLE MT TUNNEL
IRON MT PUMP LIFT 147 FT
IRON MT TUNNEL
COVE TUNNEL
PINTO WASH SIPHON
EAGLE MT PUMP LIFT 438 FT
HAYFIELD PUMP LIFT 440 FT
SHAVER SUMMIT
HAYFIELD TUNNELS
HAYFIELD RESERVOIR
EAGLE MT TUNNELS
MECCA PASS
MECCA PASS TUNNELS
COTTONWOOD TUNNEL
EAST COACHELLA TUNNEL
BEAUMONT
BANNING
INDIO
MECCA
SALTON SEA

These relief and profile views of the Metropolitan Water District of Southern California aqueduct give a comprehensive picture of the magnitude of the 385-mile undertaking and grant some conception of the nature of the terrain through, over, and around which the line will run. The page 24 section carries the aqueduct from river intakes to Coachella tunnels, while the portion below indicates its route from there to the terminal reservoir, and the distribution system.



Site of Parker diversion dam on Colorado River.

aqueduct, the pumping of aqueduct water by stages from 450-foot elevation to nearly 2000 feet, the excavation of two giant reservoirs, and the building of 241 miles of aqueduct and 144 miles of distribution lines.

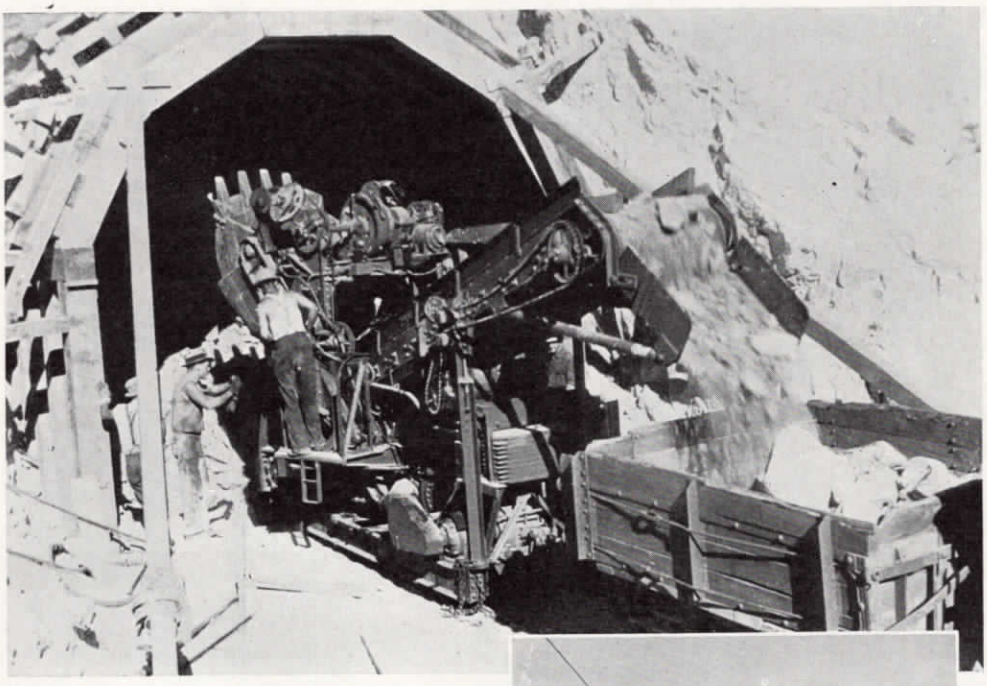
The Metropolitan Water District is made up of Southern California cities which will draw water from the aqueduct upon its completion. Member cities are: Anaheim, Beverly Hills, Burbank, Compton, Fullerton, Glendale, Long Beach, Los Angeles, Pasadena, San Marino, Santa Ana, Santa Monica, and Torrance.

The body was organized to find means of bringing water to the South Coast basin. Formation of the district was deemed imperative to accomplish the project, since no one member of the group could hope individually to finance the undertaking. The district is governed by a board of directors, one representing each city. Additional representatives may be appointed from individual cities upon a basis of the assessed valuation of the city corporates, but such representatives are required to cast their votes as a single unit in the formation of plans involving the entire district.

The need for the Colorado River aqueduct, according to municipal engineers, has been apparent for a number of years. The mighty influx of people into Southern California since 1923 has made the demand more imperative. Annual rainfall in the area for the past six years has not been sufficient to supply water needs for industrial and home consumption. Underground supplies have been overdrawn at the rate of 200,000,000 gallons daily over a long period, with a resultant drop in water levels in pumping and artesian wells. An anticipated increase in population, despite the fact that it may not rise to the optimistic figures arbitrarily set up by promotional organizations, will only aggravate the water shortage condition.

Ten years have been devoted to investigation of possible water sources for Southern California. It was determined that only from the Colorado River could a sufficient amount of water be obtained to guarantee the cities in the area a constant supply. Initial work on the aqueduct was begun in October, 1923. Approximately 100 routes were surveyed in determining that the Parker route was the best, when all elements of distance, cost, and operation had been considered. It is the only line providing intermediate storage, is entirely on California soil, and from a geological standpoint, traverses the safest terrain.

Completion of the Metropolitan Water

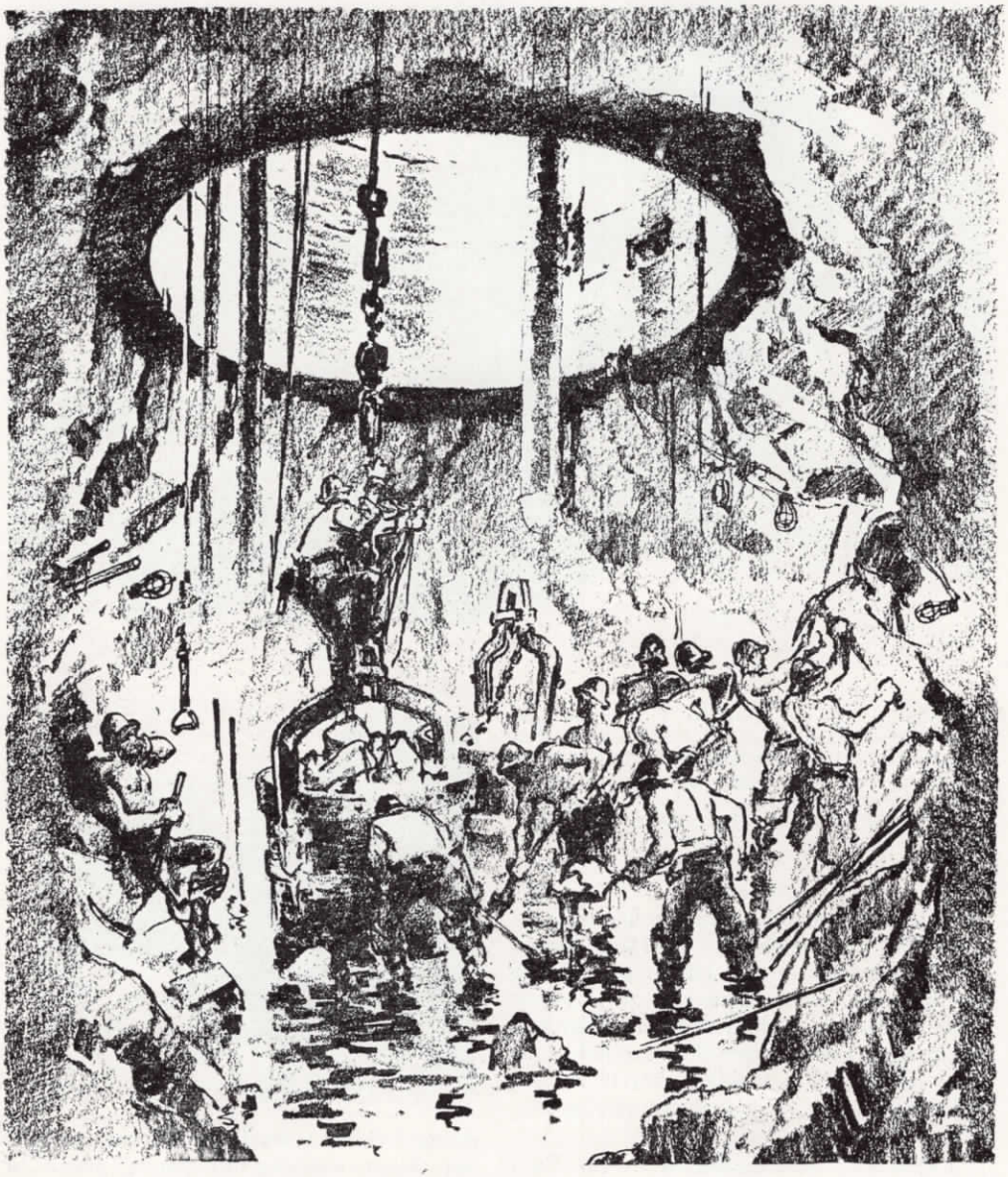


Portal of Hayfield Tunnel No. 2, with new type mucker shown at work. It scoops up material jarred loose in dynamiting and conveys it on an endless belt into dump cars. Picture at the right shows muck cars dumping rock removed from driving face of Cottonwood Tunnel.

District aqueduct six years hence will assure the daily delivery of 1500 second feet—approximatly one billion gallons—to the district. This quantity is equal to the daily average consumption of the district at the present time. From the terminal reservoir—identified as Cajalco—water will be delivered to the individual city storage reservoirs.

Exhaustive tests conducted by the Public Health Service and by individual organizations indicate that the quality of Colorado River water is commensurate with that now being used and well within requirements set up for a suitable water supply. Analysis has proven the water unusually low in flourine content. The salt deposits which will be buried under the Boulder Dam reservoir are so small as to affect only a minute part of 1 per cent of the water. Surveys by dental associations and medical societies among people who have thrived on Colorado River water for the past thirty years failed to bring to light any harm resulting to tissues, bones or teeth.

Preliminary work on the project, which included the stringing of 446 miles of high voltage transmission lines, erection of complete living accommodations and 31 construction camps along the route of the aqueduct, building of 154 miles of surfaced highways to make accessible various points on the line, and laying of 180 miles of water lines to supply camps and works, was completed late last summer and activity on the tunnels immediately launched.



Charles H. Owens here pictures the sinking of the Potrero shaft of the San Jacinto tunnel.
Reproduced by courtesy of Los Angeles Times.

Preliminary work before actual start of the tunnel work was undertaken required an expenditure of more than $5,000,000.

Tunneling constitutes the major portion of the work going forward at the present time. It also comprises one of the largest single enterprises identified with the entire job, since of the 241 miles of line from river to terminal reservoir, 91 miles consist of 16-foot, horseshoe shaped tunnelways. Experimental work on open conduit and lined canals is now being carried forward near Berdoo camp, but as yet nothing has actually been done on this phase of the work. The completed line will include, in addition to the 91 miles of tunnels, 56 miles of conduit, 66 miles of lined canals, and 28 miles of siphon, or pressure pipelines. At the 125-mile mark water may be by-passed into the giant Hayfield reser-

voir and then re-enter the line at the Hayfield pump lift. The Cajalco reservoir in the mountains between Perris and Corona is the terminus of the main aqueduct.

In its relation to other current Colorado River projects, the aqueduct is the largest single unit. It is dependent upon Boulder Dam for regulation of the river's flow, as is the All-American Canal. Need for the water which will be conveyed to Southern

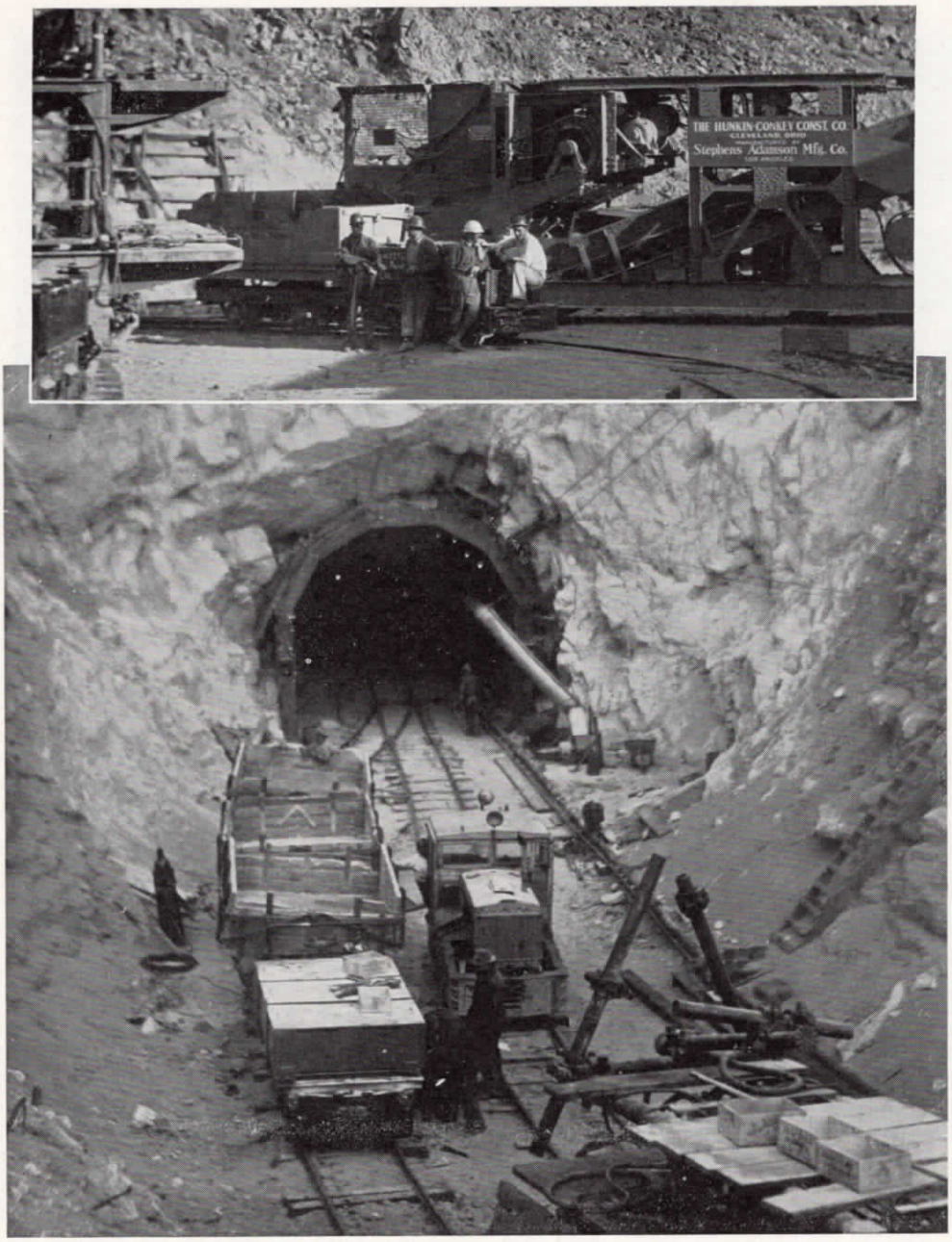
Workmen are lowering 22-inch air-vent tubing into shaft of Valverde tunnel in top picture. Potrero shaft heading of the San Jacinto tunnel is indicated in the large photograph. This shaft drops vertically more than 850 feet to reach tunnel level. Shaft workers may be seen in the circle at the left coming out of Potrero shaft in skip bucket as the shift changes.

Trucking equipment of R. A. Conyes, hauling contractor for builders of Metropolitan Water District aqueduct.

California by the aqueduct was a determining factor in Congress passing the Swing-Johnson bill which authorized building of Boulder Dam by the government. Total cost of Boulder Dam, Metropolitan Water District Aqueduct, and All-American Canal involves a sum of more than $400,000,000; the approximate cost of each, respectively, being: Boulder Dam, $110,000,000; Aqueduct, $220,000,000, and All-American Canal, $70,000,000. The district has secured legal right to divert a portion of the Colorado River for the aqueduct. Many times the amount required will be available after completion of Boulder Dam and the consequent regulation of flood run-off. A contract was signed with the federal government April 24, 1930, for water from the Boulder Dam reservoir. Agreements and contracts have been signed with other lower river groups so that no actual difficulty may be encountered in using a portion of the river's flow.

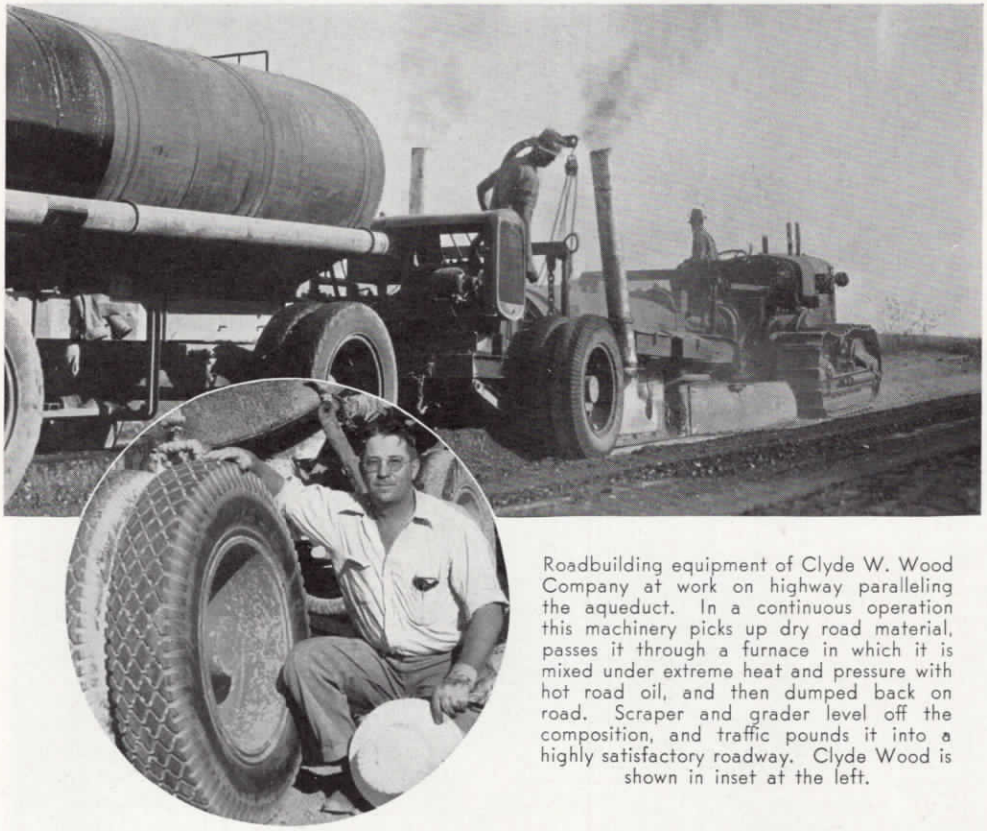
Parker Dam, by means of which water will be diverted to the aqueduct intakes, will be situated fifteen miles above Parker, Ariz., and 160 miles down the river from Boulder Dam. The canyon in which the dam will be built is about 340 feet wide and has solid rock formations on both sides. Present plans call for the building of a 280-foot dam by the Bureau of Reclamation, under contract with the Water District. The dam will be a concrete structure. Six 50-foot stoney gates will afford a high water elevation of 450 feet and a discharge capacity of more than 335,000 cubic feet per second. A power plant of 80,000-kw capacity will be built below the dam. One-half of the output of the plant will be available for use by the Water District. Diversion of water during construction of the dam will be by cofferdams and 35-foot unlined tunnels through the east wall of the canyon. Cost of the projected dam and appurtenant works is estimated at $10,000,000. At the current writing roads are being completed from Earp to the actual damsite and experimental dredging of the river bed has been started.

From the intakes at the river, the aqueduct will encompass, in its projected 241-mile length, 29 tunnels, 5 lifts, 4 reservoirs, and 2 siphons. As may be observed from the map which accompanies this information, the water is raised 591 feet to an elevation of 1036 feet by means of the Colorado River and Gene Wash lifts within a few miles of the river. It flows by pressure conduit and open canal 70 miles to the Iron Mountain Pump lift, during which it descends 136 feet. At this point it is raised to 1047-foot elevation and then runs by pressure lines and open canals approximately 40 miles to Eagle Mountain Pump lift where it is elevated to 1404 feet. After traversing approximately 16 miles of canal it empties into the Hayfield reservoir and then is pumped 440 feet to an elevation of 1807 feet, from which point it flows by pressure lines and open canal to the terminal reservoir, dropping 402 feet in the last 115 miles of line.



A new heavy duty capacity mucker, operated by Hunkin-Conkey Construction Co., on Hayfield Tunnel No. 1, is shown in the top picture. Below, tunneling equipment used on the job. Extreme left you see muck cars, gasoline powered dinky engine, and in right foreground, a jumbo upon which 12 drills are mounted for work at driving face of tunnels.

The tunnels for the aqueduct range from 500 feet in length to 18 miles, the longest being the East Coachella bore. West Coachella tunnels total 15 miles in length, and San Jacinto tunnel 13 miles. It is estimated that the tunnels alone will require an expenditure of more than $60,000,000 to complete, with five years,



Roadbuilding equipment of Clyde W. Wood Company at work on highway paralleling the aqueduct. In a continuous operation this machinery picks up dry road material, passes it through a furnace in which it is mixed under extreme heat and pressure with hot road oil, and then dumped back on road. Scraper and grader level off the composition, and traffic pounds it into a highly satisfactory roadway. Clyde Wood is shown in inset at the left.

or June, 1939, as date specified for clean-up of all tunnel work.

With the exception of the East and West Coachella tunnels, all driving of the 16-foot bores is being done under contract to the district. Work on the two Coachella jobs is being carried on by the district itself. Contractors from all parts of the United States are participating in the job. From Iowa, Minnesota, Utah, Colorado, Ohio, Oregon, Idaho, Massachusetts, Wisconsin, and Pennsylvania they have come to this greatest of all aqueduct works.

Most of the tunnels are begun from open cut excavation at land levels, or from inclines extending a few hundred feet to line level, after which boring proceeds at tunnel elevation. At the San Jacinto and Valverde tunnels, line elevation is reached from vertical shafts and tunneling done in both directions from shaft bottom. These shafts are 16-foot bores, concrete lined. All tunnels are, also, concrete lined.

Equipment used at the various construction camps is virtually uniform. Stationary air compressors for drills form the largest single units. Various types of drifters and augurs, some mounted on portable jumbo drilling rigs, are generally used. Ventilation equipment for constant circulation of fresh air to driving faces of the tunnels is universal, especially in shaft work where it plays an important part in dispersing smoke and dust after blasting. Machine muckers are used at tunnel headings to load cars, which are taken by gasoline dinky or battery locomotives to dumps. Machine shops include drill presses, shapers, bolt-threading machines, lathes, power saws, and miscellaneous equipment. Sharpening and treating the drills comprises a major portion of the machine shop work. Muck removal in the vertical shafts being sunk on San Jacinto tunnels is handled by self-dumping skips operated by slip-ring hoisting motors. Dravo Contracting Com-

In the single photograph, top, left, is J. N. Gordon, superintendent for Floyd Shofner and J. N. Gordon, contractors. Above, left to right, Ben Arp, foreman, Utah Construction Company; R. C. Copeland, Union Oil agent, and one of Arp's helpers. In the oval at the left is Frank E. Weymouth, general manager and chief engineer, Metropolitan Water District.

P. C. Guinn, left, foreman, and L. A. Dixon of L. A. Dixon & Bent Co., are shown at extreme left. Ben Ratke, field manager, Wenzel & Henock Co., is next in line. Hunkin-Conkey Construction Company's foreman, Frank Backlund, is shown in the next picture. Robert Lynch, left, and B. F. Laird, representatives of Dravo Contracting Company, are seen in extreme right phto.

pany on the Valverde tunnels is removing muck with cars lowered and raised in the shaft.

While most of the work is proceeding under the immediate supervision of contractor foremen, the entire project is under close jurisdiction of Frank E. Weymouth, general manager and chief engineer of the Metropolitan Water District of Southern California, and his corps of assistants. Water District engineers are constantly on the job at all camps in a supervisorial and advisory capacity, and the resources of the district are at the disposal of private con-

tractors at all times. Weymouth has been identified with hydraulic engineering since his graduation from the University of Maine in 1896, starting with the Metropolitan Water District of Massachusetts, then serving for two years on the Isthmian Canal Commission in Nicaragua, and two years as resident engineer for a railway in Ecuador, South America. From 1902 to 1924 he served with the U. S. Bureau of Reclamation Service—becoming its chief engineer—his principal work being on western projects. He was appointed engineer for the city of Los Angeles in 1924, and in 1929 he was selected chief engineer of the Metropolitan Water District of Southern California. To this title was added that of general manager in January, 1932.

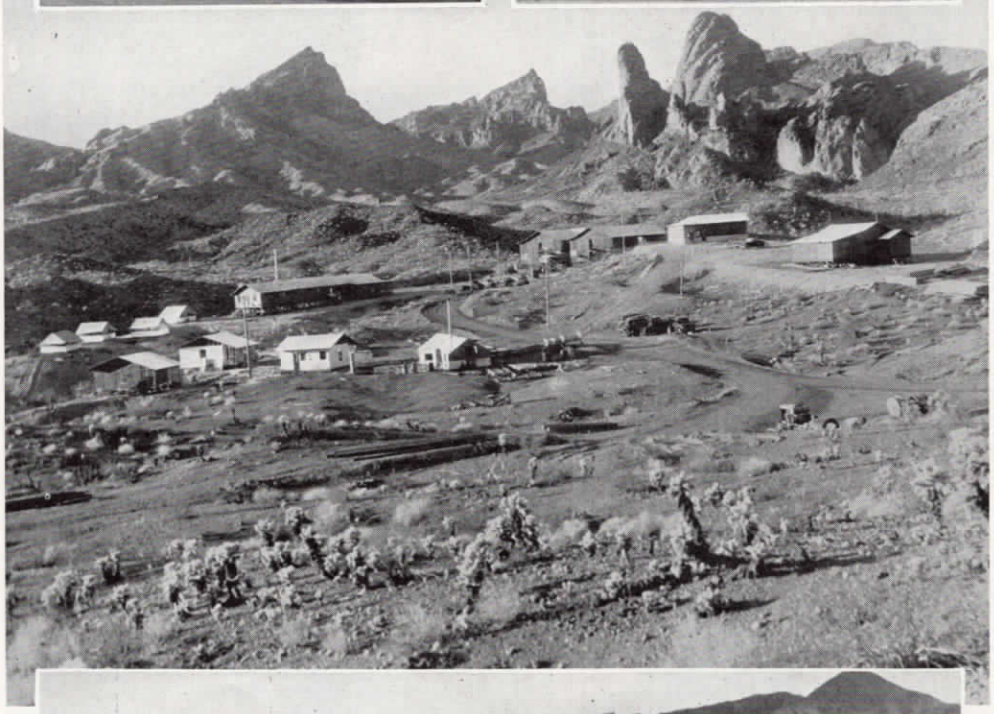
Living and eating quarters at the work camps are commodious and complete. Anderson Brothers Supply Company and Threlkeld Commissary have provided bunkhouses and mess facilities at a number of the camps. Air-conditioned sleeping and eating rooms have been furnished at desert stations. Utah Construction Company and several of the other private contractors have built and maintain their own camps. All are generally the same as those provided by the two service institutions.

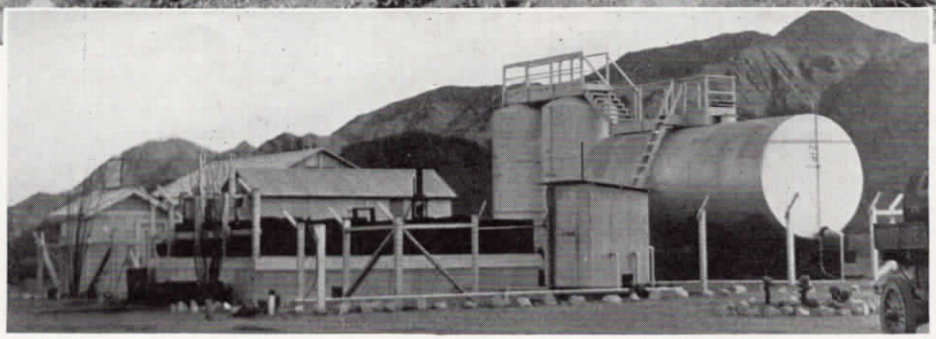
Under present progress, slightly more than 4000 men are working on the aqueduct. An average of 10,000 men will be employed during the six-year construction period. Peak activity will necessitate as many as 16,000 men being at work at one time. Wages of the men are consistent with those throughout the West and above requirements set by California state law.

Since the inception of work on the aqueduct, Union Oil products have been widely used. Road oil supplied by the company was largely used in building highways to make points along the line accessible. Work carried on by the individual contractors has necessitated large supplies of gasoline, motor oils, greases, asphalt, and stove oil. Among the contractors extensively using Union products are: Utah Construction Company (Iron Mountain Tunnel) Ben Arp, foreman; L. E. Dixon Company and Bent Brothers (West Portal Eagle Mountain Tunnel) P. C. Guinn, foreman; Hunkin-Conkey Construction Company (Hayfield No. 1 Tunnel) Frank Backlund, foreman; Floyd Shofner and J. N. Gordon (Hayfield No. 2 Tunnel) J. N. Gordon, superintendent; J. F. Shea Company (Cottonwood Tunnel) Gil Shea, superintendent; Morrison-Knudsen Company (Mecca Pass Tunnels) Sam Reardon, superintendent; Metropolitan Water District (East and West Coachella Tunnels) B. M. Merriman, superintendent; Wenzel and Henock (San Jacinto Tunnel) Ben Ratke, field manager; and Dravo Contracting Company (Valverde Tunnel) Robert Lynch, office manager.

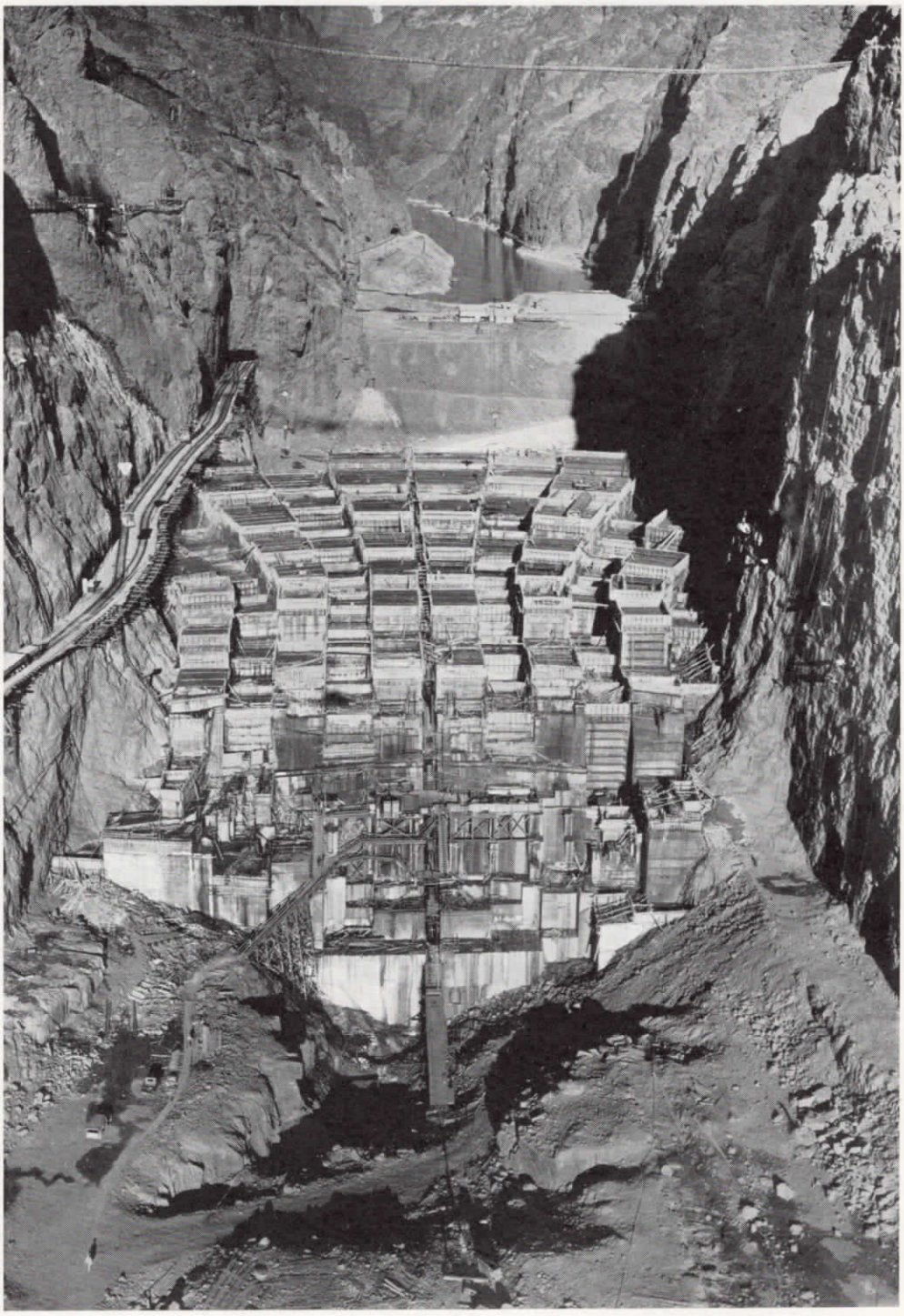
Clyde W. Wood Company, Stockton, Calif., built a substantial portion of the roads to the construction camps using Union road oil and asphalt, both for plant and road mixing equipment.

To facilitate servicing of aqueduct accounts, a substation has been built at Desert Center, midway on the line, with Vose Adams in charge. Accounts on the west end of the line are served from Coachella substation, of which W. A. Webb is agent, and Beaumont substation, where R. B. Roberts is agent. R. C. Copeland, for a number of years active for the company in the San Bernardino area and Coachella valley, has been assigned the position of aqueduct special agent.





Section of the construction camp operated by Dravo Contracting Company on Valverde tunnel is shown in upper left. Upper right shows portion of Berdoo Camp, from where work proceeds on East Coachella tunnels. Center picture is of Walsh Construction Company camp in Whipple mountains, near Colorado River intake. Lower photograph is of Union Oil plant at Desert Center, built to service aqueduct contractors.



Boulder Dam, as it looks today, with one-quarter of the concrete in place. Its proportions are dwarfed by the size of the gorge in which it is located. The average height above bedrock is 200 feet. The completed height will be 730 feet.

Third Year at Boulder Dam

BOULDER DAM is a reality.

From Observation Point you may see it. Not in its 730-foot completed height or in its 1200-foot span across the top, of course. But, there's more than 200 feet of it rearing its great bulk from the bottom of Black Canyon, Colorado River. And, the damsite remains the busiest half mile area ever observed on a major construction job.

Screeching gasoline and electric-powered dinky engines scoot along tracks niched into the sides of Black Canyon, and around man-made fills, lugging cars laden with concrete-filled buckets and agitators. Telephone-directed cableways suspended from mobile anchors sweep down over the cars and trucks, scoop up the concrete containers, spin out over the floor of the canyon, clump them into pouring forms on Boulder Dam proper, make the dump, swing back to the truck or train to drop the empty.

Founded on precarious crags, one on each side of the canyon, huge cranes, with 180-foot booms, swing steel and pouring forms into place at the gigantic intake towers through which water from the river will flow to the power plant .

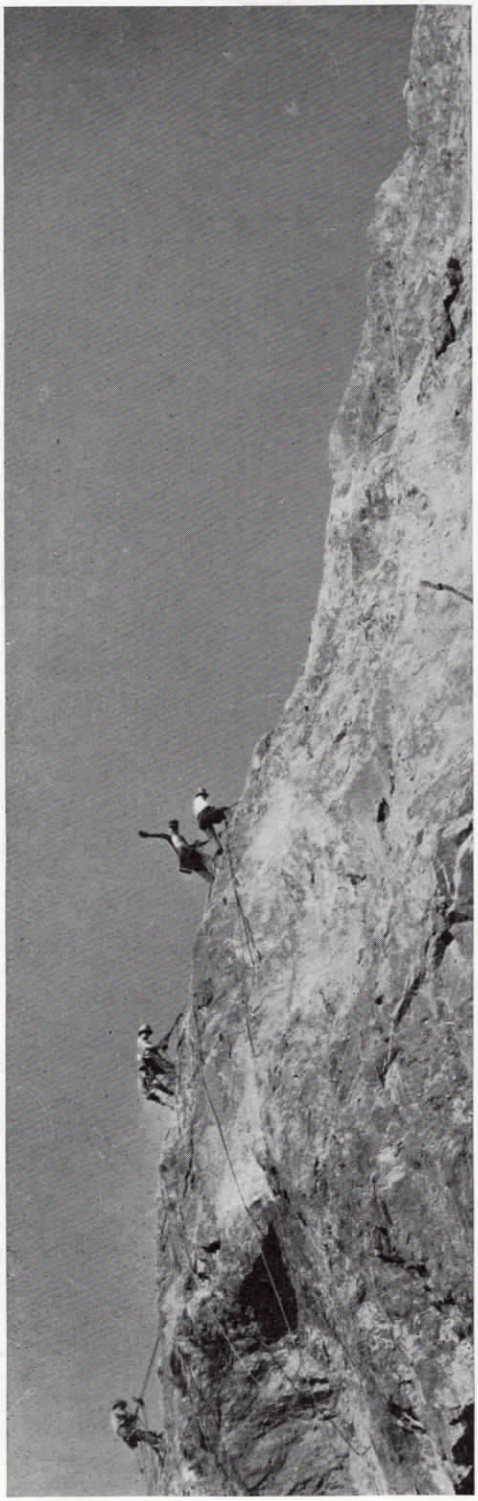
From another cableway concrete truck mixers hung from the trolley slings spin down between the canyon walls and drop onto trucks parked on ledges hewed from the sides of the cliffs. The trucks disappear into gaping holes in the solid rock wall, hauling the concrete through 37-foot penstock tunnels to where it is dumped into forms used in lining the tunnel. Other trucks convey concrete to the 18-foot penstocks through which the water to be used in power generation will flow from the larger penstocks. Dump trucks, in the seemingly endless job of removing muck from the floor of the canyon, are backed to huge shovels, piled high with excavation from the penstock tunnels, rammed across the former river bed and up the steep grades to the dumps on either side of the canyon, a half-mile below the lower portal.

The concrete spillways loom high on canyon walls upstream from the actual damsite. Work is now progressing on the inclined spillway tunnels which will permit high water during flood seasons to spill over and hurtle through the "glory holes," 750-foot bores cut through solid rock into Nos. 1 and 4 diversion tunnels, to eventually empty into the river below the dam.

A shift changes and hardy, steel-muscled men, most of them young, pour out of tunnels, drop from shovels and trucks, scamper down off the concrete forms, and desert their stations at the cableway controls to climb into huge single and double-tiered busses which carry them back eight miles to Boulder City—to clean dry clothes, plentiful well-cooked food, and bed.

There is no cessation of activity at night. The cableway trolleys, illuminated for safer control, move back and forth across the jet black curtain of the canyon, lifting slings tapering in irregular lines into nothingness. Lights are strung the length of the penstock tunnels, and the huge concrete mass, which is being reared in the old course of the river, is floodlighted to assure maximum working efficiency between dusk and dawn.

In brief retrospect: The dam, originally christened Hoover, was officially started April 20, 1931, when Six Companies Incorporated, an organization composed of outstanding "big job" contractors operating throughout the West, first broke rock to launch the project. Boulder Dam in its original conception embraces a job requiring seven years to complete; one which in itself will require an expenditure of $110,000,000 on the dam proper, power equipment, and appurtenant works. Its completed height will be 590 feet above the former water line, and 730 feet above the bedrock to which it is anchored. It will



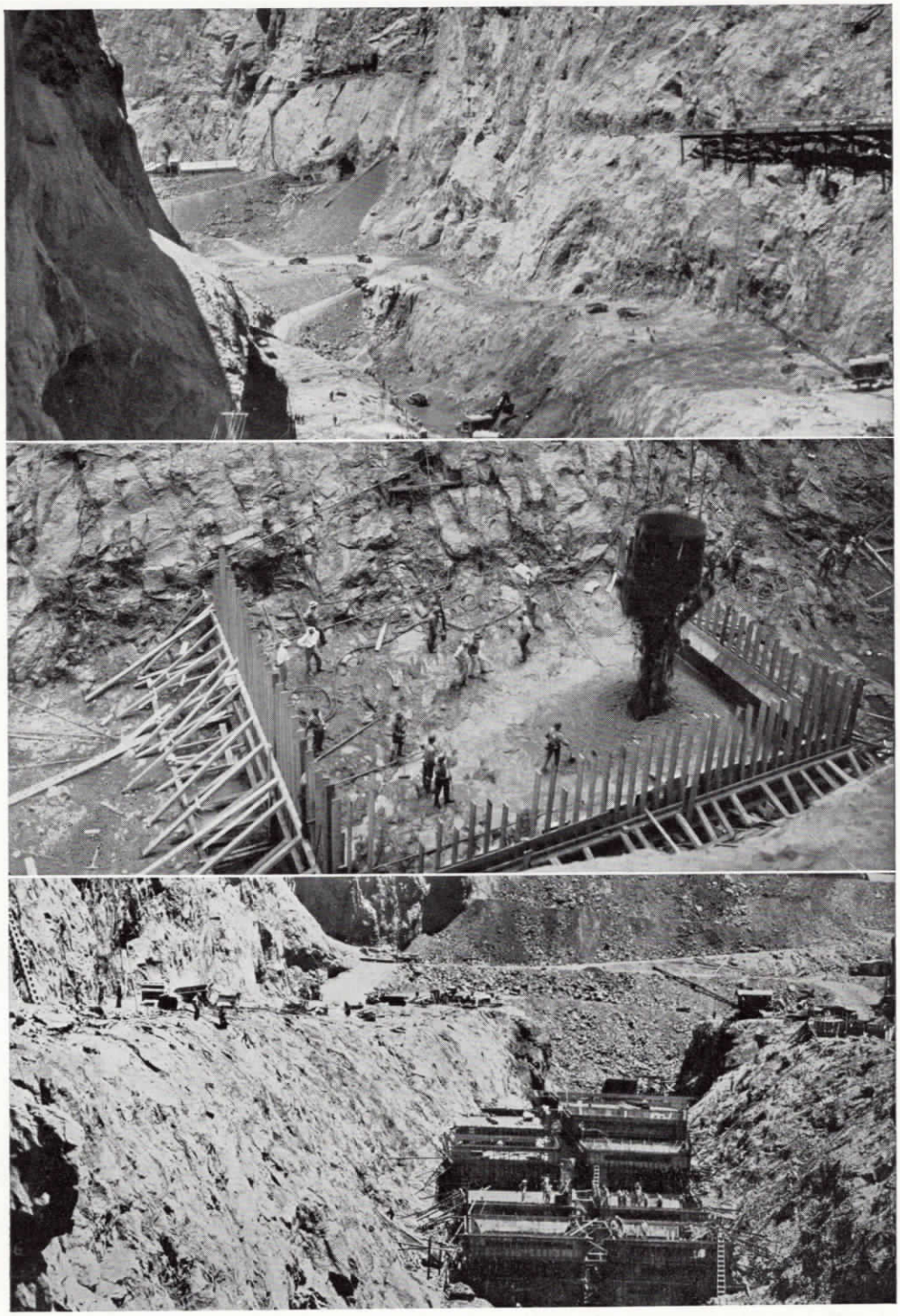
"High Scalers" chipping loose rock from canyon wall.

have a crest length of 1180 feet, will be 650 feet thick at the bottom and 45 feet thick at the top. It will impound water sufficient in volume to flood the entire state of New York to a depth of one foot. The lake created by the dam will extend back through the canyons 125 miles, and will be eight miles wide. Completed, the structure will constitute a solid mass of 3,250,000 cubic yards of concrete, the largest single body ever poured.

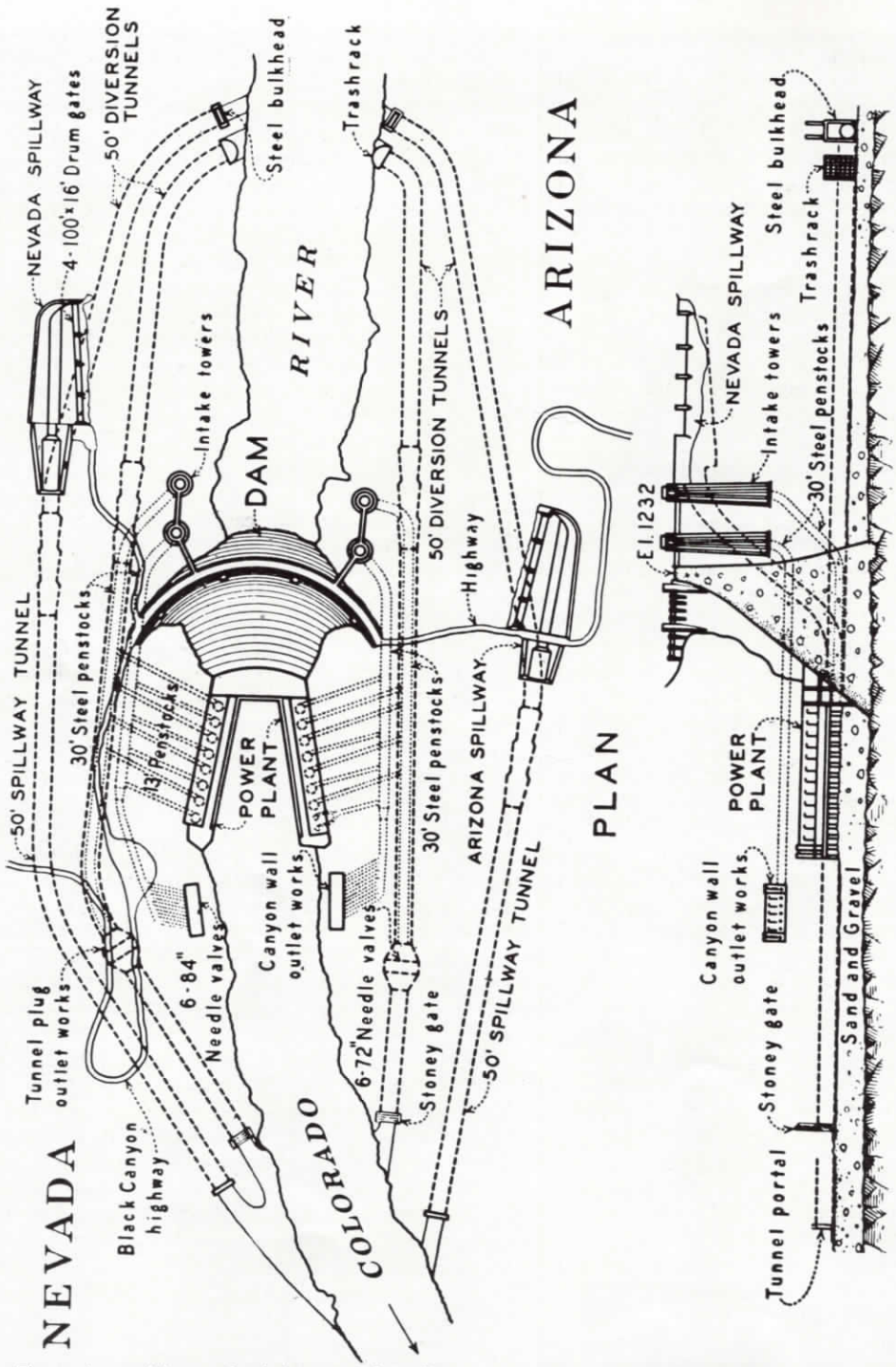
In its relation to the Metropolitan Water District Aqueduct and the All-American Canal, both of which are dependent upon its successful completion, the dam is the key unit in a building program amounting to $400,000,000, of which the aqueduct is the largest single undertaking. The power generated at the plant station will have a total capacity of 1,835,000 horsepower. Though conceived primarily to provide silt and flood control for the lower reaches of the river, storage and regulation of water for irrigation projects, and storage of water for domestic use in Southern California cities, it is through the sale of power, to be generated at the dam, that the construction of the dam has been made possible. The revenue from the sale of power will eventually repay the government for funds expended in building the dam. When the Democrats rode into power, pressure was exerted from various sources and the name of Hoover Dam was changed to Boulder in an edict by Secretary Harold Ickes.

With more than five months pouring time already logged on the dam progress sheet, and with actual work under way on the appurtenant phases of the job, the monolithic mass which will eventually control the flow of the Colorado river begins to assume definite shape.

To date, approximately 800,000 cubic yards of the 3,250,000 total which will go into the dam proper have been poured, and more than 200 feet of the 730-foot completed. So rapid has been progress by Six Companies, Incorporated, contractor with the Bureau of Reclamation for the dam proper, power plant and appurtenant works, that already the project is more than a year ahead of schedule. At the present time, with both the upper and lower level mixing plants operating at near capacity, about 6000 cubic yards of concrete are



Progress photographs showing, at the top, the river bed excavated to bedrock for the dam foundation; center, first bucket of concrete being dumped, June 6, 1933, and bottom, first concrete forms as they appeared in the excavation below the old river level.



These plan and longitudinal drawings of Boulder Dam enterprise indicate how water impounded will be handled. Flood and high water is taken through spillways on both sides down into Nos. 1 and 4 diversion tunnels and dumped back into the river below the dam. Water for powerhouse use enters through the four intake gates, passes through steel penstock tunnels into 13-foot penstocks and then into plant; also into canyon wall outlet works and tunnel plug outlet works, through which it is passed back into the river.

being dumped into the dam forms every 24 hours.

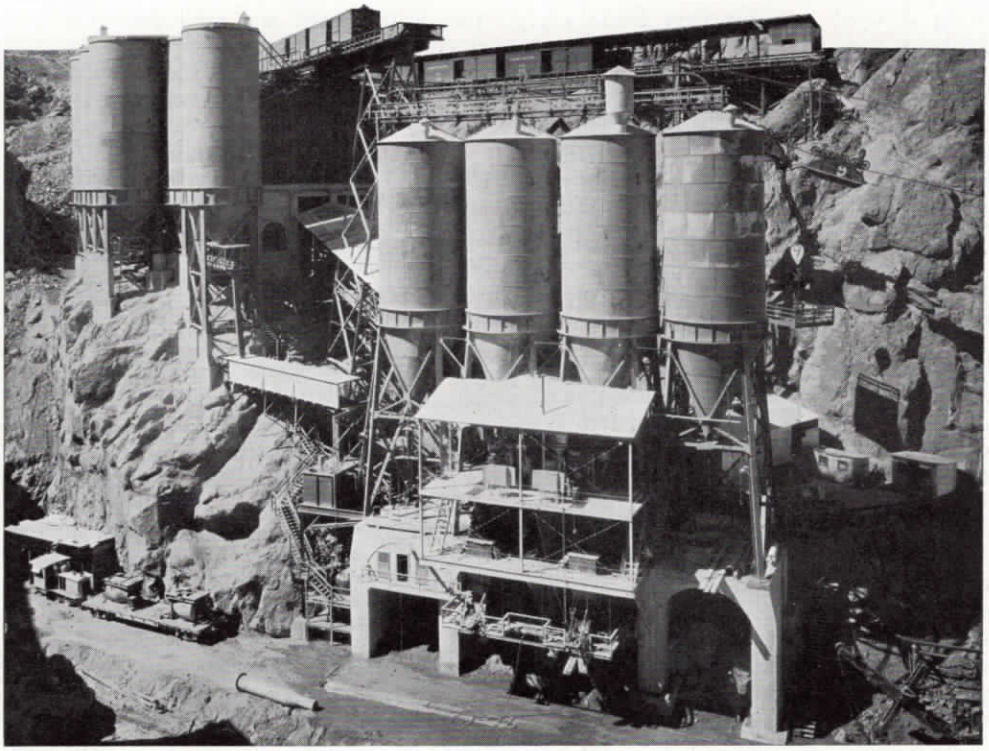
By far the most unique and interesting feature of the job at the present is the network of cableways, six in all, which have been strung across the canyon. All are being used in pouring concrete and lowering materials into the floor of the canyon. The largest cableway was built for the Bureau of Reclamation and is a six-cable suspension with multi-wheeled trolley. It has a carrying capacity of 150 tons. It is a permanent installation and will be used for lowering all powerhouse and appurtenant works equipment into position in the canyon. It is now being utilized to drop concrete used in the penstock tunnels to the canyon floor. The cableway is operated from a control house which juts out over the canyon walls 800 feet up on the Nevada side. Five of the cableways have capacity of 20 tons each and are single cable suspensions built for high speed work to expedite pouring of the concrete. The anchors are mobile, being steel counterweighted towers which operate on double track and may cover a distance of 400 feet in a movement parallel to the canyon walls in order to swing into exact position the concrete buckets which are suspended from the cable trolleys. The mobile towers move simultaneously on both sides of the canyon to assure specific spotting of the buckets. All cableways are electric-powered.

Rock and sand in the concrete in dam and tunnel forms are brought from deposits to the gravel plant, located in Hemenway Wash six miles from the damsite, thoroughly washed in what is by far the largest laundry of any kind ever built, and piled up for use. Cement, originating from four sources, is brought in freight cars. From the gravel plant the rock and sand are taken by train to the low-mix and hi-mix plants, the former upstream one mile from the damsite and at approximate river level, and the latter slightly below the site and high up on the Nevada side of the project. The combined maximum output of the two plants is nearly 8000 cubic yards daily.

To assure absolute uniformity in cement content of the concrete, a blending plant has been established in which all cement from the four sources is mixed together before being blown by air into the mixing plant bins. Conveyor belts are used in transferring rock and sand from the cars into the bins at the low-mix plant. At the hi-mix plant, full use is made of gravity flow, the rock and sand coming in from cars spotted on a spur high above the plant.

When mixed to the desired consistency, the concrete is poured into trucks equipped with agitator bodies which keep the concrete churning until it is actually dumped, or into buckets mounted on flat cars. The trucks carry agitators to points where they may be picked up by the cableways. The buckets are whisked along the canyon walls on flat cars to where they may be reached by the cableways. They are swung out over the work to the pouring location, lowered into position, dumped, and returned empty to the train. The ease and dexterity with which the concrete containers are handled by the cableway operators is a source of wonder to the spectator. Operators are unable to see the position of the buckets, being situated in the control room of the cableway head towers. Containing eight cubic yards of concrete, the buckets, loaded, weigh approximately 20 tons. They are literally plucked from the bodies of the trucks or flat cars, flung in a long swinging arc through space, and dropped into position. It's as simple as that. There is no lost motion—no jockeying for accurate position —no waiting for the bucket to stop swinging. The swinging is controlled. The bucket simply is dropped into the specified place, the tripping device sprung to send the concrete gushing into the forms. The empty bucket is swung back into position on the truck or car with the same ease and precision.

The spillways, one on each side of the canyon at points identified just in front of the completed dam, are themselves virtually finished, present work consisting of completing the weirs and installing the drum type control gates. The famous "glory holes," mammoth high water control bores extending from the inclined ends of the spillways 750 feet down into the outside diversion tunnels on each side, are the largest un-timbered shafts ever drilled by man. Yawning 70 feet in diameter at their openings, the holes extend down to an angle of 50 degrees from the horizontal into the roofs of diversion tunnels Nos. 1 and 4. The spillways are the means to release high water and to avoid overflow



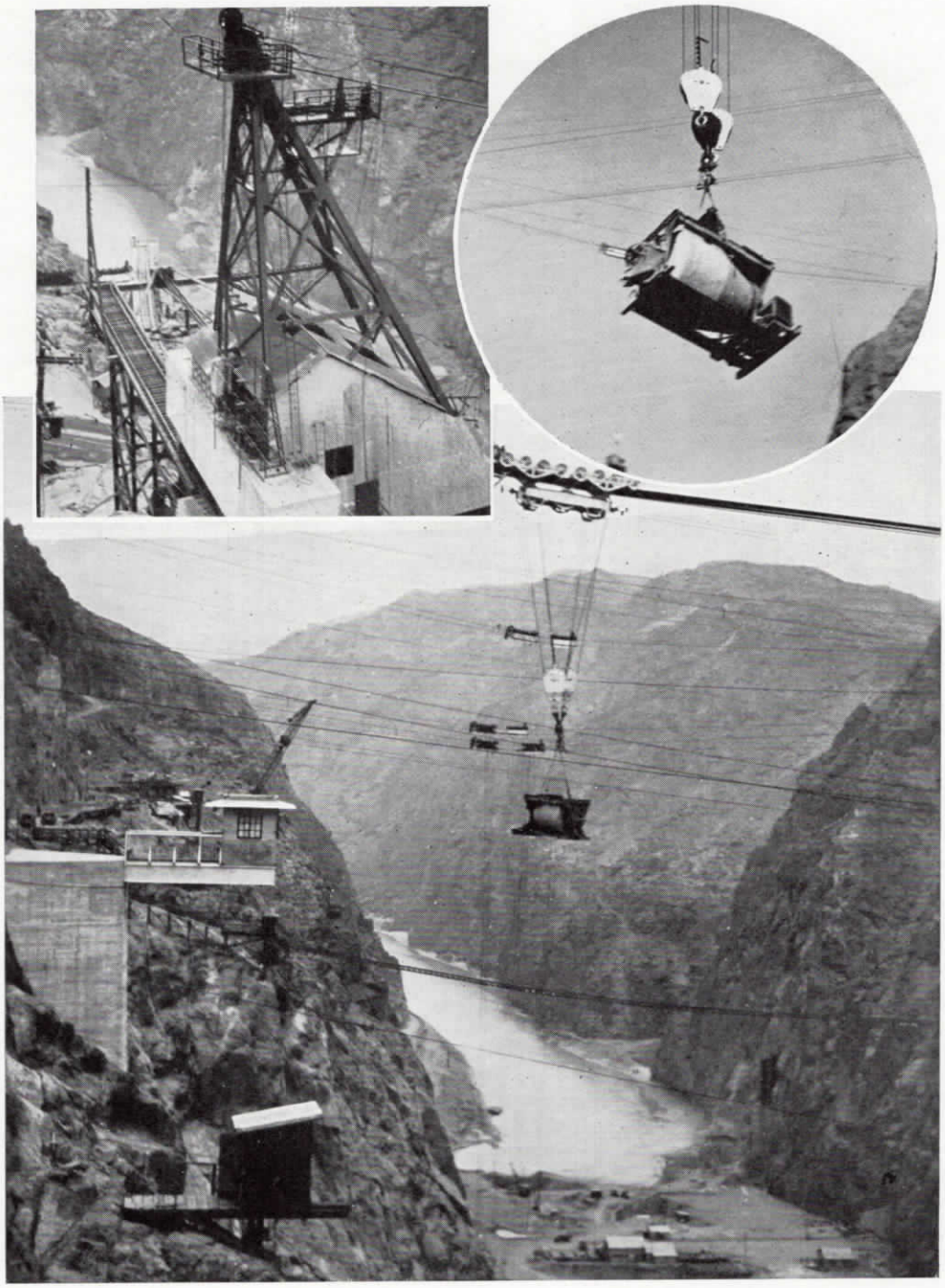
Cement blending plant, where cement, furnished from different sources, is thoroughly blended to assure uniformity, and the "Hi-Mix" concrete plant, so called because of its location high above the dam. The blending plant is on the left and the concrete mixing plant on the right. It is now being used along with the "Low Mix" plant to supply concrete for the dam, and during the later stages of construction will be used exclusively. An idea of the size of the plants can be obtained by comparing them with freight cars shown at the top of the photograph.

at the top of the dam.

Four gigantic intake towers, two on each side of the river, are at present in the construction stage. They will control the discharge of water from the reservoir to power generating turbines. The gates are cylindrical and 32 feet in diameter. The intake towers are 375 feet high. Water passing the gates will flow through 30-foot penstock pipes to the plant for use in power generation and to the outlet valves. The 30-foot penstocks traverse the canyon walls to inlets for the 13-foot penstock pipes leading into the power plant. The 13-foot penstocks branch off both sets of 30-foot penstocks. (The best apprehension of this system of tunnels may be gained from a close inspection of the plan and longitudinal drawings used in conjunction with this article.)

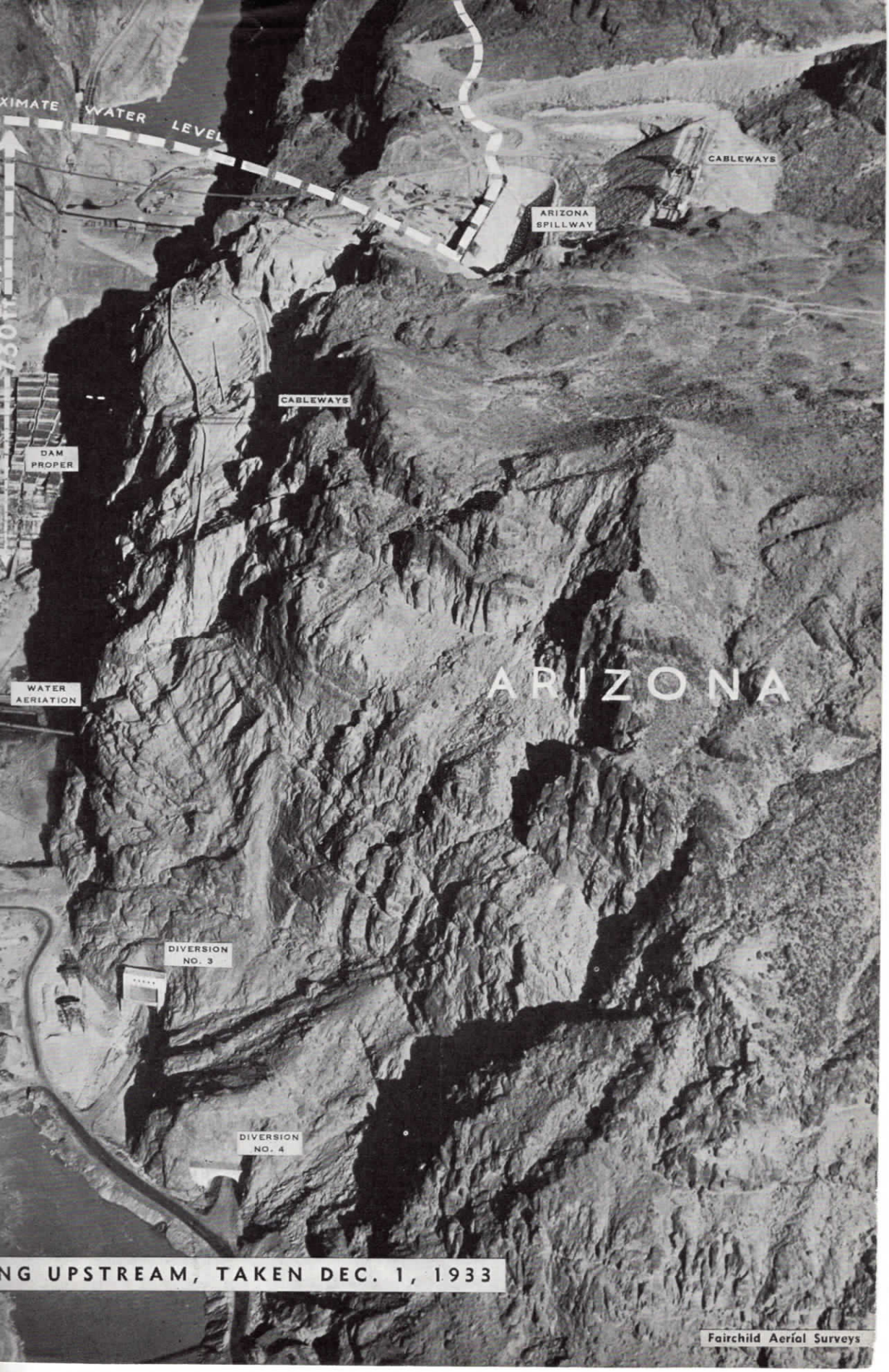
Upon completion of the dam proper, the diversion tunnels, which have represented such an important phase of the job to date, will be plugged solid with concrete about midway between the portals to prevent water from flowing through. The lower half of all the tunnels will continue to function as part of the project, Nos. 1 and 4 providing outlet for water taken through the spillways and Nos. 2 and 3 becoming units in the operation of the powerhouse.

The 30-foot penstocks, connecting the intake towers with power plant penstocks, terminate in the canyon wall and tunnel plug outlet works set up as by-pass facilities to provide for dispensing with water unused in the plant and that which may accumulate during a turbine shut-down. The canyon wall outlet works, one on each side of the canyon, and 200 feet above the river, have 12 valves, six to a side, for releasing the surplus water. There are six needle valves in each of the tunnel-plug outlet works in which the two lower 30-foot



Cableways are playing the largest single part in the present work at Boulder Dam. Top, left, inset, one of the mobile, counter-weighted cableway anchors with control house, from which trolley and lifting slings are manipulated. These anchors may be moved, by their own power, along a track for distance of nearly 400 feet in order to accurately spot a concrete conveyor over the proper dumping location. Circled inset, one of the 8-cubic yard conveyors being lowered in the canyon. The large government 150-ton cableway, operated from control house jutting out over canyon wall at the left, is shown above. Note the 6-cable suspension and multi-wheeled trolley. Trolleys of three of the five other cableways which span Black Canyon over the damsite, may be seen in the background. This view is looking upstream from observation point.

AERIAL VIEW BOULDER DAM, LOOKING


XIMATE WATER LEVEL
CABLEWAYS
ARIZONA SPILLWAY
CABLEWAYS
DAM PROPER
WATER AERIATION
ARIZONA
DIVERSION NO. 3
DIVERSION NO. 4
NG UPSTREAM, TAKEN DEC. 1, 1933
Fairchild Aerial Surveys

penstocks terminate.

Because of low water at the current season, diversion tunnel No. 1 is at present carrying all the flow of the Colorado around the damsite. The other tunnels are now closed off to enable work to proceed unhampered. They will be opened to take care of the river flow in the spring.

Cofferdams built up and down stream before excavation of the damsite was begun will continue to serve their purpose until the dam is approximately one-half done. The upstream cofferdam will remain as is, eventually to be submerged under the artificial lake that will be formed. Both downstream cofferdams will be removed to clear the way for the discharge from the power plant and outlet works. Which job, of course, means that the trusty dump trucks will be removing muck from the canyon virtually until the last phase of the work is performed.

The cooling system which functions on the dam proper to dissipate heat resulting from the chemical action of the cooling mass provides another standout in point of interest. Imbedded within the mass will be nearly 600 miles of 1-inch pipe through which refrigerated water will course. Cooling water for the pipe honeycombing the lower portion of the dam will circulate at a minimum temperature of 40 degrees, Fahrenheit. Water is passed through a cooling tower on top of the lower cofferdam to lower natural temperature and then is routed through a refrigeration plant to bring to the 40-degree point.

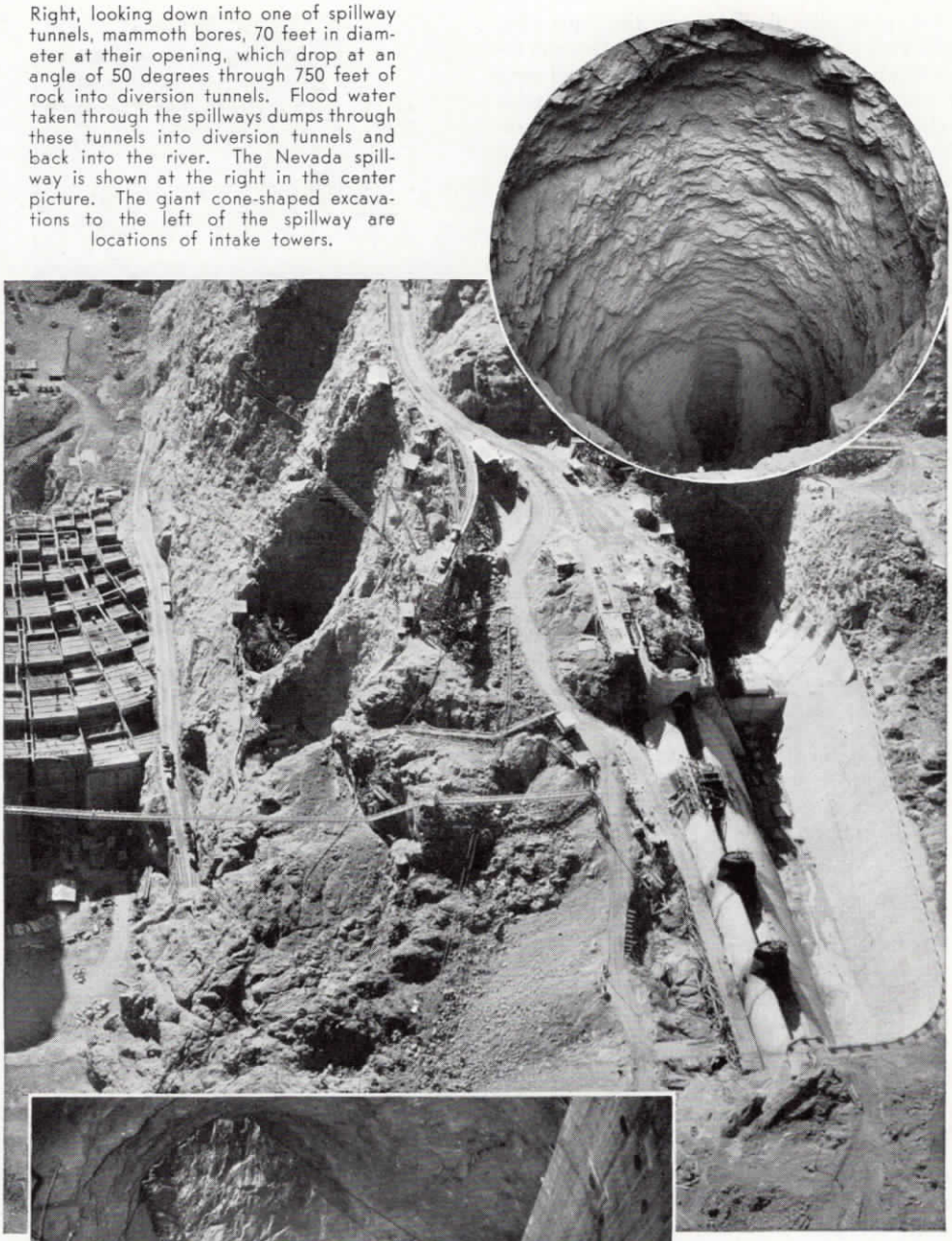
Excavation is being completed for the powerhouse.

A considerable portion of the current activity on the project is maintained at Bechtel, about a mile from the damsite, where all steel pipe for the penstock and outlet tunnels is being rolled. Babcock and Wilcox fabrication plant here is turning out the largest steel pipe for penstocks ever manufactured. Cold sheet steel, a maximum of 2⅞ inches thick, is rolled into pipe of 30-foot, 25-foot, 13-foot, and 8½-foot diameters. Rolling the 30-foot sections presents a larger job than ever before attempted and was accomplished by the installation of a special 3000-ton press. The pipe will be slid into place in the respective tunnels and pinned into a complete unit. This phase of the work serves to indicate the manner in which big jobs have been tackled on the Boulder Dam structure. A 300-foot crane runway has been built to facilitate stacking the pipe in storage until it is ready for use.

Frank Crowe, general superintendent, Six Companies Inc., builders of Boulder Dam.

The uninitiated may muse no end about this greatest of all modern construction jobs. One marvels at how finely tuned are the eyes and minds, how instantaneous the reflexes of the men who direct those cableways strung across the Black Canyon chasm . . . with what complete disregard of speed and space the men swing across the canyon on cableways and shuffle along suspension bridges hung 550 feet above the damsite . . . how methodically work on the project proceeds despite a seeming lack of concerted effort . . . how exacting is Six Companies Incorporated, under the direction of Frank Crowe, general superintendent, in doing every task, performing every job to the superlative degree . . . how infinite are the lengths to which the same organization goes in doing the possibly unnecessary rather than take the smallest chance on a slip-up . . . how completely it refuses to take more than a logical short-cut . . . how confident are the men in themselves and the job they perform . . . how good is the food in the Anderson Brothers Supply Company messhall where 1500 men may be fed at one time . . . with what disdain for precedent the corps of engineers tackles difficult obstacles, design new equipment, the like of which has never before been seen . . .

Right, looking down into one of spillway tunnels, mammoth bores, 70 feet in diameter at their opening, which drop at an angle of 50 degrees through 750 feet of rock into diversion tunnels. Flood water taken through the spillways dumps through these tunnels into diversion tunnels and back into the river. The Nevada spillway is shown at the right in the center picture. The giant cone-shaped excavations to the left of the spillway are locations of intake towers.



At left, the upstream plug in diversion tunnel No. 3.

how generally flexible are the operating plans . . . how rapidly the center of operations changes . . . how completely the man on the job dominates the equipment with which he works, despite the fact that it represents innovations in power, design, and operation . . . what a neat, orderly little municipality is Boulder City when contrasted to the sprawling, heat-ridden tent city which was its predecessor . . . what part the project is playing in the alleviation

Stored sections of 30-foot diameter pipe, to be used in lining penstock tunnels, are shown in top photograph. In the lower picture is fabrication plant of Wilcox and Babcock, where all steel pipe for lining tunnels is cold-rolled in sections. Rail lines and highway disappearing in lower right of the picture lead to top of the canyon wall overlooking the damsite.

of unemployment, not only in the area itself, but in every locality where equipment and supplies are manufactured . . . what the complete control of flood and silt will mean to the great southwest area unfolding on either side of the river between the dam and the Gulf of California . . . how skilled artisans follow the job, as indicated in the fact that many of the hard-rock miners who participated in the cutting of the Boulder diversion tunnels are now driving drills into the bores which go to make up a large part of the Metropolitan Water District Aqueduct . . . what a tourist mecca the 125-mile Boulder lake will create . . . how petty is the squabble over whether or not the great monument which will control the Colorado shall be named Hoover or Boulder Dam . . . how much time will elapse before dependent cities will actually be taking power from the Black Canyon enterprise . . . how completely ingenious are the methods devised to fit the equipment to the job . . . what a grand market for the especially constructed composition "trench" hats, worn by workmen, the Boulder Dam project proved to be . . . what a test on machinery, truck motors and chassis, and tires the job has developed into . . . to what lengths the Union Oil Company has gone in erecting facilities and supplying fuels, lubricants, greases, and other petroleum products to Six Companies, Incorporated . . . what a lot of water is the ten trillion gallons which the completed dam will impound . . . and . . . ad infinitum.

Breakthrough from diversion tunnel of one of 13-foot penstock tunnels leading into power plant, is shown in the center picture. At the top is shown one of the collapsible lumber forms used in lining the power plant penstock tunnels with concrete. The picture at the bottom shows the canyon wall outlet works tunnels, through which by-passed water is dumped back into the river.

Dipping 20 Miles of Steel Pipe

Union Asphalt Specialties Used on Pasadena Water Project

THE plant of the Consolidated Steel Corporation, Ltd,. at Maywood, Calif., in which the Union-Dipping-Enameled-protected steel pipe is being manufactured for the 20-mile Pine Canyon Dam water line, is the most complete steel fabricating plant on the Pacific Coast. Its output includes welded and riveted steel pipes of all dimensions, structural steel of every character, elevators, cranes, hoists, derricks, tanks and machinery of all kinds.

Equipment for the petroleum industry constitutes a large percentage of the business of the plant. Several units of Union Oil Company's new lubrication plant at Oleum are now being fabricated there.

Not only is the Maywood plant one of the most complete steel fabricating mills in the West, it is the most up-to-date. Where machinery has been required to do a job for which no adequate machinery existed, Consolidated's crew of highly skilled machine makers have turned out the necessary equipment. In keeping pace with developments within the past few years, this has been a frequent, rather than rare occurrence.

Throughout the plant the operation of machinery is electrically controlled. The pressing of a button moves tons of machinery into actions, swiftly, accurately and carefully. It is an example of modern mechanical wizardry.

A force of more than 2000 men are today employed by Consolidated.

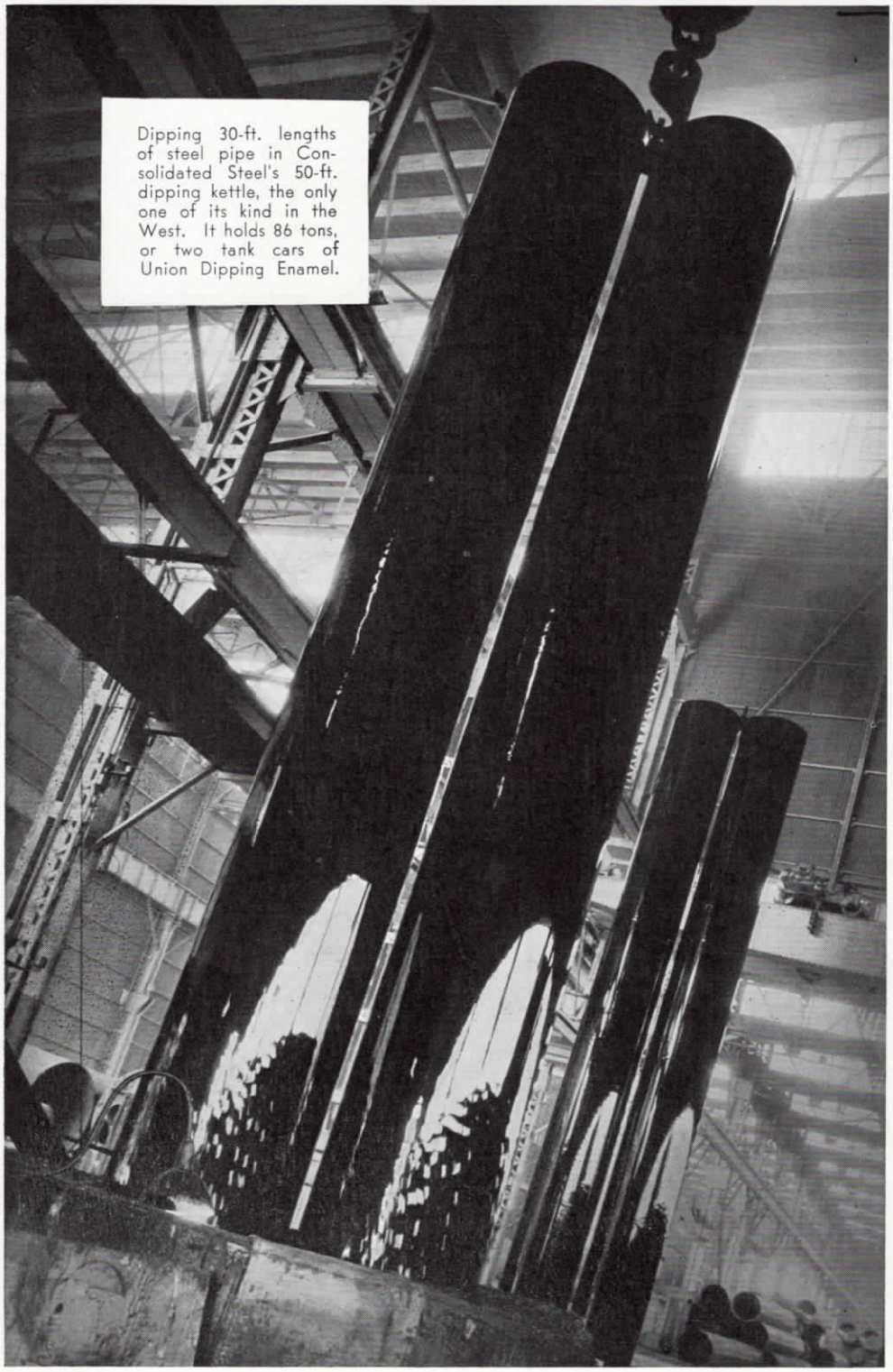
One of the features of the plant is its vertical asphalt dipping kettle used to put a protective coating on steel pipe. The kettle is 50 feet deep, sunk below the floor of the pipe shop, and 7 feet in diameter. It holds 86 tons of coating material maintained at a temperature of 450 degrees F., by means of an electrical heating device. Its size makes possible the dipping of two 30-foot lengths of pipe at one time.

THE history of Southern California, as well as of many other sections of the West, is filled with the stories of the development of water projects. Lines of large steel pipe carry water many miles to California's rapidly growing cities, and it is expected that the future will witness even greater installations than in the past. The preservation of the large investments in steel pipe lines has always presented a serious problem, and it was for the purpose of meeting this need that Union Dipping Enamel was developed.

Union Dipping Enamel is now being used to protect the 36-inch steel pipe which is to bring water to Pasadena from the new Pine Canyon Dam—a distance of over twenty miles. The steel water pipe, which is being manufactured by the Consolidated Steel Corporation at its Maywood plant, must be protected inside and out with a waterproof and weatherproof coating in order that the water on the inside of the pipe will not cause rusting and that the pipe will not be destroyed from the outside by the corrosive action of soil and weather.

Many water pipe installations have been protected in the past by dipping the pipe into hot asphalt so that a coating of asphalt is left on both the inner and outer surfaces. Even the best grades of pure asphalt, however, afford only moderately good protection because of a lack of toughness.

In order to overcome this deficiency of ordinary asphalt for pipe coating, asphaltic enamels, that is, asphalts containing finely ground mineral fillers have been employed to some extent. Probably the earliest filled asphalts used for pipe coating were made by fluxing an ordinary asphalt with Trinidad asphalt. This asphalt, as mined, con-



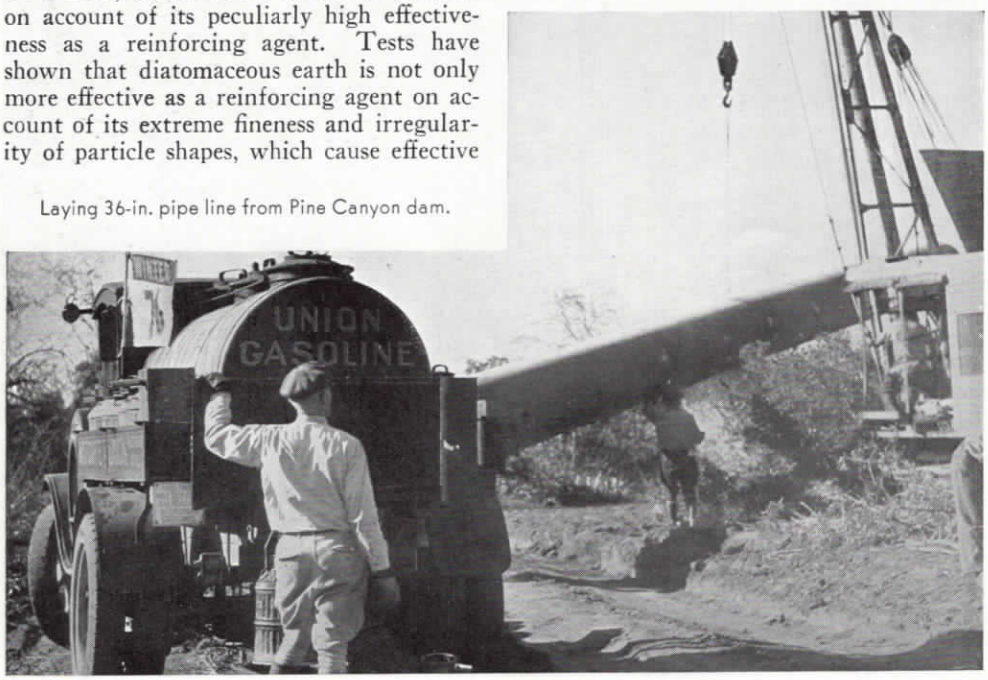
Dipping 30-ft. lengths of steel pipe in Consolidated Steel's 50-ft. dipping kettle, the only one of its kind in the West. It holds 86 tons, or two tank cars of Union Dipping Enamel.

tains from 40 to 50 per cent of clay silt which serves as a natural mineral filler. It was thought at first that the Trinidad asphalt had some inherent properties which accounted for the improved behavior of the fluxed material over ordinary asphalt. However, research has shown that it is the mineral filler present which imparts the toughness, and that the asphaltic portion of Trinidad asphalt is practically identical with ordinary paving grades of asphalt, which are known to be inferior for pipe coating purposes. It has been concluded, therefore, that the fluxing of domestic asphalt with Trinidad asphalt is beneficial on account of the filler introduced, but is detrimental on account of the inferior type of asphalt present. A better and more uniform product can be made by incorporating a proper mineral filler into a well refined petroleum asphalt of the type known to be most suitable for pipe coating purposes.

Union Enamel was first developed for use on the company's own pipe lines and then later Union Dipping Enamel was offered for general use on water lines. The asphalt selected for the purpose is a carefully air-refined petroleum asphalt made from stock which is known to have high resistance to weathering and to the destructive effects of prolonged hot storage. As a filler, diatomaceous earth was selected on account of its peculiarly high effectiveness as a reinforcing agent. Tests have shown that diatomaceous earth is not only more effective as a reinforcing agent on account of its extreme fineness and irregularity of particle shapes, which cause effective interlocking and high resistance to mechanical stress, but is superior to other fillers on account of its negligible tendency to settle out of the asphalt during hot storage or dipping.

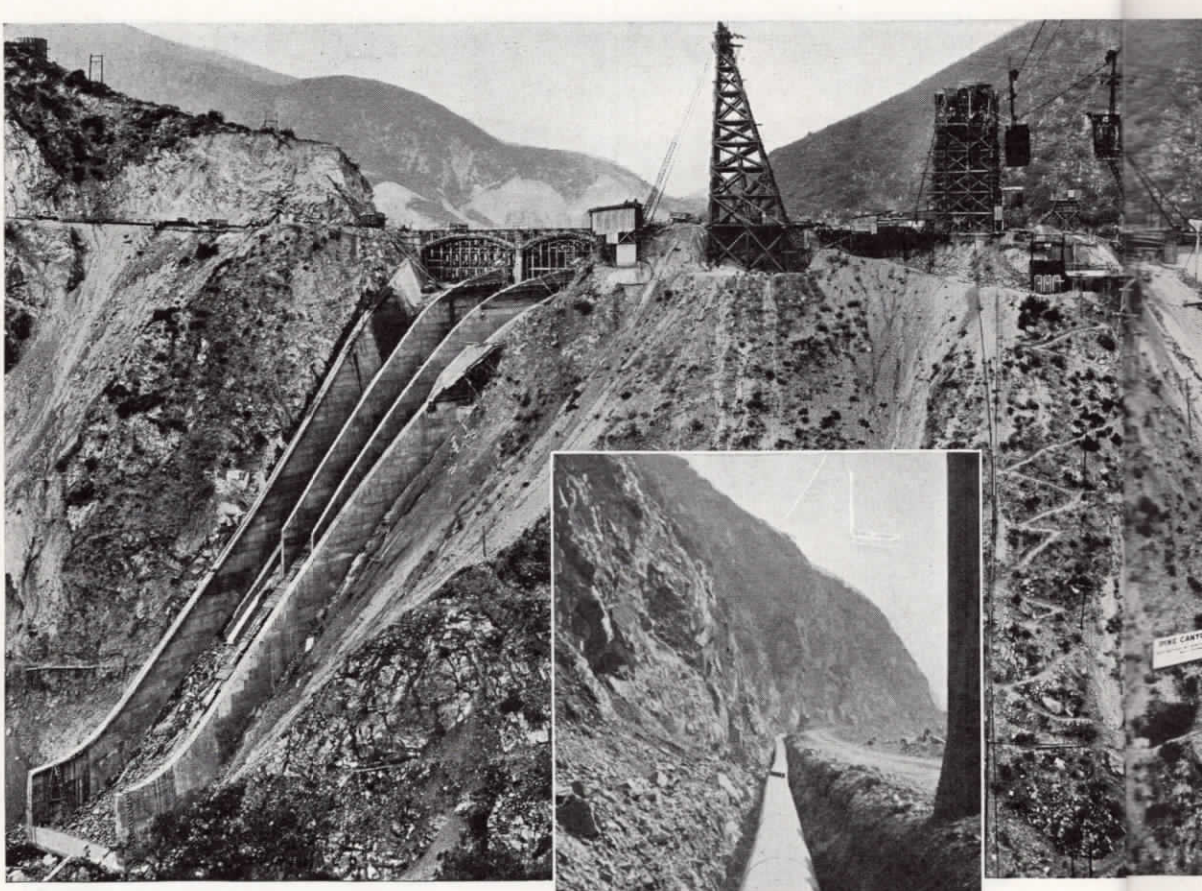
Union Dipping Enamel has been found to be very tough, highly resistant to the destructive effect of sunlight and weather, and to be little affected by extremes of temperature encountered in service. It is resistant to oxidation, coke formation and hardening during the prolonged hot storage in the dipping kettle.

Special refinery equipment has been designed and constructed which insures that the filler is thoroughly ground into the asphalt and that all air and moisture is removed so that the final product is uniform and free of even the most minute bubbles, which might impair its efficiency as a pipe coating. Union Dipping Enamel is usually loaded into trucks and transported directly from the refinery to the steel plant. The pipe manufacturers, and therefore, the taxpayers, are saved a considerable sum by furnishing the enamel hot so that it can be used immediately for dipping. It has long been standard practice among pipe manufacturers to receive dipping asphalt in steel drums, from which it had to be removed by hand, and subsequently melted, with at-



Laying 36-in. pipe line from Pine Canyon dam.

The 1/4-in. sheet of steel plate, shown at the top, is on its way to become a 30-ft. length of water pipe. Above, rolling cold sheet of steel. Right, spot-welding. Below, spot-welded pipe ready for final welding job. Inset, testing pipe for weakness under hydraulic pressure of 350 pounds per square inch. The sledge hammer is applied to the welded seam.

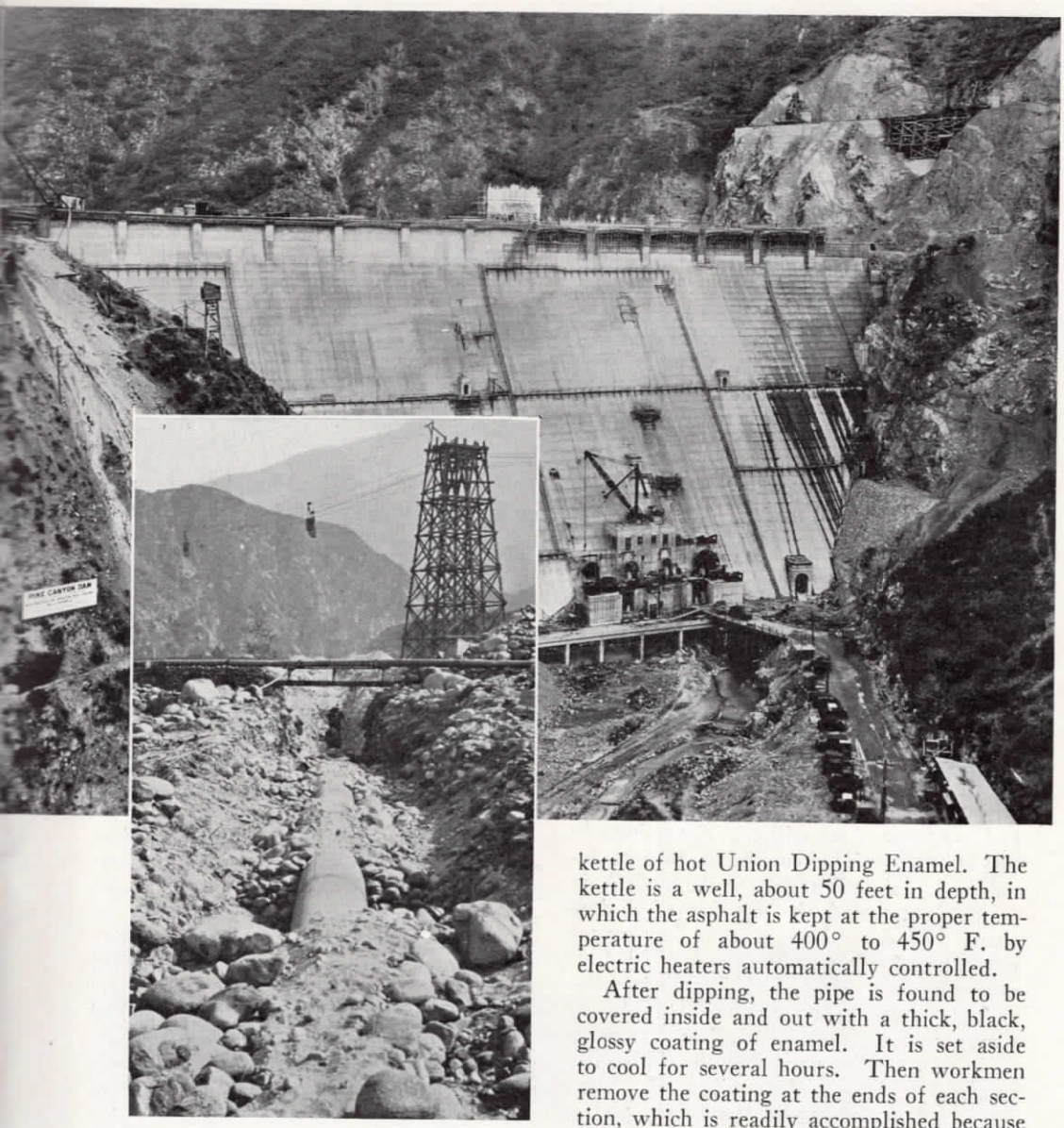


Down stream face of the Pine Canyon Dam located in the narrowest part of the main San Gabriel Canyon. It will provide water storage for the city of Pasadena and will impound a part of the flood waters of the San Gabriel River. When the Metropolitan Water District aqueduct is completed it will become part of that system. The dam is being built at a cost of slightly more than $7,000,000. The dam proper, 200 feet high and approximately 600 feet wide, is shown on page 55 and the spillway in the photograph above. Sections of the twenty miles of Union-enamel-dipped pipe line that will carry water from the dam to the points where it will be used are shown in the accompanying views. The mean annual stream flow of the San Gabriel River is 115,000 acre-ft., and the city of Pasadena is permitted to store not to exceed 65,000 acre-ft.

tendant cost and possible damage from overheating.

The entire operation of manufacturing and installing the coated pipe is a complex and interesting one. At the steel plant the metal is received in the form of huge flat sheets. The sheets are passed through rolls which bend them into cylindrical form, thus making a section of pipe. The cylinders, 30 feet in length, are then fed through an automatic welding machine where the lengthwise seam is electrically welded. After welding, each section is subjected to a water test under high pressure.

It is necessary, after the pipe has been coated with enamel, to remove the enamel completely from a narrow ring at each end to permit welding the sections together in



the field. The areas which are to be cleaned later are therefore painted with Union Anti-Stick Primer, which prevents the enamel from adhering to the steel.

After the ends of the section of bare pipe have been painted, the section is placed on small cars and is pushed into a long brick tunnel. Gas flames are turned into the tunnel in order to heat the pipe to the proper temperature for dipping. When hot enough, the section is removed, picked up by a crane, and dipped into a submerged kettle of hot Union Dipping Enamel. The kettle is a well, about 50 feet in depth, in which the asphalt is kept at the proper temperature of about 400° to 450° F. by electric heaters automatically controlled.

After dipping, the pipe is found to be covered inside and out with a thick, black, glossy coating of enamel. It is set aside to cool for several hours. Then workmen remove the coating at the ends of each section, which is readily accomplished because of the anti-stick primer, and the pipe is loaded onto trucks and hauled to the pipeline site.

The sections of pipe are placed end to end and are carefully welded together. Then another Union specialty, Union Bituminous Primer, is applied to the exposed steel at the joints on both the inside and the outside of the pipe, and finally the joints are finished by applying a coat of hot Union Pipe Line Enamel.

After pressure testing and backfilling, the line is ready for service.

The Grand Coulee Dam

DREAMS of wheat growers and farmers in the Big Bend country of the Columbia River, Washington, who for the past twenty years have visioned a means to harness the flow of the stream for development of power and diversion of water for irrigation, saw first hope of realization July 23, last, when the Board of Public Works, appointed by President Roosevelt, passed a resolution granting $63,000,000 for the building of the Grand Coulee Dam.

The Grand Coulee damsite is on the Columbia River on the course of the historic Seaton cable ferry, about 65 miles west and north of Spokane and some 25 miles due north of Almira, Wash. It is the terminal for a branch line of the Northern Pacific railroad.

The project is to be divided into two units, a low dam, from which power alone will be developed, and a high dam from which both power and water for irrigation purposes will be derived. The low dam and hydro-electric plant will cost approximately $63,000,000. The completed project involves an expenditure of $170,000,000, in which is included the erection of a dam rising 370 feet above present low water mark and having a length of 4290 feet, more than four-fifths of a mile; the installation of a power plant with 2,400,000 horsepower potential output, and construction of locks to make navigable the 150 miles of water which the dam will hold.

Preliminary contracts have been let on the low dam by the Bureau of Reclamation, Department of Interior, under which all work will proceed. Final plans are under draft, and secondary surveys are being made. Excavation at the damsite has been initiated. Core drilling, trenching, and test pit work were to have been completed prior to January 1, 1934, and actual construction, tentatively scheduled for early summer, will be started some time during the spring.

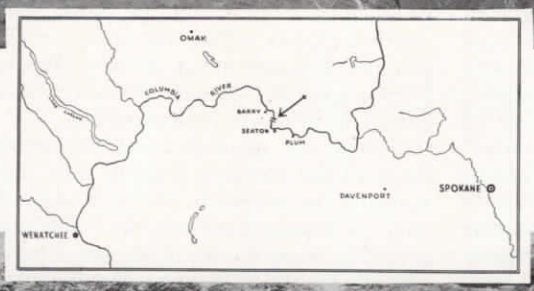
The first unit of the dam will rise 145 feet above low water. It will be a combined gravity and multiple arch-type structure 3430 feet long. Bedrock depth will be 62 feet. The obstruction will contain 2,000,000 cubic yards of concrete. A hydro-electric plant of 700,000 horsepower will be built. The lake formed by the dam will reach back 50 miles from the damsite. Provisions have been made for the protection of fish during the building of the dam.

Work on the project has been mapped on the premise that not until power is available from the dam works can reclamation of the arid lands in central and eastern Washington be undertaken. Of the $63,000,000 allocated by the government for the enterprise, only 70 per cent will be repaid by the state of Washington, the other 30 per cent, approximately $18,000,000, being presented as a gift. The $45,000,000 due the government will be repaid through the sale of power from the dam. Residents of Washington will not be bonded for the sum.

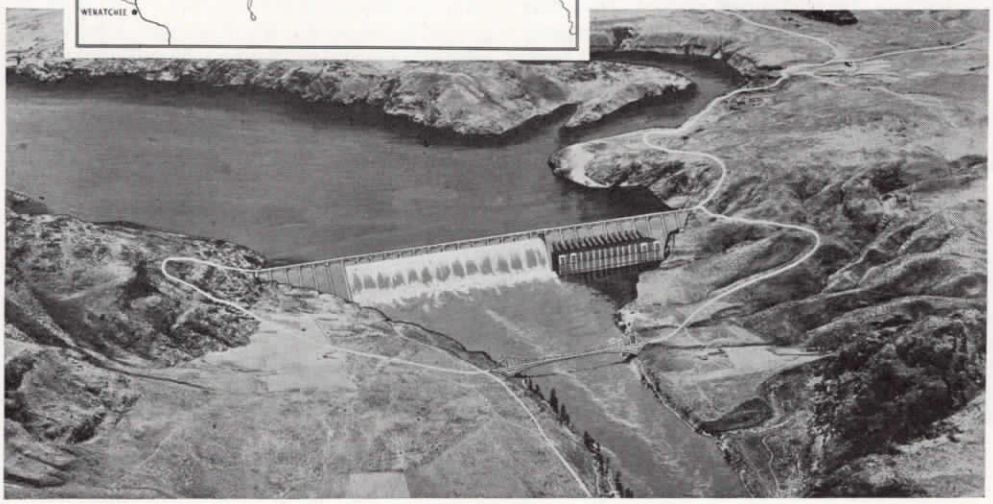
Completion of both units of the dam will provide cheap power for the great central portion of Washington and will permit the advantageous exploitation of more than a million acres of land which has lain undeveloped because of insufficient water supply.

While but a small corps of engineers and workers are at present active on the project, between 3500 and 10,000 men will be required at various times on the work of building the dam. No work is now available at the damsite. Before the job swings into full schedule, a construction camp of considerable size will spring up near the damsite. Development of the town and building of a bridge across the river will constitute the first actual work done on the job. The two are expected to cost $1,000,000 to complete. In all probability the townsite will be declared a federal reservation as was done at Boulder Dam, and municipal direction placed in the hands of the Bureau of Reclamation.

Site of the $60,000,000 Grand Coulee Dam on the Columbia River, Eastern Washington, is shown in the accompanying photographs and map. The dotted line in the upper photograph indicates location of the dam, and in the lower one the artist has pictured how the power unit will look when completed. In the inset is Frank A. Banks, reclamation engineer in charge of present construction



Arrow points to location of Grand Coulee Dam.



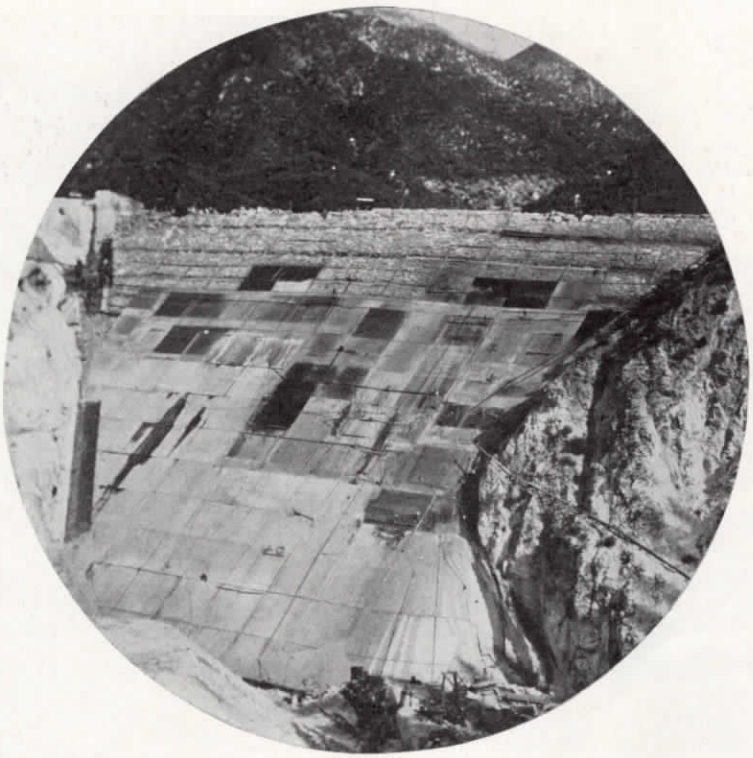
Above, the first buildings to be erected at the town which will rise at the site of Grand Coulee Dam, and, right, a view of Grand Coulee through which the Columbia River once flowed. Top insets, two geological spectacles in the Grand Coulee region. Left, Dry Falls, greater than Niagara, 417 feet high and 1½ miles wide. Right, Deep Lake.

From a geological standpoint, the site of the Grand Coulee Dam offers some interesting observations. During a glacial period of several hundred centuries ago, the river, at what is now the damsite, was blocked by ice, resulting in the channel being changed to what is now identified as the Grand Coulee. The word "Coulee," incidentally, is derived from an Indian name meaning literally "long gully." The Grand Coulee is a dry river bed with almost perpendicular walls of 200 to 300 feet extending up both sides. Evidence of seven distinct lava flows may be seen from exposed formations along the cliffs. During another glacial period, the ice cut a second channel through what is now known as Moses Coulee. Finally the river was diverted back to its present course.

Seventy-six gasoline is at present being supplied the contractors doing core drilling work on the bottom of the river at the damsite. Company products are being used in servicing a seven-car fleet maintained on the job by the Bureau of Reclamation.

Union's Entry in San Francisco N.R.A. Parade Applauded

Central division's entry in San Francisco's NRA parade held during the middle of November. The "Three Little Pigs" idea was used, somewhat reversed in outcome, the three little pigs, representing N, R, and A, playing havoc generally with the big bad wolf, who symbolized the depression. Antics maintained throughout the parade were applauded by thousands of spectators and earned recognition for the company in San Francisco newspapers.



San Gabriel Dam No. 2

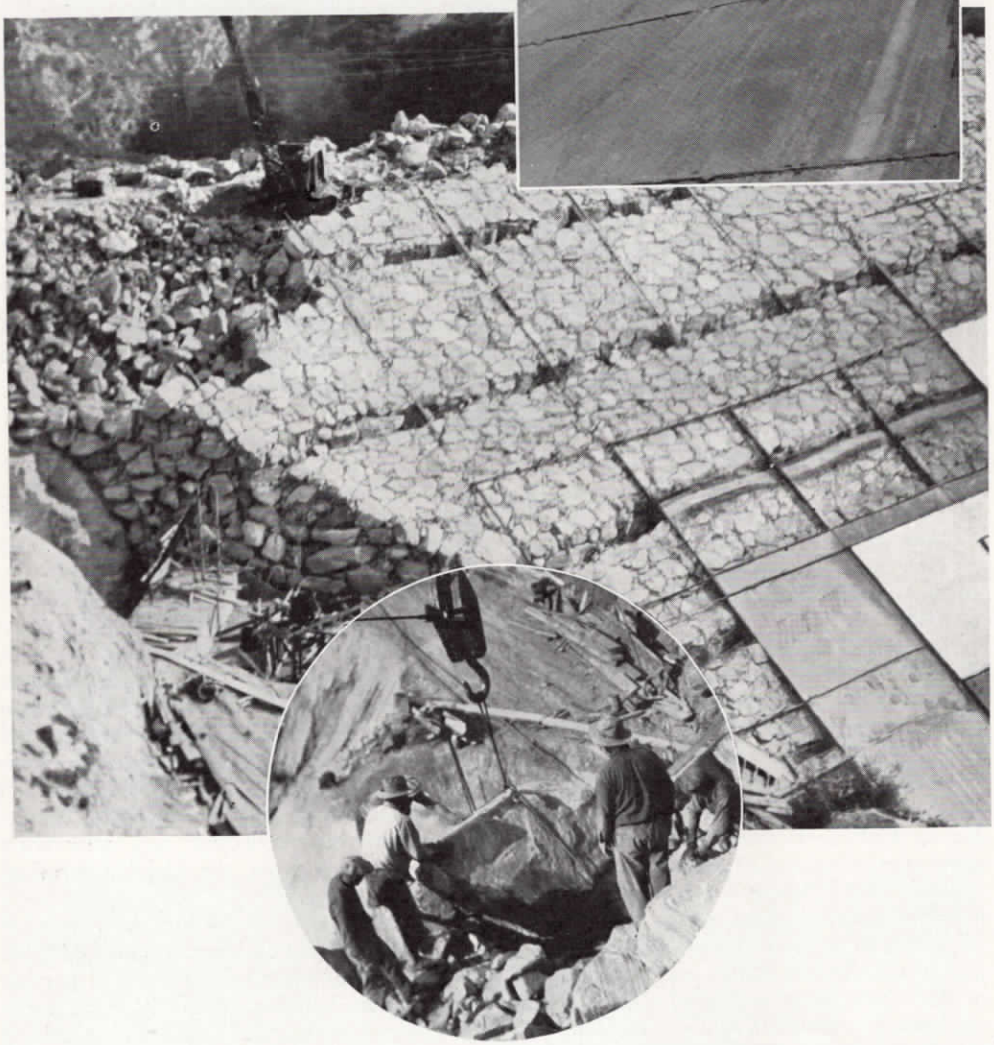
DESIGNED and built as a flood control unit under the direction of the Los Angeles County Flood Control District, San Gabriel Dam No. 2—a rock-filled structure thrown across the west fork of the San Gabriel River, 22 miles above Azusa, Calif.,—is now nearing completion after approximately 20 months' work.

Faced with laminated gunite over reinforced concrete slabs ranging from 6 to 12 inches thick, San Gabriel Dam No. 2 is 260 feet above streambed, has a crest length of 585 feet, crest width of 18 feet, and thickness at streambed of 750 feet. The crest elevation of the obstruction is 2405 feet. Total cost of the structure is $2,086,950.

San Gabriel No. 2 is the first of three dams built in San Gabriel canyon as flood control and conservation projects. San Gabriel No. 1 is being built 15 miles further down the stream, and ahead of it, a few miles from where the river empties into its cross-valley bed, is located Pine Canyon Dam, an undertaking now being carried forward by the city of Pasadena. This dam, when completed, will be a unit in the Metropolitan Water District of Southern California aqueduct and will store water pumped from the Cajalco terminal reservoir.

In the building of the dam it was necessary to make open cut excavation of 437,200 cubic yards of material. The filled portion of the dam contains 1,065,000 cubic yards of dumped rock and 52,500 cubic yards of packed rock. All rock is granite, obtained at a quarry set up four miles from the dam-site at a location where ample native rock was available. Placing of the rock brought from the quarry represented the major part of the work. The granite used is exceedingly dense—weighing 175 pounds to the

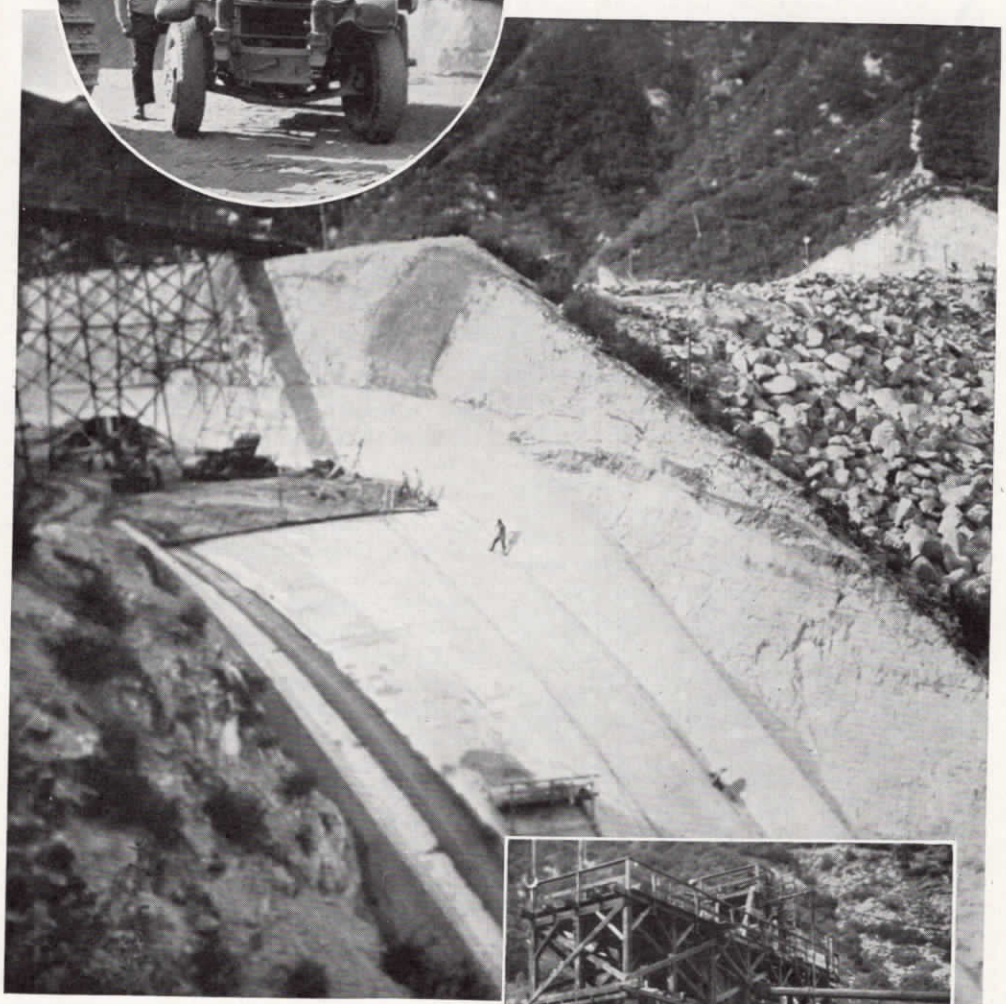
Below is shown rock-filled portion of San Gabriel Dam No. 2, with packrock facing laid out in sections. Right, looking up face of the dam, showing men at work on laminated gunite sections. In the circle, dropping a several-ton rock into place on face of the dam with the assistance of a crane.

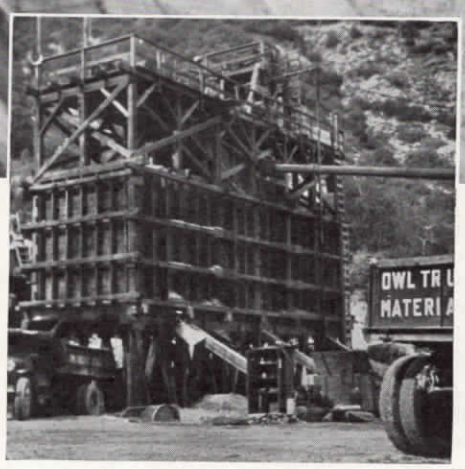


cubic foot—and many of the single pieces transported would have tipped the scales in excess of 15 tons.

The dam drains an area of 40 square miles. The capacity of the reservoir is 15,000 acre-feet of water to maximum high water. The reservoir has an area of 150 acres. It will back up water in the narrow canyon for a distance of approximately 7 miles.

All work on the dam has been performed by Macco-Lewis, Incorporated, and sub-contractors. Owl Trucking and Materials Company supplied concrete materials and McCutcheon Transportation Company hauled the rock from quarry to damsite. All are users of Union Oil products.





View of concreted spillway of San Gabriel Dam No. 2 appears above, and at the right one of the materials storage plants. The transportation of aggregate to the dam is handled by the Owl Trucking and Materials Company, a long established user of Union products.

Sales Divisions Reorganized

A COMPLETE reorganization of the company's sales force, with the exception of the head office staff, was accomplished with the close of 1933. The change includes the abolition of the ten former district boundries and the creation of 39 new sales districts, headed by the same number of sales managers, under the direction of three division managers who are carrying on the administrative work and sales supervision formerly allocated to ten district managers. While concentrating administrative authority, the new set up actually places greater responsibility for sales on the men in the field than ever before.

Under each division manager are: one division sales manager, responsible for all sales activities within the division, and having direct supervision over the division sales promotion supervisor, fuel oil supervisor, asphalt supervisor and district sales managers; one division operating manager, responsible for all marketing properties and facilities within the division; division accountant, division credit manager and division personnel supervisor, each responsible for his own sphere of activity within the division.

Whereas the old districts covered as much as one or more states, the new district territories are, for the most part, restricted in size, permitting a greater concentration of sales effort on the part of the managers.

The Vancouver District, comprising British Columbia and Alberta, Canada, remains unchanged and will continue under the direction of R. J. Kenmuir, district manager, and supervision of the Northern Division manager. Honolulu and Panama districts continue as in the past and report direct through present established channels.

The following areas are included in the three divisions: *Southern*—Southern California, Arizona and portion of Nevada; *Central*—Central and Northern California and the portion of Nevada not included in the Southern Division; *Northern*—Oregon, Washington, Idaho, British Columbia and Alberta, Canada.

January 1, M. W. McAfee, who had been in charge of the Northern Division, was transferred to Los Angeles as manager of the Southern Division, F. W. Pemberton going to Seattle to take over Mr. McAfee's former duties. W. A. Newhoff remained in San Francisco as manager of the Central Division.

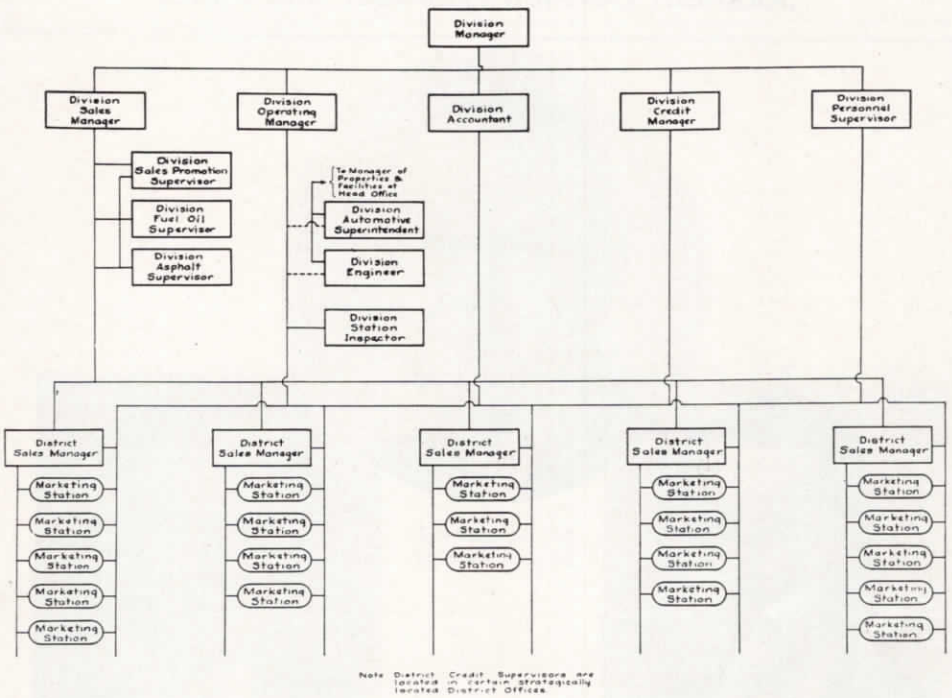
The three men who will have personal supervision of sales within the divisions are A. C. Stewart, Southern Division sales manager, S. D. Herkner, Central Division sales manager, and R. Linden, Northern Division sales manager.

Prior to his new appointment, Mr. Stewart had, since June, 1931, held the position of manager specialty sales, and as such had been largely responsible for the development and sale of the full line of Union household and automotive specialties now being marketed throughout the coast. He has been identified with the company's sales organization since his graduation from Stanford in 1928, serving for a time with the salesfax division, then as agent at San Jose, and as a member of the Fuel Oil and Export Sales departments before being assigned the task of developing the company's line of specialty products.

Mr. Herkner's service dates back to 1908, when he went to work as an order clerk at Stockton, and during the intervening 25 years he has held a number of important sales posts, including, district manager at Sacramento, manager of the "old" Central Division, and manager of the Seattle district. The latter post was taken in November, 1929. The following April he was transferred to San Francisco to take charge of that district, and in February, 1931, crossed the bay to direct the sales of the Oakland district, remaining at that post until his recent assignment.

An apprenticeship of two years as district manager of the Spokane district, and

TYPICAL DIVISION ORGANIZATION CHART



eight months as assistant manager of operations in Portland, prepared Mr. Linden for his new duties in the Northern Division. His service with the company, however, dates back to 1916, when he went to work in the Los Angeles District as voucher clerk. After serving in a number of clerical positions he became office manager, Los Angeles sales, May 1, 1927, and sales promotion supervisor of the southern division the following year. Prior to the district managership which he held at Spokane, he served successively as assistant district manager Los Angeles and filled the same position at Portland.

Responsibility for the economical operation and maintenance of storage, distribution and delivery facilities within the divisions has been placed in the hands of three division operating managers—W. F. Lewis, Southern Division; W. E. Davenport, Central Division, and J. S. Clifton, Northern Division.

Mr. Lewis will have rounded out 20 years of service with the company next March. During recent years he has held a wide variety of positions in the sales organization, including manager of refined oil sales, manager service station distribution, and, during the past year, assistant manager of operations of the Los Angeles district.

The Northern Division's operating manager has been with the company since March 2, 1916, when, as a graduate of accounting and law, he accepted a position in the Comptroller's department in the head office. A year later he enlisted in the Regular Army, serving with the 13th Field Artillery, Fourth Division, Texas, before going overseas in January, 1918, where he spent the next 18 months, seven at the front. When he returned to the company in September, 1919, he was reinstated in the Comptroller's department, serving in a number of positions until August, 1928, when he was made district accountant at San Francisco, being transferred to Los Angeles in the same capacity in 1930. He was next promoted to assistant district manager in charge of operations of the Los Angeles District, and assigned to Portland

Southern Division Manager and Aides

M. W. McAFEE
Division Manager

A. C. STEWART
Division Sales Manager

W. F. LEWIS
Division Operating Manager

R. C. INGRAM
Division Fuel Oil Supervisor

R. J. WOOD
Division Sales Promotion Supervisor

W. M. WEIR
Division Asphalt Supervisor

C. H. MANN
Division Credit Manager

J. U. WITT
Division Accountant

in the same capacity in February, 1932, remaining there until his appointment to the division.

W. E. Davenport came to the company as distribution clerk in the Seattle office December 10, 1919. Two years later, after having occupied various office sales posts, he became salesman in Seattle. From that post he was made agent in Mt. Vernon and Everett, and then in May, 1924, became

Central Division Manager and Aides

W. A. NEWHOFF
Division Manager

W. E. DAVENPORT
Division Operating Manager

S. D. HERKNER
Division Sales Manager

F. H. HAMLIN
Division Fuel Oil Supervisor

L. C. SAUNDERS, JR.
Division Sales Promotion Supervisor

F. P. SMITH, JR.
Division Asphalt Supervisor

special agent at Wenatchee. November 1, 1926, he was selected for the post of assistant district sales manager, Spokane, where, after a year's service, he was transferred to Seattle in the same position. April 1, 1930 he was appointed district manager, Spokane, went to Sacramento in the same capacity a year later, and in June, 1932, was moved to Fresno as manager of that district, in which position he served until

J. S. SWANSON
Division Accountant

S. D. MALCOMB
Div. Personnel Supervisor

Northern Division Manager and Aides

F. W. PEMBERTON
Division Manager

R. LINDEN
Division Sales Manager

J. S. CLIFTON
Division Operating Manager

H. C. DAVIDSON
Division Sales Promotion Supervisor

C. L. TOSTEVIN
Division Fuel Oil Supervisor

T. F. THOMPSON
Division Asphalt Supervisor

C. J. VORIS
Div. Personnel Supervisor

G. H. ANDERSON
Division Accountant

W. M. SHELTON
Division Credit Manager

R. J. KENMUIR
D. M., Canada

appointment last month to divisional duties.

Each division will have its own accounting unit, with a district accountant in charge, and will handle its own credit and collection matters under the direction of a division credit manager. A division personnel supervisor will be responsible to the division manager for the personnel in the division, and will have charge of all employment, promotions, changes in positions, dismissals and other personnel activities. Matters concerning sales promotional work and records, sales policy, conformity with the Marketing Code, reciprocal business, advertising, lectures, prices, survey, Code inquiries and differentials will be cleared through a division sales promotion supervisor.

In each division, also will be a fuel oil supervisor, who will devote his entire attention to developing and expanding fuel oil sales, and an asphalt and road oil sales supervisor, with the same responsibility with respect to these products.

Construction, maintenance and operation of the company's plants will be under the direction of a division engineer. A division automotive superintendent will be responsible for the proper operation of the company's rolling equipment. While co-operating with the division manager, the division engineer and division automotive superintendent report to E. Powers, manager properties and facilities.

A division station inspector, who will check the operation of marketing station plants and facilities, completes the division administrative organization.

The sales districts of the three divisions, including their respective marketing stations, are listed below:

NORTHERN

Alaska.....J. E. Boyle, D.S.M.
Chatham, Craig, Hoonah, Ketchikan, Noyes Island, Petersburg, Sitka, Wrangell, Port Alexander, Juneau.

Bellingham, Wash.....J. H. Gloor, D.S.M.
Coupeville, Arlington, Blain, Lynden, Orcas, Friday Harbor, Anacortes, Mt. Vernon, Sedro Woolley, Bellingham, Deming.

Bremerton, Wash.....C. B. Evjen, D.S.M.
Poulsbo, Port Townsend, Sequim, Hoodsport, Neah Bay, Shelton, Bremerton, Gig Harbor, Port Angeles, Mora.

Colfax, Wash.....O. H. Jameson, D.S.M.
Garfield, Rosalia, Tekoa, St. John, La Crosse, Pullman, Moscow, Pomeroy, Lewiston, Washtucna, Ritzville, Colfax.

Kelso, Wash.....C. L. Brown, D.S.M.
Winlock, Woodland, St. Helens, Clatskanie, Astoria, Ilwaco, Kelso, Stevenson, Tillamook, Vancouver, Wn.

Medford, Ore.....G. W. Keith, D.S.M.
Ashland, Chiloquin, Coquille, Drain, Glendale, Grants Pass, Klamath Falls, Marshfield, Medford, Merrill, Myrtle Point, Reedsport, Riddle, Roseburg, Sutherlin.

Olympia, Wash.....H. L. Painter, D.S.M.
McKenna, Eatonville, Morton, Tenino, Centralia, Raymond, Hoquiam, Copalis Crossing, Westport, Montesano, Elma, Olympia.

Portland, Ore.....C. S. Myer, D.S.M.
Gresham, Estacada, Kenton, Kendall, McMinnville, Willamina, Newberg, Cornelius, Beaverton, Canby, Woodburn, Portland.

Salem, Ore.....P. H. Schnell, D.S.M.
Dallas, Independence, West Stayton, Lebanon, Albany, Corvallis, Toledo, Silverton, Brownsville, Newport Fish, Salem, Cottage Grove, Eugene, Junction City.

Seattle, Wash.....J. Federspiel, D.S.M.
Renton, Ballard, Kirkland, Everett, Monroe, Snoqualmie, Redmond, Edmonds, Seattle, Edmonds Storage.

Spokane, Wash.....O. Berg, D.S.M.
Chewelah, Newport, Colville, Northport, Cheney, Reardan, Sprague, Couer D'Alene, Davenport, Creston, Spokane.

Tacoma, Wash.....C. B. Mallory, D.S.M.
Puyallup, Auburn, Enumclaw, Tacoma.

The Dalles, Ore.....C. W. Endicott, D.S.M.
Condon, Arlington, Goldendale, Wasco, Grass Valley, Maupin, Madras, Bend, Burns, Prineville, Redmond, Hood River, Bingen, The Dalles.

Walla Walla, Wash...H. E. Golding, D.S.M.
Waitsburg, Dayton, Athena, Pendleton, La Grande, Baker, Ontario, Hermiston, Heppner, Walla Walla.

Wenatchee, Wash...H. F. McDowell, D.S.M.
Waterville, Cashmere, Chelan, Pateros, Republic, Twisp, Omak, Oroville, Odessa, Coulee City, Ephrata, Wenatchee, Almira.

Yakima, Wash.....S. E. Atkins, D.S.M.
Toppenish, Sunnyside, Prosser, Connell, White Bluffs, Naches, Ellensburg, Cle Elum, Pasco, Lind, Yakima.

CENTRAL

Bakersfield, Calif.....P. C. Weston, D.S.M.
Bakersfield, Lindsay, Tulare, Corcoran, Angiola, Porterville, Ducor, Delano, Wasco, Taft, McKittrick, Arvin.

Sacramento.....H. L. Blevans, D.S.M.
Sacramento, Roseville, Auburn, Grass Valley, Placerville, Elk Grove, Clarksburg, East Nicolaus, Walnut Grove, Rio Vista.

Chico.....P. H. Goodwin, D.S.M.
Chico, Redding, Alturas, Red Bluff, Corning, Orland, Willows, Richvale, Oroville, Live Oak, Gridley, Marysville, Yreka, Grenada, Weed, Dunsmuir, Anderson.

District Sales Managers of Northern Division

C. S. MYER
Portland

O. BERG
Spokane

C. B. MALLORY
Tacoma

J. FEDERSPIEL
Seattle

S. E. ATKINS
Yakima

C. B. EVJEN
Bremerton

C. L. BROWN
Kelso

O. H. JAMESON
Colfax

J. E. BOYLE
Alaska

P. H. SCHNELL
Salem

H. E. GOLDING
Walla Walla

H. F. McDOWELL
Wenatchee

C. W. ENDICOTT
The Dalles

H. L. PAINTER
Olympia

J. H. GLOOR
Bellingham

G. W. KEITH
Medford

Eureka.....**A. E. Teaderman, D.S.M.**
Eureka, Fortuna, Crescent City.

Fresno.....**O. I. Wooldridge, D.S.M.**
Fresno, Biola, Clovis, Sanger, Reedley, Orange Cove, Dinuba, Kingsburg, Riverdale, Fowler, Raisin City, Coalinga, Hanford, Lemon Cove, Visalia.

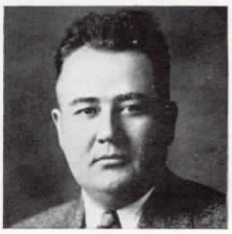
Merced.....**M. H. White, D.S.M.**
Merced, Livingston, Newman, Mariposa, Turlock, Le Grand, Chowchilla, Madera, Los Banos, Firebaugh.

Oakland.....**O. J. Maguire, D.S.M.**
Oakland, Hayward, Alameda, Livermore, Centerville, Oleum, Walnut Creek, Pittsburg, Concord.

Reno, Nevada.....**J. Noviack, D.S.M.**
Reno, Truckee, Susanville, Quincy, Min-

District Sales Managers of Central Division

H. L. BLEVANS
Sacramento



O. I. WOOLDRIDGE
Fresno

F. C. BARR
San Jose

O. J. MAGUIRE
Oakland

M. H. WHITE
Merced

E. A. BISHOP
Stockton

J. NOVIACK
Reno

P. C. WESTON
Bakersfield

E. G. COOPMAN
Woodland

A. E. TEADERMAN
Eureka

J. S. GOODALE
Santa Rosa

P. H. GOODWIN
Chico

den, Yerington, Tonopah, Fallon, East Ely, Winnemucca, Battle Mountain, Elko, Wells.

San Francisco.....**G. W. Schattner, D.S.M.**
San Francisco, So. San Francisco.

San Jose.....**F. C. Barr, D.S.M.**
San Jose, Redwood City, Santa Cruz, Gilroy, Watsonville, Hollister, Salinas, Monterey, Soledad, King City, Paso Robles.

Santa Rosa.....**J. S. Goodale, D.S.M.**
Santa Rosa, Napa, Calistoga, Lower Lake, Lakeport, San Rafael, Sebastopol, Geyserville, Ukiah, Willets, Fort Bragg, Petaluma.

Stockton.....**E. A. Bishop**
Stockton, Lodi, Ione, Westley, Sonora, Byron, Tracy, Manteca, Linden, Farmington, Oakdale, Modesto.

Woodland.....**E. G. Coopman, D.S.M.**
Woodland, Knights Landing, Arbuckle, Colusa, Princeton, Williams, Esparto, Suisun, Winters, Vacaville, Dixon.

G. W. SCHATTNER
San Francisco D. S. M

SOUTHERN

Burbank.....**N. R. Benedict, D.S.M.**
Burbank, Glendale, Canoga Park, Lancaster, Laws, Lone Pine, Mojave, Mono Lake, Newhall, Palmdale, San Fernando, Van Nuys.

El Centro.....**E. F. Smith, D.S.M.**
Brawley, Calexico, Calipatria, El Centro, Holtville, Jacumba, Packard.

Long Beach.....**H. H. Ramsay, D.S.M.**
Hawthorne, Huntington Park, Long Beach, Watts, Wilmington, San Pedro

District Sales Managers of Southern Division

C. C. IRELAND
Los Angeles

E. W. BREWSTER
Phoenix

H. H. RAMSAY
Long Beach

A. R. RICHARDSON
Santa Barbara

J. D. NESBITT
San Diego

H. F. ARMOUR
Pasadena

E. F. SMITH
El Centro

H. K. HOUGHAM
Santa Ana

K. W. TOWER
Riverside

N. R. BENEDICT
Burbank

Marine, Long Beach Marine, Fish Harbor, Hyde Park.

Los Angeles.....**C. C. Ireland, D.S.M.**
Los Angeles, Culver City, Hollywood, Santa Monica.

Pasadena.....**H. F. Armour, D.S.M.**
Alhambra, Covina, Cucamonga, El Monte, Monrovia, Ontario, Pasadena, Pomona.

Phoenix, Ariz.....**E. W. Brewster, D.S.M.**
Beardsley, Buckeye, Casa Grande, Clarkdale, Flagstaff, Globe, Holbrook, Kingman, Litchfield, Mesa, Miami, Nogales, Prescott, Sentinel, Superior, Tombstone, Tucson, Williams, Winslow, Phoenix, Yuma, McNary.

Riverside.....**K. W. Tower, D.S.M.**
Barstow, Corona, Elsinore, Hemet, Needles, Perris, Redlands, Riverside, San Bernardino, Victorville, Windmill, Boulder City, Las Vegas, Beatty, Beaumont, Blythe, Coachella, Desert Center, Palm Springs, Rice.

San Diego.....**J. D. Nesbitt, D.S.M.**
Baja California, Mexico; San Diego, Chula Vista, Coronado, Escondido, Fallbrook, Lakeside, Oceanside, Ramona, Solano Beach, Spring Valley.

Santa Ana.....**H. K. Hougham, D.S.M.**
Anaheim, Belvedere Gardens, Brea, Huntington Beach, Irvine, Norwalk, Santa Ana, Serra, Stanton. Whittier.

Santa Barbara....**A. R. Richardson, D.S.M.**
Arroyo Grande, Camarillo, Cambria, Fillmore, Lompoc, Los Olivos, Moorpark, Ojai, Oxnard, San Luis Obispo, Santa Barbara, Santa Maria, Santa Paula, Ventura.

Arizona Citrus Farming Project Proves Merit

Arizona Sweet Grapefruit Growers, Ltd., formerly the Arizona Co-operative Grapefruit Farms, Ltd., of Peoria, Ariz., in the past five years has converted a veritable desert area of 1000 acres, supporting only greaswood, palo verde and mesquite, into cultivated farm land that during the season just terminated harvested the first large crop of "Ariz-Sweet" brand grapefruit.

Literally and figuratively the land which during the past five years has been nurtured and watered with the utmost care, is now bearing fruit. An elaborate nursery required most of the effort during the first two years. These trees, transplanted to the orchard, bore their first crop last year, have grown to full size, and are ready for "bumper" production.

To an appreciable degree the success of the venture has been due to irrigation facilities not previously available and the care and watchfulness exercised by the management in properly packing and canning the fruit. Under the direction of Byron J. Showers, manager, equipment necessary for cultivation, irrigation, fertilization, replacements, and orchard training work was secured and utilized to the fullest advantage. Operation costs have been kept at a minimum.

The initial crop was disposed of at a profit. It is expected that the coming crop will approximate 15,000 boxes, and equipfent for properly packing and canning the fruit is already being purchased and installed. One of the first consignments went to the Fred Harvey System, well known Santa Fe railroad food dispensing unit, where the fruit was pronounced excellent

The picture at the right was taken in 1929 and shows grapefruit trees in early stages of growth, and in the middle below, the same trees bearing fruit early last year. The The lower left photograph shows "Ariz-Sweet" grapefruit ready for the market, and right, tractor cutting nine-foot path between row of trees during cultivation work.

and an order placed for 25 boxes each week.

Since inception of the cooperative venture, Union Oil products have been exclusively used. Twelve cars and trucks and five tractors are included among the equipment operated by the company. Said Mr. Showers, manager: " . . . we use only the best of Union Oil products. The practice of using the best oils and greases is not a hobby of the management, but the result of many carefully organized experiments wherein we compared the efficiency of Union products with other brands. We are much pleased with Union's newly developed extreme pressure lubricants, and are using the various grades in our equipment. . . . We believe oil and grease are cheaper than steel."

A. H. Hand Elected Assistant Comptroller

J. M. HANNAY
Retires

A. H. HAND
Promoted

A. H. HAND, for the past three years assistant to the comptroller, was elected assistant comptroller by the Board of Directors, at the January 8 meeting, to fill the vacancy created by the retirement of J. M. Hannay.

Mr. Hannay came to the company in July, 1911, after having previously been engaged in the citrus industry in Southern California and as secretary-treasurer of an eastern steamship company. Until 1922 he filled various positions in the disbursements division of the company, and in August of that year was appointed auditor of disbursements. He was elected assistant comptroller four years later.

Mr. Hand entered the company's service the same year as Mr. Hannay in the Los Angeles district office, and holds the distinction of being one of the company's youngest 20-year service men. He filled many assignments within the Comptroller's department until 1924, when he was appointed assistant to auditors. In 1926 he was elevated to the post of chief of general accounts, and two years later became auditor of the division. March, 1931, he was promoted to the position he occupied until his election as assistant comptroller.

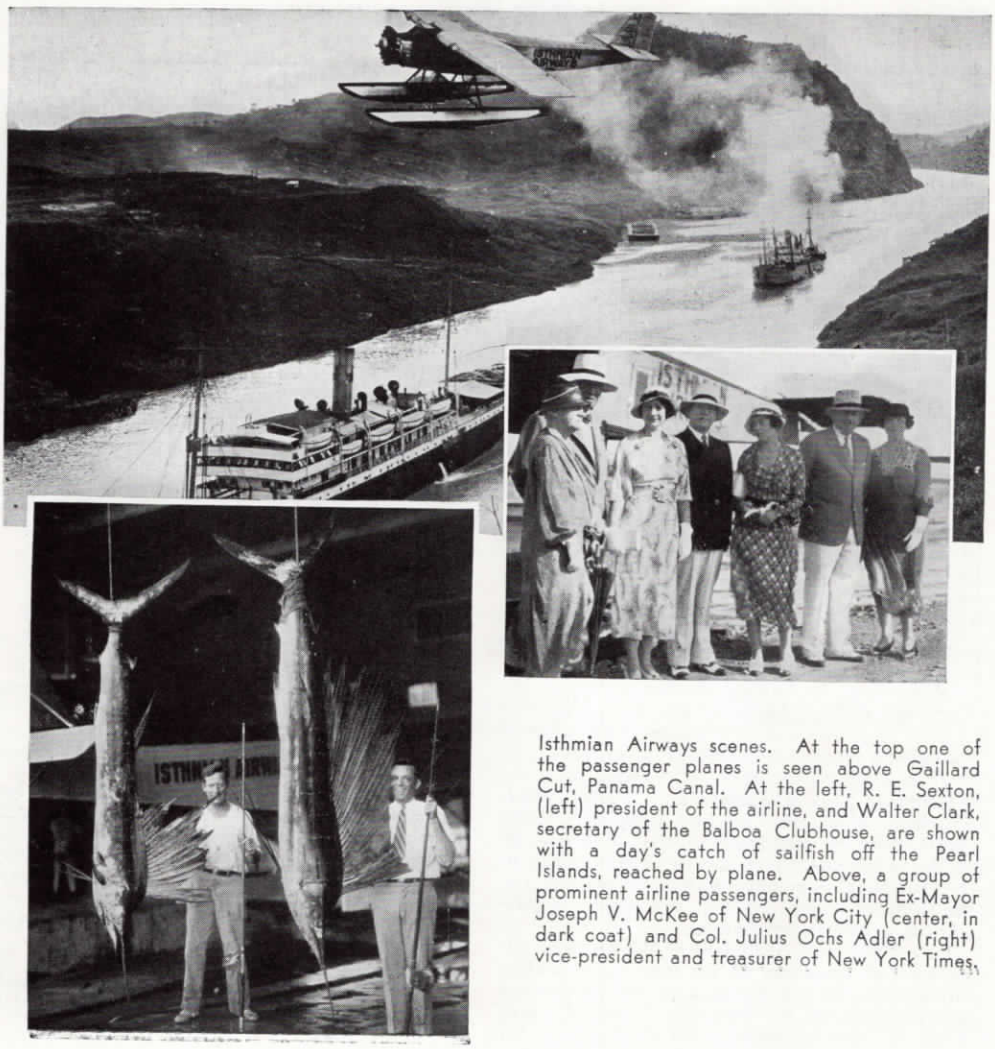
Last Quarter Dividend

A dividend of 25 cents for the last quarter of 1933, payable February 10 to stockholders of record January 18, was declared at the January 8 meeting of the Board of Directors.

Spanning a Continent in 27 Minutes

A UNIQUE air service is operated between the Atlantic and Pacific oceans over United States controlled territory in the Canal Zone at Panama by the Isthmian Airways, Incorporated. This company, operating five all-metal Hamilton sea planes, with observation cabin accommodations for eight passengers, and two Travelair two-place planes, directs its efforts principally to the transportation of passengers between terminals of the Panama Canal at Cristobal and Balboa. Three regularly scheduled flights are made each way daily, with as many additional flights as may be necessary to accommodate tourist parties and other Canal visitors. Many days during the tourist season all available equipment is in the air.

In addition to the trans-isthmian flights, this company will arrange, on short notice, trips to the interesting San Blas Indian islands on the Atlantic coast, where Indians



Isthmian Airways scenes. At the top one of the passenger planes is seen above Gaillard Cut, Panama Canal. At the left, R. E. Sexton, (left) president of the airline, and Walter Clark, secretary of the Balboa Clubhouse, are shown with a day's catch of sailfish off the Pearl Islands, reached by plane. Above, a group of prominent airline passengers, including Ex-Mayor Joseph V. McKee of New York City (center, in dark coat) and Col. Julius Ochs Adler (right) vice-president and treasurer of New York Times.

of a peculiar type are living in a primitive state similar to customs followed by them hundreds of years ago. Short trips are also arranged to the harbor of Porto Bello, rich in old Spanish history and ruins of the old Spanish forts.

Isthmian Airways are building, in conjunction with the Pacific Sailfish Club, a clubhouse and fishing headquarters on Trapiche Island of the Pearl Island group, about fifty miles from the Pacific entrance of the Panama Canal. Their airplane service will be made available to this clubhouse whenever desired. The waters surrounding the Pearl Islands have become famous for the number of large sailfish and marlin. During the present season, fifty-two sailfish more than ten feet long, and two marlin swordfish, weighing more than three hundred pounds, each, have been caught in these waters.

Since the inauguration of its service in May, 1929, the Isthmian Airways have carried more than 31,000 passengers, flown its planes more than 600,000 miles, and completed 9,000 flights successfully. This splendid record has been made while using Union Aviation products exclusively. So well pleased has Isthmian Airways been with Union Aviation products that a branch warehouse has been erected for the storage of these products adjacent to its hangar at Balboa.

Pay Tribute to 30-Year Men

Northern Division field and pipe line employees gathered at Orcutt to honor two men from the group who had completed thirty years' service with the company.

Above, left to right, J. B. Thompson and W. A. Ferguson, both of whom entered thirty year service ranks in October, and F. F. Hill, director of production, who will have been with the company thirty-five years in July of this year.

Honoring J. B. Thompson and W. A. Ferguson, both of whom had just completed thirty years' service, employees of the northern division, with more than twenty years' spent in the company's employ, gathered recently on the Newlove lease, Orcutt, to reminisce and partake of a barbecued dinner.

Lafe Todd, superintendent of the northern division, was chairman of the meeting and after commenting on the purpose of the assemblage and pointing out the fact that of the 185 men in the division, all had served the company for more than 10 years, and 47 had been working under the Union banner for more than 20 years, introduced the real old-timers. Among them were F. F. Hill, director of production, who from point of service was the oldest man present; and Ferguson and Thompson, both of whom spoke briefly on their thirty years with the company.

Fred M. Penter, manager gas operations in the northern division, cheffed the barbecue and, according to everyone present, did a swell job of it.

30 Years

J. B. Thompson

C. M. Piatt

W. A. Ferguson

Service Emblem Awards

25 Years

J. W. Steele

G. P. Grim

F. M. Woodward

I. L. Wayne

THREE decades ago October, 1933, W. A. Ferguson, J. B. Thompson, and C. M. Piatt went to work for the Union Oil Company in the field department, Ferguson in the Coast area and Thompson and Piatt in the Los Angeles Basin fields.

In October, Ira L. Wayne rounded out a quarter of a century of service with the company, and Harry L. Bowlen, J. L. Horvat, J. A. Murphy, G. E. Pyle, and R. H. Supler each completed twenty years continuous activity on the Union payrolls.

W. A. Ferguson is one of the original pipeliners in the Santa Maria field, having entered the company's service October 17, 1903. He served in the pipe line gang and as field gauger during the flush production period of the Santa Maria field. In 1913 he went into the laboratory at Orcutt as oil tester, in which capacity he worked until three years ago when he was transferred to the plant dehydrator as operator and relief gauger. September, 1933, he was moved back to the laboratory as assistant gauger.

The thirty years contributed by J. B. Thompson have all been spent in the southern division field. His first job with the company was as pumper at Brea canyon. For three years he served at Norwalk station, and was then transferred to Orcutt, in which location he has filled various capacities during the past 25 years.

Brea canyon was also the first location where C. M. Piatt worked for the company, gaining employment there through F. F. Hill, now director of production. In reminiscing about the early days, Piatt recalls some of the "busts" he, like all novices, made. He remembers when he threw a pair of lay tongs around his neck,

20 Years

J. L. Horvat

M. H. White

W. H. Watkins

Viola Agnes Day

J. A. Murphy

H. B. Amidon

A. G. Page

H. F. Black

C. G. Tornquist

H. L. Bowlen

H. J. Brownfield

G. E. Pyle

picked up a string of fittings, grabbed the dinner pail and started for work. If it was too far the crew was sent in a wagon and occasionally reached the job by 10 or 11 o'clock. In those days gasoline was made by heating it and cooling it in coils. The first gas trap was built by running pipe up the hillside. Later the pipe was run to the top of the derrick with a goose neck and the gas saved. Piatt went to Lompoc in 1904, served awhile at Orcutt, and then was transferred back to Brea and Stearns lease. He is at present gas engine mechanic in the field.

After ten years work in eastern oil fields, Ira L. Wayne came to California in 1907 and went to work for the company that year, his first job being on the pipeline from Orcutt to Avila. He later was occupied on the line from Harris station to the Newlove lease, and then from Bell

station into Orcutt. He helped in construction of the Bell station and has been employed at that location since the first oil was pumped through it in 1909.

Harry Bowlen, who joined with the company October 23, 1913, as relief pumper at the Portsmouth plant, served for three years at the marine terminal. In 1916 he was transferred to the sales department, in which he has served, successively and successfully as city salesman, agent at Astoria and other localities, service station superintendent, and stock clerk at Willbridge plant.

Employed as a laborer at Oleum refinery, J. L. Horvat soon entered the packing department, where he worked until joining the army in 1917. Upon his return from service abroad, Horvat re-entered the packing department. He now rates the standing of first-class aceteylene welder, dividing his time between that work and activity in the drum repair shop.

Shipping clerk at Portland was the first job John Murphy held with the company. He became plant foreman in 1918, and after a serious illness, was transferred to the garage, from where, in 1923, he was shifted back to the plant. At present he is in charge of the storeroom at the Willbridge plant.

Guy Pyle's employment actually began in 1910, but due to a brief period during which he was out of company service, his employment record dates from October 10, 1913. On that date he accepted the position of foreman of pipe work at the compressor plant on the Dome lease, Orcutt field. Since 1922 he has served in the capacity of foreman of construction crews in the gas and construction departments of the southern division.

The southern division of the field department has been the locale for all activity with the company by Robert Supler. He has worked as roustabout, electrician's helper, rotary helper, driller, and drilling foreman at various times in virtually every field included in the Los Angeles basin area.

In the month of November, James W. Steele and Fred M. Woodward, both now employed in the field department, southern division, completed a quarter-century of service with the company. Henry F. Black and A. G. Page both finished twenty-year service records during the same period.

Jimmie Steele went to work for the company on the Los Angeles Pipe Line November 29, 1908. Within a year he was transferred to the field department as repairman and pumper. He served for a time on the Stearns lease, went to Taft, Calif., to install gas engines, and then returned to the southern division. He is at present in charge of production at Montebello field.

Employed as tool dresser in the Orcutt November 26, 1908, Fred Woodward was soon promoted to driller. In 1922 he was moved to Brea in the southern division. He worked in the division as driller until 1931, at which time he was transferred to the production department, on the Stearns lease, where he is now stationed.

Henry F. Black, foreman, Oleum refinery, first went to work for the company in the car gang. He became a fireman at the asphalt stills in 1916, was promoted to asphalt stillman in 1918, and head asphalt stillman in 1921. He succeeded Homer Ambrosier, now superintendent, Bakersfield refinery, as Oleum refinery foreman in 1926.

A. G. Page, advisor to the director of manufacturing, came to the company November 26, 1913, and was employed at Oleum refinery as chemist. Within two years he was appointed to the post of assistant superintendent at Oleum, and later was elevated to the post of superintendent. In 1920 he was made manager of refineries, in which position he served until chosen for the post of consultant and advisor to director of manufacturing. In this capacity Page advises with W. L. Stewart, Jr., on all new processes to be undertaken and developed. Page was the company's representative sent to Germany in July, 1930, along with members from the technical staffs of 16 other major oil companies, to study the hydrogenation process developed there jointly by Standard Oil Company of New Jersey and I. G. Farbenindustrie Aktiengsellschaft.

Four days before Christmas, in 1908, George P. Grim, field department employee, came into the service of the company. His first job was as roustabout on the Stearns lease. Experience gained in Pennsylvania fields enabled him to soon secure the position of rigger-up man, and then he became combination driller. For fifteen years he was drilling foreman on the Stearns lease, during which time he supervised the drilling of a large number of successful wells. For the past two years he has been occupied in the production department of the same lease.

December saw the completion of twenty years service by H. B. Amidon, H. J. Brownfield, Viola Agnes Day, F. H. Robinson, Jr., W. H. Watkin, M. H. White, and C. G. Tornquist.

Howard Amidon was employed as assistant purchasing agent, San Francisco, at the time when southern and northern purchasing offices were maintained. He worked as assistant purchasing agent for the central territory from 1916 to 1924, when, under the supervision of H. C. Farquhar, manager of purchases, he was made district purchasing agent.

While H. J. Brownfield's period of continuous service dates from 1913, he actually first served the company in 1900 on Stearns No. 1 well. He worked as pumper, tool dresser, and driller at intervals until 1908, when he left the employ of the company. He returned in 1913 as driller in the Brea field, where he remained until 1931. Since that date he has worked in the production department at Montebello.

To Viola Agnes Day goes the distinction of being one of few women who have served the company for twenty years or more. Miss Day went to work under the late W. C. Trew as voucher clerk and general stenographer in the Portland office. Office personnel at the time consisted of but sixteen persons and there were only 6 substations. Her work is now confined to the credit department and is specialized, as

contrasted to the general type of duties she performed before the Portland office became so large.

Teamster at Orcutt was the first job Carl Tornquist had with the company. He worked through various capacities in the field until 1920 when he went on as part-time driller. Going to Huntington Beach as driller in 1922, he has worked in that capacity at southern division fields for the past 12 years.

Pumper on the Fox lease, Santa Maria field, was the capacity in which W. H. Watkins went to work with the company. Watkins, after serving in the world war, returned to the field as foreman in charge of camps and water systems. Since May 1, 1929, he has held the position of foreman of the coast district.

The Potrero plant, San Francisco, was where Murray White went to work for the company as truck driver. He has served successively as agent at Napa, city salesman in San Francisco, service station superintendent for 7 years, jobbing representative, and was then transferred to Oakland district and made agent at Hayward. He worked as agent at Bakersfield for a short time. He is now special agent in the Oakland district.

Fifteen Years—October

Allen, Chas. A.....Mfg., Los Angeles Ref.
Bravo, Ralph E.....Sales, Head Office
Dixon, Sarah E.....Comptrollers, Head Office
Globe, Michael.....Sales, South America
Linsdell, Ethel A.....Mfg., Head Office
Mackie, James G.....Sales, Head Office
Manley, Frances S.....Comptrollers, Head Office
Smith, Frank G.....Sales, San Diego
Soto, Ross E.....Pipe Line, No. Div.
Stamm, C. H.....Mfg., Oleum Refinery
Stemmle, J. W.....Mfg., Oleum Refinery
Stillman, W. H.....Sales, Spokane
Stowell, Harry B.....Mfg., Oleum Refinery
Youngberg, Karl H.....Marine, "SS" Oleum

Ten Years—October

Davis, Catherine.....Sales, Sacramento
Fitzgerald, G. R.....Mfg., Oleum Refinery
Joki, John F.....Marine, "SS" Warwick
Juhl, Ada E.....Gas, Southern Division
Leao, Jose T.....Mfg., Oleum Refinery
McGarigle, R. S.....Automotive, No. Div. Garage
Mabry, Wm. R.....Mfg., Oleum Refinery
Nicholls, Thos.....Mfg., Los Angeles, Ref.
Slate, Harold.....Mfg., Oleum Refinery
Sumner, George A.....Pipe Line, No. Div.
Uyeda, Gunpei.....Sales, Honolulu
Vardaman, Wayne L.....Sales, Phoenix

Fifteen Years—November

Blanchard, Jos. E.....Field, So. Div.
Campbell, H. P.....Sales, San Francisco
Cosbie, Ruth M.....Purch., San Francisco
Pyle, Ford.....Gas, Southern Division
Wagnon, C. R.....Field, Northern Division

Ten Years—November

Ashton, H. B.....Sales, San Francisco
Blackwood, William.....Mfg., Oleum Refinery
Cave, Arnold S.....Mfg., Los Angeles Ref.
Forquer, Arthur.....Field, Southern Division
Gibbs, Edward M.....Mfg., Los Angeles Ref.
Grainger, Rolla.....Pipe Line, No. Div.
Hasund, John.....S.S. "Warwick"
Keans, Harold F.....Gas, Southern Division
Maddy, Merle.....Mfg., Los Angeles Ref.
Mortizia, N. G.....Mfg., Oleum Refinery
Sneddon, Richard.....Transj., Head Office
Vanderburgh, A. E.....Sales, Fresno
Vogt, Florence.....Bldg., Union Oil Building

Fifteen Years—December

Cline, Julia.....Sales, Portland
Davis, Chester A.....Field, No. Div.
Eldred, Allen H.....Sales, Fresno
Graves, H. D., Jr.....Field, Southern Division
Groehler, Fred P.....Field, Southern Division
Green, L. L.....Compt., Northern Division
Haynes, Homer C.....Pipe Line, No. Div.
Koon, Norman F.....Field, Southern Division
Lange, Elvina S.....Sales, Head Office
Lorenzen, J. T.....Sales, Oakland
Martin, John.....Pipe Line, No. Div.
Towle, Fred C.....Sales, Sacramento

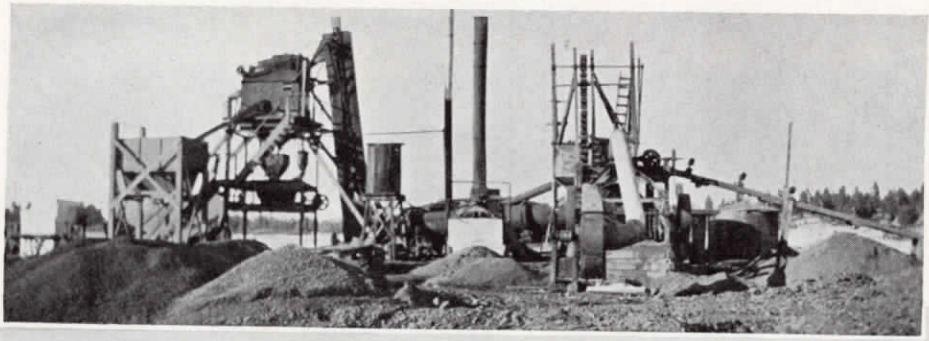
Ten Years—December

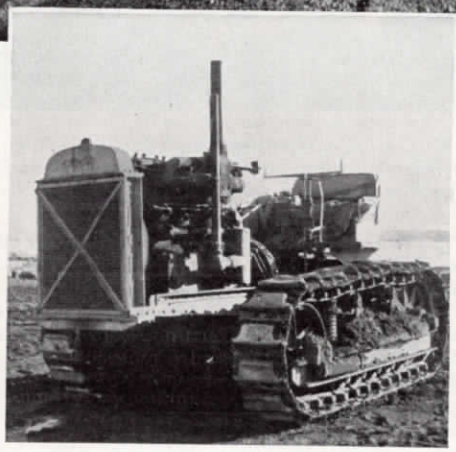
Hall, Richard F.....Sales, Los Angees
Jackson, W. H.....Mfg., Research
Kirkpatrick, Elmo.....Sales, Portland
Meyers, Walter E.....Sales, Los Angeles
Pate, Bonnie B.....Mfg., Head Office
Ray, John R.....Mfg., Los Angeles Ref.
Roy, Melvin.....Field, Southern Division
Robertson, John L.....Mfg., Los Angeles Ref.
Robertson, R. W.....Sales, Portland
Swain, Calmar A.....Marine, "La Purisima"
Swearington, Bert.....Mfg., Los Angeles Ref.

Tanker Carries Potato Cargo

Co-operating with the Brea Unemployed Association, the Union Oil Company recently transported 54,000 pounds of potatoes by tanker from Stockton to its marine terminal at Wilmington, where they were loaded on Lacey Truck Company trucks. The potatoes were donated by the Stockton Potato Growers Association and placed aboard the M. S. Redline at Stockton for delivery to Oleum where they were transferred to the S. S. Utacarbon. Approximately 300 families in Orange County participated in the distribution of the cargo.

Where New Section of U. S. 66 Crosses Arizona Divide





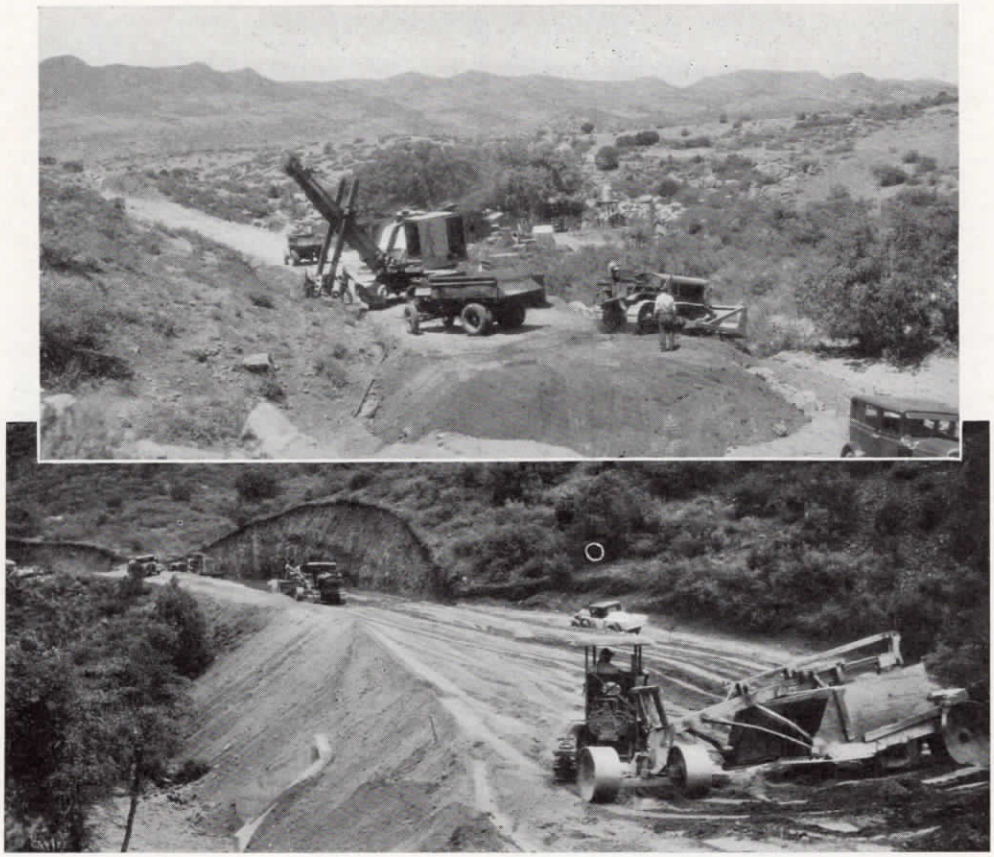
New Mexico Construction Company, the petroleum products for which are supplied by Union Oil Company from the Williams, Ariz., substation, is now building at a cost of $128,000, a section of highway on U. S. Highway between Flagstaff and Williams, Ariz.

The job begins at camp "49" and goes up over the Arizona divide, the elevation of which is 79000 feet. The job terminates in the Flagstaff city limits.

Gold Field Dredger

Located at Stanfield Hill, 25 miles east of Marysville, a famous gold mining region, this dredger, built by H. G. Kumle, handles 3500 tons of gold-bearing gravel in 24 hours. Its operating crew consists of 15 men. Union oils and greases fill its lubrication requirements.

U. S. Highway No. 60 Extended



Sections of the 42-mile Globe to Salt River length of U. S. Highway 60 recently completed. The top picture shows L. E. Dixon Company equipment filling-in a short stretch of the highway, and, below, large fresnos at work on another section of the road.

A 42-mile stretch of highway extending from Globe, Ariz., north to Salt River was completed during the middle fall of 1933 and added to U. S. Highway No. 60. The entire section is now being maintained by the state and is in excellent shape.

The 42-mile length was built in four sections, identified as A, B, C, and D. Expenditures to date for construction are in excess of $1,250,000. Section A, extending 10 miles south from Salt River was the most difficult part of the job, it being necessary for C. G. Willis and Sons, contractor, to build round-about roads over rough mountain trails to the working areas.

Sections B, C, and D were built under contract by L. E. Dixon Company. The entire section represents some of the heaviest road construction work done in the state, the line demanding cuts as deep as 100 feet and fills 50 feet deep and as much as 500 feet long. Grades on the finished highway do not exceed 6 per cent and no curve is sharper than 6 degrees. The entire project was carried on under the supervision of R. C. Perkins, district highway engineer.

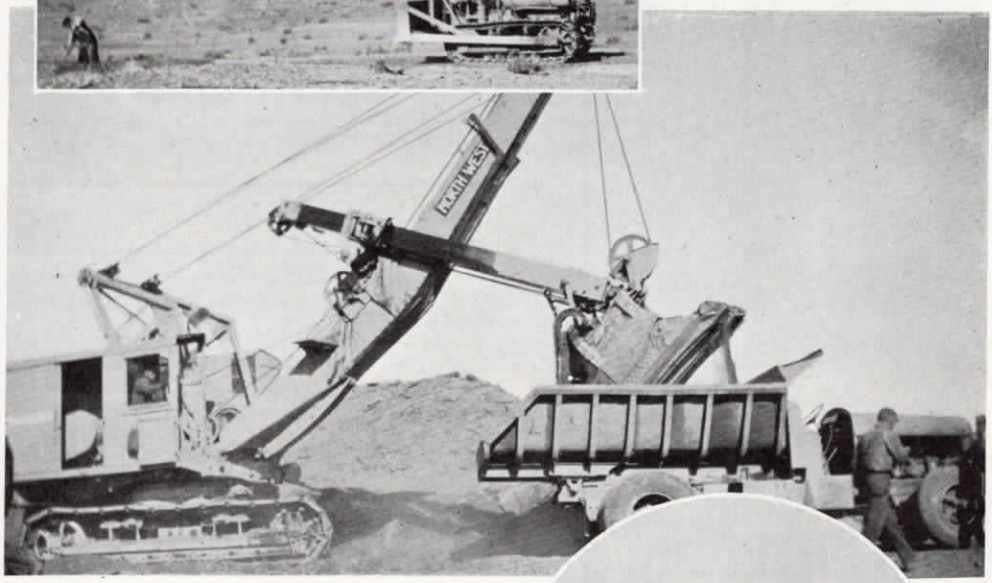
Both C. G. Willis and Sons and L. E. Dixon Company were serviced 100 per cent with Union Oil Company products during the construction of the 42 miles of highway.

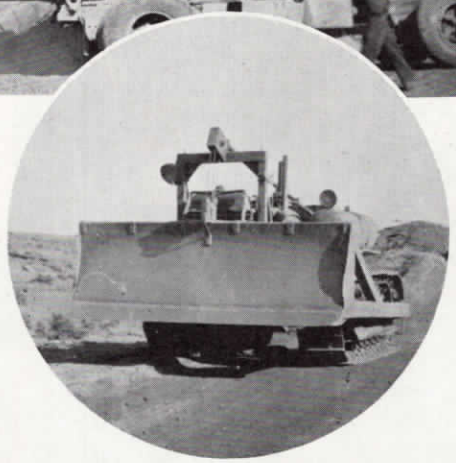
Crown Company Court Champs

Finals of the 1933 Union Oil Company tennis tournament found L. Spencer, Los Angeles refinery, and R. A. Nevens, head office, battling across the net, with Spencer finally winning out to receive the President's Cup for the second consecutive year. Spencer teamed with H. Cameron, also of the Wilmington plant, to win the men's doubles and the vice-president's cup.

Stella Fitchett defeated Dorothy Burr to walk off with first honors in the women's singles matches.

New Highway Approach To Grand Canyon National Park





At a cost of $216,866, Morrison-Knudson, large construction contractor, is building a long stretch of road on the Desert View-Cameron Highway approach to Grand Canyon National Park in Arizona. The contract for the job was awarded by the U. S. Bureau of Public Roads and will require approximately 10 months to complete. Petroleum product needs of Morrison-Knudsen Company are being supplied 100 per cent by Union Oil Company from its Williams substation.

Dunsmuir Airport

Just south of the picturesque Siskiyou mountains, 4 miles north of Dunsmuir on Pacific Highway No. 99, the board of supervisors of Siskiyou County are establishing an airport, which has grown from a landing field 250 feet wide and 1800 feet long, to an airport about twice that width and length, lighted by a beacon and border and field lights. It has added to the safety of planes crossing the Siskiyou range. The field is now under the direction of the Department of Commerce. Its development has been brought about through the cooperation of the Department of Commerce, State Chamber of Commerce, California, Oregon Power Co., and Dunsmuir Chamber of Commerce with the board of supervisors of Siskiyou County. Further work is to be done this year.

Girls' Club Dance

An interesting event of November was the dance given by the Union Oil Girls' Club at the Breakfast Club on Riverside Drive, in Los Angeles. This was the fifth of these dances which the girls have given, each of which has proven a great success. Approximately six hundred employees and their friends attended.

The dance committee consisted of the following: Helen Curran, general chairman; Elva Dawson, Esther Koch, Jane Milne, Estella Goeser, Belle Rugg, Mildred Radanovich, and Hazel Sober.

The Girls' Club was originally started by Miss Helen Curran of the Insurance and Personnel Department, Head Office, and is now in its sixth year.

Deer Creek Cut-off

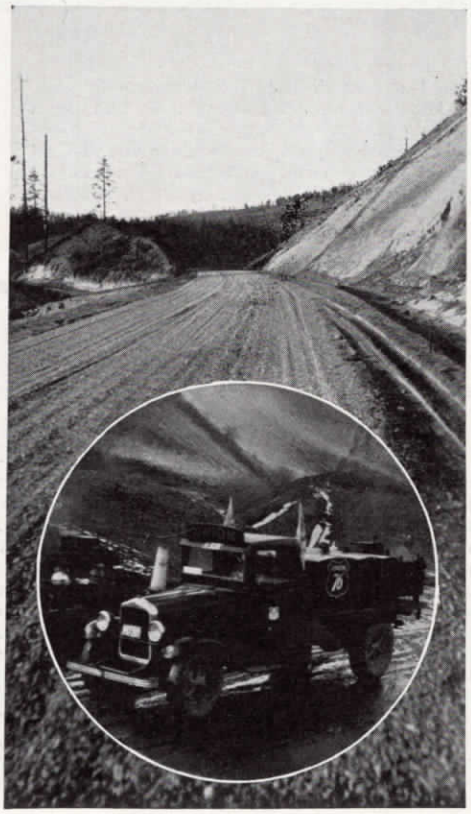
The top picture shows gas-operated shovel at work on Deer Creek Cut-off. Center picture shows shovel on another section of same roadbuilding project. Frank C. Cuffe, contractor for a portion of the new highway, left, and E. G. Flannigan, Union Oil represenative, are seen in the bottom photo.

Joining the Susanville State Highway and Chico, Calif., in the Lassen National Park, a new section of road identified as the Deer Creek Cut-off is now under construction and will open up 50 miles of virgin forest and many streams to vacationists and hunters.

The highway is being built in 6 sections under the direction of the U. S. Bureau of Public Roads. It will provide a short cut between San Joaquin valley and Sacramento valley points and Lassen National Park and Mount Shasta. Individual contractors are building the road. Sections C. and D., built by Frank C. Cuffe, have just been completed at a cost of $175,000. Union Oil Company products, including gasolines, lubricants, and greases, have been exclusively used by Cuffe in the two shovels, four tractors, air compressors, and dump trucks which he operated in finishing his units of the new road.

Eastern Washington Highways

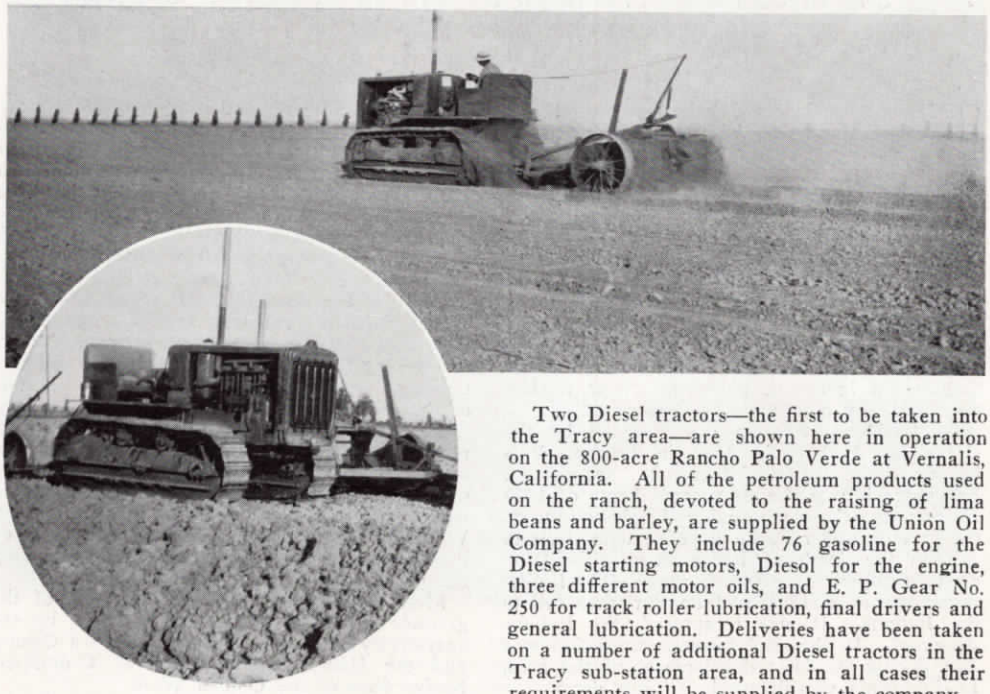
During 1933 Union products were used partially or 100 per cent on 15 Eastern Washington highway projects, two of which are represented in the photographs below. A view of a section of the state road between Williams and Onion Creek, a part of the improved highway between Spokane and Canada, is shown in the larger picture. In the inset is one of the company's trucks on the newly paved portion of the highway between Spokane and Pullman. The Norris Brothers were principal contractors on this 10-mile section on which Union products were used.



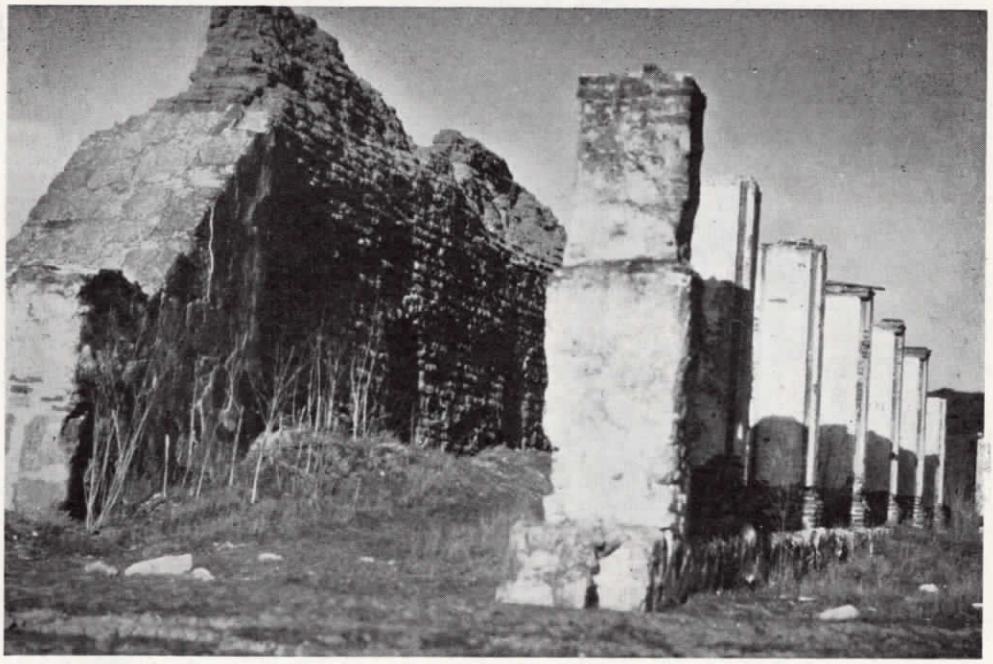
Fresno Office Employees Turn Salesmen

Proving that the office personnel could be turned into an emergency sales force, the Fresno district office in October conducted a sales drive in which 423 gallons of lubricating oil, 1,980 pounds of grease, 136 Wilco guns, 136 pints of Penetrating oil and 59 Solvidors were sold. Three teams participated, headed by Miss Frances Champion, J. E. Crawford and L. L. Lorimor. The latter's team won. Individual high points were scored by Lloyd Gleim, W. E. Davenport, then district manager and now Central Division operating manager; J. E. Crawford and Miss Champion, in the order named. Members of the office sales force are presented above.

Union Products Selected for Diesel Tractors



Two Diesel tractors—the first to be taken into the Tracy area—are shown here in operation on the 800-acre Rancho Palo Verde at Vernalis, California. All of the petroleum products used on the ranch, devoted to the raising of lima beans and barley, are supplied by the Union Oil Company. They include 76 gasoline for the Diesel starting motors, Diesol for the engine, three different motor oils, and E. P. Gear No. 250 for track roller lubrication, final drivers and general lubrication. Deliveries have been taken on a number of additional Diesel tractors in the Tracy sub-station area, and in all cases their requirements will be supplied by the company



Site of La Purissima Mission Deeded Santa Barbara County

THE La Purissima Mission—one of 12 in California which identify the period of the padres—which came into the possession of the Union Oil Company with the purchase of property in the Lompoc Valley nearly thirty years ago, has been deeded, along with all other ruins and grounds upon which they stand, to Santa Barbara County.

Through the joint efforts of R. M. Adam, supervisor fourth district, Santa Barbara County, and the Native Sons of the Golden West, the ruins are to be restored as far as is possible without incurring too great an expense, and the famous old landmark guarded against further destruction by man and the elements.

La Purissima Mission was founded by the Franciscan Fathers in 1788 in Lompoc Valley, northerly section of Santa Barbara county. For years it was the sequestered home of 1500 Indians, to whose material and spiritual needs the fathers, under Padre Payeras, administered.

With the death of Padre Payeras in 1823, the peaceful existence was disrupted. The Indian revolt spread in 1824, and La Purissima fell to the Indians. It was recaptured, the Indians dispersed. In the civil turmoil which followed and during the later development of the area, La Purissima was deserted, fell into decay.

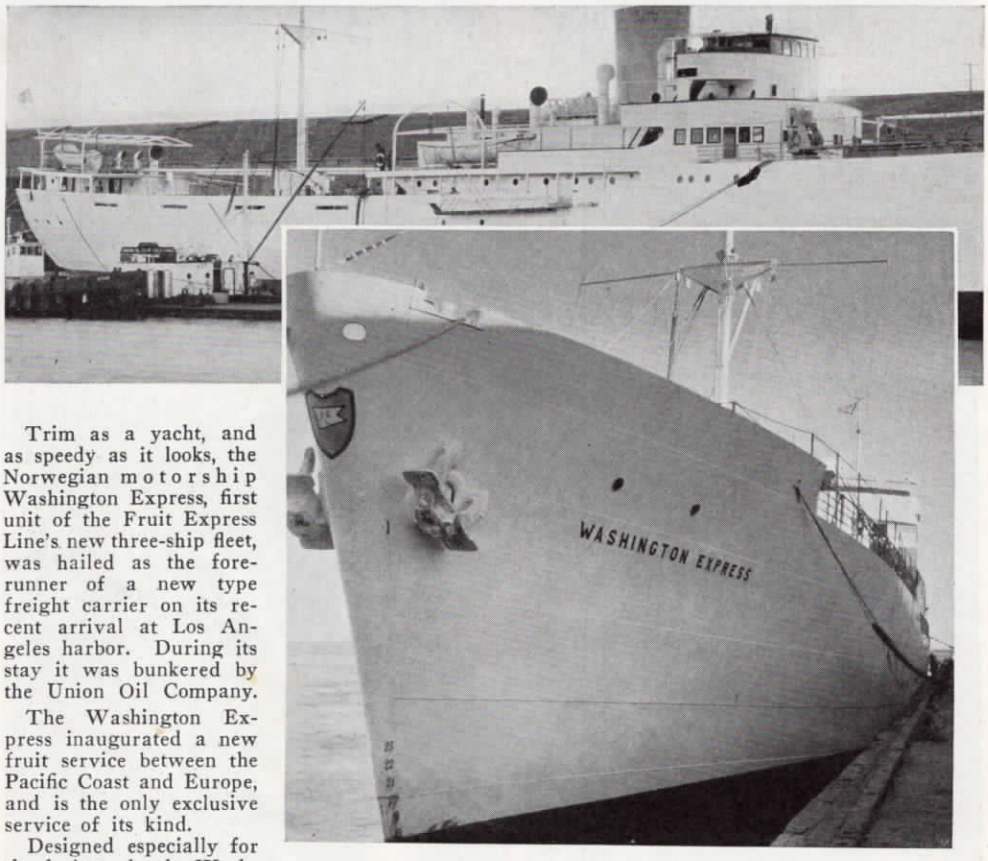
When the property and mission came into the hands of the company it was in deplorable condition. Being conscious of some responsibility for the preservation of the historic building, men under F. F. Hill, then superintendent for the company in the Lompoc Valley, gathered together and stored all loose tile from the roof. Sheeting was put up in spots to keep out rain and wind. Negotiations later opened with the California Landmarks Club resulted in the company deeding various pieces of property, the sites of the mission, church, cemetery, reservoir, and spring house, to the club upon the stipulation that $1500 be spent in repairing the roof of the mission.

The club was unable to obtain money for restoration work and the property and buildings after several years reverted to the possession of the company. When the Santa Barbara supervisors and Native Sons of the Golden West evidenced interest in the restoration of the Mission, arrangements were made to deed the property to them.

Minor repair work and rehabilitation of the grounds surrounding the mission will be cooperatively carried on by Santa Barbara County and the History and Landmarks Committee, Native Sons of the Golden West.

The Field Department, at Santa Fe Springs, wishing all who pass through this famous oil field, a cheery Christmas greeting. The erection of an ornamented tree on top of one of the company's Santa Fe Springs wells has become an annual custom. The tree is made out of two-inch pipe with branches of trees attached to complete the illusion of being a real product of the forest.

Norwegian Express Ship Built Like Racing Yacht



New Norwegian Motorship at Los Angeles Harbor

Trim as a yacht, and as speedy as it looks, the Norwegian motorship Washington Express, first unit of the Fruit Express Line's new three-ship fleet, was hailed as the forerunner of a new type freight carrier on its recent arrival at Los Angeles harbor. During its stay it was bunkered by the Union Oil Company.

The Washington Express inaugurated a new fruit service between the Pacific Coast and Europe, and is the only exclusive service of its kind.

Designed especially for the fruit trade, the Washington Express is 352 feet long, with a total of ten refrigerated compartments of 180,000 cubic feet, sufficient to carry 90,000 boxes of fresh fruits. Temperature in each compartment is controlled independently, permitting the separate stowage of varieties of fruit requiring different temperatures. Principal movements will be apples from the Northwest, apples and pears from Northern California and citrus fruits from Southern California.

As the new vessel is exclusively a fresh fruit carrier, the delivery of coast fruits to European markets will be greatly expedited by the elimination of general cargo ports. On her initial outbound voyage in the trade, the Washington Express carried a capacity cargo of apples and pears.

Her sister ships are the Oregon Express and California Express. The line provides scheduled sailings from the coast every three weeks. European discharging ports are Havre, London and Hamburg.

Union Products Used on New Arizona Highway

Beginning at Marble Canyon Bridge on U. S. Highway 89, and extending toward the Kaibab National Forest, a 9.2-mile stretch of 24-foot highway, with drainage structures and surfacing, was started March 22 and completed September 16, 1933.

Joining the 9.2-mile length of roadway, a 19-mile section, which will reach to the Kaibab National Forest boundary, is now under construction, with completion scheduled for late winter.

The 9-mile stretch was constructed by Hodgman and MacVicar, contractor, at a cost of $135,000. Hodgman and MacVicar, along with Packard and Tanner, are jointly building the 19-mile section reaching to the forest boundary at a cost of $205,000. The latter section is also a highway 24 feet wide.

Road Rimming Lake Tahoe Completed

This section of highway built by Anderson Brothers, contractors of Sacramento, Calif., completes the roadway which rims Lake Tahoe. Anderson Brothers were supplied 100 per cent with Union products during the progress of the work.

Fourth Kettleman Hills Well Brought In

As an appropriate climax to 1933 drilling operations, King No. 4, on the company's Amerada holdings on the North Dome of Kettleman Hills, was brought in New Year's eve with an initial production of 7500 barrels of 35.8 gravity oil and 11,000,000 cubic feet of gas. On a wide-open, 24-hour, flow test, the well produced 10,000 barrels of oil. This is the fourth well to be completed on the 160-acre property held jointly by the company and Amerada Corporation. Following the flow test the daily output was restricted to comply with the company's allowable production.

King No. 4 was drilled to a depth of 8530 feet, and is producing between that point and 7553 feet where the final water shut-off was made.

Impersonate Santa

For the past three years the production department on the Stearns lease, in charge of Vivian Washbon, has liberally donated from its employees' welfare fund for the relief of needy families in the Brea, Calif., district.

A year of welfare service was culminated during the Christmas season just passed when huge food boxes were presented to 23 deserving families in the neighborhood on Christmas day.

F. W. Lake Resigns

F. W. Lake, general field department superintendent of the Southern Division, resigned from the company in December to carry on consulting practice.

Mr. Lake has been associated with the company since 1922, starting his service as geologist in the Orange County district. With the increasing attention given to production he assumed the duties of production engineer for the Orange County division. He was later made production superintendent for the Southern Division, in charge of both drilling and production.

Mr. Lake's principal work has been in the development of gas lift, gas repressuring and underground oil storage, to which development he has made very substantial contributions.

He has taken a prominent part in the affairs of the Production Division of the American Petroleum Institute and the American Society of Mining and Metallurgical Engineers, and has published numerous papers on production and related subjects, as well as being the co-author of a hand-book, "Petroleum Engineering," which is widely used in the industry.

Vancouver, B. C., District Employees' Dance

The smartly decorated Aztec Ballroom of the Hotel Georgia, Vancouver, B. C., was the scene of gayety, November 17, when the Union Social Club held one of the most successful dances of the winter season. The patronesses were Mrs. R. J. Kenmuir, Mrs. A. P. Bennett and Mrs. James Adam. The committee responsible for the outstanding success of the event included: Miss Helen Wightman, Leslie O'Neill and Hubert Bennett. The affair was attended by more than 350 members of the club and their friends.

This mustached gentleman piloting the archaic delivery piece is K. G. Bentson, agent, Union Oil Company, who drove the ancient Union tank wagon in the Wilmington, Calif., Diamond Jubilee celebration, a feature of which was a parade of old and new equipment.

REFINED AND CRUDE

By RICHARD SNEDDON

Sports have been given a tremendous impetus in America this year by the fact that the President is a three-letter man, N. R. A.

For example, only last week, a certain employee of Union Oil Company, whose name we modestly refrain from mentioning, stepped out in his very first golf attempt and made a hole in one—hour.

Merely proving once again that some people are born great, some have greatness thrust upon them, and some just grate.

And now our readers will be pleased to learn that we received twenty dollars for a magazine story a few days ago. It was lost by the Express Company.

To change the subject, however, we note that women's shoes are being made from snake skins, and animal skins of all sorts. Slippers, of course, are still made from banana skins.

Also, although we have gradually drifted away from the sea life, we still remember vividly going with dad on numerous whaling expeditions to the woodshed.

And according to the latest magazine in our dentist's reception room, a big improvement in business conditions may be expected two years ago.

An English newspaper carries an item to the effect that a man received a heavy jail sentence for demanding money with threats. We sincerely hope the article catches the eye of our landlord.

Won't it be swell, by the way, when people begin to lie about their gains again, instead of their losses?

A couple of friends came over to the house last night for a friendly game of cards, but we changed our minds and played bridge.

English Professor: "Correct this sentence:—Before any damage could be done, the fire was put out by the volunteer fire department."
Bright Student: "The fire was put out before any damage could be done by the volunteer fire department."

The old fashioned buggy had one distinct advantage over the automobile. It didn't turn into the ditch and roll over three times when a bee got in with the driver.

And the horse always had enough sense to dodge another horse.

Babe Ruth, in high dudgeon, declared some time ago that he would retire before he would accept a salary of $50,000. We fully expect to do the same thing.

There is no doubt also that Franklin D. Roosevelt is the worst president the pessimists ever had.

So, if you're inclined to be skeptical of inflation, just remember what it did for the tire industry.

In any case there are always two sides to every question—the wrong side and our side.

Diner: "Are you the waitress who took my order?"

Waitress: "Yes, sir."

Diner: "You're still looking well. How are your grandchildren?"—Penn State Frosh.

Times are still tough enough this winter so that most men are smoking cigars they got at Christmas.

And have you heard of the married man who wrote the Street Railway a stinging rebuke, because when he boarded the car there was only one seat, and his wife had to stand up all the way?

Vocalist: "I'm going away to study singing."

Friend: "Good! How far away?"—Answers.

The Thomaston Times says a man recently crossed Broadway, New York, by walking a rope stretched from the top of one tall building to another—the coward.

And there is every indication that the cult of nudism will be very popular next summer—with the mosquitoes.

In conclusion you will find it comforting to reflect that the price of soap has been dropping tremendously, so that if some genius will only provide financial relief for the other six nights of the week, the depression will be definitely over.

Happy New Year.

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