Gage Irrigation Canal
(Gage Canal)
Running 20.13 miles from the
Santa Ana River to Arlington Heights
Riverside
Riverside County
California

HAER No. CA-120

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

REDUCED COPIES OF MEASURED DRAWINGS

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HISTORIC AMERICAN ENGINEERING RECORD

GAGE IRRIGATION CANAL
(Gage Canal)

HAER No. CA-120

Location:	Running 20.13 miles from the Santa Ana River to Arlington Heights, Riverside, Riverside County, California
Date of Construction:	1885
Type of Structure:	Irrigation Canal
Use:	Transport of water from the Santa Ana River to the citrus groves and citizens of Riverside.
Designer/Engineer:	Matthew Gage C.C. Miller, chief engineer William Irving, engineer
Fabricator/Builder:	Robert Gage, supervisor of construction Grant Brothers, contractors Stephen and Frank Townsend, contractors/earthmovers W.H. Perry Mill and Lumber Company, contractors/lumber
Owner:	City of Riverside and other private interests
Significance:	The Gage Irrigation Canal was instrumental in the development of citrus production and the settlement of the Riverside area. At the time of its completion, the canal was the most ambitious irrigation project ever undertaken in California. The presence of the canal opened up former desert wasteland to irrigation, contributing to Riverside's reputation as the premier navel orange growing region in the world.
Project Information:	Documentation of the Gage Irrigation Canal was completed by the Historic American Engineering Record (HAER), administered by the National Park Service, Department of the Interior, as part of the California Citrus Heritage Recording Project undertaken during summer 1991. For more information on this project and related reports, refer to HAER No. CA-118 (California Citrus Heritage Recording Project, Riverside, Riverside County, California). Kevin B. Hallaran, HAER Historian, 1991 Christopher Foord, HAER Historian, 1991 Christine L. Madrid, HAER Historian, 1993

HISTORY

The successful settlement and agricultural development of Riverside, California was contingent upon bringing water to what was otherwise, technically, a desert landscape. Members of John W. North's Southern California Colony Association realized this early on; within a year of their 1870 arrival, the settlers of this cooperative colony had engineered the so-called "Upper Canal," actually no more than a ditch then, to bring water from the nearby Santa Ana River (with an intake near present day La Cadena Avenue in Colton) to the town's central Mile Squere area.[1]

About 1874, S. C. Evans and W. T. Sayward began a second canal to bring water to the undeveloped lands of the Hartshorn Tract south of present-day Arlington Avenue. Being about 30 feet lower in elevation, this ditch was named the "Lower Canal."[2] The Upper and Lower Canals never really offered any competition to each other. In 1875, Evans and Sayward purchased controlling interest in the Southern California Colony Association and formed the Riverside Land and Irrigating Company with control over both canals.[3]

By 1885 when the canals, after a long legal battle, were given over to the Riverside Water Company, southern California was in the middle of its most expansive nineteenth-century land boom. Among the boomers was a young Irish-Canadian jeweler and watchmaker from Kingston, Ontario, Canada, named Matthew Gage. Together with his wife, Gage arrived in Riverside in 1881, already the owner of twenty acres of fruit orchards purchased for him by friends in the town. Once arrived, Gage rented shop space for his jewelry business in a corner of James Roe's drug store. Later he built his own shop on the town's Main Street.[4]

On March 6, 1882 Gage filed a claim for 640 acres in Section 30, T. 2 S., R. 4 W. under the procedures of the Desert Land Act of 1877. The act had recognized the difficulty of cultivating lands in the arid west. It defined desert lands as those which would not produce agricultural crops without irrigation. The law allowed for claims of up to 640 acres at a cost $1.25 per acre provided the claimant was able to irrigate the property within three years of filing.[5]

In order to irrigate the Section 30 acreage, Gage purchased 160 additional acres in the area of Box Springs Canyon at the base of the mountains of the same name. His intent was to tap into and develop, by way of wells, the natural flow of water in the extant springs there, and utilize this to irrigate the dryer Section 30. But, even with the extra flow Gage was not able to develop enough to irrigate his homestead.[6] Without any apparent alternatives, he began setting in motion a more ambitious plan.

The San Bernardino Artesian Basin, approximately twelve miles from Section 30, though not well developed at the time, was quite well known by the 1880s. Indeed, the growth of cottonwoods, willows, and grasses attested to underground water there. And, the Parish Ditch, already present on the northern edge of the Santa Ana River bottom in 1884, was flowing approximately 157 miner's inches. The Hunt and Cooley Ditch, also present, meintained an old water right to the surface flow of the Santa Ana River at the point of intake.[7]

On July 27, 1885, Matthew Gage purchased 6/7 of the Hunt and Cooley Ditch from its owners. Then from J. Alphonso Carit, Gage purchased an option to buy approximately 1000 acres of Carit's tract of land, a tract which sat more or less directly atop the geographical center of the artesian basin. Carit's asking price was a prohibitive $175,000, on which Gage paid a $5,000 down payment. The price included Carit's one-sixth interest in the Hunt and Cooley Ditch. At the same time, he also entered into a mortgage arrengement with Carit: one mortgage for $50,000, and a second for

$75,000, both to be paid by 1891. By the end of the year, Gage was in possession of, or held options on, approximately 2800 acres atop the artesian basin.[8]

Construction of the canal is believed to have commenced, probably from both ends, in October or November 1885. In late September the press announced the awarding of the initial contracts. Stephen and Frank Townsend, brothers from Los Angeles, were let the contract for earthmoving, i.e, the actual digging of the canal as well as tunneling, filling, etc.[9]

Gage was not inclined, as yet, to let the contract for the construction of the necessary flumes. How that work was to be accomplished was not stated. It seems likely that Gage was in contact with his brother Robert back in Kingston, Ontario, and was attempting to persuade him to come and oversee the work. Robert Gage was at the time an engineer employed by the architectural firm of their brother-in-law, William Irving. Robert, accompanied by their mother, arrived in Riverside on January 1, 1886; Robert began "at once [to] proceed to put in the flumes."[10]

In the meantime, the W. H. Perry Mill and Lumber Company received the contract to supply lumber and timber for the flumes and tunnels at about the same time as the Townsend brothers received their earthmoving contract. The initial cost of the canal, from the headwaters to Section 30, was estimated at $180,000.[11]

Drilling of the wells in the Carit Tract property began during the first week of November 1885. William Manson, using a drilling rig of his own invention was drilling an average of 50 feet per day and striking water at 100 feet to 125 feet down. His rig was described as:

> worked by a ten horse power [steam] engine, which operates the sand pump and drills, and also works a pump connected with two hydraulic jack screws attached to the pipe, and which can be made to exert a pressure of 26 tons each. With this machinery and apparatus a well can be sunk to any depth, and through any kind of soft bowlders [sic] or rock forming no impediment to it, and the greater part of the time and labor is consumed in joining the pipe which slides into the ground under the enormous pressure in a few moments.[12]

Though Matthew Gage was a jeweler by trade, there is some evidence that he had working knowledge of engineering. Whether he was self-taught or whether he came by his knowledge through some informal tutelage from his brother Robert and brother-in-law William Irving is not known. Even with his rudimentary knowledge, he nevertheless chose to leave the formal engineering of his canal to the experts, though later he would take a more active role. C. C. Miller, a civil engineer originally from Wisconsin, was hired as chief engineer and was assisted by Robert Gage who acted as supervisor of construction. Miller had once worked for Union Pacific builder Grenville Dodge building railroads during the Civil War. In 1876 he built a large adobe home for his family that within a few years would become the Glenwood Hotel--the precursor of the city's most notable landmark, the Mission Inn.[13]

Work on the canal was brisk during the first few months. By mid-November three miles of the canal itself had been excavated. Shifts working day and night had completed "some" of the shorter tunnels and all of the tunnel work was expected to be completed by the middle of the following month. Timbering and cementing, it was thought, did not appear to be necessary on some of those tunnels through harder rock material; still others would require both. At the same time, William Manson, the well digger, had completed two wells in one week of work and expected to bring in a third at any time.[14]

To all appearances, Matthew Gage's canal looked to be on the verge of becoming a reality, and even before completion was being praised:

> We believe that during the next year a large acreage under the Gage canal will change hands on a basis of a good water right and that homes will spring up all over that heretofore desert place. Such a settling up of that country would contribute largely to the wealth and prosperity of Riverside . . .[15]

This had not, apparently, always been the case. In one newspaper story, it was intimated that Gage had been considered something of a laughing stock when first proposing the idea of the canal:

> The day for jeering over the Gage canal has passed. The man who should sell short on Gage water stock would soon be in a worse condition than if he were to be caught in a Kansas cyclone.[16]

It might be interesting to speculate here on the character of Matthew Gage. Here was a man of little means; a retail jeweler and watchmaker; without formal training in the science and techniques of engineering; initiating a project which could rightly have been called the most ambitious engineering project Southern Californie had ever witnessed. More interesting was not that he was able to convince himself of his ability to accomplish this feat, but rather how he was able to instill that confidence into a lerge number of investors to the tune of over $1,000,000.

Stephen H. Herrick, who had come to California to take charge of the Iowa Syndicate and develop the Highgrove area east of Riverside, estimated that Gage's financial worth at the time the canal was begun was no more than $5,000. Before construction had even commenced Gage had necessarily busied himself securing rights-of-way across the plain and contracting with landowners below the route of the canal to furnish them with water. One of these, Herrick's Iowa Syndicate, rather than go ahead with their own plans to build a canal, instead contracted with Gage in August 1885. For $167,500 Gage would deliver water in the amount of 335 miner's inches. With this major infusion of capital, Gage was able to attract other investors and arrange more agreements with landowners along the route. (There were nearly 200 such agreements, mortgages, and deeds indexed under the name of Matthew Gage in the County of San Bernardino County Records.) Gage's standard agreement with landowners was to:

> furnish them with an inch of water to five acres, for which they will pay $100 per acre. On this contract I [Matthew Gage] gave five years time, at 8 per cent interest from the time the water is placed upon the land, the payments to be secured by mortgage on the lands to be irrigated." [17]

By June 1886 cost estimates on the canal hed risen to $450,000, and Gage categorized the costs for a Press and Horticulturist reporter thus: $175,000 for the artesian water property (Carit Tract); $125,000 for the cenal, flumes, and tunnels; $125,000 for cementing the canal; and $25,000 for water development (sinking the wells).[18]

In the same month, the city reported that the lands about to be watered by the canal had increased substantially in value as the canel approached completion. Six thousand acres that had been assessed at one dollar an acre only a year before were now being essessed et $25 per acre.[19]

At the beginning of July 1886:

> The total completed length of the canal [was] eight miles. Over one mile of tunneling has been done, and a granite tunnel 650 feet in length is now being constructed which, when completed, will make the total length of the canal, from water sources to present terminus fifteen miles, and available for irrigation a distance of twelve and a half miles.[20]

The unfinished tunnel was in an area known as "Point of Rocks" overlooking the community of Highgrove.

Apart from the canal project proper, Gage had also nearly completed a two-story house near the head waters for the use of William Manson, the well digger, and his family, newly arrived from Galt, Canada.[21]

Resolving the question of who was actually supplying the manual labor on the project is one that has, so far, proved elusive. No direct documentary evidence has surfaced in answer to this question. Neither of the local Riverside newspapers then publishing at the time ever gave any indication as to who was actually wielding the picks and shovels. Gage's accounts, ledgers, and other documents generated during the construction phase have been lost.[22]

Two reliable informants (both related to William Irving, and one a former chief engineer for the canal company)[23] have stated that much of the labor was imported, many from Canada or the British Isles. After William Irving took over as engineer of the project in 1887, he enlisted Scotch-Canadian stone cutters and masons to carve the canal's bulk heads. He may even have had them accompany him on his own trip to California. These men also cut and laid the foundations for one of Irving's Riverside homes, known as Greystones.[24] Some of the cementing and flume construction may also have been performed by Canadian immigrants.

Teamsters were mainly Irish, perhaps Irish-Canadians, as was their employer, Matthew Gage. Soft-soil trenching of the canal was done by "scrapers" hauled by teams of mules or horses. The scrapers:

> were flat wooden beds with a steel cutting blade at the leading edges and a short wooden tail from which a short rope extended. These were dangerous for a novice to manage and very tiring, but for an expert teamster they appeared easy and in these hands could provide a precise result.[25]

The more arduous unskilled labor of digging by hand quite probably was done by Chinese laborers. Chinese numbers in Riverside had been growing throughout the 1880s. In the early part of the decade they had begun supplanting Native Americans as the primary source of labor in the citrus groves. Still others were involved in railroad construction in several arees of Southern California. One crew of Chinese workmen was employed in 1881 in the grading of the Box Springs Canyon grade of the California Southern Railroad, near where Gage had purchased his 160 acres hoping to develop a water source. Members of this same Chinese work force had only recently completed a six-month long task of blasting the reilroad through the granite of Temecula Canyon, about 30 miles south of Riverside. Still other Chinese had labored on other cenals in the area: a crew of 50 had been employed in the building of the North Fork Canal in San Bernardino in 1885; and, in the same year Chinese workmen had dug tunnels through granite for the Cucamonga Development Company.[26] Clearly, there was the experience and the willingness among the Chinese population to take on the kind of work required for the Gage Canal.

In 1977, R. Stewart Malloch, a grandson of William Irving, wrote that Chinese were definitely employed as laborers in the digging of the canal. Malloch wrote, "Correspondence existing in 1960 testified to 'contract' labor for Chinamen for digging and hand-labor."[27] The whereabouts of the "correspondence," or by whom it was generated is not known.

The first phase of construction, that which went as far as Tequesquite Arroyo and Section 30, was nearing completion in October 1886 when Gage announced that he had purchased 1500 acres of Evans' and Sayward's Hartshorn Tract. The acreage was known as the "Arlington Plains" and was located southwest of the town of Riverside. Gage then expanded on his original idea and began making plans to extend the canal to water the new property. Over the course of the following year Gage purchased an additional 3500 acres.[28]

On November 9, 1886 water was released to flow the entire 12-mile distance of the canal from the head gates to Tequesquite Arroyo. The flow was a controlled trickle that enabled Gage and his crew to watch "the progress of the water to prevent breaks and see that the first soaking up of the canal resulted in no damage."[29] By the following day, the water had flowed as far as the Point of Rocks tunnel and was expected to reach the terminus at the arroyo by nightfall.[30]

Hundreds of people showed up at various places along the route to congratulate Gage. The Daily Press also responded favorably:

> No enterprise of this character hes probably ever been brought to a successful issue under such peculiar circumstances. Mr. Gage entered upon the work two years ago without money and almost without friends who believed in his ability to carry on such a work that would require so much capital to complete before he could get any returns. His persistent work, his ability to overcome obstacles, his well known integrity and strict business honesty soon commanded respect, end capital soon came to his assistance. With the delivery of the water today, $80,000 becomes due him immediately [from the Iowa Syndicate] and good securities worth several times that amount become available. Mr. Gage has carried the entire work in his own name and is now in a position to receive the profits of his vast undertaking as well as the credit of an enterprise requiring the highest order of financial engineering.[31]

With the completion of the first phase of construction, engineer C. C. Miller moved on to other projects. In January 1887, William Irving arrived to take over as chief engineer. During the following spring he busied himself surveying the lower route of the canal from the arroyo to the Arlington Plains. The survey was not completed until late-1887 or early-1888 when the terminus wes located 8.26 miles from Tequesquite Arroyo. When the lower section was completed, the canal would be 20.16 miles long.[32]

In early-1888, work on the lower portion of the canal was commenced. The contract for excavation was let to the Grant Brothers. "The flume construction was done by Mr. M. Gage, under the supervision of W. Irving as engineer and Mr. R. Gage as superintendent of works, end the whole was practically completed in the early part of August the same year except a short interval . . . about 1700 feet." Flume No. 9, which crossed over the Tequesquite Arroyo and was the longest on the canal route at approximately 1000 feet, had been completed eerlier in March. By mid-April 1889, the canal was complete. Cost of construction of the lower section was $30,251.[33]

While construction of the lower section was taking place, Irving, apart from supervising the work of Matthew and Robert Gage, had also been occupied with the surveying and subdividing of the Arlington Plain property. The completed subdivision was designated Arlington Heights. The intersecting system

of streets Irving platted enclosed blocks of 40 acres; these blocks were then subdivided into ten-acre lots. Throughout 1890 and 1891, the main thoroughfare through Arlington Heights, Victoria Avenue, was graded and surfaced. Plans for the extension of the avenue across Tequesquite Arroyo by means of a bridge were drawn up in 1890 as well. The Victoria Bridge was completed the following year with opening ceremonies taking place on Thanksgiving Day (November 26, 1891).[34] [See HAER No. CA-122 for further information on the Victoria Bridge.]

During the summer of 1889 Matthew Gage travelled to London on the advice of Wilson Crewdson. Crewdson was a resident of London whom Gage had met in 1884 while the former had been visiting California. The two had talked of forming a partnership in the canal project, but nothing came of these discussions. Nevertheless, Crewdson had been sufficiently impressed by Gage's plans to loan Gage the sum of $5,000 subject to a mortgage.[35] By the time of his visit to London in 1889, Gage had found himself in dire financial straits. He had, in the past few years, borrowed heavily to purchase:

> certain ditches, water rights and some 7171 acres of land, at a total cost of over $1,000,000: at the time I was carrying an indebtedness of over $800,000, and in order to fully end vigorously develop the water supply, cement the canal throughout its length, (some 20 miles), lay a system of distributing pipes through the land, end otherwise properly improve the property, I needed a further sum of $500,000.[36]

The California land boom of the 1880s had bottomed out by 1889, and though Riverside was not as adversely effected as were other parts of the state, the banks were no doubt hesitant to make loans, especially with someone whose credit was stretched as far as Matthew Gage's.

In London, Gage was introduced to Crewdson's uncle, Edwin Waterhouse, a senior partner in the firm of Price, Waterhouse and Company, chartered accountants.[37] A deal was struck with members of Price-Waterhouse whereby Gage sold them all of his interests in the canal, water rights, and the Arlington Heights property to a newly formed corporation, Riverside Trust Company, Ltd. The corporation was provisionally formed in London on December 13, 1889. Formal incorporation took place the following year.

Under the terms of egreement, Gage was to receive $168,000 plus 800 shares in preferred stock. He would also receive 38,000 pounds sterling per year out of the company's profits. Gage would also assume a position in the compeny as managing director for which he would receive $10,000 per year. The Riverside Trust Company, for its investment, would receive the canal, water rights, and real estate, plus fulfill Gage's obligations and assume his debts. According to the company's articles of incorporation, its purpose was to "develop the resources by clearing, draining, fencing, road making, farming, building, improving, mining and settling, and to sell, lease and mortgage" their new property in California.[38]

To manage the canal, the Riverside Trust formed the Gage Canal Company on November 5, 1890. Its first board of directors was elected in January 1891 and consisted of officers Matthew Gage, President, Robert Gage, Vice President, William Irving, Treasurer, and W. G. Fraser, Secretary. Austin Jennings and N. B. Kellogg completed the six-member board.[39] Capital stock of the company was valued at $2,500,000 representing 50,000 shares at $50.00 each. The stock certificates issued certified:

> that __(name)__ is the owner of __(number)__ shares of capital stock of the Gage Canal Company,
> . . . together with such water rights as may be provided for in the endorsement hereon when signed by the President and Secretary; provided, that all such water rights are

> end shall be subject to all the conditions in that behalf specified in said endorsement, and in the Articles of Incorporation, and in the by-laws adopted, or to be adopted . . .[40]

Matthew Gage's association with the canal he hed built end the real estate he had been responsible for reclaiming ended in 1894. At some point early in their tenure, the Riverside Trust Company, Ltd., opted to enter the citrus production industry rather than concentrate its efforts in real estate development and by 1907 had under cultivetion 4,000 acres in oranges and another 1,000 acres in lemons. Gage had counted on the sale of land in Arlington Heights to allow him to take part in massive profits, but with the turn toward private production rather than sales, the profits failed to materialize. In 1894, he resigned his position with the company, unable to convince them that there were more profits to be made in real estate sales than in citrus. In August he brought suit against them for not paying him the share of profits agreed upon in 1889. The Trust Company maintained it had made no profits. Gage countered by saying the company had indeed been making profits, at least $200,000 net by March 1891, then accused them of fraud and falsifying the company's accounts.[41] When Matthew Gage died in 1916 he was virtually penniless.

In 1910, because of anti-trust legislation, the Riverside Trust Company, Ltd., initiated a reorganization in which two companies were formed, but without any real change in management. The company deeded all of the canal property--water rights, canal, right-of-ways, machinery, et al.-- to the Gage Canal Company. This reorganization, then, fixed ownership of the canal with the shareholders. The company's citrus groves and real estate became managed under the banner of the Riverside Orange Company, whose owners remained mainly in England. The Riverside Trust Co. liquidated all of its interests in 1928 under what seems to have been a cloud of possible mismanagement, the nature of which is probably impossible to determine at this late date; the company, for reasons not understood, incinerated their records at the time of the liquidation.[42]

In 1925 the Gage Canal Company became involved in an altercation with the Temescal Water Company, the major supplier of water to the Corona area, which took on elements of a frontier-style showdown. Temescal Water had been supplying its users with water obtained by pumping wells in the Perris Velley. About 1923, this water began exhibiting high concentrations of salt: enough to begin adversely effecting crops in the Corona area. Attempts were made to secure transport rights to the Gage Canal from new wells in Santa Ana River basin as early as 1924. In fact, the Gage Canal Board of Directors had even approved the sale of 500 miner's inches of surplus water belonging to the Riverside Orange Company in that year. However, the agreement was declared null and void when, at the 1925 Gage Canal Company annual stockholder's meeting, shareholders responded to the deal with a resolution of their own in which it wes stated that the arrangement with Temescel Water was perhaps not quite legal; the shareholders had discovered that three of its own board members were "personally interested" in the approved sale.[43]

Gage Canal Company eventually consented to ellow Temescal Water to connect a pipeline to the end of the canal so as to convey Temescal water from their pump station near Palm Avenue in Riverside. The agreement stipulated that Temescal would run no more than 112 miner's inches through the canal, that e measuring device be installed to monitor the flow, end that Temescal Water would pay a proportional share of maintenance and operation costs of the cenal. In August, Temescal Water apparently requested that they be allowed an increase above the specified 112 inches; the request was denied.[44]

John Mylne, Sr., Superintendent and Engineer of the Gage Canal, was notified on September 17, 1925 that Temescal Water Company had completed their pipeline and pump station at Mt. Vernon [Avenue] near Colton. They expected to test the pump the following Saturday by running epproximately 200

miner's inches through the canal on a experimental basis. Mylne consented with the stipulation that Temescal Water would turn off the pump station at Palm Avenue while the testing was going on, i.e., not run both of the pumps at the same time. Temescal ignored the request and ran both pumps.[46]

Four days later, on September 21, Temescal Water Company manager, H. R. Case wrote to Mylne that the test had been satisfactory and that Temescal Water would begin its "regular run" of 90 miner's inches of water through the Gage Canal on the following Tuesday.[46] Mylne, with Gage Canal president W. G. Fraser, took the letter to the company attorney for an opinion. Evidently, there was no agreement in effect that allowed for a "regular run" of 90 inches, or possibly the Gage Company considered any existing agreements to be have been voided by the running of both the Palm Avenue and Mt. Vernon pump stations at the same time. In any event, a letter was drafted and hand-delivered by Mylne to Case at his home in Corona saying:

> you are hereby notified that we [Gage Canal Company] deny any right on your part to turn any such water into the canal, or to take any such water therefrom, and you are hereby forbidden to do so; and any attempt on your part to do so will be resisted by this Company.
>
> Yours truly,
> Gage Canal Company[47]

While Mylne waited, Case telephoned Joy Jameson, Temescal's president, and explained the situation, during the course of which the letter was read to Jameson. When the conversation was over, Case told Mylne that Temescal Water Company "claimed the right [to run water through the canal] from the Regents of the University of California [shareholders in the canal], and intended to put the water in, in the morning." When Mylne reported back to President Fraser, he was told to make sure that Temescal did not get any water into the canal.[48]

What occurred next smacked of stereotypical frontier individualism, if not vigilantism, but in a twentieth-century context. The events are best described, though with a certain amount of fondness and nostalgia for days gone by, by the late Stewart Malloch, one of the participants:

> The episode of plugging the Temescal pipeline is perhaps the only one I have with a sense of latent danger in it, and so worth telling. Looking back, I wonder if the danger was real. At the time my Uncle Bill Irving, his wife Maude Gage, and their son, my cousin Gage Irving were living at Raeburn[49] with my mother and me. At the time Uncle Bill was at the height of his career in water law, and Gage and I must have been about 18. We were all in the library before dinner when my Uncle John (Mr. Mylne, Sr.) came in. He told Uncle Bill that one of his Sanjeros [sic] had told him the [Temescal people] were ready to turn their water into the surplus flowage of the Gage Canal that night, and he asked Uncle Bill what he should do. Uncle Bill said: "Well John, it is simple. Possession is 9 points of the law. If Temescal gets their water into your flowage they will have possession of it and you will have to prove they have no right. If they do not get the water into the flowage, you will have possession of it and they will have to prove their right to it." My Uncle John went to the telephone without hesitation and called Jimmy Sheddin [actually James Sheddon, superintendent of the canal's headgate], who ran Camp Victoria at the head of the canal, and his instructions were simple and direct. He said: "Jimmy, load a truck with cement, sand and gravel. Bring five men with shovels, buckets, and lanterns. Knock the heads off some picks and bring the handles. We are going to plug Temescal's line where it enters the Canal and we will be at the top of Jap Hill when you arrive." He then called my Uncle Norman Irving, and my three Uncles, with Gage and me, set out by car. Gage and I

were not invited. The unspoken assumption that we would go along on this 'daring do,' without the need of an invitation, was the tacit and first admission to manhood that Gage and I ever got. The second being, of course, our first offer of a smoke, sometime later.

When Jimmy Sheddin arrived the pick handles were handed out more, I think, as a defense in the event of attack than as a means of imposing our will. For four or five hours the men mixed mortar and carried it over the bluff in buckets, each man with a lantern, and rocks were gathered from the hillside to give the filling bulk. As dawn began to lighten the work was done. Several yards of the pipe were solid masonry and the sinister plan of the Temescal Water Co. was foiled. Jimmy took his men back to Victoria and my Uncles took us boys to a place across from the Loring Opera House on 7th Street which was famous among working men for bacon end egg breakfasts at that time. The night to me was like a night of piracy on the rough coast of Scotland, dimmed lanterns moving up the cliffs from the shore with casques of French brandy.

Years later, at the dinner on my cousin John's [John Mylne, Jr.] retirement from the Company, I found myself sitting beside the retired manager of Temescal. He took the [occasion] to recount the iniquity of the Gage Canal in plugging their line, and I was able to tell him that happily . . . I had been there.

I have been happy enough to tell it again. Those were men you could trust and love. They thought straight and acted on their decisions without hesitation, for they were without tortured consciences. They were without moral doubt, for in that world there was still right and wrong, and men to know the difference. Those days are gone and it may be that my reluctance to write about them is to avoid comparison with the present. My interest is fatally attached, perhaps uselessly, to discover what may be done, what should be done, to try to retrieve such a world . . . [50]

The raid on Temescal's pipeline [actually a weir box] took place at 3:00 a.m. on the morning of September 22, 1925; Temescal manager Case was notified about 6:30 that morning.[51] Evidently, Joy Jameson spoke to Gage Company officials that same morning, and later wrote a letter confirming the nature of that communication:

Sept. 22nd, 1925.

Gage Canal Company:

Referring to our weir box for discharging waters into the Gage Canal, which you have partially filled up with cement, and which will soon harden if not removed, this is to confirm our verbal understanding, namely, that we shall immediately remove said cement without interference from you, in order to restore the property to its original physicel condition; but such removal shall be upon the understanding that we will not attempt to discharge water into said canal within ten days after date hereof without your consent, it being understood that you deny and prevent us from discharging said waters, even though said cement is removed. Nothing herein stated shall prejudice any rights we may have to use said canal in eccordance with our claims, after our rights thereto shall be established.

Temescal Water Co.
Joy C. Jameson, President[52]

W. G. Fraser replied for the Gage Company: "Leave to remove said cement is granted, without prejudice to your or our rights."[53]

More agreements, as well as disagreements, were entered into between the Gage Canal Company and Temescal Water Company during the next two years. Sometime after early 1928 (the precise date was not found) the two companies settled most of their differences and Temescal water was allowed to flow through the canal with the necessary upgrading, including the increase in flow capacity, to its terminus and then by pipeline to the Corona area.

In the autumn of 1959, the City of Riverside announced its intentions to initiate a "friendly" condemnation of the Gage Canal system.[54] Since the end of World War II, the city had become increasingly urbanized. Concomitant with this move toward an urban atmosphere was a rise in the value of undeveloped real estate. Citrus groves, then, were uprooted in order to make way for housing developments and shopping centers. This process was not unique to Riverside, but occurred to some extent in virtually every southern California community.

With an increase in population came the need for a greater potable water supply for domestic purposes. Hence, Riverside's decision to condemn the Gage Canal in order to gain municipal control of the canal's valuable water rights and transport system.[55] The city's decision was approved by the populace with the passage of $5.6 million bond issue in November 1960. The proposal for the condemnation required the approval of 50% of the Gage Canal Company stockholders and by mid-October 1961 this number was reached; 7,550 out of a total of 14,055 shares voted to approve the sale to the city.[56]

Not everyone approved of the sale. Four stockholders (Stewart Malloch, Robert Irving, Harry Erwin, and Errol Fleming) filed suit against the canal company to block the proposed transfer, claiming that possession of the canal, its water rights, and equipment, were vested in the individual shares of the company and not with the company itself. The complainants did not question the city's right to seek control through condemnation, but insisted that to do so, it would have to negotiate the sale with the individual stockholders. The canal company, on the other hand, maintained that the water rights had always been held in the company name and that the shareholders held only the right to obtain water, and did not have fee title to the water rights. In court, Judge Thomas Bucciarelli agreed there were merits to the plaintiffs' case and placed a temporary injunction barring the transfer of the canal to the city.[57]

After more than five years of negotiations and litigation, a stipulated agreement was entered into between the city and the canal company in June 1965, an agreement approved by 72% of the shareholders in the company. In the agreement the city gained possession of the company's assets including the water rights, approximately 220 acres of land in Riverside and San Bernardino Counties, and the canal right of way. To those shareholders who agreed to sell, the city would pay $225 per share up front. When the shares were eventually transferred to the city, at an unspecified future date, (but presumably when the lands became subdivided and no longer needed irrigation water) the shareholders received an additional $175, for a total of $400 per share.[58] Control of the Gage Canal Company would continue to reside in its stockholders, and thus would operate the canal in the same manner as it always had. The city's voice in canal operations became that of a shareholder, albeit a majority shareholder. Then, as more and more of the irrigable (i.e., citrus) lands watered by the canal became subdivided, the city would acquire more and more of the company shares until, eventually, all of them became city-owned. Until that time arrived though, the individual shareholders would continue to receive the water they needed, for as long as they needed.[59]

In this manner the Gage Canal continues to irrigate nearly 5,000 acres of citrus groves in the Arlington Heights section of Riverside. The Gage Canal and the groves it made possible together represent a by-gone era in the development of the city. Their continued presence in a landscape that has become progressively more urbanized and congested offers its residents and visitors a glimpse into a past that

in other areas of California, especially those in the south where citrus was the hub and magnet of development, has all but disappeared.

TECHNOLOGICAL ASPECTS OF THE GAGE CANAL

The Gage Canal is 20.13 miles in length, stretching from its source of water in the artesian basin of the Santa Ana River in San Bernardino to its terminus at McAllister Street in the Arlington Heights Area of Riverside. The canal, when originally constructed, was open the entire length of its course. Today the water is piped from the wells in San Bernardino to Linden Street (near the University of California in Riverside), and a large proportion of the canal is covered.

The canal was built in two sections. The first section from the Santa Ana River to the Tequesquite Arroyo, on Matthew Gage's Section 30 land, was completed sufficiently for water to run through the canal in the fall of 1886.[60] During the years 1887 and 1888 the canal was extended over the Teqesquite Arroyo to its present terminus. From 1886 to 1890 the upper section of the canal was used continuously, carrying ebout 700 miners inches[61] of water. The lower section of the canal at this time, however, was very little used, save for the purpose of running water through for consolidation and to reveal gopher holes and other weak spots.[62]

In order to keep a constant grade of 2 feet of fall per mile,[63] and to bring the canal from the river bed of the Santa Ana River to the higher plains of the mesa in Riverside, a number of engineering structures were necessary, including fifteen tunnels, thirteen flumes, and a number of cuts and fills.[64] A variety of soil types were encountered during the construction of the canal, including two thousand feet of sandy loam and thirteen thousand feet of "elluvial adobe". Other soil types through which the canal was excavated were gray clay, marly earth, heavy red mesa soil and hard granite (necessitating a 700 foot long tunnel). The depth of the open canal was three feet below the natural surface on its lower side, with the top foot of the water-way being supported by an embankment. The width of the bottom of the channel was eight feet for 14,000 feet, six feet for 41,312 feet, and five feet for the lower 40, 647 feet. The slope of the sides throughout was one to one.

Fourteen of the tunnels on the canal occur within 2.5 miles, and were driven in marly earth, soft sandstone or cemented sand, and soft decomposing granite. The tunnels thet were driven into rock were 6.5 feet wide and 6.5 feet high to the top of the arch. The tunnels driven through earth were originally left uncemented, but after water was run through them in 1886 creating considerable damage, they were all cemented. Thus, during the winter of 1886-87 the tunnels were lined along their sides and bottom with 4 to 6 inch thick Portland cement.[65] The roof of the tunnels were timbered, and where the tunnels ran through "cemented clay" the roof timbers were inserted into the sides and the concrete was carried up around them. Temporary shores and lagging were used in the construction of the tunnels where the roof would not stand without timbering. In total, 5,500 feet of tunnel were lined with concrete and cement.[66]

The thirteen flumes on the canal were constructed of redwood, with three heving a cross section of seven by four feet, five with a cross section of six by four feet, end five with a cross section of four by five feet. The largest flume wes referred to as Flume No. 9, crossing over the Tequesquite Arroyo near the present intersection of Central and Chicego avenues; measuring 1,000 feet in length and 80 feet high at its deepest part. The flume was supported by well braced trestle bents spaced 16 feet apart. It is believed that these flumes were constructed by Canadian carpenters.[67] [see photograph HAER No. CA-118-22]

Initially, the water ran through the uncemented excavated ditch, but, due to problems of vegetation growth, numerous breaks and seepage, in 1891 arrangements were made for the cementing of the canal from the head gates to the No. 6 flume.[68] By 1900, 5 miles of the canal remained uncemented. The contract for the work on the lower section of the canal was given to Messrs. Martin and Ormond. By 1903 the canal had been cemented from Horace Street to Madison Street, a distance of 6,600 feet. The final cost of the cement work, including the installation of storm water pipes, from Horace Street to the terminus was $17,948.73. During the month of December of the same year, the work of cementing the upper section of the canal at the head gates was completed.[69]

The method of cementing adopted by the canal company was to form corrugations at intervals in the side of the channel so that when the surface was coated with cement plaster 3/4-inch thick (in the ratio of 1 part Portland cement and 4 parts of clean sharp sand[70]) it would form ribs on the inner surface of the coating, which increased the strength of the whole structure. A wooden form was used to make the corrugations at intervals of about 20 inches.[71] For the fills, 6-inch walling laid in hydraulic mortar and coated with 3/8-inch-thick cement mortar in the ratio of 2:1 was used. The cost of this walling was 11 cents per squere foot. Before any lining to the canal was applied the channel was thoroughly saturated to induce settlement.[72]

In April 1926 the Gage Canal Company entered an agreement with the Temescal Water Company. This agreement allowed the Temescal Water Company to run 528 miner's inches of water through the Gage Canal. At the end of the canal the water entered the Temescal Water Company's pipeline to Corona. In order to carry an extra 528 miner's inches of water the canal had to be enlarged, which involved alterations and improvements to its structure including flumes.[73]

The Headworks

Water for the canal was obtained in two ways[74]: by surface water from the Santa Ana River and from artesian (later pumped) wells bored into the bed of the river. Water entered the canal through head gates on the south bank of the river. A 300-foot-long wood diverting dam built across the low water channel, end a portion of its extreme flood-water way, impounded the water and directed it to the head gates. The head gates were framed into a 30-foot long by 10-foot wide and 8-foot deep receiving chamber. The floor of this chamber was 18 inches below the level of the canal, allowing sand to settle out before the water entered. In this way, the receiving chamber served as a sand box and a sluice-way at its lower end, just above the canal head gates, enabled the sand to be cleared when necessary. The canal head gates were arranged in two beys and were closed by wooden gates operated by a rack and pinion arrangement. The sluicing gates operated in the same manner.[75]

The diverting dam also carried within it a flume, intended to carry water from the artesian wells north of the river across and under its channel to the head gates, where the water entered the chamber on the side at its upper end. In February 1888, however, a freshet carried away the north section of the dam.[76] Temporary dams constructed of sand and brush were thereafter used to divert the water into the head gates. These dams had three-foot diameter corrugated iron pipes running through them, the ends of which were closed with wood covers. These covers could be slid open to let the water through the dam in order to prevent the dam from being washed away if the build up of water behind the dam was too great.[77]

In 1907, considerable work was carried out in raising and extending the levee, originally constructed in 1890, which ran from the head gates for a distance of about a mile up the Santa Ana River. This levee protected the pumping plants, wells and head gates from the flood waters of the river. New concrete head gates were also constructed in 1907 at a cost of $850.00. Flood water, especially in the spring, was a periodic problem for the canal. A number of storm drains and levees were

constructed to carry the flood waters over or under the canal so that the banks would not wash away, reducing the amount of send deposited in the canal by the inundations. Other measures taken by the canal company included spreading the flood waters over the bed of the canal and allowing it to filter through into the artesian basin below. This operation not only helped reduce the damage caused by the floods, it also served to supply water to the canal. The spreading of from 4,000 to 13,500 miner's inches of water in the river bed reised the weter level throughout the artesian basin and thus reduced pumping costs.[78]

Further flood protection work was carried out in 1931 when a string of "Kellner Jetties", 512 feet in length, were laid along the face of the levee on the south bank of the Santa Ana River. Located about 3/4 mile above the head gates, the jetties protected the levee from the erosive effects of the flood water. The total cost of this work was $1390.87.[79]

Sand was also a great problem for the canal, for it would settle into mounds and reduce the carrying capacity of the canal. A number of methods were used to control the sand, in addition to periodic cleaning of the canal by hand (a long laborious and costly operation).[80] The first line of defense was the receiving chamber at the head gates. Sand could also be flushed out at the No. 1 flume and back out into the Santa Ana River. These measures, however, were not sufficient to contain the problem. In 1924 sand basins and checks were planned at flume Nos. 1, 2 and 9 in order to prevent the sand being carried down into the lower section of the canal. Work on the construction of the sand box[81] athe t No. 1 flume was started on December 20, 1926, by L & L Peving Co. and was completed on Wednesday, February 9, 1927, at a cost of $4,633.14. On June 28, 1927, the sand basin was flushed for the first time; most of the sand passed into the bypass to the river. This operation took 40 minutes, used 67 miner's inches of water and cost just $6.00. The sand box in Section 2 of the canal was completed on March 26, 1928.[82]

Despite the many earlier attempts to deal with the problem of sand in the canal, a great deal of cleaning was still necessary. This was due in part to greater rainfall in the years 1936, 1937 & 1938 which meant a great deal more water was being taken in through the head gates from the river than usual. This led the Gage Canal Company to take up an idea presented to them by a visiting engineer. Thus, in May 1938, the installation of a secondhand Victor Kimball-Krogh G-187 sand pump with a 6-inch diameter discharge pipe and a 60 horsepower Westinghouse electric motor was completed. A six-inch-diameter pipe ran across the canal from the sand pump with a swivel mechanism inserted to allow the pipe to rotate in order that two 6-inch suction pipes could be submerged in the water without turning the pump. In theory the pump could deal with objects up to 2 inches in size, although the pump never operated as intended. A jet of water was needed to egitate the sand so that the two pipes would suck up more than just 6-inch diameter circles of send. This was not considered before the pump was installed. Therefore the pump, which cost $2,691.17 to buy and install, was not a great success and was abandoned after only one year. The shed in which the pump and motor were installed, along with the motor, pump and transformer, were still in situ in 1991.[83] The only real solution to the sand problem came in the 1940s when the use of river water was abandoned in favor of total reliance on artesian and pumped well water.

Plans were elso made in 1938 to replace the head gates. The designs for these were completed and submitted to several contractors in October 1938. The design of the head gates included an overflow device which consisted of a float well containing a float linked to a Calico radial gate by a shaft and pulley wheel. When the water level in the float well reached a certein level it would raise the Calico radial gate and allow water into a chamber below the main structure end back out into the river channel. Water for the canal would enter through e series of wooden gates and down into another chamber where it entered the canal intake through a 4-foot Calico gate. The head gates were constructed in 1939 at a cost of $6,425.82. These gates remain today at the headworks although

river water is no longer used to supply the canal. Sheet piling work installed to protect the levee, and hence the canal and head gates, from the damaging effects of flood waters was another improvement carried out in 1939.

Water sources: Wells and Pumps

The first 6 wells for the canal were sunk by a Mr. Manson[84] between December 1, 1885, and January 1, 1886, providing 500 miner's inches of water.[85] By 1887, there were 14 wells producing 600 miner's inches of water. A further 12 wells were excavated in 1888, these being 10-inches in diameter and providing 120 miner's inches of water. Other wells were bored in subsequent years, so that by 1892 there were 55 wells producing 1793.45 miner's inches[86]. The water was brought to the head gates in open trenches, which were improved in 1899 by lining with wood work to form submerged flumes.[87] The wells were capped until needed to supply the canal when the flow from river water was insufficient.

Between 1892 and 1900 there was a gradual depletion of the surface flowing river water, as well as a diminishing discharge from the artesian wells. Thus, after 1893 more and more wells were opened up to maintain the supply until 1897 when all the wells were uncapped and the supply was reduced to about 1,500 inches. Over this same period the flow from river water was reduced from 450 inches to just 15.[88] Therefore, in January 1900 William Irving installed a centrifugal pump[89] and experimented using a steam engine to power it. One hundred and thirty miner's inches were produced from the group of six wells using this pump. Another pump, this time powered by a 10-horsepower gasoline engine, was installed at the group of four wells near Sargent's place. Two other pumps were also installed in 1900, one using a 40-horsepower gas engine at the No. 10 well, producing 200 miner's inches, and the other using a 15-horsepower gas engine at the No. 5 well, producing 100 miner's inches.[90] Despite the use of pumps, the amount of water flowing from the wells was only 906.47 inches.[91] Therefore new wells had to be sunk. The contract for the excavation of a new 12-inch diameter well was given in February 1901 to Osborne and Parker.[92]

In 1901 the 40-horsepower Weber gas engine was damaged by fire, and was replaced by a 30-horsepower electric motor. Another gas engine fractured a cylinder in the same year, and so a contract was placed with the Redlands Electricity Company to replace all the gas engines with electric motors. In 1902 two electric pumps were installed and one of the gas engines was sold. By February 9, 1904, nine electric motors (a total of 270 horsepower) were in operation and only two gas engines, a 25-horsepower unit and a 15-horsepower unit, remained. By 1905 there were no longer any gas plants in operation.[93]

Originally, the pump heads were located in a pit lined with wood. In October 1910, however, a contract was placed with Cyrus French to replace the wooden lining with concrete.[94]

During the 1920s a new phase was entered in terms of the pumping plants and the wells themselves. In 1920 some of the electric motors for the pumping plants were taken out and overhauled, many for the first time since they were installed.[95] New deeper and larger wells were also being sunk at this time. In July 1920, a new 20-inch diameter well was completed to a depth of 269 feet and at a cost of $4,250.00.[96]

Throughout the 1920s many new wells were excavated at increasing depths and diameters. New Byron Jackson deep-well turbine pumps[97] were installed in these wells powered by increasingly more powerful electric motors. During the mid-1920s, however, the Edison Electric Company, who supplied the Gage Canal Company with electricity, was experiencing difficulties in maintaining supplies, which entailed power shortages for their customers. Therefore, in order to maintain water supplies for the

canal, the Gage Canal Company instelled two new netural ges engines, both 75 horsepower, at the De Berry Street pumping plant. These two engines began operation on August 5, 1924 and pumped 175 miner's inches of water.[98]

In the 1930s two new wells were excavated end many existing pumping plants were replaced with larger motors and new pumps. Well No. 30-1[99] was completed to a depth of 936 feet and produced around 100 miner's inches of artesian flow. Well No. 31-1, 24-inches in diameter, was excavated to a depth of 422 feet and had a direct connected deep well turbine installed. It was in operation on May 13, 1931.[100]

In 1946 the Edison Electric Company changed to 60-cycle electricity. This necessitated the rewinding of the motors, and the total cost of the change was $34,200.00.[101] In 1948 the possibility of using Byron Jackson Tractor gas engines was considered due to power shortages. The pump pit and pipeline for Well No. 46-1, the only well excavated in the 1940s, was completed on November 8, 1948 and the pump was installed later by Gage Canal Company employees. The well wes complete and ready to deliver water in April 1949.[102]

The 1950s saw the continuation of the replacement of pumps, and in 1951 a new well was bored. In the mid-1950s came the replacement of all the electric motors with natural gas engines. This decision was taken due to a number of factors, but the main consideration was the price of electricity, which hed been increased substantially by the Edison Electric Company. Another consideration was the falling water table, which would have necessitated the replacement of the electric pumps themselves (Natural gas engines are more controllable than electric motors, giving greater flexibility of operation). Discussions were held with the General Electric Company in order to find a suitable variable speed device which would provide economical pumping using electricity. A motor acceptable to the Gage Canal Company was not found, however, and so preparations were made for the installetion of natural gas engines.[103]

By the end of 1954 all the engine foundations for the new gas pumping plants were completed and eight Climax engines from the Wilson Engine and Equipment Company were installed at a cost of $72,173.02.[104] The Southern California Gas Company supplied the gas, extending and reinforcing their main et Tippecanoe Street to do so. The Gage Canal Company connected their own gas pipelines to the pumping plants, with meters end regulators at each pumping plant. This enabled the amount of gas used and the amount of water pumped to be monitored and recorded. By April 1955, the eight gas engines were operating end were pronounced "very satisfactory."[105]

In 1956 a well was drilled to 1,128 feet and in September 1956 a Byron Jackson pump was installed in the pump pit. A gas line to the well was installed in January 1957 and the well was tested. By April of the same year the pump house was completed. During the remainder of the 1950s and into the 1960s new pumps and gas engines were installed in the wells. The last well to be excavated was completed to a depth of 808 feet and a pump installed by September 1966. The total cost of this well came to $43,255.00.[106]

The last major work concerning the wells and pumping plants was carried out in 1975, when the City of Riverside filled in the pump pits with concrete and raised the concrete floors so that the water was pumped to the surface into an enclosed pipe before it entered the new pipeline to Riverside.[107] Previously the pump heads were located in pits and the water was pumped into the canal below ground level, saving money in terms of wested pumping but not conforming to California State Health Department specifications which addressed the possibility of bacteria and polluted water seeping into the canal. Today, 14 pumping plants, equipped with deep-well turbine pumps and natural gas powered engines provide the water for the Gage Canal.[108]

Flumes

The flumes which carried the canal water over the numerous arroyos initially had only wooden foundations. But, after only a few years of operation, the timbers began to rot due to contact with the earth. Therefore, in the fall and winter of 1890 "retaining walls of heavy masonry were constructed at the ends of all flumes...thus removing the woodwork from all contact with the clay."[109] This work, however, took considerable time to complete; the rebuilding of the No. 2 flume on concrete piers was not completed until April 11, 1905.[110]

Although these flumes were quite substantial structures, they did have a tendency to leak. The joints of the wooden sections were straddled by sheets of iron which were filled with hot tar to seal them. They were also vulnerable to flood waters end the debris which washed against the flume. On February 2, 1906, the No. 2 flume "moved two feet out of alignment due to a cloud burst...which brought a large volume of water and drift wood down against the flume."[111]

By 1907 the No. 6 flume was in such poor condition that it had to be replaced by an inverted steel syphon at a cost of $1,327.34.[112] In the 1910s many projects were completed on the flumes. The Western Reinforced Pipe Company replaced the No. 3 flume with a 66-inch pipe, at a cost of $4,183.92 in 1917. In 1919, the No. 11 flume was replaced by a 800-foot long, 60-inch reinforced concrete pipe costing $11,440.00. In 1920 the No. 4 flume was replaced by a 66-inch syphon.[113]

The woodwork for flumes Nos. 9, 10 and 12, however, was only repaired. By 1920 it was recommended that the No. 9 flume be replaced during that winter due to deterioration of the wood. This flume, however, remained in use without any replacement, though it was necessary from July 1923 to bring in a night man to check the extent of the leaks. The flume was finally replaced in 1924 by a 62-inch concrete syphon by the Lacy Manufacturing Company. The syphon was completed on April 22, 1924 at a cost of $18,832.36.[114]

Although a 90-foot section of the No. 2 flume, spanning Dry Creek, had collapsed due to dry rot on September 15, 1920, it was not replaced by a syphon until 1926 when the Western Concrete Pipe Company laid a 66-inch concrete pipe.[115] Flume No. 12 was replaced by a 326-foot long reinforced concrete pipe in 1927 and the No. 10 flume, constructed in 1888, was replaced by 184 feet of gunite pipe in 1928.[116]

The next round of flume replacement came in the 1940s when the American Concrete and Steel Pipe Company completed replacement of the No. 8 flume with a syphon on March 10, 1941.[117] The No. 6 syphon was replaced in 1948 by a concrete flume due to problems caused by the narrow nature of the arroyo in which the flume was laid.[118] This flume is still visible today, although water has not run through it since the construction of the pipeline in 1974.

Two 33-inch diameter concrete-lined steel pipes replaced tne No. 5 flume in February 1956 at cost of $7547.23. The pipes were inclined against the gradient in order to prevent trapped air bubbles.[119]

In May 1968 the iron flume across the Mockingbird Dam was removed and a pipe costing $13,000.00 installed.[120] The only flume that remains in use as part of the canal today is a small steel flume in the lower section of the canal across Harrison Street Arroyo.

In terms of cost, the concrete syphons were less expensive than steel. The use of pre-cast concrete sections replaced the earlier method of building up a frame of steel wire and then concreting in situ. The syphons were cleaned about every three years, although the rate of maintenance depended on e number of factors. During the reiny season and in the presence of surface run off (which would bring

mud, and debris into the canal) the period between cleanings was abbreviated. The syphons were cleaned using a slip scrapper attached to a cable that was pulled through the syphon to clean the dirt out.[121]

Mockingbird Dam

In 1911 an earth fill dam reinforced with a concrete core wall was proposed to cross Mockingbird Canyon, close to where the canal crossed the canyon on the No. 13 flume. The purpose of the dam was to create a storage lake by running some of the winter flood waters of the Santa Ana River through the canal and diverting them into this reservoir.[122] Construction of the dam started in 1912, but by November of that year the cost of the work had already exceeded the estimates. By the end of September 1913 the cost of the dam had reached $150,836.27 -- $11,496.69 over the original estimate. This was due to changes in design and the necessity to excavate deeper to prevent leakage and storm damage.[123]

On March 27, 1915, the first storage water was run into Mockingbird Lake, continuing until April 14, 1915, when all the water in the canal was required for irrigation. By this date the level in the lake had reached 38 feet. By June, 7 1915 the remaining work on the dam was completed. Some seepage had occurred through the bank of the arroyo on the north side, 75 feet below the top of the embankment and about 5 feet above the bottom of the arroyo. Problems with seepage plagued the dam throughout its history and prevented it from fulfilling expectations. Despite this difficulty, the dam was a reasonable success and was used to supply Duffrin Avenue, Van Buren, Gibson, and Jackson Streets through a pipe at the bottom of the dam. In 1932, a concrete spillway, required by, and under the direction of, the Division of Dams, State Division of Water Resources, was constructed to carry excess water safely away. Today, the lake still supplies a few pipelines, although the dam is unable to hold water above a level of 19 feet. Complications associated with leakage still exist today.[124]

Distribution

In a letter to the Builders Iron Foundry Co., manufacturers of water measuring devices, dated May 1, 1901, William Irving described the distribution system of the canal:

> The total body of water (13,500 gals. per minute) is curried [sic], in the first instance, in an open canal a distance of over 20 miles along the highest contour of the lands to be irrigated. At intervals of one fourth of a mile along the line of the said canal there are inserted main distributing pipes commencing at canal with pipes 10 inches in diameter and terminating with 6 inch at lower levels.
>
> From these main pipes lateral connections are made along their whole length at intervals of about 660 feet-right and left - said lateral pipes being, generally, 4 inches in diameter, and terminating in a Hydrant and Hydrant box for the discharge and measurement of the water. By these means we are enabled to distribute the total body of water carried in canal to each 10 acres of land, consisting, in aggregate, of about 8000 acres; requiring, as you will note, about 800 different discharges with tier [sic] accompanying measuring devices.
>
> In addition to these we have a measuring weir at the entrances from the canal to each main distributing line.[125]

The water entering the pipelines today is still measured using weirs, of which there are four types: the Snow weir; the Riverside weir; the Corona weir; and the Orifice weir. The Snow weir consists of two five-inch-high gates which slide open to allow the water through. Above these gates is a graduated rim, marked off in miner's inches. To measure the amount of water flowing through the weir, the

gates are opened until the water level is just at the top (called "dusting of the top") of the graduated rim . The amount the gate is open is read off from the graduated line. This figure is multiplied by 5 (the height of the opening through which the water is freely flowing) to obtain the amount of water in miner's inches flowing through the weir. To reduce or increase the amount of water flowing through the weir into the pipelines, the gates are opened or closed to the desired reading. Then the valve in the weir box is opened or closed until the water is once again "dusting off the top" of the weir.

The Riverside weir is essentially the same as the Snow weir, and the Corona weir, instead of using gates, uses one-inch-wide metal plates which slot into the opening in the weir. The Orifice weir measures the water in a different way, requiring backed-up, rather than free-flowing, water to operate. The Orifice weir consists of a round hole through which the water flows. The amount of water passing through the weir is determined by the differences in the water level on each side of the opening and therefore needs backed-up water to operate.

When in 1888 William H. Hall, C. E., State Engineer for California, made a study of the Gage Canal system, the distribution system was:

> composed generally of pipes of iron and cement and wooden flumes of small size, the grade of the plain laterally from the canal being seventy-five to one hundred feet per mile. All distribution is effected at the expense of the purchasers of water-rights, who have planned and carried out their works in their own way, as best suited their means and convenience, in some cases individually, and in some cases by combining together in little districts. As far is known, these laterals are at present about as follows: Two miles iron pipe; 4.12 miles cement pipe; 12.12 miles wooden flume; three miles open ditch, all varying much in size. The aggregate cost of these is given at $17,469.[126]

This system supplied the area of land through which the first section of the canal ran. In 1890 William Irving began laying out the pipelines for the Arlington Heights area:

> Pipe lines of riveted steel plate were laid on Adams and Jane Streets during the early part of the year. And substantial Bulk Heads constructed in canal where pipelines connected therewith. And a vitrified pipe line similarly connected was laid on Evans Street as far as Dufferin Avenue.[127]

The "Bulk Heads", it is believed, were carved from local granite by Canadian stone-masons, who also carved the stone foundations for "Greystones," one of William Irving's houses built in Arlington Heights.[128] The purpose of the bulk heads was to build up water pressure for the distributing pipelines. The bulk heads were essentially a narrowed section of the canal with carved vertical slots in which boards could be placed to raise the weter level behind them and thus increase the water pressure. These bulk heads continue to be used today for the same purpose.

A great deal more work in laying the distributing pipelines was carried out in 1891, with pipelines laid on Maude, Horace, Washington, Gratton, Irving, Jackson, John, McAllister, and Stuart streets. Also, laterals were laid from these main pipelines to over 1,000 acres of land, and further bulk heads were placed where the pipes entered the canal.[129]

Pipelines were placed on Arlington Avenue, Anna, Mary, Madison, Evans, St. Lawrance, Jefferson, Irving, Monroe, Van 8uren, Robert, and Harrison streets in 1892, and "a large number of laterals were extended from the mains to the lands to connect with irrigating flumes." [130]

The laying of pipelines continued in Arlington Heights during 1893, with pipelines placed on Monroe and Gibson streets and leterals to about 800 acres of land. During the same year:

> An improved Hydrant and Hydrant Box was adopted - the latter being formed of cement, and attached to all the irrigation laterals and flumes that were put in during the yeer, end in ceses where new Boxes were needed elsewhere. They were substituted as being a great improvement on the old forms.[131]

The hydrent was the device by which water was let out of the mein pipeline and into the lateral pipelines of the land owner.

In 1899 it was recognized that "the structures of wood on the line of the canal and the pipelines for the distribution of the water cannot last forever and we [the Gege Canal Company] must be prepared, perhaps in the near future, for the cost of renewals of these works."[132] Thus, in 1914 the replacement of the distribution pipelines began. This operation was to last until the 1950s. In 1914, three lateral 4-inch pipelines in Section three of the canal were replaced by 8-inch gravity lines costing $255.34.[133]

By March 30, 1922, the renewal of 50 miles of pipes in Arlington Heights had begun. Eight hundred and sixty feet of 6-inch steel pipe, 8,326 feet of 8-inch cement pipe and 1,480 feet of 10-inch cement pipe replaced 3,730 feet of 6-inch steel pipe and 14,321 feet of 4-inch steel pipe. The total cost of this replacement amounted to $4960.85.[134]

The replacement of the old pipelines by new steel and cement pipe continued throughout the 1920s end 1930s. In 1953, however, there was still original pipeline laid prior to 1913 in use. This 1,100 foot long section of pipe along Gibson Street was replaced by 18-inch diameter steel, and 18-inch diameter concrete pipeline at a cost of $6.00 a foot.[135]

The Gage Canal then is basically a gravity flow system with water being distributed in pipelines to the individual plots of land below the level of the canal. The canal, however, also supplies water above the line of the cenal. This is achieved by using pumps to bring the water through pipelines to the highest point to be irrigated and then allowing the water to flow by gravity through the pipelines to the individual groves. At one time there were es many as 12 pumping plants stretching from above the Tequesquite Arroyo to the end of the Canal.

Originally, Triplex pumps were used. These had three cylinders and pistons of twelve or fourteen inches in diameter and were belt driven, at low speeds, via a huge flywheel. A mechanism enabled the pistons to work in succession in order to keep a steady flow of water; valves let the water in, shutting closed when the back pressure came on. The pistons were lubricated by water leaking from the cylinders, although if the flow became too great the packing would have to be tightened. These pumps were later replaced by centrifugel pumps.

One of these pumping plants, the Prenda pump, located on Hawarden Drive, had a Quimby rotary pump which wes directly connected with a 6-inch diameter pumping mein. It was powered by an electric motor from the General Electric Company and was a 20-horsepower, 3-phase induction motor operating on 60 cycles et 200 volts.[136] This pump and motor, which could operate at a capacity of 450 gallons per minute, was installed in 1897, but on August 5, 1900 the transformer burned out and a rupture in the pump occurred. The ensuing correspondence between William Irving, who was President of the Prenda Pumping Co., and various concerned parties, shed e little light on the operation of the pump. The pumping operetion was under the care of two officiels,

> One - a "Jap." has under his care the running of the pump, and in order that as much of his time as possible - he having other duties to perform as a domestic servant - his sleeping apartment is in the pumping-house. The other official - Norman Irving- has the care of all distribution of the water from the said pump - or at the time of the rupture- and therefore attends to the opening and closing of all hydrants.[137]

The Lincoln Heights Pumping Company's pump-house et Grace Street retains the sleeping apartment of the pump attendant. In this partitioned section of the pump house there is still a bed, a desk and the remains of a telephone line. In the corner of this room is an opening through which the stack of a small stove would have projected. One of the reasons cited for the need of constant supervision of the pump was the possibility of a power failure. If the pump went out during the night and there was no one to restart the pump when electricity was restored, a whole night's pumping would be lost.[138]

Originally, the Lincoln Heights Pumping Co. pumping house had two vertical pumps. Connected to them was a surge tank, still in situ today, which was filled with air from a belt driven compressor. The surge tank acted as a cushion when the water was back running, and with over a hundred feet rise in the pipeline a lot of pressure would have been hitting the valves of the pump. Now that the lift is only 20 feet or so, the surge tank is no longer used. In recent years, with less distance and water to pump, one of the vertical pumps was replaced by a smaller 7-horsepower horizontal pump from the Wiffen pump house. The old vertical Stockhom 125 pump and shaft with a four-stage bowl remains in the pumping house.[139]

Covering of the Canal

One of the problems involved in maintaining an open canal is the accumulation of sand, mud, and plant growth which reduces the capacity of the canal. The buildup of debris necessitates periodic cleaning of the canal, requiring that the water be turned out of the canal during the winter months and making it unavailable for irrigation. Therefore, during the 1920s the Gage Canal Company began covering the canal. In April 1927, the L & L Paving Company completed a reinforced concrete box between the No. 2 syphon at e point 200 feet south of the Southern Pacific Railway. The construction consisted of a two-compartment concrete box 213.5 feet long costing $21,094.70. Water was first run through the box on April 20 1927.[140]

In 1928 a 1,577 feet long section of canal from the north end of the No. 2 syphon towards the Head Gates was covered.[141] The covering was a framework of reinforcing rods which was then concreted.

Much of the covering of the canal, however, was carried out in the late 1940s and 1950s, using gunite and later specially fabricated forms. On February 1, 1949, work began on covering the canal in the section above the No. 1 weir. By February 11, 1949, 400 feet of the floor and 48 feet of the erch section wes covered during each working day. On February 26, 1949 the last 481 feet of arch section was poured, completing a job which cost $5,094.47.[142]

Covering of the canal continued during the 1960s, and on February 26, 1973, the last section of the canal covering on section 2 was completed.[143]

The Pipeline

So that the water pumped by the Gege Canal Company could be used for domestic water for the City of Riverside and conform to health regulations, a pipeline was constructed in 1974 by the City's

contractor, Dorfman, from the headworks to Linden Street in Riverside. On May 1, 1975 the first deliveries of water began. Approximately 1,365 miner's inches of water came down the new pipeline from San Bernardino to Linden Street where it passed into the old canal. On June 27, 1975, the City of Riverside started taking water at Linden Street through their newly installed pipeline.[144]

In 1991 an agreement was made between Riverside Public Utilities and the Gage Canal Company for the exchange of agricultural water for domestic water. Under this agreement, the City of Riverside receives up to 6,400 acre-feet of potable water a year from the Gage Canal, which is transported to the City's Linden and Evans Reservoirs. In return the Gage Canel receives a maximum of 8,000 acre-feet a year of agricultural water pumped from the Riverside Canal at the Olivewood Booster station. In order to achieve this exchange, six new pumps were constructed et a cost of $538,000 at the Olivewood Booster Station. These pumps increased the capacity of the station from 700 Miner's Inch Days (6,300 gallons a minute) to 1,350 Miner's Inch Days (12,150 gallons a minute).

Conclusion

Throughout its history, the operators of the Gage Canal have been striving constantly to bring water cheaply and efficiently to Riverside, end particularly Arlington Heights. Although not the first canal in Riverside, nor one with particularly unique engineering problems to overcome (although the wooden flumes must have made impressive sights when they were built), the canal was of major significance to the local area. The Gage Canal represents the ingenuity and vision of Matthew Gage who saw the potential of opening up the higher lands south and east of Riverside to development. When completed, the canel nearly doubled the irrigated area of Riverside to 12,000 acres.

The technology of the canal was developed over the years in order to maintain supplies of water. This entailed the excavation of deeper wells, the use of turbine pumps and eventually the replacement of electric motors with natural gas engines. This development is mirrored in the structure of the canal itself with the replacement of wooden flumes with syphons, the gradual covering of the canal, and the ultimete piping of the water from the Headworks in San Bernardino to Riverside. Although modern technology has permeated the running of the canal today, (the valves and measuring devices can be controlled remotely on the upper section of the canal) traditional technology prevails. The miner's inch is still used to measure the water, along with weirs; parts of the canal remain open and ere lined with cement that was epplied almost a century before; and, although the distribution pipes to the groves have been replaced, their general operation remains the same.

The quality of the Gage Canal irrigation system has assured the canal's continued use essentially for its original purpose, just as it was at the turn of the century when engineers from India, Germany, Australie and Hawaii went to "Washington with letters to the Government, and from thence sent here...[the Gage Canal]... being the best illustration of water distribution in the United States..."[145]

ENDNOTES

1.Local Riverside journalist and historian Tom Patterson has discussed the topic of these early canals in his book, A Colony for California, (Riverside, CA: Press-Enterprise Co., 1971). The canals are also favored topics among numerous articles in his weekly column "Out of the County's Past" in the Riverside Press-Enterprise. See for instance, "Remnants of Riverside's Canals a Reminder of a Different Age," 26 January 1986, p. B-2; "Looking Ahead at Water Needs, Looking Back at Canal Projects," 4 August 1991, p. B-7.

2.Patterson, "Remnants of Riverside's Canals a Reminder of a Different Age," Riverside Press-Enterprise, 26 January 1986, p. B-2; "Looking Ahead at Water Needs, Looking Back at Canal Projects," Riverside Press-Enterprise, 4 August 1991, p. B-7.

3.Ibid.

4.Patterson, Colony, p. 179; "Gage Canal System," Riverside Daily Press, 1 July 1886, p. 1; "Gage Canal System," Riverside Press and Horticulturist, 10 July 1886, p. 1.

5.Patterson, Colony, p. 179-181; Patterson, "Mr. Gage's Canal--It Succeeded; He Did Not," Riverside Press-Enterprise, 11 January 1970, n.p. (clipping on file at Local History Collection, Riverside City and County Public Library); W. W. Robinson, Land in California, (Berkeley, CA: University of California Press, 1948: reprinted 1979), pp. 170-171.

6.Patterson, Colony, p. 181.

7.E. W. Hilgard, "Report of E. W. Hilgard on the Gage Canal System of Riverside, San Bernardino County, California," (San Francisco, CA: George Spaulding and Co., Printers, [ca. 1889], p. 5. (Hilgard was a professor of agriculture from Berkeley who did an assessment of the canal system and its water sources at the request of the House Life Insurance Company of San Francisco He arrived in April 1889, according to chief engineer, William Irving, "History and Journal of the Gage Canal to 1894," [Unpublished MS, n.d.], p. 11);

8.Patterson, Colony, p. 181; Hilgard, "Report . . . on the Gage Canal System," p. 5; San Bernardino County Recorder's Office, Book 45 of Deeds, pp. 528-530; Pauline Mazzetti Brandon, "The History of the Gage Canal Company of Riverside: A Story of the Development of Arid Land in California," Unpublished MS, 1962, p. 28, citing Book T of Mortgages, (San Bernardino County Recorder's Office), p. 455; "Gage Canal System," Riverside Daily Press, 1 July 1886, p. 1; "Gage Canal System," Riverside Press and Horticulturist, 10 July 1886, p. 1.

9."The Gage Canal," Riverside Press and Horticulturist, 24 September 1885, p. 2.

10."Local News," Riverside Press and Horticulturist, 2 January 1886, p. 3.

11."The Gage Canal," Riverside Press and Horticulturist, 24 September 1885, p. 2; "Local News," Riverside Press and Horticulturist, 2 January 1886, p. 3.

12."Artesian Water for the Gage Canal," Riverside Press and Horticulturist, 10 November 1885, p. 1; "The Gage Canal" Riverside Press and Horticulturist, 14 November 1885, p. 1.

13.Patterson, Colony, pp. 58, 66, 75. Irving, "History and Journal," p. 1.

14."The Gage Canal," Riverside Press and Horticulturist, 14 November 1885, p. 1.

15.Ibid.

16.Ibid.

17.Stephen H. Herrick, "A Brief History of the Gage Canal as First Planned," Riverside Museum Associates Museum Report, October 1966, n.p.; Brandon, "History of the Gage Canal," p. 30; Grantee Index, 1854-1926, San Bernardino County Recorder's Office; Grantor Index 1854-1926, San Bernerdino County Recorder's Office; "Water on the Desert," Riverside Press and Horticulturist, 1 June 1886, p. 3 (article included an interview with Gage).

18.Ibid.

19."Local News," Riverside Daily Press, 24 June 1886, p. 2.

20."Gage Cenal System," Riverside Daily Press, 1 July 1886, p. 1; "Gage Canal System," Riverside Press and Horticulturist, 10 July 1886, p. 1. (Both papers were reprinting an undated edition of the Los Angeles Express.)

21.Ibid.

22.R. Stewart Malloch, "Answers to questions in Mr. Kinucan's letter of August 30, 1977," (Copy in possession of Harry Lawton, n.d.), p. 12. Mr. Kinucan was at the time in the employ of the Riverside County Historic Resources Commission.

23.R. Stewart Malloch was both grandson to William Irving and great-nephew to Matthew Gage. John Mylne, Jr. was also Irving's grendson end succeeded his father as chief engineer and manager of the Gage Canal Company. Malloch and Mylne both spent their much of their lives in Riverside and apart from being cousins, they were also close friends.

24.John Mylne, Jr., personal communication, August 1991.

25.Malloch, "Answers to questions," p. 6.

26.Harry W. Lawton, "A Selected Chronological History of Chinese Pioneers in Riverside and the Southern California Citrus Belt," in Wong Ho Leun: An American Chinatown, vol. 1, pp. 53-140. (San Diego, CA: The Great Basin Foundation, 1987), pp. 71, 74, 77.

27.Malloch, "Answers to questions," p. 12.

28."Extension of the Gage Canal," Riverside Daily Press, 13 October 1886, p. 2; "Arlington Heights," Riverside Press and Horticulturist, 1 October 1887, p. 1.

29."Gage Water: First Delivery Through the Gage Canal," Riverside Daily Press, 10 November 1886, p. 3.

30.Ibid.

31.Ibid.

32.Irving, "History and Journal," pp. 2, 5.

33.Ibid, p. 6, 10, 11.

34.Ibid, p. 10, 17, 18; "Map of Arlington Heights," recorded on 8 December 1890 Map Book 11, (San Bernardino, CA: Sen Bernardino County Recorder's Office), p. 21; "The Opening of Victoria Bridge," Riverside Daily Press, 27 November 1891, p. 3; "The Opening of Victoria Bridge," Riverside Press and Horticulturist, 5 December 1891, p. 1.

35.Affidavit of Matthew Gage, "Matthew Gage and Jane Gage vs. Riverside Trust Company," United Stetes Ninth Circuit Court, No. 1223, p. 1; Book R of Mortgages, San Bernardino County Recorder's Office, p. 276.

36.Affidavit of Matthew Gage, "Matthew Gage and Jane Gage vs. Riverside Trust Company," United States Ninth Circuit Court, No. 1223, p. 2.

37.Affidavit of Matthew Gage, p. 2.

38.Brandon, "History of the Gage Canal," pp. 47-48; "Articles of Incorporation," Riverside Trust Company, Ltd., London, 1890.

39.Minutes of the Board of Directors of the Gage Canal Company, 1891-1910, 17 January 1891; 22 April 1891.

40.Stock certificate issued by the Gage Canal Company. On file at Gage Canal Company offices, Riverside, CA.

41.Brandon, "History of the Gage Canal," pp. 53-54. The court's final decision, if rendered, was not found during the course of this investigation.

42.Patterson, Colony, p. 320, 377-378.

43.Minutes of the Gage Canal Board of Directors, 18 June 1924; Minutes of the Annual Stockholder's Meeting, 13 January 1924; John Mylne, Jr., personal communication, 1991. Mr. Mylne stated that two of the company's directors had received $10,000 cash from the president of Temescal Water, Joy Jemeson, in exchange for allowing Temescal to run several hundred miner's inches through the Gage Canal, and without the benefit of a written agreement or having to go through the necessary formalities of a board meeting. This may be the "personal interest" the shareholders were up in erms about.

44.Minutes of the Gage Canal Board of Directors, 24 June 1925, 7 August 1925.

45.H. R. Case to John Mylne [Sr.], 17 September 1925, in Minutes of the Gage Company Board of Directors; John Mylne [Sr.] to H. F. Case, 17 September 1925, in Minutes of the Gage Company Board of Directors; John Mylne, Sr., Superintendent and Engineer's Report of the Gage Canal, 12 October 1925.

46.H. R. Case to John M. Mylne [Sr.], 21 September 1925, in Minutes of the Board of the Gage Canal Company.

47.W. G. Fraser to Temescal Water Company, 21 September 1925, in Minutes of the Board of the Gage Canal Company.

48.Mylne, Superintendent and Engineer's Report, 12 October 1925.

49.Raebum was, and is, one of the homes built by canal engineer, William Irving. The house was named for Scottish town of Raeburn, Dumfries County, where the Irvings had originated.

50.R. Stewart Malloch to John Adams, 8 October 1987. (Copy in possession of Harry Lawton, University of California, Riverside.

51.Mylne, Sr., Superintendent and Engineer's Report, 12 October 1925.

52.(Copy of) Joy C. Jameson to Gage Canal Company, 22 September 1925, (on file at the Gage Canal Company office, Riverside, CA.)

53.Ibid.

54."Water company will build," Riverside Press-Enterprise, 29 October 1959; "Judge allows delay in Gage water suit," Riverside Press-Enterprise, 30 October 1961.

55.In September 1959, the Gage Canal Company's were appraised at a value of $39,133,500. ["Gage group says motives not hidden," Riverside Press-Enterprise, 3 March 1962 (quoting R. Stewart Malloch, company secretary)].

56."Stockholders vote Gage sale," Riverside Press-Enterprise, 13 October 1961.

57."Judge allows delay in Gage water suit," Riverside Press-Enterprise, 30 October 1961.

58.The canal company was also reimbursed $547,276 by the city for its legal fees and court costs.

59."Riverside captures ownership of Gage Canal water system," Riverside Press-Enterprise, 10 June 1965.

60.William Irving, "History and Journal of the Gage Canal," 1894, p. 1. (Handwritten, on file at the Gage Canal Company office, Riverside.)

61.A miners inch is a measurement of the rate of flow of water. It is not a standard measurement but varies geographically. The miners inch adopted by the Gage Canal is equivalent to 9 gallons a minute. One miners inch is the amount of water that flows through a one inch square hole with a 4 inch pressure of water above it, measured from the center of the opening to the surface of the water. Irving, "History of the Gage Canal", p.191; William Irving to Elwood Mead, 17 October 1901, William Irving Letters, p.101-102, private collection of John M. Mylne III, Riverside, California.

62.William Irving to Professor Mead, 14 June 1902, William Irving Letters, pp. 340-345.

63.A grade of 2 feet fall per mile was just steep enough for the water to flow, but shallow enough to prevent erosion.

64.W. H. Hell, Irrigation: California (Sacramento, CA: State office, 1888), pp. 2-3. See Appendix A for summary of canel perts and Appendix B for the break down of the costs of the first section of the cenal.

65. Irving, "History of the Gage Canal," p. 1.

66.Hall, Irrigation, pp. 2-3.

67.John Mylne Jnr., interview, August 1991. Mr Mylne was the General Manager and Chief Engineer of the Gage Canal Company 1938-1972.

68.Irving, "History of the Gage Canal," p.1.

69.Gage Cenal Company, Minutes of the Meetings of the Board of Directors, 1891-1980, meeting of 9 Jenuary 1900 (on file at the Gage Canal Company office, Riverside, California); Ibid., January 1903; Ibid., 9 February 1904.

70.Irving, "History of the Gage Canal," p.24.

71.Irving to J. B. Lippencott, C. E., 12 April 1902, William Irving Letters, p.298.

72.Irving to R. H. Russell, 5 July 1902, William Irving Letters, p.346.

73.Gage Canal Company, Minutes, 12 October 1926. Mylne, interview, August 1991.

74.See appendix C.

75.Hall, Irrigation, p. 2.

76.Ibid.

77.John Mylne Jnr., interview, August 1991.

78.Gage canal Company, Minutes, 18 October 1906; Ibid., 3 January 1907; 14 January 1908; Gage Cenal Company, Superintendent and Engineer's Report, 1901-1961, report of 18 October 1906. (on file at the Gage Canal Company office, Riverside California); Ibid., 12 March 1907; October 1914.

79.Gage Canal Company, Superintendent and Engineer's Report, 8 December 1931.

80. A slip scraper was used to clean the canal. This device resembled a snow shovel with two handles instead of one. A cable was ettached to it and a winch placed down stream. The slip scraper would then be dragged down stream by the winch. This action piles the sand up which is then removed by shovel. The process then begins again. Mylne, Interview, August 1991.

81.The sand box consists of a concrete box with a central divider. The water enters the sand box at one end end the sand settles to the floor. The water then passes over the central divider and flows back into the canal. Gates at the end of the sand box allow the sand to be flushed out into the channel of the Santa Ana river.

82. Gage Canal Company, Superintendent and Engineer's Report, 28 April 1915; Ibid., 5 December 1924; Ibid., 8 February 1927; Ibid., 13 December 1927; Ibid., 17 July 1927; Ibid., 10 April 1928; Gage Cenal Company, Engineers Daily Dairy, 1905-1938, entry 20 December 1926 (Handwritten, on file at the Gage Canal Company office, Riverside, California.); Ibid., 9 February 1927.

83.Gage Canal Company, Superintendent and Engineer's Report, 12 January 1938; Ibid., 9 May 1938; Ibid., 14 June 1938; John Mylne II, Interview, August 1991.

84."an experienced well borer" Riverside Daily Press, 1 July 1886.

85.Riverside Press and Horticulturist, 5 June 1886; Ibid., 1 July 1886.

86.Irving to Dr. Hilgard, 11 August 1901, William Irving Letters, p.57.

87.Gage Canal Company, Minutes, 9 January 1900.

88.Irving to Dr. Hilgard, 11 August 1901, pp. 57-60.

89."A centrifugal pump consists of a circular casing with its inlet or suction end connected to the center, and its outlet or discharge end forming a tangent to the outer circumference. Inside the casing is a runner or impeller, which is keyed on the shaft and revolves with it. It consists of curved vanes closely fitting the casing. The revolution of the pump shaft and impeller imparts a centrifugal force to the water between the vanes which forces the water away from the center to the rim of the casing and into and through the discharge pipe. The outward flow of the water in the pump casing produces a partial vacuum at the center of the impeller which causes water to flow into the casing, giving a continuous discharge." B. A. Etcheverry and S. T. Harding, Irrigation Practice and Engineering, Vol. 1: Use of Irrigation Water and Irrigation Practice, 2nd ed. (New York: McGraw-Hill Company, Inc., 1933), p. 215.

90.Gage Canal Company, Minutes, 5 February 1900; Ibid., 7 May 1900; Ibid.,2 July 1900.

91.Irving to Hilgard, 11 August 1901, p.60.

92.Gage Canal Company, Minutes, 4 February 1901.

93.Gage Canal Company, Minutes, 4 June 1901; Ibid., 14
January 1902; Ibid.,13 January 1903;Ibid.,9 February 1904; 9 January 1906; Gage Canal Company, Superintendent and Engineer's Report, 8 July 1901.

94. Gage Canal Company, Superintendent and Engineer's Report, 31 October 1910.

95. Gage Canal Company, Superintendent end Engineer's Report, 8 January 1920.

96.Ibid, 20 July 1920.

97.Deep-well turbines a form of centrifugal pump designed to operate in the confined space of the well casing. To do this they use small-diemeter impellers or "bowls" to reduce the lift obtainable from each stage. A separate stage or bowl is used for each 15 to 30 feet of lift. The pump is suspended in the well from the pump head and is powered through a verticel shaft by either a directly connected vertical motor or via a belt. The discharge pipe surrounds the driving shaft which is enclosed in a pipe. Etcheverry and Harding, Use of Irrigation Water and Irrigation Practice, pp. 221-223.

98.Gage Canal Company, Superintendent and Engineer's Report, 8 July 1924; 19 August 1924; 8 December 1924.

99.Each well was numbered according to the year it was excavated, and how many wells were excavated in that year. The first well bored in 1931 was numbered 31-1, the second 31-2 etc.

100.Gage Canal Company, Superintendent and Engineer's Report, 9 June 1931; Ibid., 8 December 1931.

101.Gage Canal Company, Superintendent and Engineer's Report, 15 October 1946; Ibid., 12 November 1946; Ibid., 8 February 1947; Ibid., 10 May 1947.

102.Gage Canal Company, Superintendent and engineer's Report, 8 March 1948; Ibid., 9 November 1948; Ibid., 13 December 1948; 11 April 1949.

103.Gage Canal Company, Superintendent and Engineers Report, "Report to Water Sources Committee," 1954; Tom Patterson, "Retiring Gage Canal manager also has been engineer and diplomat" Press-Enterprise, 29 October 1972, p. B2; Mylne, interview, August 1991.

104.Gage Canal Company, Superintendent and Engineer's Report, 11 December 1954; Ibid., "Report to Water Sources Committee," 1954.

105.Gage Canal Company, Superintendent and Engineer's Report, 11 April 1955.

106.Gage Canal Company, Managers Report, 1962-1977, report of 7 February 1966 (on file at the Gage Canal Company office, Riverside, California.); Ibid., 7 March 1966; Ibid., 11 April 1966; Ibid., 9 May 1966; Ibid., 10 October 1966.

107.In 1974 the City of Riverside, who had taken over the canal, replaced the canal with a pipeline from the headworks to Linden Street, Riverside, where the City took water for domestic purposes.

108.See Appendix D.

109.Irving, "History of the Gage Canal," p. 16.

110.Gage Canal Company, Superintendent and Engineer's Report, 11 April 1905.

111.Gage Canal Company, Superintendent and Engineer's report 13 February 1906.

112.Gage Canal Company, Minutes, 14 January 1908. An inverted syphon is basically a pipe which is laid in a trench excavated down the side of a valley, along the valley floor, and back up the other side. The down stream end of the syphon must be at a lower level than the up stream end to enable the water to flow through the syphon.

113.Gage Canal Company, Superintendent and Engineer's Report, 28 April 1917; Ibid., 14 November 1919; Ibid 26 February 1920; Ibid., 9 March 1920.

114.Gage Canal Company, Superintendent and Engineer's Report, 12 March 1918; Ibid.,15 October 1920; Ibid., 9 October 1923; Ibid., 13 February 1924; Ibid., 28 April 1924; Ibid., 13 May 1924.

115.Gage canal Company, Superintendent and Engineer's Report, 15 October 1920; Ibid., 14 December 1926; Ibid., 8 February 1927; Ibid., 13 December 1927.

116.Gage canal Company, Superintendent and Engineer's Report, 13 December 1927; Ibid., 14 February 1928; Ibid., 11 December 1928.

117.Gage Canal Company, Superintendent and Engineer's Report, 10 February 1941; Ibid., 8 March 1941; Ibid 7 April 1941.

118.Gage Canal Company, Superintendent and Engineer's Report, 9 February 1948.

119.Gage Canal Company, Superintendent and Engineer's Report, 4 October 1955;Ibid., 6 October 1955; Ibid., 13 February 1956: Mylne, interview, August 1991.

120.Gage Canal Company, Managers Report, 12 February 1968; Ibid., 12 March 1968; Ibid., 13 May 1968.

121.Mylne, interview, August 1991.

122.Gage Canal Company, Superintendent and Engineer's Report, 10 October 1911.

123.Gage Canal Company, Superintendent and Engineer's Report, 12 November 1912; Ibid., 11 November 1913.

124.Gage Canal Company, Superintendent and Engineer's Report, 28 April 1915; Ibid., 7 June 1915; Ibid., 10 May 1921: Ibid., 9 December 1930; Ibid., 13 December 1932; Mylne, interview, August 1991.

125.Irving to the Builders Iron Foundry Co., William Irving Letters, 1 May 1901, pp. 43-44.

126.Hall, Irrigation, p.4.

127.Irving, "History of the Gage Canal," p. 16.

128.Mylne, interview, August 1991.

129.Irving, "History of the Gage Canal", p. 23.

130.Ibid., p. 28.

131.Ibid., p. 32.

132.Gage Canal Company, Minutes, 24 January 1899.

133.Gage Canal Company, Superintendent and Engineer's Report, October 1914.

134.Gage Canal Company, Superintendent and Engineer's Report, 13 October 1919; Ibid., 30 March 1922.

135.Gage Canal Company, Superintendent and Engineer's Report, 10 November 1953.

136.Irving to F. E. Booth, William Irving Letters, 11 April 1901, pp. 35-40.

137.Irving to F. Booth Esqr.,11 April 1901, p.38.

138.Mylne, interview, August 1991.

139.Mike Schulte, foreman of the lower section of the Gage canal, personal communication, August 1991.

140.Gage Canal Company, Superintendent and Engineer's Report, 15 March 1927; Ibid. 10 May 1927.

141.Gage Canal Company, Superintendent and Engineer's Report 11 December 1928.

142.Gage Canal Company, Superintendent and Engineer's Report, 8 March 1949.

143.Gage Canal Company, Managers report, 12 March 1973.

144.Gage Canal Company, Managers Report, December 11 1973; Ibid., 12 February 1974; Ibid., 12 March 1974; Ibid., 14 May 1974; Ibid., 8 October 1974; Ibid., 12 November 1974; Ibid., 11 February 1975; Ibid., 8 April 1975; Ibid., 13 May 1975; Ibid., 28 August 1975.

145. Irving to Robert [Gage], William Irving Letters, 23 June 1903, p. 663.

GAGE CANAL

Appendix A

SUMMARY OF CANAL PARTS
after Hall (1888)

	First Division		Second Division		Total Canal	
	Feet	Miles	Feet	Miles	Feet	Miles
Tunnel - Clay and Soft rock	5,478	...	...	...	5,478	...
Tunnel - Hard Rock	700	...	...	...	700	...
Tunnels, total	6,178	1.170	...	...	6,178	1.170
Flumes, 7x4 feet	688	...	...	...	688	...
Flumes. 6x4 feet	722	...	...	...	722	...
Flumes, 5x4 feet	...	...	2,760	...	2,760	...
Flumes, total	1,410	0.267	2,760	0.523	4,170	0.789
Structures, total	7,588	1.437	...	0.523	10,348	1.959
Earth, 8 feet wide	14,000	...	...	...	14,000	...
Earth, 6 feet wide	41,312	...	...	...	41,312	...
Earth, 5 feet wide	...	...	40,647	...	40,647	...
Earth, total	55,312	10,472	40,647	7.698	95,959	18.170
The canal, in all	62,900	11,909	43,407	8.221	106,307	20.129

GAGE CANAL

Appendix B

COST OF FIRST DIVISION
after Hall (1888)

From the Santa Ana River and the Tequesquite Arroyo, 11.91 miles:

Ordinary open excavations and fills	$36,000.00
Clay and cemented sand tunnels, 5,500 feet	27,500.00
Rock tunnel (not cemented), 700 feet	11,500.00
Cementing and timbering tunnels, 5,500 feet	31,500.00
Flumes and stone foundations, 1,410 feet	14,100.00
Total	$120,300.00
Dam and head-gates	$3,500.00
Engineering	5,900.00
Right of way	95,300.00
Lands of which water sources form a part (2,700 acres)	175,000.00
Artesian wells (29)	25,000.00
Total	$425,000.00

GAGE CANAL

Appendix C

WATER AVAILABLE FOR THE GAGE CANAL JULY 30, 1888
after Hall (1888)

From Santa Ana River	400 miner's inches.
From Spring Ditch	103 miner's inches.
From sixteen artesian wells	764 miner's inches.
Total	1,267 miner's inches.

SUMMARY OF WELLS
after Hall (1888)

Group	Number	Diameter (Inches)	Average Depth (Feet)	Flow (Miner's Inches)
A	2	7	140	135
8	6	7	150	256
C	4	10	226	329
Total	16			764
Scattered	4	7	115	130
Hunt	9	7	115	130
Total	29			954

GAGE CANAL

Appendix D

WELLS IN OPERATION DECEMBER 1979

WELL	ENGINE	HORSE POWER
21	ROLINE V8-H884	140
26-1	CLIMAX K-75	185
27-1	CLIMAX K-75	185
27-2	CLIMAX K-75	185
29-1	CLIMAX K-75	185
29-2	CATERPILLAR G353	250
29-3	CLIMAX V-85	270
30-1	ROLINE H-844	135
31-1	WAUKESHA GNKRB	190
46-1	CATERPILLAR G353	250
51-1	CLIMAX R-165	150
56-1	CLIMAX K-75	185
66-1	CATERPILLAR G353	250
Deberry	CLIMAX X-80	225
Total		2785

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ADDENDUM TO
GAGE IRRIGATION CANAL
(GAGE CANAL)
California Citrus Heritage Recording Project
Running 20.13 Miles from the
Santa Ana River to Arlington Heights
Riverside
Riverside County
California

HAER No. CA-120

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