

History of S.D. Water Dept.

FOURTH ANNUAL REPORT
OF THE SUPERINTENDENT
DEPARTMENT OF WATER

City of San Diego
California

UNDER THE COMMISSION FORM OF GOVERNMENT
FOR THE YEAR ENDING DEC. 31

1912



HERBERT R. FAY
MEMBER OF COMMON COUNCIL
SUPERINTENDENT



HERBERT R. FAY

SUPERINTENDENT DEPARTMENT OF WATER
CITY OF SAN DIEGO, CALIFORNIA
(MEMBER COMMON COUNCIL)

ANNUAL REPORT
DEPARTMENT OF WATER

CITY OF SAN DIEGO
CALIFORNIA

1912

OFFICIALS
DEPARTMENT OF WATER
CITY OF SAN DIEGO
CALIFORNIA
1912

SUPERINTENDENT
HERBERT R. FAY, Member Common Council

ASST. SUPERINTENDENT
H. A. WHITNEY, Hydraulic Engineer

BUREAU OF ACCOUNTABILITY
H. L. WORTHEN, Chief Clerk F. C. FERRIS, Cashier
A. E. BLETHEN, Investigator

BUREAU OF DISTRIBUTION
N. E. ROGERS, Foreman of Services
W. W. ALBIN, Foreman of Construction
W. L. WISEMAN, Foreman of Operation

BUREAU OF CONSERVATION
RUDOLPH WUESTE, Supervisor
E. C. HARRINGTON, Overseer
J. M. VONEIDA, Foreman of Pipe Lines

OFFICE—CITY HALL

Office Hours - - - 8:30 a. m. to 5:00 p. m.
Saturday - - - 8:30 a. m. to 12:00 m.

SHOPS—ELEVENTH AND BEECH STS.

Hours - - - 7:30 a. m. to 4:30 p. m.
Trouble Department - - Open Day and Night



Loyalty—Efficiency—Harmony
insures
Safety to the Service

"The People Be Pleased"

ANNUAL REPORT

SAN DIEGO, CALIFORNIA, January 1, 1913.

HONORABLE JAMES E. WADHAM,
Mayor of the City of San Diego, California.

SIR:

Complying with the provisions of Section XII, Article X, Charter of the City of San Diego, California, I have the honor to herewith respectfully submit the annual report of the Department of Water, for the year ending December 31, 1912.

As Superintendent of the Department of Water I have confined myself in this report to a review of the work accomplished by the Department during the past year, making such recommendations at this time as I deem proper and necessary, leaving the more detailed reports to the Assistant Superintendent and other officials

I. RESUME

During the year of 1912 this department lost by death a most efficient, loyal and beloved official, Mr. Edward F. Frailey, my Assistant Superintendent.

Mr. Frailey was so imbued with the spirit of loyalty to his trust, to his department, and to his City that although he was suddenly called from this life, his records were complete and properly preserved as public documents, and his successor found no difficulty in taking up the work where he left it.

1912 was to the officials of the Water Department a year fraught with many difficulties in construction and service, and many changes in the personnel of our force, yet taken as a whole was the most successful year ever experienced by the department.

San Diego is situated in the most southwesterly portion of "The Great Southwest", in what is called the "Semi-Arid Section," where large natural lakes and constantly flowing rivers are not available for our source of water supply. Therefore in years past we have had to dam up gorges to impound the run-off from the winter rainfalls and to build conduits, flumes, and pipe lines to bring these waters into our City.

As a town, San Diego was well supplied from a system so developed in the adjacent mountains by the Southern California Mountain Water Company, but in 1911 San Diego became a city,



WATER DEPARTMENT EXHIBIT AT SAN DIEGO INDUSTRIAL FAIR

and in 1912 became the most talked of city in the United States, because of our wonderful and unequalled growth in population, in building, in bank clearances, in postal receipts, in freight and passenger traffic, and in municipal expenditures and improvements. In this one year San Diego so grew in size and importance that every public utilities corporation and municipal department was taxed to its utmost in endeavoring to keep pace with the city's expansion and growth. In this respect the Water Department had exceptional conditions to contend with.

The winter's rainfall for 1911-1912 amounted to very little. The amazing growth of the city and the accompanying tremendous increase in water consumption overtaxed the delivery pipes of the impounding system and they were found to be inadequate.

The building up of the city required expensive extensions and enlargements to the distributing system within the City Limits, and the extensive and unparalleled amount of street paving done during 1912 called for costly outlays in renewals of mains, laterals and services.

San Diego covers a very large area, being 27 miles in extent from north to south and varying from two to four miles in width.

The Water Department's mains extend in nearly every portion of the city's territory and we have 368 miles of pipe in service at the present time.

DIFFICULTIES OVERCOME

In addition to our legitimate difficulties of 1912, which it was a pleasure to meet and overcome, as they spelled the success and prosperity of San Diego, this department in January, 1912, faced a problem, which if it had not been successfully combatted with and solved, and the malcontents weeded out of the department, this city would have suffered an irreparable loss, which had it continued on could never have been estimated in the dollars and services wasted.

For years the Water Department had practically been under the control of a few men, who for their own personal advantage did not keep reliable public records of the locations of the gate valves of the system, and such maps as were at hand were not authentic and in many instances were incorrect and misleading. In the past, whenever an employee of the department, not acceptable to the select few, endeavored to learn the locations of valves not recorded, he would shortly be discharged or laid off.

In endeavoring to accumulate the data regarding this system for the purpose of recording same as public property in the interest of public safety and in justice to all, I was met with opposition that eventually resulted in a strike by a few who believed they could intimidate me and continue in their heretofore uninterrupted control of the department.

In addition to the former Assistant Superintendent and those who struck in his interest, I discharged many others, and in a few hours thereafter, assisted by Mr. Frailey, was conducting the affairs of the department with those faithful to their trusts, and the new men I had employed to fill the vacancies.

For the next forty days, life as Superintendent of the Department of Water of this City was one of ceaseless turmoil. The High and Low Services tried to pass each other in the same pipes, gate valves, even to the 30" size would seemingly open and close by thought transference. Pipes broke if you looked at them and some did while you were not looking. Hydrants leaked as never before or since, and I think by the time my recall died because of want of life I was the best known and the most cursed official in San Diego. But the public data that I was after is today public record and I feel repaid for my troublesome experiences.

Today there are twenty-four books in existence and distributed in the department, showing where every gate valve in the system is located, its size and how it operates. Today there are twenty-four books showing where every fire hydrant is located. There are now four complete sets of wall maps showing every water main in the system, their location and size, and all gates, fittings, hydrants, etc., and there is completed a loose leaf system of records, to be kept in the vaults at the City Hall, that even shows where the services are located, the meter data and all the additional information required in excess to that given upon the maps and other books issued for the convenience of the employees and the public, and towards the efficiency of the department.

All those carrying the valve and hydrant books receive daily reports of additions or changes and the maps and loose leaf records are attended to daily by the Department Statistician.

BOND ISSUE

As in 1911, the people of San Diego in 1912 voted the Water Department \$340,000.00 to expend in new work. This Bond Issue was voted on March 14, 1912, and the work is now being prosecuted. It cared for the purchase of the following described cast-iron water pipe and the trenching and laying of the same:

RE-ORGANIZATION

To properly care for this department after taking over the impounding system, I have perfected a re-organization of the department as follows:

The department to be under the personal supervision of the Superintendent, assisted by the Assistant Superintendent.

The Clerical Division, under the Secretary, cares for the executive work.

The Engineering Division, under the Hydraulic Engineer, cares for the engineering work.

The Division of Lands, under the Forester, cares for the lands and forestry.

The Bureau of Accountability, under the Chief Clerk, cares for the bookkeeping, cash and collections, meter registrations and accounts, statistics and property accountability.

The Bureau of Distribution, under a General Foreman, cares for the installation of reservoirs, pumping plants, mains, laterals, services, meters, hydrants, etc., and the maintenance and operation of all that portion of the distributing system as lies within the City Limits.

The Bureau of Conservation, under the Supervising Engineer, cares for the impounding system, which includes the watersheds, rights of way, creeks, dams, conduits, pipe lines, filtering plants, etc., outside the City Limits.

Each chief is the responsible head of, and personally in charge of his respective division or bureau. By a chart I have shown each official and employee his position in our organization, and his relation to each other official or employee.

This department's physical valuation, including the properties of the Southern California Mountain Water Company, which will be transferred to the City in February, will be \$6,500,000.00.

SUMMARY

During 1912 this department laid 38.64 miles of pipe, the total in use December 31, 1912, being 368.02 miles.

There were 2241 services installed in 1912. Total to date, December 31, 1912, 12,681.

There were 2402 meters installed in 1912, making a total of 12,681 meters in use December 31, 1912.

In 1912 we placed 48 hydrants of the improved California Iron Works pattern, adopted by and made only for the City of San Diego. There are now 785 hydrants placed in this city.

San Diego is one of the few cities of its size that has 100 per cent. of its water services metered; also it has more miles of water mains in service than any other city of its size and a better protected business district, due to the type, number and location of our fire hydrants.

The amount of water purchased in 1912 from the Southern California Mountain Water Company was 2,141,120,000 gallons, an increase of 278,750,000 gallons over 1911.

The average daily consumption in 1912 was 5,723,817 gallons, an increase of 621,817 gallons over 1911. X

The largest daily consumption in 1912 was 9,798,909 gallons, that for 1911 being 7,170,000 gallons, an increase of 2,628,909 gallons. X

The receipts for 1912 were \$286,681.67, an increase of \$51,481.12 over 1911.

*The disbursements were \$302,092.79, being \$8,825.43 less than for 1911.

WATER FUNDS

In 1901 when the city purchased the properties of the two water companies, then operating within the city limits, a promise was made to the people of San Diego that the Water Department funds would be left separate from the other city funds and used only for the benefit and needs of the Water Department.

At various times since 1901 sums amounting to over \$30,000.00 have been transferred from the Water Funds to other funds for purposes other than benefits or needs of the Water Department, and each time such transfers or loans were made the promise has been that same would be repaid into the Water Funds.

Since my taking office in June, 1910, there have been no transfers of moneys from the Water Funds to any other funds.

HOUSE NUMBERING

During 1912 the Water Department officials worked out a house numbering system for the entire city, which was adopted by the City Council as official and approved and adopted by the Postmaster of San Diego.

*Note:—I am pleased to invite your attention particularly to the item of disbursements for 1912, wherein I am able to show that this department, notwithstanding the added work involved in caring for the wonderful growth of this city for the last year, conducted its affairs at a saving of nearly \$9,000.00 under the expenses of 1911.

Later in the year, owing to the location being better adapted to the convenience of the public, this system was transferred to the office of the Building Inspector.

Twice during the past year this department had to enlarge its quarters in the City Hall, and yet the end of the year found us again handicapped because of the increasing volume of business and the lack of proper room to care for same.

RULES AND RATES

In April, 1912, I presented to the Common Council an ordinance containing new rules and rates relating to water services, the same being adopted.

This ordinance provided for the water rates, defined the districts for meter readings, and the dates for payment of water bills, the conditions under which water will be furnished, the limit for service extensions, the regulations regarding fire services and fire hydrants, steam boiler connections, watering troughs, private systems, inspections, installations, etc.

REVIEW

In the Spring of 1912 I had remodeled a "Mitchell" four-passenger touring car, making same over into an auto-service wagon and found that, with this motor-driven wagon, the same crew could do fully twice the amount of work accomplished with a horse and wagon.

As in former years, I made frequent inspection trips over the impounding system and other available sources of water supply adjacent to San Diego. Following the date of the bond issue voted by the people of San Diego to purchase the impounding system of the Southern California Mountain Water Company I made a most exhaustive inspection of these properties and took a complete inventory of same. In the Fall of 1912, in company with U. S. Forest Supervisor H. N. Wheeler and City Pueblo Forester Max Watson, I gave particular attention to the forestry condition of our watersheds.

In addition to my duties as Superintendent of the Water Department I have participated in my legislative duties as a member of the Common Council.

Property accountability is accurately accomplished in this department, an inventory of all properties being taken every six months. All responsible employees are bonded for the safe-keeping

of the properties entrusted to them and the proper performance of their respective duties.

By the addition of a bookkeeper and new forms and systems in the office, the work of attending to the public and their accounts has been greatly facilitated.

The Night Emergency System installed and maintained to care for leaks has improved the efficiency of the service and lessened the expenses chargeable to loss by water waste and overtime paid to employees.

The new machines, and other added improvements at the shop, yards, and stables have all aided in minimizing costs and improving the service.

I am pleased to report that all my recommendations made in 1912 were adopted by the Common Council, with the exception of the half-holiday for the construction forces, and the allotment of a portion of the reclaimed tide lands for the use of the various city departments, both of which recommendations I renew for consideration during 1913.

PERSONNEL

In August, 1912, Herbert A. Whitney was engaged as Hydraulic Engineer for the Department of Water, and upon the death of Mr. Frailey was given the additional responsibility of Assistant Superintendent.

Under the supervision of Mr. Whitney development maps, showing a comprehensive system of reservoirs, mains and laterals for the "Greater San Diego," have been and are being perfected.

The Department of Water was never better organized or more efficient than at the present.

The personnel is above the average, the esprit de corps being fully developed, with every official and employee a loyal San Diegan, and to them collectively belongs the credit for whatever advance this department has made in the past year.

"Loyalty, Efficiency and Harmony" are our watchwords, "The Public Be Pleased" our motto, and "From Mountain To Meter" our slogan.

II.

RECOMMENDATIONS.

Anticipating the taking over and the management of the impounding system of the Southern California Mountain Water Company, which the people of San Diego last year voted to pur-

chase, I most earnestly recommend that an additional 5c on each \$100.00 valuation of property be levied annually by the Common Council for the purpose of improving and developing the impounding system of the Water Department lying outside of the corporate limits of the City of San Diego.

That this amount so obtained to be expended solely in providing an adequate water supply for the city and to prosecute such investigations, explorations, improvements and developments as are needed for this purpose.

This fund to be separate from all other water funds and to be known as the *Water Development Fund*.

As there will be over 11,000 acres of watersheds, reservoir sites and other lands added to this department by the acquisition of the Southern California Mountain Water Company's system, and the conservation of the forestry resources, calls for a very essential consideration, I would recommend the placing of the City Pueblo Lands with the Department of Water so that the services of the City Pueblo Forester could be acquired for this department without the additional expense of two foresters in the city's employ. Public water and public lands could very properly be successfully developed under one general management.

Continuing with recommendations relating to the impounding system, I urge the installation of at least four more units to the filtering plant at Chollas Heights, the laying of another pipe line from Chollas into the city, also another line from Otay to Chollas, or into the eastern end of the city, the extension of the Dulzura Conduit to the Otay, the prosecution of the development at Barrett dam and the protection of the watersheds against forest fires and cattle grazing.

I do not deem all these absolute necessities for 1913, but do consider the filtering plant and Chollas pipe line recommendations very essential to the immediate welfare and protection of this city and its inhabitants.

That the Common Council appropriate from the 1913 tax levy a sufficient amount to repay into the *Water Fund* all moneys borrowed therefrom and used for purposes other than benefits to the Water Department.

I most earnestly recommend that the "Water Fund" be protected by Charter Amendment, or Ordinance, from transfer, in whole or in part, to any other fund, or for any other purpose other than the development, enlargement or maintenance of the Water System.

That upon the completion of the development maps, showing a comprehensive system of reservoirs, mains and laterals for the "Greater San Diego", the same be adopted as official by the Common Council and all installations ordered thereafter be in accordance with such recommendation.

I recommend an ordinance whereby no tract or subdivision or street shall be approved and accepted by the Common Council, except same have installed therein adequate water mains and laterals to care for the domestic requirements and fire protection as estimated by the Hydraulic Engineer of the Department of Water.

That no extensions of water mains be granted to exceed the equivalent of 100 linear feet of 2" pipe, together with fittings and labor, for any one consumer, and that all such extensions as may be granted shall be for service to a property upon which there are buildings already erected, or for which the Building Inspector's permit for the erection of a building has been granted, and same is exhibited when water extension is applied for.

That new rules and rates be adopted for 1913.

That all elevator and fire services be metered.

That all meter boxes be set, or reset, to be flush with the curb, and covers of metal replace those of wood.

That all water rates less than 8c per 100 cubic feet be abolished, and that all consumers or city departments paying a less rate be required to pay the same as charged the citizen.

That as rapidly as consistent with the growth of the city and the requirements of the department motor vehicles replace the horse and wagon.

That city telephones be installed in the Superintendent's residence, thus permitting communication, day or night, with all employees at reservoirs, pumping and filtering plants, conduits and pipe lines, shops, yards and stables.

That the weekly half-holiday now granted the clerical forces in the city's employ be extended by ordinance to include all city employees.

That as a convenience and benefit to the day laborer, all employes of the city except the charter officers and those provided for by a regular monthly pay roll, be paid weekly and in cash, rather than by warrant.

I desire to call attention to the lack of space in the present City Hall for the transaction of the business of the Water Department, the unsafe condition of the present building against fire or burglary, and the necessity for a new City Hall immediately.

the remainder for a period not to exceed ten years, at the rate of $4\frac{1}{2}\%$ per annum on \$1,500,000, with the privilege of purchasing same at any time at the above figure.

LIST OF PROPERTIES PROVIDED FOR IN PURCHASE.

The Bond Issue as voted on August 15, 1912, provides for the purchase of the following properties:

1. The Barrett Dam site and reservoir site with the adjacent water sheds.
2. All the water rights of the above company on the Cottonwood and Pine Creeks to the Mexican line.
3. The Dulzura Conduit.
4. All flowage and riparian rights and rights of way of this company along the Dulzura and Jamul Creeks.
5. The Upper Otay dam and reservoir.
6. The Lower Otay dam and reservoir, together with certain lands adjacent thereto.
7. The pipe system and right of way from the Lower Otay dam to the University Heights reservoir.
8. Chollas Heights reservoir and certain adjacent lands thereto.

LANDS THE CITY VOTED TO LEASE.

The City of San Diego also voted, at the above mentioned election, to lease from the Southern California Mountain Water Company—

1. The water rights on the Cottonwood Creek, east of the Barrett reservoir site.
2. The Morena reservoir and dam.
3. The adjoining lands to the Morena reservoir, together with the use of the Morena reservoir water.

"FROM MOUNTAIN TO METER"

The accompanying map will illustrate the various stages necessary to bring our water "*from mountain to meter.*"

The Morena reservoir is supplied by the water shed of the Cottonwood creek, which rises in the Laguna mountains. The water is let out in such quantities as may be needed and drains to the Barrett reservoir site as shown at ("B"). The Barrett reservoir site is also supplied by the drainage waters from Pine Creek. From the Barrett reservoir site it is accumulated by a small diverting dam and run into the Dulzura Conduit shown at ("C"). This conduit is $13\frac{1}{2}$ miles long and travels through solid rock tunnels and winds

around steep mountain sides. It discharges into the Dulzura creek, shown at ("D"), from whence it flows into the Lower Otay reservoir.

The Lower Otay reservoir, shown at ("F"), is supplied not only by the water flowing from the Cottonwood and Pine creek water sheds but also secures the drainage of the Upper Otay water shed and the Lower Otay shed ("E"), Jamul creek and the shed of the Dulzura creek.

The entire accumulation of the various reservoirs is taken from the Lower Otay reservoir through a 40" wood stave pipe two and one-half miles long. This pipe branches into a 36" wood stave pipe to the northwest and a 20" wood stave going west. The 36" line supplies San Diego and the 20" supplies Coronado, as shown by ("T").

The 36" line supplying San Diego (see "G") is six miles long and is reduced to a 32" steel pipe which passes through Bonita valley and is reduced to a 30" wood stave pipe which passes to the north until it reaches the filtration plant and reservoir at Chollas Heights, a distance of fifteen miles from the Lower Otay reservoir. From the filtering plant a 24" wood stave pipe leads to the west to the University Heights reservoir, shown by ("K") and ("L").

THE DISTRIBUTING SYSTEM OF SAN DIEGO.

Water is delivered through a Venturi meter into the University Heights reservoir ("K"), at an elevation of 396', where it passes over an aerating table into the 17 million gallon concrete covered reservoir supplying all parts of the town. From the 17 million gallon reservoir the water equalizes into the small University Heights reservoir as shown at ("L") in the map.

Water is taken from the small reservoir by a centrifugal pump and forced into a stand pipe, adjacent to the reservoirs, from which it flows into the high service district in the immediate vicinity.

The northern part of the city, known as Pacific Beach and La Jolla, is supplied by reservoirs, noted as (P) and (Q), which are fed by a line leading from the main reservoir. Lower Point Loma is supplied by reservoirs noted as (N) and (O), which are fed by a 12" pipe line leading from the main reservoir, while Upper Point Loma is supplied by a stand pipe ("Q") which receives its water from a pump, pumping from reservoir ("N").

LOW SERVICE.

On account of the extreme pressure to which the mains in the down town portion would be subjected, the city is districted into a

low service west of Arctic Street to Date Street, south of Date to Second Street, west on Second to "A" Street. South on "A" Street to Twelfth Street, west on Twelfth to "F" Street, south on "F" to Sixteenth, west on Sixteenth to "N" Street, south on "N" to Main, southeast on Main to Sampson and southwest on Sampson to Logan, south on Logan to Thirtieth and National, south on National to Thirty-second, and west on Thirty-second to the bay. A difference of 76 pounds is maintained between the high and low pressure systems. The water is bled from the 12" high pressure main at Sixth and "A" Streets by a 6" reducing valve and an 8" reducing valve at Arctic and Juniper Streets. In case of a large fire the Foreman of Services and the Foreman of Operation respond to the second alarm, opening such additional valves as may be deemed necessary.

SERVICE PIPES.

The life of a galvanized iron pipe is, according to the report of my Foreman of Services, extremely short, consequently I lay nothing but wrought iron pipe dipped in a heavy bath of asphaltum varnish. All our connections are leaded. We make all the lead connections at a cost of less than \$1.75 for our $\frac{3}{4}$ " sizes. I advocate a strong corporation cock and service cock. Our services are all metered and I recommend that we replace the wooden meter boxes by either a concrete or metal box with a metal cover. On account of the unsightly appearance of the cost of up-keep the cover, at least, should be of cast iron. The city does all the work of installing services up to and including the meters.

The following is an analysis of the water as passed through the meter and used in the City of San Diego:

	Parts Per Million.
Odor	None
Taste	Good
Color	12.5
Sediment quick falling	Very Slight
Turbidity (Standard Scale)	About 1.0
Total Solids	320.0
Volatile and Organic Matter	90.0
Chlorine	88.0
Free Ammonia	0.05
Albumenoid Ammonia	0.18
Nitrogen in Nitrites	None
Nitrogen in Nitrates	None
Oxygen required to oxidize organic matter at 212 degrees Fahrenheit	3.5
Hardness, French degrees—	
Permanent	1.5 degrees
Temporary	13.8 degrees
Total Hardness	15.3 degrees

REVIEW OF THE INSPECTION OF THE IMPOUNDING SYSTEM.

Shortly after the date of the bond issue whereby the City of San Diego purchased the system of the Southern California Mountain Water Company I was appointed Hydraulic Engineer of the Department of Water and my first duty was a tour of inspection of the impounding system in company with Major Herbert R. Fay, the Superintendent, and H. L. Worthen, now Chief Clerk of the Department of Water, from September 3d to 13th, 1912.

I think it best to start at the extremity of the Morena water shed (the Upper Cottonwood creek) which has its source in the Laguna mountains, giving general description of the various improvements for the entire 63 miles as we walked from one end to the other.

DESCRIPTION OF THE COTTONWOOD CREEK.

The Tia Juana river discharges into the Pacific Ocean below San Diego Bay, near the Mexican boundary. Its principal tributary, the Cottonwood creek, rises in the Laguna mountains, or the Coast range, and flows southwest for about 20 miles, where it is joined by the Pine Valley creek from the north. It then flows southward for 12 miles to its junction with the Tia Juana, thence to the Mexican boundary, about 22 miles east of the coast line. The total drainage area of the Cottonwood creek above its junction with the Tia Juana river is approximately 340 square miles. It lies south of the Otay and Sweetwater basins, and Pine Valley creek is its only important tributary. The basin of the Cottonwood is rough throughout, although it contains a few valley areas and several high elevations, and is only broken by a short stretch of open country with a comparatively light grade at the junction of the Pine Valley creek. The altitude ranges from 600 feet elevation where it empties into the Tia Juana river to 5,000 feet in the Laguna mountains.

The water shed is very barely forested, and the timber consists of scattered oak, cottonwood and alder. The rainfall averages from eight to ten inches in the foot-hills to thirty-two inches in the mountains. The Barrett reservoir site is located at the junction of the Pine Valley creek at an elevation of 1,506 feet, and the Morena reservoir on Cottonwood creek at the lower end of Morena valley, is eight miles above the Barrett reservoir site. There is a reservoir site for Pine creek at the west end of Pine valley. The

Pine creek enters Cottonwood Valley creek about a mile above the Lyons creek, and the drainage area included therein is approximately 270 square miles, which includes the Morena reservoir and water sheds, Barrett reservoir water shed and Pine creek. (You will notice from the above that this leaves practically 70 miles of water shed below the Barrett dam site to the Tia Juana river.)

THE MORENA RESERVOIR.

The Morena reservoir is situated about eight miles due east of the proposed site of the Barrett dam, at a distance of 63 miles by highway from San Diego, and contains an area of about 135 square miles. The outlet of the reservoir is at an elevation of 3,100 feet. The reservoir, extending back to the south, covers more or less of a flat country, the southern end of which is, at the present time, more or less swampy, and will be covered with water in the very near future. There is also considerable grass and vegetation along the edge of the present water level, and above and below same. An average for the past six years of the Morena water shed gives 23 inches of rainfall.

We have an evaporation of about four feet. The area of the Morena water shed is 135 square miles, and the area of the Morena reservoir, when submerged, is 1,370 acres, or about $1/64$ of the total water shed.

I have not had the time to make an accurate determination of just what the run-off of this water shed should be, for it is possible for rain to fall at such intervals and quantities that the run-off of this water shed would be, scarcely anything, as the evaporation is much greater in some months than others. We have a record of the years 1905 and 1906 where the peak flood amounted to four and one-half billion gallons a day, or in other words it was equivalent to three times the entire run-off of 1911. This only continued, however, for a short time. The records kept at Barrett show that in 1906 Barrett had a rainfall of slightly less than 30", while at Morena we had a rainfall of $34\frac{3}{4}$ inches. The run-off totaled nineteen and one-half billion gallons, or $11\frac{1}{2}$ per cent of the precipitation. In 1907 we had a run-off of eleven billion gallons, which amounted to 13.4 per cent of the precipitation, while to illustrate my point still further I would say that in 1911 the rainfall was almost identical with that of 1907, and that only had a run-off of 1,582,000,000 gallons. These records were for Cottonwood creek as a whole, including Morena dam and Pine creek.

THE DAM FOR MORENA RESERVOIR.

The dam for impounding the water is one of the finest pieces of work of its kind that I have seen. It is of the rock filled type with a concrete back so designed that an additional height of $5\frac{1}{2}$ feet may be added without any danger. The workmanship throughout is of the very best, and there is no leakage whatsoever that can be noticed. The total height of the finished dam from the top to the foundation is 265 feet. $112\frac{1}{2}$ feet of the lower part of this dam extends from the original creek bed through a fissure which developed after the dam was started. At the present writing there are over a billion gallons of water in this reservoir which can be delivered to San Diego should the demand so require. The total capacity of this dam is 15,000,000,000 gallons. It is built in a canyon of solid granite. The up-stream face of the dam is composed of six to ten ton rocks of rubble granite set in concrete mortar, one of cement to two and a half sand, and is built on a slope of nine horizontal to ten vertical. Grooves have been left in the masonry into which are subsequently placed solid concrete. The water face of the dam is composed of re-enforced concrete slabs eighteen inches thick, which are attached to the solid masonry by means of iron rods on four-foot centers anchored in same. The top of the dam is sixteen feet wide by 500 feet long. The down stream side is composed of loose rock-fill on a slope of one and one-half to one, most of which is hand placed, the crevices being carefully chinked with small stones, so there will be no serious settlement when the dam is filled, and even this point is looked after to the extent of placing expansion joints between the slabs as before mentioned. There are over 300,000 cubic yards of granite used in this work. It is the highest dam of its kind in California. The outlet tower is $15\frac{1}{2}$ feet outside diameter, with an average thickness of 30 inches. It is well re-enforced and the gates, four in number, each control the outlet into a tunnel drilled in solid rock. This tunnel is 387 feet long, eight feet wide, and seven and one-half feet high. Opposite the outlet valves, as mentioned above, there is an independent 24-inch scouring gate, used for washing the accumulation of sediment near the outlet tower. The scouring gate connects into the tunnel at the foundation of the outlet tower.

As before mentioned the water leaves Morena dam and seeks a continuation to the San Diego water system by gravity through the Cottonwood creek until picked up by the Dulzura conduit.

THE BARRETT DAM SITE AND PROPOSED RESERVOIR.

The proposed Barrett dam is located in the NW. $\frac{1}{4}$ of Section 22, Twp. 17, Range 3 East of San Bernardino Meridian. The crest of the dam will be at an elevation of about 1,600 feet, or 175 feet above the bed of the Cottonwood creek. It will make a reservoir having a capacity of 15,000,000,000 gallons of water, which will make the capacity the same as that of Morena. We have an annual average rainfall of 19 inches at this point. The number of acres flooded by the proposed reservoir will be 1,370. The distance to Barrett dam by way of Cottonwood creek is eight miles, and the distance to the nearest point on the water surface of the Barrett reservoir, from Morena, will be four miles, only a short distance for a conduit for power plant purposes, considering that we may gain a head of over 1,400 feet in this distance.

THE PROPOSED DAM.

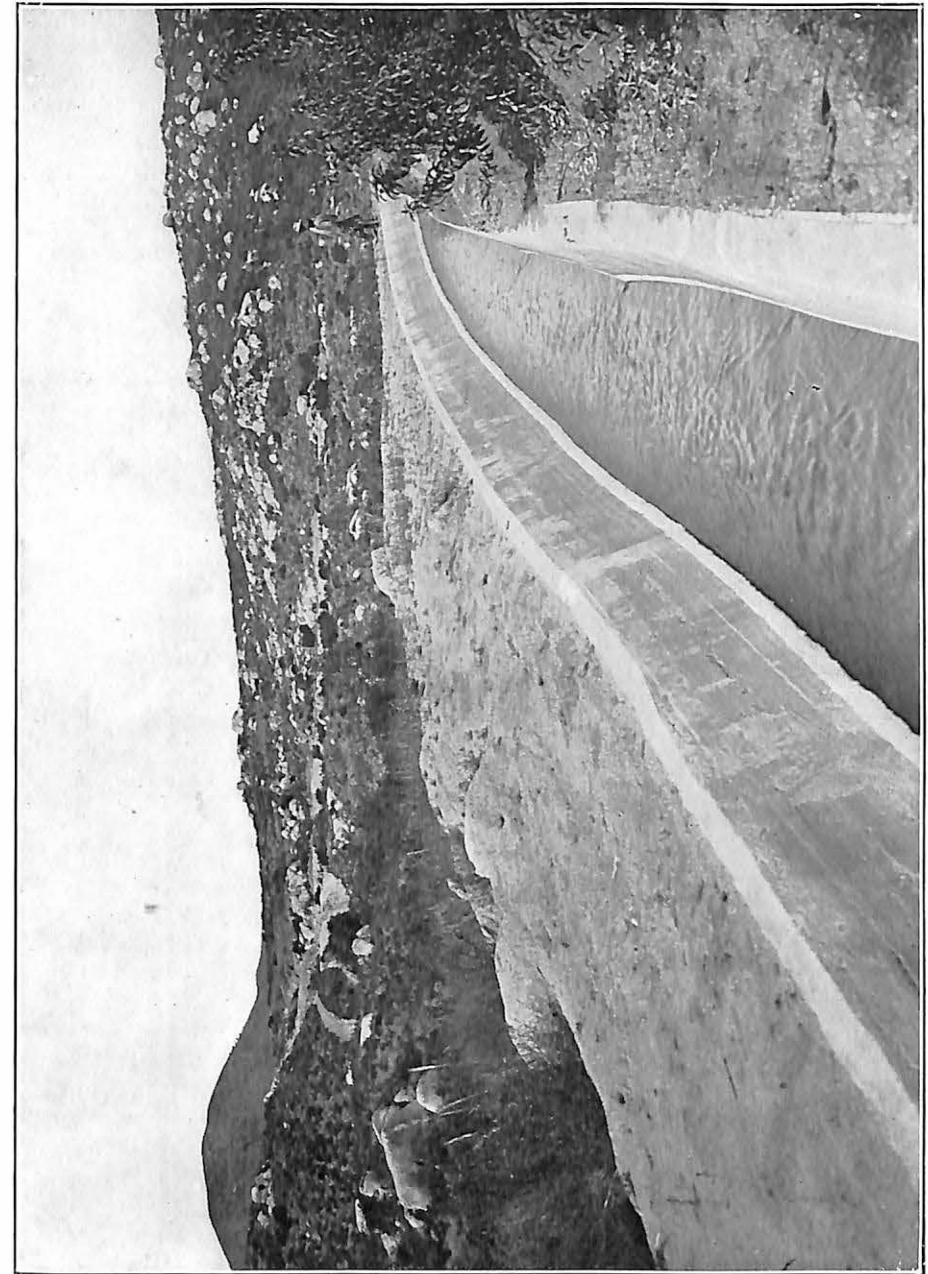
Borings indicate that we will have to go nearly 100 feet deep before we secure a satisfactory foundation at bedrock. Furthermore we will have to carry the ends of the dam quite a distance into the walls of the gorge in order to secure an adequate bond. There are a number of other engineering difficulties that it will be necessary to overcome before the work will be permanently started.

The east end of the proposed dam runs, for a long distance, into disintegrated granite before a good bond is secured, while on the west a good connection is secured at a short distance from the present walls of the gorge. As a rough estimate I should say that it will cost \$850,000 to construct a proper dam at this site. I am not prepared at this time to suggest the proper type.

There has been considerable prospecting for the bed-rock of Barrett dam and a number of shafts have been sunk and a few tunnels driven through the hardest kind of granite. One tunnel is run fifty feet east, while in a southeasterly direction a shaft 135 feet long has been drifted without hitting solid rock. There is quite a force of men working on the tunnels as well as building up the sides of the conduits. This is entirely at the expense of the Southern California Mountain Water Company.

REASONS FOR BUILDING THE BARRETT DAM.

The object of our building the dam at Barrett is not only to catch the surplus waters of the Morena water shed, but also to store all the waters coming down the Pine creek and Lyons creek. We can catch only 40,000,000 gallons per day through the Dulzura



THE WATERS OF THE COTTONWOOD AND PINE VALLEY RIVERS BEING DIVERTED BY THE DULZURA CONDUIT

conduit. When you consider that the peak flood run-off at Barrett for a short time was 4,523,904,000 gallons, you will see that there are millions of gallons running to waste into Mexico every year and will continue to do so until we have a dam to conserve the supply.

THE DULZURA CONDUIT.

The Dulzura conduit was completed four years ago, on January 3, 1909. It is constructed of wood flumes, rock tunnels and concrete lined aqueducts, making a total of 13.38 miles. There are 56,957 feet of concrete lined aqueducts averaging five feet wide by four feet two inches deep. The walls are four inches thick and when in danger of a slide above, are covered with re-enforced concrete slabs. The tunnels are seventeen in number and are six feet wide and seven feet deep. These tunnels are unlined and the bottoms and sides are of rough rock. There are 4,490 feet of wood flumes carrying the water across deep canyons when the topography forbids the use of conduit and tunnels are impracticable.

CAPACITY.

The capacity of the Dulzura Conduit is 40,000,000 gallons of water per twenty-four hours, and it carries the waters of the Cottonwood creek (as gathered in the Morena reservoir) and the water flowing from the Pine valley (by way of the Pine and Lyons creeks) through the divide of the Cottonwood creek water shed, into the water shed of the Lower Otay valley, emptying into the Dulzura creek having a drop of four feet in 5,000 feet, or about 52 feet in the 13.38 miles. The elevation of the Dulzura conduit at the proposed dam site will be 1,506 feet.

TOPOGRAPHY.

Owing to the almost impassable condition of the country through which the aqueduct was built it was necessary to build several miles of road at a cost of over \$100,000. This road winds around precipitous mountain sides, passes over deep gorges, and is blasted for miles through granite walls.

THE INTAKE AT COTTONWOOD CREEK.

The intake of the Dulzura conduit is located at a distance of about one-half mile above the junction of the Pine and Cottonwood creeks. It consists of a box made of concrete, having openings to keep the channel scoured as free from sand as possible. The accumulation of sand in the bottom of the flume is one great diffi-

culty which will be overcome when an adequate dam is built at Barrett. This locality will be covered by 100 feet of water and what accumulations that gather will be settled in the low portions of the reservoir.

The intake at Pine creek consists of a wing dam of concrete spreading on either side of the conduit to the adjacent wall of the rock bank of Pine creek.

A flume trestle carries the water of the Pine and Cottonwood creeks across Pine valley. Should we have a forest fire in this vicinity the chances are that the trestles would burn. This is one of a great many trestles that are requiring close supervision.

A half mile below the Pine creek intake is a small flume which conveys the drainage of Lyons valley water shed into the Dulzura conduit.

FLUMES.

These are several wood flumes along the conduit, varying from a few feet to 1,000 feet long.

TUNNELS.

The tunnels in most cases are cut through solid rock and vary from forty feet in length to 2,060 feet long. They are about seven feet high and six feet wide. The outlet of the Dulzura conduit from the long tunnel, and the last on the system, is into a large ditch, excavated through solid rock. Being unlined the bottom of the canal is entirely covered with a rank growth of weeds and bushes.

The lower end of the outlet canal passes through a weir at an elevation of about 1,450 feet into the Dulzura creek, and after passing through the Dulzura water shed for a distance of twelve miles, it finally reaches the Lower Otay reservoir. By continuing the concrete conduit for the remaining twelve miles the water would be kept free from contamination a great deal, and more could be saved.

LOWER OTAY RESERVOIR AND DAM.

The Lower Otay reservoir was formed by building the Lower Otay dam across the Otay river at a height of 130' above the bed of the river. This dam was commenced in 1887 and finished in August, 1897.

It is one of the first and by far the largest and best type loose rock free dam, in Lower California.

It is made with a center steel web plate extending full length and depth of the dam, in fact it filled the entire cross section of

the canyon in which the dam was built. The thickness of the plates varies from one-fourth to three-eighths inches. They were covered with burlap dipped in hot asphalt after the joints were thoroughly calked. The base of the core wall sits in a trench of rubble concrete masonry. There was 180,000 yards of stone used in building this structure. The elevation of the outlet pipe is 400 feet, the capacity of the reservoir is thirteen billion gallons, the area of the reservoir is one thousand acres. The area of the water shed is 80 square miles.

It is from the Lower Otay reservoir that all the water used in San Diego is taken. It receives not only the flow from the Morena reservoir, the Barrett dam site, the Pine creek, the Upper Otay, but also the catchments of the eighty square miles of its water shed.

UPPER OTAY RESERVOIR.

The Upper Otay reservoir is directly above the Lower Otay reservoir. It has a capacity of 1,090,000,000 gallons. It has a water shed of twenty square miles and an area of 164 acres. The dam is re-inforced arched concrete type. The elevation of the outlet is 521 feet. The water at the present time is stored as a reserve in case of damage to or contamination of the Lower Otay reservoir.



METHOD OF AERATING WATER RECEIVED FROM PIPE LINE BEFORE IT ENTERS UNIVERSITY HEIGHTS RESERVOIR

THE PIPE LINE FROM THE LOWER OTAY INTO SAN DIEGO.

The outlet from the Lower Otay reservoir passes through a forty-eight inch pipe line, and a steel line conduit into a valve house, whence it is taken by a forty-inch continuous wood-stave pipe, leading for a distance of two and one-half miles to the junction between the Coronado and San Diego Water Systems. It branches out toward the Highland reservoir to the west by a twenty-inch wood-stave pipe line, and toward the north from the junction by a thirty-six inch continuous wood-stave pipe leading for a distance of six miles to Bonita valley, across Bonita valley a thirty-two inch steel pipe is laid under an extremely heavy pressure, reducing as it reaches higher ground to a thirty-inch pipe, from thence to the Chollas filtering plant. From the Lower Otay reservoir the distance is about $13\frac{1}{4}$ miles, and from the Chollas filtering plant a twenty-four-inch wood-stave pipe leads the water into the University Heights reservoir, passing as has been shown into the distributing system.

CHOLLAS HEIGHTS RESERVOIR.

The Chollas Heights Reservoir has a capacity of ninety million gallons and is used as a balancing reservoir. Chollas Heights Dam is of the earth built type, with a concrete protected steel core, being in first class condition and is very nearly full. Should anything happen to the Otay pipe line it is so arranged that water may be passed directly to town from Chollas Heights.

FILTRATION PLANT

The filtering plant is located about four miles from San Diego in Chollas Valley, and has a capacity of seven million gallons per day. It consists of a battery of ten filters of the New York-Jewell horizontal filter type. The building is of wood and is in first class condition. The floor and foundation are constructed of concrete and it is so designed that unit by unit may be added as the needs of the city require. Each filter is eight feet in diameter, and twenty feet long, and made of plate one-fourth inch thick. The sand that is used for filtering purposes was brought from Cape May, New Jersey, and it is the best pure silica sand obtainable. Each filter holds about thirty tons. The water entering the top of the filter percolates through the sand and enters the laterals, passing into the large main, thoroughly cleansed of all impurities. The cleansing of the filters is accomplished by reversing the flow of the water from the top to the bottom and blowing all the objectionable mat-

ter through the waste pipes, an operation that occupies only nine minutes and takes the time of only one man. Lately they have been cleansed every twenty-four hours, although in the past once in forty-eight hours has been deemed sufficient.

DESCRIPTION OF DISTRIBUTING SYSTEM.

The distributing system comes into the University Heights reservoir by way of a twenty-four inch wood-stave pipe from the Southern California Mountain Water system, and is distributed from the reservoir through a thirty-six inch cast-iron pipe leading south to University Avenue, and branching east and west. The main leading down town on the west is by means of a sixteen inch pipe line passing the south on Fifth street to Laurel street, where it branches into a twelve inch main. The main leading on the east side of town is by means of a thirty inch cast-iron pipe passing to the south of Thirtieth street, branching into a twenty-four inch and two twelve inch mains at Juniper street, and branching into a sixteen inch main at Thirtieth and Ash, and passing down to the south by a twenty-four inch line. These pipes either branch or cross-connect with all the districts south of Balboa Park. All the large mains are laid by means of bond issues. The repairing is done at the expense of the water fund, and what small pipes used for temporary supply have heretofore been installed at the expense of the receipts from the department. The service connections are put in from revenues received from the applicant for whom the service is installed.

ORGANIZATION OF DEPARTMENT OF WATER.

The Department of Water is governed by a member of the City Common Council known as the Superintendent of the Department of Water, who is responsible for the different branches of the department, and as a member of the Common Council initiates all legislative acts in connection with the department, passes upon all ordinances, resolutions, petitions, etc.

The Superintendent is assisted by a Hydraulic Engineer who acts as Assistant Superintendent. The Assistant Superintendent is responsible to the Superintendent for each of the various bureaus and divisions into which the water department is divided. There are three divisions, namely: Clerical Division, Division of Lands, and Engineering Division.

Clerical Division:

The clerical division consists of the secretary, stenographer, and office help in connection with the Superintendent and Assistant Superintendent's office. The duty of the clerical division is to prepare all ordinances, resolutions, attend to all correspondence, and to gather together printed matter, such as catalogues and reports from different cities, for the aid and benefit of the Superintendent and Assistant Superintendent, also to assist in compiling all reports.

Division of Land:

The division of land consists of the Forester, Gardener and his assistants. His duties are to oversee all lands pertaining to the department, to make reports on the different classes and varieties of trees, shrubs, and flowers and report anything in connection with land soils, the different reservoirs and water sheds of which he may be in charge.

Engineering Division:

The Engineering division is in direct charge of the Hydraulic Engineer to officially advise the Superintendent as to the best methods of construction and operating the Department of Water of the City of San Diego, and of all the additions thereto, and to that end it is his duty when requested to prepare, and submit plans, details, and specifications of any work proposed to be done by the said Department and he has in his charge, and under his control, subject to the superior authority of the Superintendent, all construction work necessary for the perfection, preservation, and maintenance of the water works system, and of all employees connected therewith. He has charge of all the maps, diagrams, service reports, papers, records, and data of every description, pertaining to said water works system, and keep and maintain them, as the records of his office, in the Department of Water. The said Engineer is, upon request of the Superintendent of the Water Works, supposed to do all necessary surveying required in the prosecution of such work as may be done under the direction of the Hydraulic Engineer, and furnish him full reports of such services as may be necessary.

Aside from the three divisions mentioned above in connection with the Department of Water, there are three bureaus known as, The Bureau of Accountability, The Bureau of Distribution, and The Bureau of Conservation.

Bureau of Accountability: is divided into four parts.

Part One: Pertaining to all books, bills, and time keeping.

Part Two: Pertaining to the receiving of all cash and to the issuing of all orders for services and work to be done.

Part Three: Pertaining to the meters, investigation, and monthly reading of same.

Part Four: Property which pertains to the receiving and compilation of all statistics, and the keeping of stock in the yards of the Department of Water.

The Bureau of Accountability is in direct charge of a chief clerk whose duties are to have charge of the receiving of all moneys, making out receipts for same, issuing orders for the installation of new services, giving information to the different water consumers, keeping check of the finances pertaining to the Water Department, having charge of the entire accounts, and the bookkeeping, pertaining to this department, give notice to those who are delinquent in paying their water bills, adjusting such misunderstandings as may arise between water consumers and the Department of Water, making such investigations as may be necessary, in order to determine whether water is being illegally used, or if the Water Department in certain cases is getting proper returns for the water consumed. He also has under his charge and direct control all the reading of meters and reporting of same to the Bureau of Distribution for repairs when same may be out of order. His duties are to keep correct account of all property under the control of the Department of Water, keep detailed statistics of all the pipe that is laid in the ground, location of all the valves, hydrants, and service pipes, the size of all mains, and to this end the department has compiled and prepared a complete printed list of every known gate-valve, and hydrant in the city, and bound them in the form of loose-leaf books, giving size and location of same, and every foreman and official who has any connection whatsoever, with the outside working of the system, has a copy of same. The inspection of all faulty gates is under his supervision, and repair orders are issued from this office. All pipes, valves, fittings, and other material connected with the Department of Water, and the inventory of same, is in the charge of the Bureau of Accountability until same is laid in the ground and a proper receipted record is returned to the chief of this bureau, by the Chief of the Bureau of Distribution.

The connecting link between the Bureau of Accountability and the Bureau of Distribution, and Bureau of Conservation, is formed by three classes of orders, viz:

Form No. 61, Work Orders; Form No. 62, Service Orders and Form No. 9, Extension Orders.

Channels for Form 61, Work Order.

Upon receiving a written order from the Superintendent, Assistant Superintendent, or Resolution of Council, the Chief Clerk issues a Work Order, known as Form 61, to any or all of the various foremen for execution.

Form 61 is made out in triplicate—Original (white), 2nd sheet (blue), and 3rd sheet (yellow). After being properly filled out by the Chief Clerk and retaining the 3rd copy for his files he will pass the Original and 2nd copies to the Statistician who places a drawing on the reverse side of the original in space set aside for this purpose, after which they are sent to the Assistant Superintendent for approval, who takes the 2nd copy for his files and sends the Original to the foreman to whom addressed for execution.

The foreman will send the original back to the Assistant Superintendent as soon as the work is completed, the Assistant Superintendent then sends it to the office of the Chief Clerk, where the actual cost data is inserted by the bookkeeper, and the new work entered on the official maps by the Statistician, and the Meter Registrar takes his portion through the Addressograph for collection of revenue, then the Chief Clerk takes his yellow copy and pastes it to the Original, ready for the Department files.

Channels for Form 62, Service Orders.

Form No. 62, known as Service or Tap Orders, are made out in triplicate. No. 1 is a pale green, No. 2 pink and No. 3 is a white color.

This order is issued by the Service Clerk at the window where applications for water are made, then sent to the Chief Clerk who has them checked by the Statistician, and sent to the Assistant Superintendent for approval, he retains the white copy No. 3 for his office files.

The Assistant Superintendent then issues to the Foreman of Services who retains a copy, No. 1, and issues copy No. 2 to one of the service wagons for actual execution. The man in charge of this service wagon enters labor and material data on copy No. 2 and returns it to the foreman of services who copies this data on sheet No. 1, returning same to the Assistant Superintendent, and retaining copy No. 2 for his files. Copy No. 1 is then sent to the office of the Chief Clerk, where the cost data is entered by the book-

keeper and passed to the Statistician who enters the service on the plat books, showing actual locations, date installed, etc. Then copy No. 1 is handed to the Meter Registrar who makes a plate with Typograph from which water bills are printed each ensuing month. Copy No. 1 is then filed for future reference.

*Channels for Form No. 9, Petition to City Council,
For Extension of Water Mains.*

Form No. 9 is a single copy made out by the applicant for an extension of city water mains in order to secure privilege of city water.

After same is properly filled in and signed by applicant, it is given to the Service Clerk, who sends it to the Chief Clerk together with one or more Service Orders. Chief Clerk has them all approved and verified by the Statistician; then the Chief Clerk takes the Service Orders from the petition and inserts the required data on the back of same and sends to the Superintendent for signature, passing it then to the stenographer who sees that the City Clerk gets it in time for the following council meeting. After council action, the City Clerk or his deputies, return resolution covering said petition, to the Chief Clerk, who then gathers the Service orders that originally accompanied it, and issues a Working Order to cover the extension, attaching service orders thereto, all of which then go to the Assistant Superintendent, who in turn issues to the Foreman of Services. The resolution covering the action of this petition will be found on file in the City Clerk's office as well as the Superintendent's office.

Bureau of Distribution:

The Bureau of Distribution is in charge of a General Foreman, who is responsible for the work initiated in his bureau. His duties are to take all orders issued to the Bureau of Distribution and segregate and apportion same to the several sections into which his bureau is divided. It is his duty to keep an accurate report sheet showing where each of the several gangs are working; to make out, with the assistance of his section foreman the charts showing the location of the various gangs for each subsequent day, to make out orders to the Superintendent's office for all material needed to supply the depleting stock, to see that the necessary material, such as picks, shovels and work boxes are delivered in time to avoid the loss of work in the various departments, to keep account of all orders issued for stock and see that the same is delivered in ample time, to advise, from time to time, his various

section foremen the most efficient methods of pursuing their work. This bureau is divided into three sections, viz: Section of Construction, Section of Services, and Section of Operation. Each section is in charge of an assistant to the General Foreman.

Duties of the Foreman of Construction:

As assistant to the General Foreman the Foreman of Construction shall have the direct charge of laying all the cast-iron water mains as laid under the Department of Water of the City of San Diego. He shall visit the various gang bosses and advise the General Foreman from time to time regarding the amount of work being done. It shall be his duty to see that all the pipes, valves and fittings pertaining to his sections of work are delivered upon the work in plenty of time, and to this end it is his duty to inform the General Foreman of what material shall be needed for each subsequent day in order that there be no delay due to the lack of delivery of same. A daily report is made showing the length of ditch, the amount of excavation, the sizes of the pipe, the number of gates and hydrants, and the locations of same as installed each day for each gang under his supervision.

This report is transmitted to the Bureau of Accountability and recorded by the Statistician upon the official records.

Section of Services:

The Section of Services consists of laying and installing all pipes 3" and smaller, in fact any work that is done by pipe fitters is directly in charge of the Foreman of Services, who is required to install (when so ordered through the Chief of the Bureau of Accountability) all service pipes tapping the water mains as installed by the Section of Construction. He also installs all meters, meter boxes and meter box covers. All service connections are connected to the water mains by means of a corporation cock and a lead connection brought one foot inside the curb line, and a service cock and the meter installed on same. Inasmuch as 100 per cent. of all services in the Department of Water of the City of San Diego are metered, it requires a meter for each separate installation. All night troubles of any character whatsoever are under the direct charge (subject to the orders of the Superintendent, the Assistant Superintendent or the General Foreman) of the Foreman of Services, and to that end he is instructed to get out the proper crew should there be a break in any city water main, service connection, hydrant, or any trouble of a like character.

Section of Operation:

The Section of Operation is in charge of an employee known as the Foreman of Operation. His duties are to have charge of all machine work connected with the department, the repairing and testing of all meters, and such blacksmithing work as needs to be done for the Department of Water, and working in conjunction with the representative of the Bureau of Accountability he takes all pipes, valves, fittings and material from the yards of the department and delivers them as needed (upon the order of the General Foreman) to such jobs as may be designated. He is in charge of the teamsters, stablemen, automobiles, auto trucks and motorcycles, and it is his duty to report same when in need of repair, and on order from the Assistant Superintendent to place them in proper condition. It is necessary that he report from time to time the efficiency of the different pumps and make recommendations regarding the repair of same. He has the overseeing and charge of all pump stations, reservoirs and stand pipes, and the repair of all faulty gates and the reinstallation of all hydrants and such other work as may be deemed necessary by the Superintendent and his assistant.

CONSTRUCTION WORK UNDER BOND ISSUE.

In reviewing the work done by the Department of Water for the year of 1912 I am pleased to call your attention to the fact that under the ordinance, No. 4152, of the bond issue of 1910 there were twelve jobs of installation, viz:

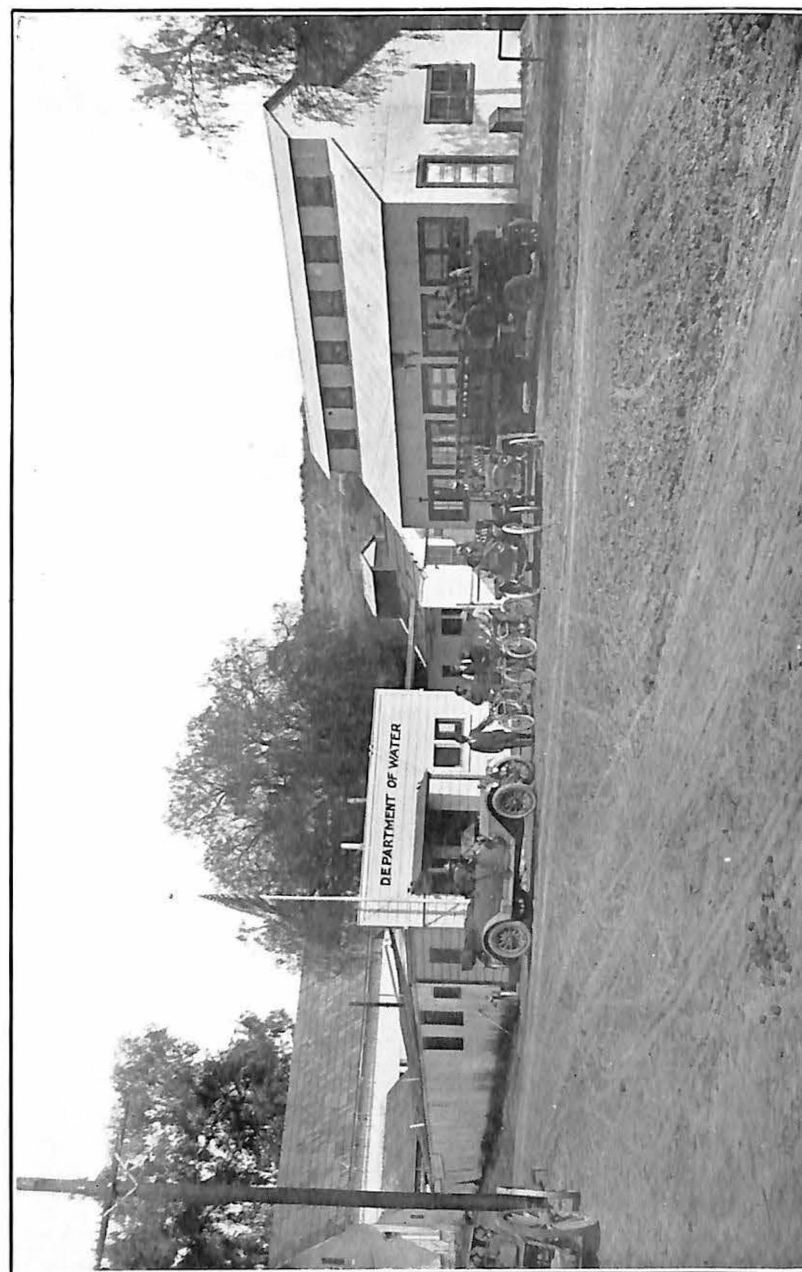
Job No. 1—Oregon street from the southwest corner of the reservoir to University Avenue, 1400 feet of 36" cast-iron pipe installed.

Job No. 2—From Oregon street to Park Boulevard, 3580 feet of 36" pipe installed.

Job No. 3—University Avenue, from Park Boulevard to Fifth street, 4390 feet of 30" pipe installed.

Job No. 4—On Polk street from the southeast corner of the new University Heights reservoir to Thirtieth street, 980 feet of 30" pipe installed.

Job No. 5—Thirtieth street, from Polk to Juniper, 8090 feet of 30" pipe installed. This work was carried in 1912 as far as Laurel street. A continuation of the work is being prosecuted at the present time.



REPAIR SHOPS—DEPARTMENT OF WATER

Job No. 6—On Thirtieth street, from Juniper to "B", 4150 feet of 24" pipe to be installed. Nothing has been done on this work except that the pipe is laid on the ground. This job will be installed in this coming year.

Job No. 7—2930 feet of 16" pipe on "B" street from Thirtieth to Twenty-fifth. This pipe is installed.

Job No. 8—There was 360 feet of 16" pipe installed on Twenty-fifth street from "B" to "C".

Job No. 9—El Cajon Avenue. There was to be 1640 feet of 16" pipe from the city limits to Idaho street and 3720 feet of 16" cast-iron pipe from Idaho to Park Boulevard. There was nothing done on this job aside from the delivery of the pipe upon the ground.

Job No. 10—16,000 feet of 12" pipe was installed on the Old Town flats from the intersection of Stephens and Lewis streets to the Lower Point Loma reservoir.

Job No. 11—There was installed 21,000 feet of 10" pipe from Pacific Beach to the La Jolla reservoir.

Job No. 12—This consists of 2650 feet of 12" pipe on University Boulevard from El Cajon avenue to University avenue. Nothing was done in 1912 on this work aside from the delivery of the pipe upon the ground.

Aside from the installation of the above work under bond issue would say that I have put the smaller of the two University Heights reservoirs in good repair, it having been discovered that there was a serious leak along the entire south end and a quarter of the distance of the western side. It was necessary to break two feet of the bottom of the reservoir and lay a tile drain, and put in a new footing to the side wall. At the present time it is in first class condition.

All of the various trestles carrying pipes across gullies and deep gulches were in a bad state of decay and in many cases on the point of giving away. During 1912 these were rebuilt or thoroughly repaired, and the pipes leading across same have been painted and protected from the elements.

The department has purchased a large tapping machine and is now able to install hydrants and new mains from the large feeders, in size up to and including 8" in diameter, without the necessity of shutting off the water from the consumers.

SERVICES.

On account of the several miles of paving placed in the streets of San Diego it has been necessary to install over 800 service connections in the past year as well as lower several thousand feet of pipe. Some of this pipe, for instance on Fort Stockton Drive, was as large as 18" in diameter, and it was a case of where we had to lower under pressure to an additional depth of three feet 3000 feet of pipe and I am pleased to inform you that there was no serious accident in any of the above work.

Aside from the renewal of the above services there were 2241 new services installed, being an increase of 645 over 1911. This meant 61,217 lineal feet of service pipe laid. There were a great many leaks repaired and the auto service wagon was used almost continually day and night on the installation of services and the repairing of the mains, and I recommend for the year of 1913 that three auto service trucks of a capacity of not less than one and one-half tons replace the six horse-drawn vehicles which we at present utilize.

At the present time we have one Metz runabout automobile, one Maxwell runabout, the Assistant Superintendent has an Overland four passenger automobile, aside from the above mentioned auto truck. Besides the above there are two twin-cylinder motorcycles and one single cylinder motorcycle, used by the Inspector, the Foreman of Operation and the Chief Meter Reader. I recommend the purchase of two more motorcycles and two additional runabouts. I furthermore recommend the purchase of a five-ton chain-driven truck for the conveying of the large material to the different jobs and the hauling of the pipe as purchased under bond issue of Ordinance No. 4685.

As a review of the work done under the Bureau of Distribution I have prepared for your benefit tables showing work done in Section of Construction, the Section of Services, and the Section of Operation:

BUREAU OF CONSERVATION.

The Bureau of Conservation is under the direct charge of the Supervisor, and is divided into three sections, Conduits, Reservoirs and Pipe Lines.

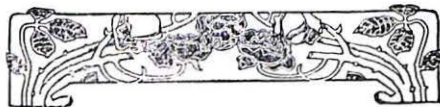
Section of Conduits:

The conduits include all the concrete flume lines and the wooden flume trestles between the proposed Barrett reservoir and

the outlet of the Dulzura Conduit into the Dulzura Creek, a distance of about 13½ miles, a description of the same I have mentioned in the early part of this report. There are thousands of feet of tunnel passing through the mountains which have to be continually looked after, especially during the rainy season. The wooden flumes passing across the high trestles are in constant danger of fire and it is necessary that they have the closest supervision for fear that they may be destroyed during the dry season by fire and during the rainy season by washouts. These are looked after by a foreman and a conduit walker.

Section of Reservoirs:

The reservoirs, together with the watersheds, are divided into four parts: the Upper and Lower Otay reservoir and watersheds, the Chollas Heights reservoir and watershed, the Morena reservoir and watershed and the Barrett reservoir watershed. Each of these watersheds have a caretaker, and in addition to a caretaker at the Otay reservoir watersheds there is an overseer, whose duty is to look after the various pipe lines and inspect the outlet valves daily and to see that the watersheds are properly protected from contamination, and report any trespassing upon the city's reserves. At the Chollas Heights reservoir watershed the caretaker has charge of the filtration plant that takes the water as it eventually reaches this filtration plant from the various impounding reservoirs, whose duty is to operate the filtering plant and look after the repair and cleansing of same. The caretaker at Morena and Barrett reservoirs gives constant supervision to the watersheds and reports any trespassing and gives notice of any dangerous condition due to the dams or headworks of these reservoirs, as well as making a daily report of the amount of water impounded or let out of these reservoirs through the conduits. The pipe lines from the Lower Otay reservoir into the City of San Diego are in charge of a pipe line foreman, whose duty is not only to inspect the line, but also to repair and make the necessary improvements to keep the pipe lines in first class condition. He has supervision over twenty miles of continuous wood stave pipe varying in size from 20" to 42" in diameter, and is assisted by two pipe walkers.



IV.

REPORT OF THE CHIEF CLERK

SAN DIEGO, CAL., Jan. 16th, 1913.

MAJOR HERBERT R. FAY,

Superintendent Department of Water, City of San Diego.

SIR:

In accordance with your letter of the 15th inst. I have the honor to submit herewith the following data from the records of the Bureau of Accountability, consisting of the financial status of the Department of Water, its Statistics and Operations for the year of 1912.

Respectfully submitted,

H. L. WORTHEN, *Chief Clerk,*

BUREAU OF ACCOUNTABILITY.



RECEIPTS.

Balance in City Treasury, Jan. 1st, 1912.....	\$ 98,072.22	
Receipts from—		
Public Consumers	\$224,620.73	
Municipal Consumers	9,182.05	
Meters and Services.....	48,825.89	
Service Renewals	368.15	
Sale of Material	3,314.28	
Miscellaneous	370.57—	286,681.67
Transfer of Funds		9,316.89
Bureau of Public Works80
Refunds		32.57
Cancelled Warrant		290.33
Auction Sales of Material.....		523.50
Total		\$394,917.98

DISBURSEMENTS.

Water Fund—		
Accounting	\$ 18,910.66	
Construction	160,670.61	
Operating—		
Water Purchased	\$84,128.80	
Other Operating	27,037.64—	111,166.44
Maintenance		11,195.08
Legal		150.00—
Water Addition Fund, Construction.....		\$302,092.79
Balance in City Treasury, Dec. 31, 1912.....		83,788.78
		9,036.41
Total		\$394,917.98

Receipts from all Sources during the year 1912

Month	Public Consumers	Municipal Consumers	Meters & Services	Service Renewals	Sale of Material	Miscellaneous	Total
January	15717.02	476.81	2750.70		298.15	9.00	19251.68
February	15258.62	257.45	3269.00	6.50	5.00		18796.57
March	17498.16	431.30	3765.00	233.65	255.83	14.95	22198.89
April	15944.95	17.90	3338.00		75.60	18.00	19394.45
May	16456.07	227.95	3485.00			.50	20169.52
June	18910.07	2745.73	4209.52	78.00	520.27	14.00	26477.59
July	19452.16	845.19	4260.02		57.88	61.65	24676.90
August	21669.90	807.25	4375.50	40.00	562.21	11.00	27465.86
September	22047.90	704.03	4192.50	10.00	1019.05	21.50	27994.98
October	20873.09	1664.62	4359.00		189.79	19.50	27106.00
November	20343.71	572.54	5273.00		272.25	66.50	26528.00
December	20449.08	431.28	5548.65		58.25	133.97	26621.23
Total	224620.73	9182.05	48825.89	368.15	3314.28	370.57	286681.67
Average	18718.39	965.17	4068.82	30.68	276.19	30.89	23890.14

FOURTH ANNUAL REPORT

Disbursements for the year 1912

. W A T E R F U N D							Bond Issue	Total
Month	Water Purchased	Accounting	Mainten- ance	Operating	Construc- tion	Construc- tion	Total	
January	5491.60	1028.65	500.50	2780.55	1782.63	56124.22	67708.15	
February	5296.00	1237.60	1480.44	1204.87	3725.13	20232.29	33176.33	
March	6798.40	1824.63	592.55	2488.05	15859.18	7155.13	34717.94	
April	4692.80	1598.81	1128.59	1825.08	14875.46	242.14	24362.88	
May	5190.40	1566.95	697.89	1882.22	43375.85	35.00	52898.31	
June	7344.80	1765.25	718.81	1664.04	15238.92		26731.82	
July	8635.20	1477.90	772.85	1973.59	10515.79		23375.33	
August	8284.00	1526.45	690.25	716.34	13825.68		25042.72	
September	9260.40	1397.75	701.15	1706.28	12292.79		25358.37	
October	8656.40	1903.58	1211.47	3526.37	12774.81		28072.63	
November	7424.00	1846.99	781.45	3027.58	8599.26		21679.28	
December	7054.80	1736.10	1919.13	4242.67	7805.11		22757.81	
Totals	84128.80	18910.66	11195.08	27037.64	160670.61	83788.78	385881.57	
\$150,00	legal expense in May							

DEPARTMENT OF WATER

Disbursements

Water Fund.

ACCOUNTING—Salaries, Office Furniture, Stationery and Printing.
 CONSTRUCTION—Labor and material expended for extensions and improvements to the system, including the replacing of old and small mains to precede street paving.
 OPERATING—Toll for the acquisition of the water supply, and labor and material expended in its distribution.
 MAINTENANCE—Labor and material expended for the upkeep of the water system.

Water Addition Fund.

(Bond Issue)

CONSTRUCTION—Labor and material expended to lay Point Loma line, La Jolla line, University Avenue line and Oregon Street line.

The receipts for the year 1912 from water delivered to consumers were \$233,802.78; from installations of meters and services, \$48,825.89; from service renewals, \$368.15; from sales of material, \$3,314.28; and from miscellaneous sources, \$370.57; making a total of \$286,681.67, an increase of \$51,481.12 over the receipts for 1911.

The disbursements for the year (exclusive of bond issue) were \$302,092.79, being \$8,825.43 less than for 1911.

The amount of water purchased from the Southern California Mountain Water Company during 1912 was 2,141,120,000 gallons, an increase of 278,750,000 gallons over last year.

The average daily distribution of water was 5,723,817 gallons, which was approximately 75.23 gallons per capita.

The largest monthly consumption was 227,277,608 gallons in July, and the largest daily, 9,798,909 gallons on August 19th, by far the greatest quantity of water used in one day in the history of the city.

The net increase in the number of meters in service was 2,402, making a total of 12,681 in use on December 31st, 1912.

The number of fire hydrants in service on the same date was 785, being 48 more than for the preceding year.

During the current year 146,919', or 27.82 miles of mains were laid, making a total of 368.02 miles in service.

The number of new services installed was 2,241, and old services renewed, 813.

Of 43 cities in California, with water rates ranging from eight to seventy-five cents per thousand gallons, San Diego, with her eight cent rate, is one of the lowest. When it is remembered that several eminent chemists have rendered the most favorable reports on the quality of our water supply, this low rate becomes a source of great satisfaction to the citizens of this city.

Statement of Bond Issues

Issued January 1, 1911. Due 1948. Rate of Interest, 4 1/2 %				
Name of Issue	Amount	Interest payable	Terms of payment	Purpose of Issue
Water Addition	\$340,000	Semi-An.	\$9,000 An.	Extension of Water Mains

Issued July 1, 1912. Due 1952. Rate of Interest, 4 1/2 %				
Name of Issue	Amount	Interest payable	Terms of payment	Purpose of Issue
Water Extension	\$340,000	Semi-An.	\$8,500 An.	Extension of Water Mains

Annual Receipts from all Sources

and the increase each year since the purchase of the water system, August 1st, 1901.

Year.	Receipts.	Totals.	Annual Increase.
1901 (5 mo.)	\$ 32,766.65		
1902	86,418.00	\$ 119,184.65	\$53,651.35
1903	89,704.22	208,888.87	3,286.22
1904	97,771.25	306,660.12	8,067.03
1905	103,455.38	410,115.50	5,684.13
1906	121,542.83	531,658.33	18,087.45
1907	125,401.71	657,060.04	3,858.88
1908	150,458.84	807,518.88	25,057.13
1909	170,726.29	978,245.17	20,267.45
1910	191,376.35	1,169,621.52	20,650.06
1911	235,200.55	1,404,822.07	43,824.20
1912	286,681.67	1,691,503.74	51,481.12

Estimated Value of the System

December 31, 1912

Lands	\$ 61,900.00
Improvements	142,325.00
Rolling Stock	6,012.00
Reservoirs	130,000.00
Mains and Laterals	2,102,232.00
Gates Installed	25,540.00
Hydrants	47,100.00
Meters	103,448.00
Stand Pipes	6,500.00
Pipe in Stock	26,458.00
Supplies and Materials	7,212.00
Fittings in Stock	14,884.00
Total	\$2,673,611.00
Depreciation	393,611.00
Net	\$2,280,000.00

Summary of Statistics for Year 1912

GENERAL STATISTICS.

Population by Census of 1910, 39,000.
 Date of Purchase, August, 1901.
 By whom owned, City of San Diego.
 Source of Supply, Drainage of the watersheds of Pine Valley, Cottonwood Creek, Dulzura Creek, Otay River.
 Mode of Supply, Gravity.
 Filtration, Yes.

FILTRATION STATISTICS.

1. Builders of Filters, New York-Jewell.
 Type, Horizontal Pressure.
 Total Capacity, 7,500,000 gallons.
2. Is water pumped to filters? No. It is gravity flow.
3. Total gallons filtered per year, 2,094,917,138 gallons.
 (a) Total wash water used 26,000,000 gallons.
 (b) Average per cent. wash water 1.3% gallons.
4. Description of Coagulants, Sulphate of Alumina.
5. Per cent. Sulphate of Alumina in alum used, 10 parts per million.

Statistics of Consumption of Water

1. Estimated total population at date, 76,000.
2. Estimated population supplied, 76,000.
3. Total consumption for the year, 2,094,917,138 gallons.
4. Passed through meters, 2,094,917,138 gallons.
5. Percentage of consumption metered 100%.
6. Average daily consumption, 5,723,817 gallons.
7. Gallons per day to each inhabitant, 75.23 gallons.
8. Gallons per day to each consumer, 75.23 gallons.
9. Gallons per day to each tap, 451.37 gallons.
10. Cost of supplying water, per million gallons, figured on total maintenance plus interest on the value of the property, \$198.00.
11. Cost of supplying water, per million gallons figured on total maintenance (Item CC), 10c per 1000 gallons.

Statement of Water Received

From the Southern California Mountain Water Company, and water supplied to consumers during the year 1912.

MONTH	Number of gallons received from the S. C. M. W. Co.	Number of gallons supplied to consumers
January	137,210,000	135,901,795
February	164,780,000	164,547,265
March	118,480,000	133,091,913
April	134,820,000	134,192,056
May	195,020,000	193,508,648
June	209,430,000	210,535,715
July	216,700,000	227,277,608
August	222,640,000	163,687,734
September	207,550,000	212,100,791
October	187,870,000	186,738,775
November	174,050,000	173,502,748
December	172,570,000	159,832,090
Total	2,141,120,000	2,094,917,138
1911	1,862,370,000	1,820,926,497
Increase 1912	278,750,000	273,990,641

Receipts

Balance Brought Forward—	
(a) From ordinary (maintenance) receipts.....	\$ 23,603.83
(b) Receipts from bonds, etc.....	74,469.39
Total	\$ 98,072.22
A. Meter rates	\$221,765.16
B. Miscellaneous earnings, building purposes, etc.....	2,855.57
C. Total from consumers.....	\$224,620.73
D. For hydrants	\$ 1,535.45
E. For street watering.....	3,477.23
F. For public buildings	343.05
G. For miscellaneous use	3,826.32
H. Total from municipal departments.....	\$ 9,182.05
I. From bond issue of 1912.....	\$340,000.00
J. From other sources	1,585.92
K. Advanced by city for bond interest.....	9,316.89
L. Service Construction	29,192.74
M. Meter Sales	19,633.15
N. Construction Material	3,314.28
Total	\$394,917.98

Expenditures

Operating, Expenses, Renewals, Etc.	
AA. Operation (management and repairs).....	\$ 27,037.64
BB. Special: Water purchased	84,128.80
CC. Total Operating	\$111,166.44
WATER WORKS CONSTRUCTION:	
DD. Extension of mains.....	\$ 83,788.78
EE. Construction	160,670.61
FF. Total construction	\$244,459.39
GG. Unclassified legal expenses	150.00
HH. Accounting	18,910.66
II. Maintenance	11,195.08
JJ. Balance—	
(aa) Ordinary	9,036.41
Total balance	9,036.41
KK. Total	\$394,917.98
Disposition of balance—	
L. Net cost of works to date, \$2,500,000.00.	
M. Average rate of interest, 4½%.	

List of Charitable and Other Institutions Supplied with Water at Less than Regular Rate, 1912

Talent Workers, Eighth and Robinson Streets.....	\$1.00 per annum
Seaman's Rest, Foot of H Street.....	\$1.00 per annum
San Diego Industrial School, National Avenue and Beardsley Street	\$1.00 per annum
King's Daughters, 1744 First Street.....	\$1.00 per annum
Children's Playground, Eleventh and I Streets.....	\$1.00 per annum
Children's Home, Sixteenth Street and Balboa Park..	\$1.00 per annum
Helping Hand Day Nursery, Twenty-third and G Sts..	\$1.00 per annum
Twenty Churches5c per 100 cu. ft.
Twenty-one Schools5c per 100 cu. ft.
All Municipal Departments5c. per 100 cu. ft.

Mains—Services

MAINS—

1. Kind of Pipe—Cast-iron.
2. Sizes—From 2" to 36".
3. Extended 146,919 feet during year.
4. Total now in use—368.2 miles.
5. Length of pipes less than 4" in diameter—190.65 miles.
6. Number of hydrants added during year, public and private—48.
7. Number of hydrants, public and private, now in use—785.
8. Number of stop gates now in use—1886.
9. Number of stop gates smaller than 4"—779.
10. Range of pressure on mains—10 lbs. to 150 lbs.

SERVICES—

11. Kind of pipe—Wrought iron dipped.
 12. Sizes— $\frac{3}{4}$ " to 6".
 13. Extended—61,217 feet.
 14. Number of service taps added during year—2,241.
 15. Number on and in use—12,681.
 16. Average length of service—15 feet.
 17. Number of meters added—2,527.
 18. Number now in use—12,681.
 19. Percentage of services metered—100%.
 20. Percentage of receipts from metered water (B-C)—100%.
- Payments (monthly). In advance (No).

Schedule Meter Rates

Highest rate per 1000 Gallons.....10 cents
 Lowest rate per 1000 Gallons.....7½ cents.
 Meter bills payable monthly.

MINIMUM ANNUAL METER RATES.

$\frac{5}{8}$ "—\$1.00. $\frac{3}{4}$ "—\$1.00. 1"—\$1.00. 2"—\$1.00. 4"—\$1.00.
 Meter rent per annum. No rent.
 How often collected?—Monthly.
 Meters furnished by the City.
 Average price paid by City for fire hydrants each, per annum,—
 \$25.00 rental.
 Automatic sprinkler, for fire supplies—Yes.
 Metered or unmetered—Metered.

STATISTICS OF WATER SUPPLIES OF CITIES OF CALIFORNIA.												
CITY	COUNTY	Rate per 1000 gallons	Average rainfall, inches.	The source of supply	Is the water purified	Capacity of reservoirs gallons	Are the distributing reservoirs covered	Mileage of water pipe.	No. of fire hydrants	Number of taps	Daily consumption in gallons per inhabitant	Number of meters in use
Berkeley	Alameda	.35	24	Wells	Yes	73000000	No	190	354	-	45	10000
Escondido	San Diego	.13	16	Gravity system	No	99400000	No	14	12	449	18	440
Livermore	Alameda	.20	16	Wells	No	750000	Yes	21	36	600	225	75
Los Angeles	Los Angeles	.10	32	Gravity	No	898000000	Yes	540	3600	75000	-	51200
Modesto	Stanislaus	.20	13	Wells	No	200000	Yes	21	150	1703	225	-
National City	San Diego	.25	10.5	Sweetwater River	Yes	11542000000	No	79	46	1950	47	843
Palo Alto	Santa Clara	.12	15	Wells	No	350000	Yes	20	117	1350	84	1250
Pasadena	Los Angeles	.135	20	Wells, etc.	No	68000000	Yes	170	471	10500	128	8500
Pomona	Los Angeles	.20	12	Wells	No	1000000	Yes	85	248	3000	300	1800
Redlands	San Bernardino	.16	13	Wells	Yes	12000000	No	45	62	3000	300	700
San Bernardino	San Bernardino	.13	17	Wells	No	27500000	Yes	80	300	3800	380	180
San Diego	San Diego	.10	10.5	Gravity system	Yes	41907250000	Yes	368	785	12681	102	12681
San Francisco	San Francisco	.30	24	Gravity system	No	29000000000	No	560	4384	61000	87	18000
San Jose	Santa Clara	.25	15	Wells	No	220000000	Yes	187	411	9500	175	3537
Santa Ana	Orange	.13	10	Wells	No	9000000	Yes	25	180	3330	145	2200
Stockton	San Joaquin	.25	15	Wells	Yes	1500000	Yes	45	250	6000	140	600
Santa Barbara	Santa Barbara	.20	18	Gravity system	No	3000000	No	53	225	3300	170	2118
Suisun	Solano	.50	26	Wells	No	70000000	Yes	9	29	275	60	50
Vallejo	Solano	.20	17	Wells	No	100000000	No	50	150	2500	150	1200

Impounding System

Name	Type	When Built	Capacity (gallons)	Elevat'n Top	Elevat'n Outlet	Area of Reservoir (acres)	Area of Watershed (sq. mls.)
Chollas Hts.	Earth Fill and Steel Plate	1901	90,000,000	432'	390'	17
Lower Otay	Rock Fill and Steel Plate	1895-97	13,000,000,000	484'	400'	1000	80
Upper Otay	Arched Concrete	1901	1,090,000,000	555'	521'	164	20
Barrett	Arched Concrete or Rock Fill	Proposed	15,000,000,000	1621'	1506'	936	185
Morena	Rock Fill	1912	15,000,000,000	3032'	2913'	1370	135

Distributing Reservoirs

Name.	Built Date	Construction.	Elevation.	Capacity Gallons.	Condition.
University Heights, Old	1886	Concrete in Excavation Light Emb't.	396.0 Top. 383.5 Bot.	3,172,000	Good
University Heights, New	1909	Reinforced Concrete High Emb't.	396.0 Top. 383.5 Bot.	17,620,000	Good
Old Town	1887	Concrete lined High Emb't.	157.0 Top. 144.0 Bot.	3,620,000	Poor
Lower Point Loma	1909	Concrete lined High Emb't.	344.0 Top. 335.0 Bot.	382,000	Good
Upper Point Loma	1886	Excavation	385.0 Top. 371.0 Bot.	1,190,000	Poor
Pacific Beach	1909	Excavation & Embankment Concrete lined	297.0 Top. 285.0 Bot.	2,400,000	Good
La Jolla	1909	Excavation & High Emb't.	265.0 Top. 250.0 Bot.	988,999	Good
Stand Pipe at University Heights	1910	Steel on Earth and Concrete Base	448.4 Top. 396.0 Bot.	490,000	Good
Stand Pipe at Point Loma	1910	Steel on Earth and Concrete Base	435.6 Top. 388.0 Bot.	442,965	Good

All the above reservoirs, with the exception of the two stand pipes are covered and screened.

Mains Laid During the Year 1912

	1"	2"	4"	6"	8"	10"	12"	16"	24"	30"	36"	Total
Jan		2169			16							2135
Feb		4441						7940		4366	3930	20677
Mar		11785				4918	703					17516
Apr		6330		312	808	931	2860	108	670			12059
May		6200			144							6681
June		10430	3149	2377	100			70		3592		20242
July		10731	1000	790								13272
Aug		4672	1278	796								6925
Sept		5250		75	206					1708		7239
Oct		6786		2280	1870		84					11020
Nov		17013		78	170		76					17337
Dec		11766										11766
Total	1301	97573	5427	6708	3314	5849	3723	8118	670	9666	3930	146919

Statement of New Services, 1912

Month	3/4" Pipe			One Inch			One and half inch			Two Inch			Over Two Inches			Total		
	No.	Pipe	Lead	No.	Pipe	Lead	No.	Pipe	Lead	No.	Pipe	Lead	No.	Pipe	Lead	No.	Pipe	Lead
January	184	4876'	307'	4	106'	8'	1	21'	3'	4	126'	12'				193	5129'	330'
February	170	4487	284	1	28	2	2	48	4	2	80	4	1	Six inch 41	3	176	4684	297
March	172	4106	258													172	4106	258
April	190	4781	285	6	223	10	1	12	2	2	47	4				199	5063	301
May	118	2751	177	5	232	8				1	14	2				124	2997	187
June	185	5001	278	5	161	9	1	38	2	5	157	12	1	Six inch 15	3	197	5372	304
July	213	5770	320	5	84	8	5	90	12	12	268	24				235	6212	364
August	191	5777	287	6	184	12	3	165	8	13	379	32	1	Three inch 9	3	214	6514	342
September	169	4528	253	6	329	10	4	95	8							179	4952	271
October	127	5962	161	11	197	12				4	102	7				142	6261	180
November	203	5077	271	19	173	32	2	36	4	10	301	20	2	Four inch 50	3	236	5637	330
December	158	3902	210	6	122	10	1	15	2	7	231	25	2	Three inch 20	6	174	4290	253
Total	2080	57018	3091	74	1839	121	20	520	45	60	1705	142	7	135	18	2241	61217	3417
1911	1532			25			10			22			7			1596		
Increase	548			49			10			38						645		

FOURTH ANNUAL REPORT

Statement of Renewed Services for the Year 1912

Month	3/4 inch			One inch			One and half inch			Two inches			Total		
	No.	Pipe	Lead	No.	Pipe	Lead	No.	Pipe	Lead	No.	Pipe	Lead	No.	Pipe	Lead
January	138	2505'	40'	14	378'	28'				5	530'	15'	157	3413'	83'
February	16	319	9	11	287	22				1	232	3	28	838	34
March	12	314	1 1/2	73	1928	70				1	25	2	86	2267	73 1/2
April	12	271	18	12	328	20				1	35	2	25	634	40
May	17	349	8	78	2240	130				2	50	4	97	2639	142
June	18	540	26										18	540	26
July	57	2115	86				1	10	3				58	2125	89
August	32	910	49	58	1691	97				2	75	3	92	2676	149
September	44	1023	74							2	208	4	46	1231	78
October	36	1084	48	1	1	1 1/2							37	1085	49 1/2
November	116	2842	155	4	131	7				2	37	4	122	3010	166
December	46	1647	75 1/2	1	17	1 1/2							47	1664	77
Total	544	13919	590	252	7001	355	1	10	3	16	1192	34	813	22122	1007
1911	427			74						6			507		
Increase	117			178			1			10			306		

DEPARTMENT OF WATER

COMPARATIVE STATEMENT of the number of miles of pipe in service.			
Size	Dec. 31, 1911	Dec. 31, 1912	Increase.
3/4"	50.	60.31	10.31
1"	4.	4.45	.45
1 1/2"	.90	.90	
1 1/2"	.60	.70	.10
2"	100.31	119.07	18.76
2 1/2"	1.27	1.27	
3"	3.78	3.78	
4"	60.41	61.45	1.04
5"	.28	.28	
6"	38.56	39.84	1.28
7"	.41	.41	
8"	13.65	14.29	.64
10"	16.26	17.37	1.11
12"	26.18	26.89	.71
16"	4.53	6.07	1.54
18"	2.49	2.49	
20"	.78	.78	
24"	.86	.99	.13
26"	1.16	1.16	
28"	1.00	1.00	
30"	.83	2.66	1.83
36"	1.12	1.86	.74
Total	329.38	368.02	38.64

List of Gate Valves used in the Department of Water,
City of San Diego, California

1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	16"	20"	24"	30"	36"
4	5	770	5	450	300	89	114	113	19	1	11	3	1

Total number of gates in use, 1885.

Month	STATEMENT OF METERS SET AND REMOVED DURING THE YEAR 1912.													Total Set	Total Removed	Net			
	5/8"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	16"	20"				24"	30"	36"
Jan.	159		1	2	2												164	12	152
Feb.	132		3	1													136	1	135
Mar.	231		1														232	3	229
Apr.	188	1	3	1	4												197	5	192
May	193		2	1	1												197	1	196
June	197	X	4		5			2									208	12	196
July	217		2	3	10												232	1	231
Aug.	196		6	2	11	2											218	6	212
Sept.	179		4		4												187	11	176
Oct.	236		8	2	4												250	25	225
Nov.	210		11		8												229	16	213
Dec.	255	1	9		9	3											277	32	245
Total	2393	3	54	12	58	5	2	2	2	2	4	2	1	2	2	1	2527	125	2402
1911	1532		25	10	22	4	2	2	10	2	2	2	1	2	2	1	1596	126	1470
Increase	861	3	29	2	36	1	0	1	0	1	0	1	1	0	1	1	931	1	932

Statement of Fire Hydrants, 1912

Month	Placed	Removed	Net
January			
February			
March	2		2
April			
May	22		22
June	10	2	8
July	8	2	6
August	3	1	2
September	2		2
October	6		6
November			
December			
Total	53	5	48

COMPARATIVE STATEMENT
of Fire Hydrants in service.

December	1910		623
December	1911		737
December	1912		785

List of Cast-Iron Pipes to be laid in 1913 by the
Department of Water, San Diego, Cal.

Job.	Size.	Class	No. of Ft.	On Street	From Street	To Street
A	10"	B	562	D	Arctic	Atlantic
B	10"	B	549	Juniper	Arctic	Atlantic
D	12"	B	1140	30th	National	Main
E	12"	B	2760	Main	30th	Schley
F	12"	B	1350	26th & Schley	Pierce	National
G	12"	B	4620	Pierce	Schley	Sigsbee
H	12"	B	1520	Sigsbee	Pierce	Logan
I	12"	B	1270	National	Sigsbee	N
J	12"	B	5440	S. F. Rt. Way	G	N
K	12"	B	5450	Atlantic	G	Juniper
L	12"	B	1520	Evans	Logan	Pierce
M	12"	B	1340	Date	Front	Arctic
N	12"	B	2800	16th	H	1400-A Park
O	12"	B	560	A	Arctic	Atlantic
P	16"	B	6500	Park Blvd.	University	C. of Park
Q	12"	B	1400	Laurel	Front	Fifth
R	12"	B	3040	Front	Laurel	Date
S	16"	B	7360	L	16th	32nd
T	24"	B	5600	30th	Ash	N
U	24"	B	6300	Park Blvd.	C of Park	10th & A
V	12"	B	3020	25th	F	N
W	12"	B	2160	N	9th	16th
X	12"	B	1860	Front	Date	B
	8"		1840			B
Y	6"	B	2700	State	Date	Kalmia
Z	12"	B	200	8th	M	200' S
AA	12"	B		Schley	Pierce	26th
BB	8"	B	1740	Woolman	30th	East
CC	8"	B	80	K	E-L, 22nd	W-L 22nd
DD	8"	B	1320	K	30th	32nd
EE	8"	B	1680	J	20th	25th
FF	8"	B	3420	20th	D	N
GG	8"	B	1530	28th	National	Colton
HH	8"	B	640	6th	Univ. Ave.	Washington
II	8"	B	300	Washington	5th	6th
JJ	12"	B	125	Columbia		Across D
KK	12"	B	325	Columbia	A	B
LL	12"	B	125	State		Across D
MM	12"	B	325	State	A	B
NN	12"	B	470	Union	C	D
OO	12"	B	325	Union	A	B
PP	12"	B	125	Front		Across D
QQ	12"	B	325	Front	A	B
RR	10"	B	125	First		Across D
SS	10"	B	125	Second		Across D
TT	10"	B	80	Second		Across D
VV	12"	C	1400	Date	5th	Front

V.

Letter from Rudolph Wueste, Assistant Engineer
Southern California Mountain Water Company

BARRETT DAM, Dulzura Post Office, Calif.,
January 13, 1913.

MAJOR HERBERT R. FAY,
Superintendent of the Department of Water,
San Diego, California.

DEAR SIR:

I have at hand a copy of your request for data for your annual report with manuscript request that I participate in same. Delay in receiving this invitation and press of work has made it impossible to concentrate on the matter until now.

Trusting that this will arrive in time to be of use to you,
I am

Very truly,

R. WUESTE, *Asst. Engr.*



ANNUAL REPORT.

I take pleasure in giving you any information I may possess on the part of the system of the Southern California Mountain Water Company with which I am connected. I assume that points you would be most interested in would be such as have a general bearing or are of a recommendatory nature. My own time at present is too short to prepare anything striving at detail; also, in order to make this letter of value to you, you probably should have it at once.

Commendable Record.

As directors and workers in the building of some of the structures of the Southern California Mountain Water Company we

have just cause for a little pride in the result we have accomplished. On one hand we worked in a pioneer field where failure was in some cases predicted; on the other hand we worked where others had failed. We worked against a great many odds. The topography of the eastern division of the Southern California Mountain Water Company's system is exceedingly rough; transportation and communication conditions were crude and unsatisfactory in exact proportion. The settlers had much of the frontiermen's attitude about them. Our work in these hills was an intrusion of the activity of the city spirit. We have all benefitted by better acquaintance.

Essentials Covered. Upon completion and commencement of operation of the Dulzura Conduit early in 1909, the next step in the logical scale of importance was immediately begun. And so it was that we worked unswervingly on the Morena Dam until its completion last summer. We are glad to say that we covered every essential in these two jobs, busy as we were. In making this statement we do not gainsay that there are some refinements that we have omitted. We believe that it will be largely these refinements that will occupy the attention that will be devoted to these two completed structures. It is always, of course, necessary to consider in this rough section where water development is so costly whether the end justifies the means. Proposed structural refinements should pass this test.

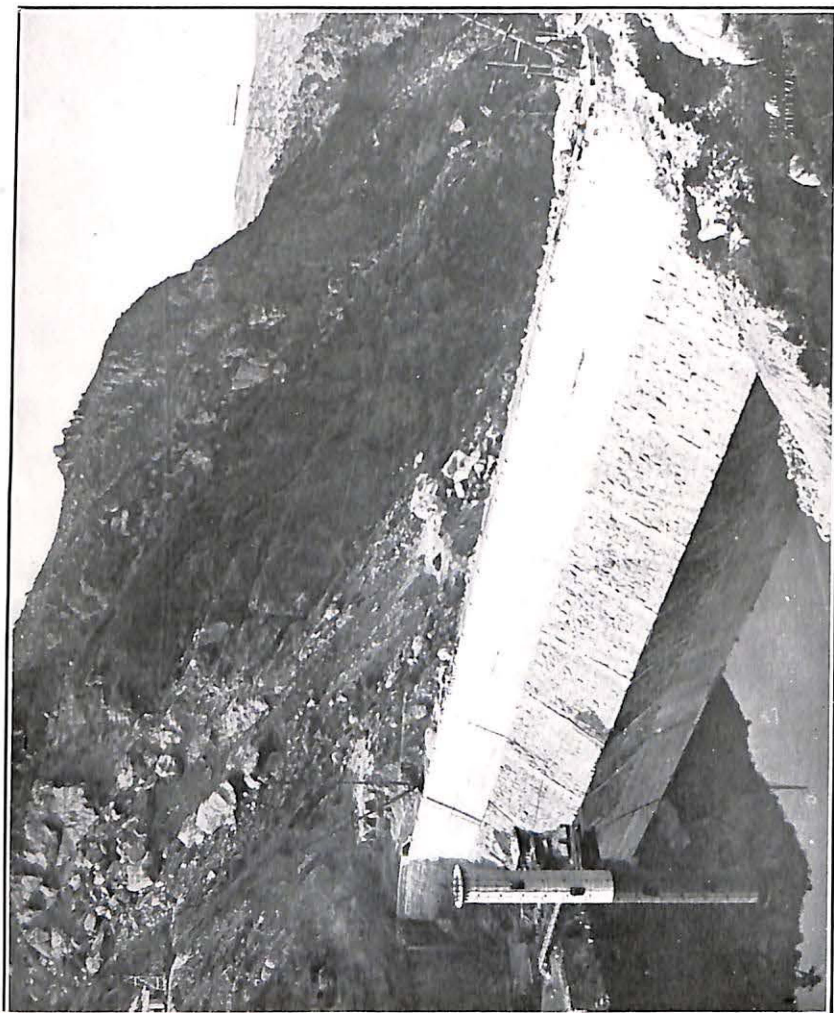
Necessity for Further Work. Preparations will also now probably be made for taking hold of other new structures. The future consideration of these was always realized and never obscured.

Morena Dam. The Morena Dam is finished and here many of the little extras have already been added. Others will doubtless crop up and will have to be met as they arise.

We do not believe that many problems in the operation of Morena have escaped us. The man in charge there has letters from me covering all of his routine work. His duties are diverse in nature. He must do everything from cowboying after cattle to operating the outlet valves.

A system of hunting and fishing permits that will make the operation of the Morena boats self-sustaining, will be welcome. Nearly \$1000.00 are tied up in the Morena boats and there will be constant expense of repainting and repairing.

The Morena keeper should be given power to make arrests. This may serve well in dealing with poachers or an attempt at anarchistic destruction of property. It should be remembered



MORENA DAM—THE LARGEST ROCK-FILLED DAM IN THE WORLD

that the one vulnerable point in the Morena structure is the Outlet Tower.

Dulzura Conduit Intake Improvements. We spent about \$3000.00 on the Dulzura Conduit in August, September and October of 1912 on a job that we designated as Number 108 and called "Intake Improvements". With unregulated diversion conditions now localized at Pine Creek, it was advisable to make conditions there safer and more convenient. This work has been finished in first class shape and will, we believe, show up well under actual working conditions this season.

Conduit Maintenance. Besides the above improvements, we spent roughly \$700.00 in our Conduit Maintenance Account over and above the salaries of the two regular Conduit employees. This sum paid for the calking and tarring of eight of the important flumes of the line and a considerable amount of fixing up around the Barrett premises.

Johnson Camp House. Also we spent another \$250.00 over and above regular salaries in the construction of a house at Johnson Camp, that would be fit for a man with a family to live in. The expenditure of these sums is a very unusual example of the bona fide policy I was allowed to pursue since the closure of the sale of our system to the City of San Diego.

Further Conduit Improvements. There are further necessary improvements that will naturally fall to the share of the new owners. Nearly all these receive general mention in a report, which I forwarded to Mr. O'Shaughnessy on October 9, 1912. Also in this same report will be found much detail that involved considerable labor to collect and which may be used as a base to work upon, whenever any of these lines of improvement are contemplated.

Cottonwood Flume. It will be advisable to carry the Cottonwood Intake upstream about 3100 feet in the shape of a trestled flume. A better temporary diversion dam-site is found at this point and elimination of sand will be made possible. Roughly this will cost \$4000.00 if the flume material on hand at present were used.

Tunnel Number One. Tunnel Number One will require some concrete lining near the center. This is the only one of the eighteen tunnels of the Conduit showing any deterioration. Of course a sudden blockage in this tunnel with the ditch running full will cause hayee at some point north of the tunnel mouth.

Slabbing and Trimming. Considerable slabbing and trimming should be done along the open sections that are dangerous.

A careful list of these places appears in my report of October 9, 1912, and I there make special mention of the section between Tunnel 1, South and Tunnel 1 $\frac{1}{4}$, North, the Tunnel 3, Tunnel 4 section, the Jap cut above Johnson Camp and the open cut at the south end of Tunnel 5 $\frac{1}{2}$. It is better also to bring down dangerous rocks and earth with powder in the summer time than to wait for them to come down in the rainy season.

More Waste Gates. Additional waste-gates at Tunnel 1, North, Tunnel 3, South and Tunnel 4, North, would be insurance against possible disaster in sections controlled by such gates.

Open Cut Tunnel 6 S. The open cut at the south end of Tunnel Number 6 clogs badly with grass and willows every year. This section is unlined and the sluggish current deposits silt in which the vegetation grows. Lining would cure this condition.

Flume Repairs in 1912. Our work on the flumes of the Conduit was in a way experimental this season. The results of this season's work will determine what to do with the flumes next season. Flume repairs in the shape of calking and tarring have incurred in annual expenses.

Road Repairs. Our roads and trails will require the usual maintenance work to keep them from washing.

Telephones. The Jamul-Barrett-Morena-Campo telephone situation is covered in my letter to you January 13, 1913, devoted to that subject entirely.

The transfer of the telephone line from Barrett to Johnson Camp to the Conduit bench is advisable. It was originally strung along the rocks and trees in the Cottonwood gorge so as to avoid injury from the shooting in the road construction from Barrett to Dulzura Summit and has never been changed. Trouble shooting on this line is almost forbidding. Ready accessibility and emergency use recommends changing this line to the Conduit itself.

Exploration of the Barrett Dam-site. Our Job 105 (Barrett Drift) is still in progress and the rock being pierced now is of very good quality. The continuance or non-continuance of this exploration work lies with you. To date I have worked under Mr. O'Shaughnessy's personal supervision on this particular. I unhesitatingly say that a change of crew in this case would mean a loss of time and money. The two men in the drift are Mexicans, but were chosen with reference to their honesty and steadiness. Their wages are \$3.00 and \$2.50 respectively. They are now 85 feet in on the first proposed course of about 150 feet.

Beautification and Maintenance of Premises. I am pleased to note your attitude on the care of the immediate premises of the homes of the employees of the Water Department and the appearances of the vicinities of the structures. It is right that these little patches should be in first class order and be made beautiful by suitable plantings. Right here, too, should come the proper maintenance of the buildings themselves. Painting of the Johnson Camp, Barrett and Morena care-takers' quarters will both preserve them and enhance their attractiveness.

Otay Museum. If you carry out your Otay museum idea I shall be an enthusiastic worker for the same.

Hay Crops. I have already written on our local hay-raising problems in my letter of December 23, 1912. I speak of this question with some insight, because of additional sundry and contingency expenses that I have personally experienced in a fling at the farming game that puts actual costs far above first estimates.

Automobile. I also spoke to you in that same letter of December 23, 1912, of the advisability of the purchase of a light, cheap automobile for this country use.

Permits and Deputy Game Warden. The hunting and fishing permit question is one that you have considered sufficiently yourself. I am furnished copies of all such permits at present, and it will be well for such practice to continue. The keepers at the Otays, at Morena and the Supervisor will well be deputized as game wardens with power to arrest.

Reporting to City Hall. A system of daily reporting of water heights and general conditions to headquarters is customary on all systems of this kind. I shall be glad to discuss this with you.

Standard Forms and Stationery. I am assuming that you are working up a system of standard forms and stationery from your reference to report blanks for the Conduit force. Since September 1, 1912, I have carried on a system of diary cards for the employees that have been very helpful. Under this caption would naturally fall the posting of properties with standard notices.

Technical Research. Whatever lines of technical research have been so far conducted in connection with the Southern California Mountain Water Company should under no circumstances experience interruption through the transfer of the properties to the City. The value of leakage, evaporation and movement records is dependent in a great measure upon the regularity with

which they are kept, and if continued, this value increases year by year. I will take up the matter of the Jamul and Harvey Ranch gauging stations with you when next in San Diego.

The Larger Questions. I have purposely refrained from dwelling upon the larger questions of the system. These fell upon Mr. O'Shaughnessy's shoulders heretofore. I however hope to merit any confidence you will place in me in these matters in the future when I have assumed my new duties. Also I know that you have yourself put these questions under cross-examination.

I intend spending several days on the western division of the system this week if the weather continues fine. I shall see you in San Diego before going on this trip.

VI.

Letter from Max Watson, M. H., Pueblo Forester



January 14, 1913.

MAJOR HERBERT R. FAY,
Superintendent Department of Water,
San Diego, Calif.

DEAR SIR:

In compliance with your request to participate in the annual report of the Water Department with special reference to the problems that will be confronted in taking over the holdings of the Southern California Mountain Water Company, I am submitting the following data and recommendations, which I consider will be of value in the management of this property.

The problems that are involved in taking over the entire system are ones that are of the utmost importance, and should be given careful study, as it is upon this part of the system that the entire life and existence depends. The Department becomes interested and should seek to control as far as possible, not only the

lands which come into its actual possession, but all of the area included in the drainage basin.

Upon this consideration the problems most important to be handled are those of conservation and watershed protection; and as a result involves questions of Forestry with special reference to fire protection and grazing privileges.

Considering that practically all of the watershed of the system is included in the Cleveland National Forest of which the Government has control, it might be well to first submit data and recommendations as to the relationship that is bound to exist between the Department and the Forest Service.

Approximately 200,000 acres of the drainage basin are included within the bounds of the National Forest. Upon this area the Forest Service has three regular ranges all the year around and two extra fire guards during the fire season. All the money expended by the Forest Service upon this area is expressly for the conservation and maintenance of the watershed, and without this purpose would have no reason to be expended.

The following is a list of the amounts expended by the Forest Service of which the city received direct benefit:

Ranger at Dulzura.....	\$1100.00
Ranger at Campo.....	1100.00
Ranger at Descanso.....	1100.00
Guards	1350.00
Office expenditures for regulation.....	1000.00
Forage for Rangers and Guards.....	800.00
Average extra cost of extinguishing fires.....	1500.00

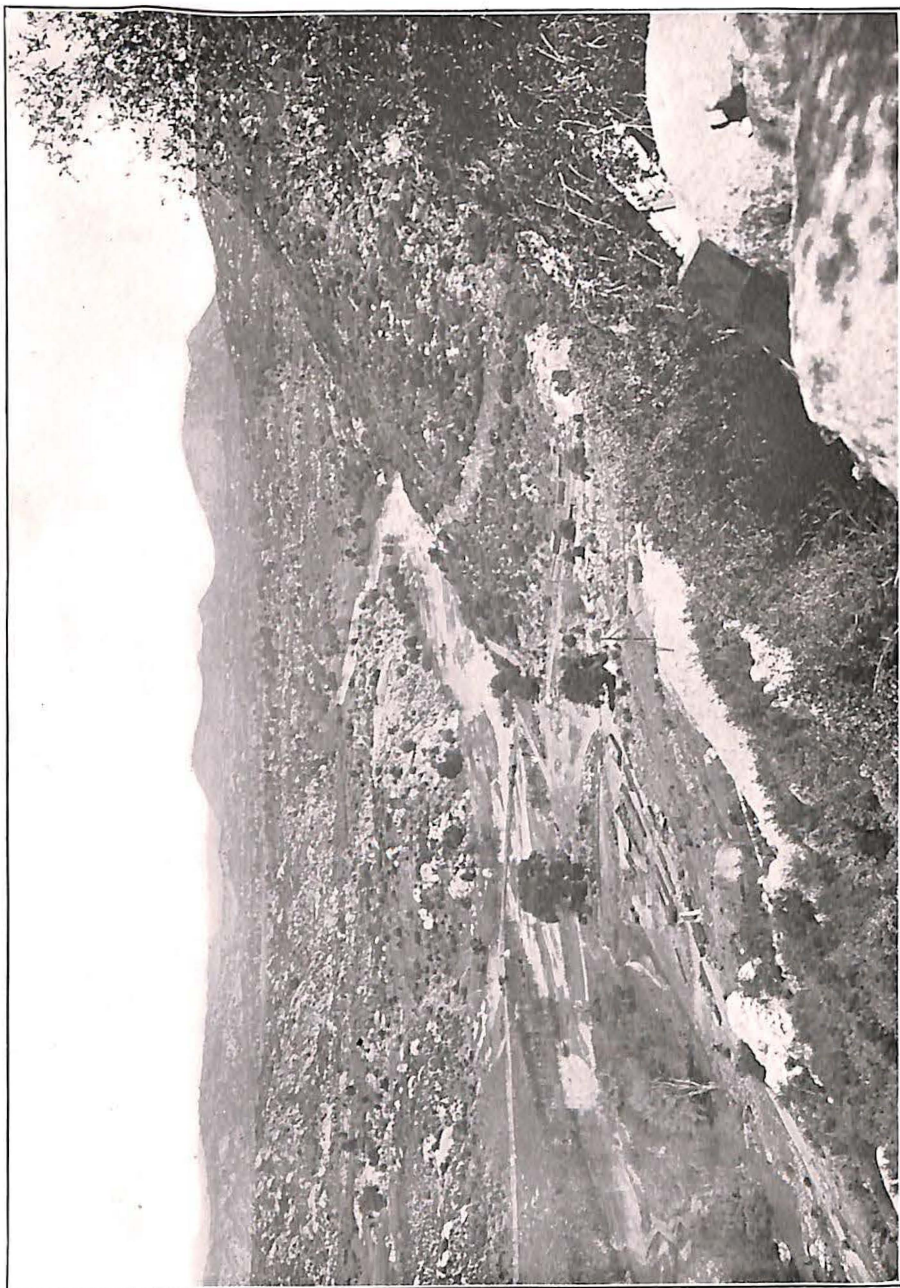
Total expenditure per year on watersheds. . \$7950.00

Aside from this the Forest Service has established houses and barns and purchased tools for fire protection to the amount of \$4000.00.

Taking into consideration that the Government has already established a system and each year expends a considerable amount for their protection, it becomes apparent that the Water Department should endeavor to work as harmoniously as possible with the Forest Service.

The following recommendations are largely those suggested by the Supervisor of the Cleveland National Forest.

As direct a connection as possible should be established in the telephone service between the Ranger Stations and the Water Department Stations, with special reference to the connection between Campo and Morena Dam. Assistance should be given to the different ranchers upon the watershed toward installing telephones with the regulations that official business should have a right of way on the line and that the telephones would always



THE WATERSHEDS OF THE COTTONWOOD RIVER

be at service of the Forest Service in case of fire. The men working for the Water Department should have a regular time during the fire season for getting in touch with the Rangers so that any fire could be reported promptly and the two departments be kept in close touch with each other. The Water Department men should have complete maps of the drainage basin showing the location of all ranches and the location of all tool boxes.

The man in authority at each Water Department Station should be appointed a State Fire Warden and in case of fire should take the initiative in calling out men and should notify the nearest ranger as soon as possible. All men should be instructed as to what would be expected of them in case of fire so that prompt action might be secured.

An arrangement should be made with the stores so that supplies could be secured by any one in authority without delay in case of fire.

In case of a large fire machines should be available in the city for taking men to the fire.

A policy of education should be taken up through the country schools and in every other way possible to educate the people living on the watershed in regard to the work that the Forest Service and the Water Department are endeavoring to do in the protection of the Drainage System, and they should be made to feel that this work is for their direct benefit and that they should co-operate in every way possible. They should be instructed as to the care of their springs and the danger of over grazing so that the valleys might be protected from erosion. They should be made to understand clearly the danger of setting fires and especially upon land that was unfit for agricultural purposes. Nothing would do so much toward the protection of the watersheds as the co-operation of the people living thereon, as most of the fires are started through carelessness and could be easily prevented.

Aside from these recommendations as to the relationship which should be established with the Forest Service, I would recommend that a careful inventory be made of all the land actually owned by the city and a comprehensive plan made for its development. There are a number of locations where the planting of trees would be of a great benefit and of considerable value. A nursery should be established at one of the dams where shrubs and trees could be grown for the beautification of the sites, and the planting of groves should be one with the idea of the continued perpetuation of the system as a heritage to be forever in the hands of the people for their benefit.

Trusting that this report covers the ground desired, I am

Respectfully yours,

MAX WATSON, M. H., *Pueblo Forester.*

VII.

History of San Diego Water Supply

By FRANCIS C. FERRIS,

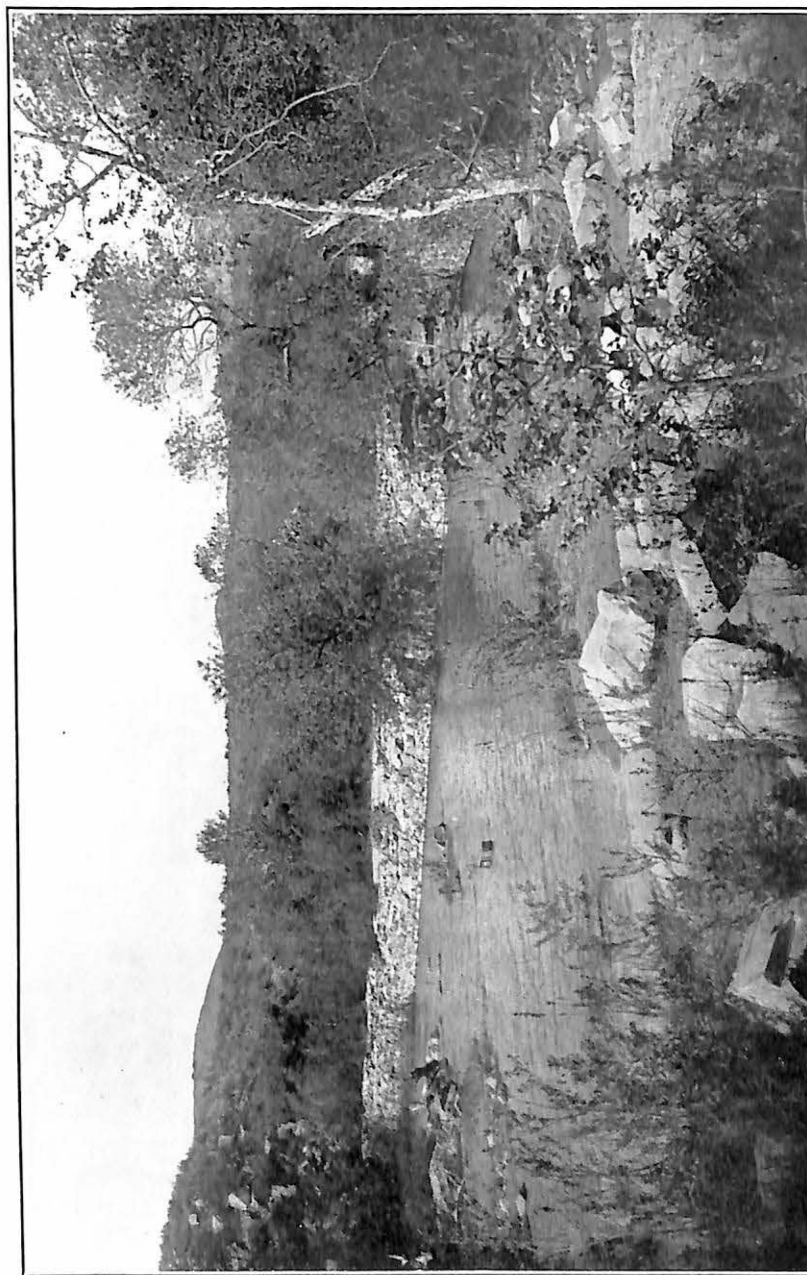
Cashier, Department of Water, City of San Diego.



Among the traditions handed down regarding the early history of San Diego, after its discovery by Cabrillo, is one that the great explorer knew a good harbor when he saw it. After entering San Diego Harbor he sent his men ashore for a supply of water. They landed at Point Loma and followed the river channel until they found a pool. This was in September, 1542, at which time of the year, the water of San Diego river is seldom seen above the surface of the river bed, although there is always an abundance just beneath the dry, sandy surface.

The importance of water was also apparent to the founder of the first Missions in California, Father Junipero Serra, and his wise colleagues, who in selecting a site for the first mission in Alta California, selected one at San Diego of magnificent view and wonderfully fertile soil. They also realized that water was essential to their success, and settled on the gentle slope above the river. The running water of the river supplied their needs for domestic uses and also for their fields, except for a few dry months of the year when they dug shallow wells in the valley.

This was their water supply for about six years. As their fields extended and their numbers increased, it became necessary to procure a greater and more certain supply of water. The Franciscan Fathers, having an unlimited supply of cheap labor, went about ten miles up the river to where it flowed through a narrow gorge with a rock bottom. Here they constructed a crude, but substantial dam of solid masonry across the river bed. This dam was two hundred and twenty-four feet long, fourteen feet thick and about fourteen feet high. From this they conducted the im-



THE FIRST DAM BUILT ON THE PACIFIC SLOPE BY THE FRANCISCAN FATHERS

pounded water through well-constructed ditches, flumes, and tunnels to the mission buildings and to their fields on high ground, thus providing an abundance of water at all seasons of the year. Later they built another dam similar to the first, and parts of these can still be seen, standing out as a lasting tribute to their builders, and establishing the first water conservation project on this side of the continent.

Water has always been one of the great problems to San Diego. The Government records show that San Diego has a greater number of days of sunshine than any other city in the United States. This means there is less rain and more evaporation. If we depend alone on the local rainfall, our hopes for becoming a great city would remain a dream. But San Diego is fortunately situated, being nearly encircled by lofty mountains within a radius of sixty miles, gradually decreasing, range after range and valley after valley, from a height of 6,800 feet to sea level.

The first settlement at La Playa had to depend on wells or haul their supply of water from the San Diego river at Old Town. There was one attempt made to strike artesian water at La Playa, but this project was abandoned after they had sunk 300 feet without success.

At Old Town the only water system was the village pump or well. For sometime after A. E. Horton (known as Father Horton) had settled here and laid the foundation for the present San Diego, water was hauled from the San Diego river and sold from house to house for twenty-five cents a pail. Later competition brought the price down to twenty-five cents a barrel.

As the town grew a number of wells were sunk. Among the most important of these wells was the one on the Court House grounds. Another well was located where the Old Horton House stood, now the site of the U. S. Grant Hotel. This well was considered inexhaustible. Besides supplying the needs of the leading hotel, it furnished water to the entire neighborhood. Another was sunk by Captain Sherman at Twenty-second and H streets.

In 1871, the enterprising firm of Calloway and Company made an attempt to find artesian water. They struck water at a depth of 250 feet. They asked the City of San Diego for aid to continue the work, but the proposition to issue \$10,000 City Water bonds to complete the work was defeated at an election held in July, 1872.

San Diego experienced its first "boom" in 1872. This promised to take it out of the village class and the primitive water sup-

ply was soon outgrown; and with the prospect of a railroad, and the consequent increase in population, the need of water development was plain. To meet the demand the first water company was organized and incorporated, January 20, 1873, under the name of the "San Diego Water Company." There were seven incorporators; the life of the corporation was for fifty years and H. M. Covert was the first president.

On March 19, 1873, the City of San Diego entered into a contract with this company, granting to the company the right to dig or bore wells, erect pumps, hoists, buildings, tanks or reservoirs on the park of O. P. Calloway (later City Park, now Balboa Park), also to lay mains and pipes through the city's streets. In return for these rights or franchise the Company agreed to furnish to the City, "free of expense," 10,000 gallons of water per month for irrigation of parks (about \$1.00 worth), also all water necessary for extinguishing fires in the city. This contract was for fifty years.

The Company's first task was to complete the well in Pound Canyon (now Balboa Park). This well was developed to a capacity of 54,000 gallons per hour. The water was pumped into two small reservoirs constructed by the Water Company. One of these (located near the Water Department's present repair shop) had an elevation of 117 feet and the other a 200 foot elevation. The combined capacity of these reservoirs was about 170,000 gallons.

In March 1874 the Company laid nearly 18,000 feet of pipe, covering the following district: from the reservoir at Eleventh and Beech streets to Eleventh and D streets, from Eleventh and D to Fifth and D streets, thence to K street, along K street to Eleventh street and also from Ninth and D to K street. This was the first water system and it was estimated at that time, that the supply was sufficient for a population of 30,000 people. It became apparent in a few years, however, that the existing supply was inadequate and in 1875 the Company increased its capital stock to \$250,000 for the purpose of improving the system. They planned to bring water from San Diego river and to accomplish this, pumps were established in Mission Valley near the Sandrock grade. A reservoir was built on the high mesa above, known as University Heights, near Adams avenue and Boundary. The water was conveyed from the pumps in the valley to this reservoir and for a time the system was supplied from this source, but because of the several hundred feet lift the pumping was expensive so new wells were sunk about

one-half mile west of the old county farm near the river bed, to which the pumps were moved. The first wells and reservoirs, which are still in existence were abandoned.

From this second pumping plant the Company drove a tunnel through the hills, beginning at the foot of the hill below the County Hospital and making a gradual ascent to the top of the hill near the head of Curlew street. This tunnel was supposed lessen the cost of pumping. The water was piped through this tunnel to a new reservoir at Fifth and Hawthorne.

This reservoir was considered sufficiently high for pressure, for at that time there was little thought that the higher land, now known as University Heights, would ever be improved.

There were some extensions to the system of mains at this time also. In 1886 the Company installed a pumping plant at Old Town, with a capacity of 6,600,000 gallons per day. They also built a reservoir at Old Town with storage capacity of 4,206,000 gallons and a standpipe on Spreckels Heights 136 feet high and thirty-six inches in diameter. The top of this standpipe was 401 feet above sea level, the object of which was to regulate the pressure of the entire system.

In 1887 and 1888 the average consumption was about 30,000,000 gallons per month, with an estimated population for 1887 of 32,000 inhabitants. (The consumption for 1913 will average nearly 7,500,000 gallons per day.)

In 1886 and 1887 the company renewed and increased all of their system of mains. In January, 1890, they estimated there were over sixty miles of mains in the system at a cost of \$800,000.00. There were 185 fire hydrants for which the city paid the Company \$100.00 each per year.

While the San Diego Water Company was the only concern existing and supplying water to the city, a few enterprising and far-sighted citizens were diligently working to organize a new company to develop new sources. They met and overcame many obstacles and finally in May, 1886, were incorporated under the name of the "San Diego Flume Company," with George D. Copeland as president. The capital stock was \$1,000,000, divided into 10,000 shares of \$100.00 each. Their principal object was to irrigate and develop lands in El Cajon Valley and La Mesa and ultimately to supply San Diego. Douglas Gunn's "Picturesque San Diego" tells us that with the completion of this flume system, San Diego would have enough water to care for a population of 200,000 inhabitants. This proved to be a wild estimate, for as a matter of fact, there was more water contracted for than the system could produce at

times, for when the Flume Company was promoted their funds were largely derived from the sale of water rights along the route.

This system gets its supply from the Cuyamaca dam, constructed of earth and rock, forming a great lake at the foot of Cuyamaca Mountain, at an elevation of about 4500 feet. From the outlet at the dam, the water runs in a natural creek bed for eleven miles, from which it enters an open flume, and runs through El Cajon Valley and La Mesa to the city limits of San Diego. The work of this company has been of the greatest importance in the development of the orchards and farms and for domestic and irrigation purposes of the suburbs east of San Diego.

In 1894 the San Diego Water Company and the San Diego Flume Company were merged into one corporation under the title of the Consolidated Water Company. The new company continued to serve San Diego; though the owners of the water rights of the old Flume Company protested and took the matter into the courts, contending that the company could not legally reduce their contracted allowance of water in order to sell water to the city. This case was finally decided in favor of the Company and the city.

On July 21, 1901, an election was held and carried on a proposition to issue \$600,000 Water Bonds for the purchase of the distributing system, within the city limits, from the Consolidated Water Company. This purchase included all the mains, buildings, water rights, pumping plants, reservoirs, water bearing lands in Mission Valley, machinery, tools, horses, wagons and all equipment owned by the Company in the city. Two months later or in September, 1901, the city took over the system.

From that date the city derived its water supply entirely from the San Diego river, using the two large pumps at Old Town and installing six auxiliary pumps at different points along the river. This gave sufficient water for the time being, but as usual the city soon outgrew the supply and it became necessary for the Water Department to make certain restrictions and limitations in street sprinkling and irrigation. The city was divided into districts, each section was permitted to irrigate three days per week, the different sections alternating, as prescribed by the Department. Anyone caught irrigating at any time not prescribed, was subject to a fine and the penalty of having their water shut off. The streets were sprinkled with salt water. The water situation became the life and death issue of the city's existence. It could not grow under existing water conditions; our rival cities to the north had a standing joke at our expense. They used to tell all prospective visitors to

this city that it was safe to go to the "City of Bay and Climate," providing they carried their own jug of water with them.

At last the situation resolved itself into two propositions. The first and most popular of which was for the City to purchase water bearing lands at Santee, install pumps, etc. The second was to enter into a contract with the Southern California Mountain Water Company for a period of ten years, said company to complete a pipe line from the Lower Otay reservoir to the University Heights reservoir. The first proposition for the purchase of the Santee lands was submitted to a referendum vote in 1905 which carried by a large majority but fell short of the necessary two-thirds vote. The Honorable John L. Sehon was elected Mayor that year, as a champion of the purchase proposition, while a majority of the Common Council were favorable to the Southern California Mountain Water Company contract.

After the failure of the Santee purchase, the City Council, in May, 1905, entered into a contract with the Southern California Mountain Water Company to supply the city with pure water for a period of ten years, at the rate of four cents per thousand gallons. The city agreeing to use from no other source, not even their own pumps, and the Southern California Mountain Water Company agreeing to furnish all the water which the city might call for up to the maximum of 7,760,000 gallons per each twenty-four hours.

Soon after this contract with the Southern California Mountain Water Company was in force, the city, by what was known as the Ludington Ordinance, reduced the meter rates to consumers from fifteen cents per 100 cubic feet to seven and a half cents per 100 cubic feet, which rate was later raised to eight cents per 100 cubic feet.

For the last six years the residents of San Diego have been getting the purest mountain water and with few exceptions at the lowest price of any city in the United States. While it is pure mountain water to begin with, it is thoroughly filtered and aerated by the most scientific method before it reaches the consumer.

Many of our citizens, past and present, are entitled to worthy mention for the important part they have taken in developing San Diego's water supply, each in their own way performing a great public service. Perhaps the foremost among these is E. S. Babcock, who began in 1885 to lay the plans and foundation of the great system known as the Southern California Mountain Water Company. He organized the Otay Water Company and later consolidated it with the Mount Tecarte Water Company which formed

the nucleus of the present Southern California Mountain Water Company. Mr. Babcock, realizing that an immense amount of capital was required to properly develop this system, interested the Spreckels Brothers, who have spared no trouble or expense in completing the system.

This gigantic system with its enormous supply of pure water has been one of the greatest factors in San Diego's upbuilding. While the city's contract with this company holds good until 1916, it would be unreasonable to expect to renew our contract at the same price for water, owing to the great amount of capital expended in building the Dulzura Conduit and the increased values of the lands, etc., besides, as a private corporation it is always subject to a change of control and at some future date it might be impossible for the city to acquire the system.

With the interest of the city in mind Honorable H. R. Fay, Superintendent of the Water Department, in his two last annual reports, of 1910 and 1911, recommended that negotiations be entered into with a view to purchasing the system before the expiration of the present contract. This recommendation was approved by Mayor James E. Wadham, who with Superintendent Fay and other members of the Common Council opened negotiations which resulted in a proposal from the Southern California Mountain Water Company:

(1) To sell to the city for \$2,500,000.00, all that part of the system situated west of the east line of the Barrett Dam and reservoir site, consisting of 7053.94 acres of land, including the Barrett Dam site, reservoir site, Dulzura Conduit of thirteen and one-half miles, Upper Otay Dam and reservoir, Lower Otay Dam and reservoir, Chollas Heights Reservoir, filtering plant and all pipe lines, water rights, rights of ways, etc.

(2) A second proposal offering to lease to the city, the balance of their system, known as the Morena Dam and dam-site, for a period of ten years, for an annual rental of \$67,500.00 to be paid in twelve equal monthly installments of \$5625.00. This proposal also granting to the city an option to buy this remaining part of the system, covered in this lease, for \$1,500,000.00 at any time within ten years, from the beginning of the lease.

These propositions were submitted to a referendum vote, August 15, 1912, which carried by an overwhelming majority. The vote in favor was 8491, and against 1405.

An important part of the agreement between the city and the company was an arrangement whereby the Spreckels Company were to take the Water Bonds in payment, thereby saving the city

time and expense in floating the bonds. The preliminary arrangements having all been completed, the actual transfer of the properties will probably be completed February 1, 1913.

This purchase places San Diego in possession of one of the greatest water systems in the country, as there is at present sufficient water stored for seven years' supply.

This system comprises a water shed of 350 square miles of rugged mountains with four dams, with storage capacity as follows:

Morena Dam	15,000,000,000
Upper Otay	1,090,000,000
Lower Otay	13,000,000,000
Chollas Heights	90,000,000

Present Total Storage Capacity.....29,180,000,000

The proposed Barrett Dam, when completed, will have a capacity of 15,000,000,000, making a grand total of over 44,000,000,000. Besides this the city has within its limits seven reservoirs and two steel tanks, having a storage capacity of 30,257,000 gallons. While this volume of water seems enormous, San Diego is growing at a phenomenal rate and must prepare for the distant future, as well as the present. With this in view the Superintendent of Water is preparing to re-establish the Old Town pumping plant. Superintendent Fay has also proposed to have added to the regular assessment, five cents to each \$100.00 valuation, to create a special water development fund, for the purpose of making surveys, tests and investigations of new water supplies, courses and watersheds which might at some future time be acquired or developed for the benefit of the "Greater San Diego."



Weather Conditions in San Diego

U. S. DEPARTMENT OF AGRICULTURE

Local Office of the Weather Bureau

San Diego, Cal., Jan. 18, 1913.

MAJOR HERBERT R. FAY,

Superintendent Water Department, San Diego, Cal.:

Sir—In response to your request, it gives me pleasure to hand you the following data from the records of this office:

Climatic data for the months of January and July, with the year's average for the period of 41 years. Record to Jan. 1, 1913.

Data.	Jan'y.	July.	Year.
TEMPERATURE—In degrees Fahrenheit—			
Average or normal.....	54	67	61
Average daily range.....	16	10	13
Mean of warmest.....	58	69	63
Mean of coolest.....	50	63	58
Highest or maximum.....	83	93	101
Lowest or minimum.....	32	54	32
HUMIDITY—In percentage—			
Average relative	71	81	75
PRECIPITATION—In inches—			
Normal	2.00	.00	10.01
WIND—			
Prevailing direction	N.W.	N.W.	N.W.
Average hourly velocity in miles per hour..	5	6	5
WEATHER—			
Average number of clear days.....	17	16	196
Largest number of clear days.....	26	30	291
Smallest number of clear days.....	3	0	53
Average number of partly cloudy days.....	7	11	104
Largest number of partly cloudy days....	15	28	185
Smallest number of partly cloudy days....	2	1	26
Average number of cloudy days.....	7	4	65
Largest number of cloudy days.....	22	17	171
Smallest number of cloudy days.....	1	0	34
	Less		
Average number rainy days (.01-in, or more)	6	than 1	43
Largest number of rainy days.....	13	4	81
Smallest number of rainy days.....	1	0	30

E. HERBERT NIMMO

Local Forecaster

INDEX

	Page
Officials of Water Department.....	5
REPORTS—	
Superintendent	7-18
Hydraulic Engineer	20-44
Chief Clerk	45-61
Supervisor	62-68
Pueblo Forester	68-71
History of San Diego Water Supply.....	72-80
Weather Conditions in San Diego.....	81

