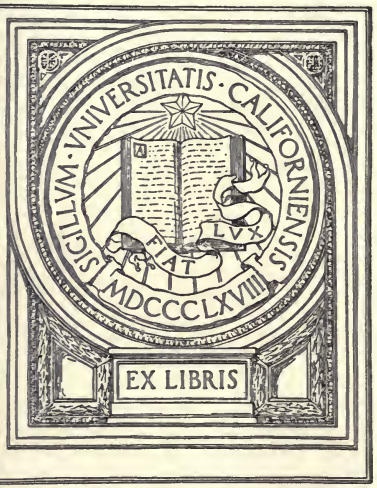
Butte Water Supply and Land Project

By

William Hammond Hall



BUTTE WATER SUPPLY AND LAND PROJECT:

The Physical, Engineering and Business Problems & Conditions,

WM. HAM. HALL.

A Report Addressed to

MESSRS. FRANK MCLAUGHLIN,
A. F. JONES, AND
E. W. FOGG,
Oroville, California.

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BUTTE WATER-SUPPLY AND LAND PROJECT.

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SAN FRANCISCO, Sept. 30th, 1891.

Messrs. FRANK MCLAUGHLIN, A. F. JONES, E. W. FOGG,
Oroville, Cal.

Gentlemen:

Complying with your commission to me, I have made an extended preliminary examination of the field for irrigation and water-supplying enterprise in Butte County, over the region lying between Chico, Oroville and Biggs, and including the commanding watersheds of the West Branch of Feather River, and the Butte Creeks, and now submit a report, as follows:

REPORT AND MAPS.

The report is written and maps prepared, so that you may, upon their authority and with their data, explain the situation to those who know nothing of the locality, and are altogether unfamiliar with the subject. Hence, there is much necessarily said and shown that is not new to yourselves.

Two general maps are handed you: (1) One, small scale, of the upper end of the Great Central Valley of California, showing the location of the region referred to, with reference to well-known geographic features; and (2) A large-scale map covering the special field reported on. Careful examination of these will serve to illustrate the generalities of the situation better than any explanation, however extended or detailed; hence, in this connection, I write little else than short notes and references, to induce study of the maps themselves.

THE LOCATION.

THE GENERAL LOCATION.—In Butte County, North-Central California; on the eastern side of the Sacramento Valley, and

at the western footing of the Sierra Nevada Mountains. There are three irrigable areas adjacent to each other, in this neighborhood, available for the enterprise, as follows :

THE PLAIN'S IRRIGABLE AREAS.—*First:* Upon the plain between Feather River (on the south) and Butte Creek (on the north), the foot-slopes of Table Mountain (on the east), and the Oregon division of the Central Pacific Railroad (on the west). The town of Chico (5,000 inhabitants), about ten miles north ; the town of Oroville (1,800 inhabitants), immediately south. The city of San Francisco, 180 to 200 miles (seven to eight hours) distant by rail, via Sacramento, and twenty to forty miles nearer by the Knights Landing route. (See small-scale general map.)

Referring to the larger-scale map, we find this same general locality definitely outlined and shown more in detail.

THE PLAIN'S IRRIGABLE AREAS.—*Second:* The rolling lands and plains next south of Feather River, and practically a continuation of the first body of lands named.

THE FOOTHILL IRRIGABLE AREA.—*Third:* We also see on the larger map the outlining of a foothill region, favorable to enterprises of the class proposed. This higher irrigation field lies at elevations between 1,000 and 2,100 feet above the sea, on the sloping plateau-like ridge and spurs between the cañons of the West Branch of Feather River and the Butte Creeks, which are next written of. This irrigable area is sometimes referred to herein as Paradise Plateau, from the name of the principal settlement now there.

WATER SUPPLY.

The streams of perennial supply which immediately command these irrigable areas, and are available in large part for their watering, are the West Branch of the North Fork of Feather River, generally known as and hereinafter referred to simply as the "West Branch," and the Butte Creeks, hereinafter spoken of as "Little Butte" and "Big Butte," respectively.

The West Branch heads about forty miles north and eight

miles east of Oroville, flows in a general direction quite nearly south, passing about seventeen miles east of Chico; joins, about twelve miles northeasterly from Oroville, the main North Fork, which in turn, seven miles east and north of the same town, joins the main river; and the waters, thus combined, find their way to the plain through a foothill gorge at the town itself.

The West Branch is in a precipitous mountain cañon throughout its length. Rising at an elevation of about 5,800 feet above the sea, it falls about 5,000 feet within the thirty miles (in a general alignment, or about forty miles by the windings) of that part of its course (to the point known as Cape Horn) considered in this report. This is at an average rate of about 166 feet per mile of the more direct alignment, or 125 feet per mile of channel.

East of this cañon lies a main ridge of the Sierra Nevada mountains; west of it is the Dogtown ridge, whose western footing, in turn, is in the cañons of the Butte creeks.

An appeal to the map shows the West Branch and Big Butte as the main cañons of the local system, with Little Butte as an intermediate mountain drain tributary to Big Butte.

Like the West Branch, Big Butte is a rapid-falling torrent, held in a mountain-flanked gorge. Little Butte has the same character, only its cañon is less deeply cut.

Diversion of waters from either stream is an accomplishment of apparent great difficulty. But owing to the very rapid descent of the cañons, and considerable longitudinal dip of the intervening ridge, the length of grade lines practicable on which to bring waters from the cañon's depths to the ridge's summit, are not as great as casual inspection would lead one to suppose.

The gold miners discovered this fact along in "the fifties," and during the twenty-five years, from 1855 to 1880, six ditches out from the West Branch brought waters over "the ridge," and two or three from the Big and Little Buttes surmounted it from the opposite direction.

They constitute the material evidence of the appropriation of these water supplies, and represent rights to utilize all, and

more than all, of the ordinary low-water flow of the several streams named.

In order of location from the head of the stream down, the West Branch ditches are the Dewey and Miner's, Snow, Hendricks, Miocene, and Flea Valley. The two first named have served to take West Branch waters over the ridge into Big Butte creek, from whence they were again diverted at lower points for mining purposes.

The Snow served chiefly to carry West Branch waters over the ridge into Little Butte, for diversion thence by ditches below. The Hendricks, Miocene, and Flea Valley each brought West Branch waters out to the top of the ridge, thence along its top and slopes to points between Pentz Valley and Oroville, for mining purposes.

Leading out from Little Butte on to the ridge, are found the Thompson Flat and Nickerson ditches. The first represents the oldest water-right herein named. The last is of the most recent construction, and is not one of the real old mining ditches first above referred to, at all.

The Snow, Hendricks, Miocene, Flea Valley, Thompson Flat, and Nickerson ditches, being owned by you, represent the water-rights and existing works with which I am called upon especially to deal.

To keep the main part of the report as brief as possible, I omit detailed descriptions of these properties at this point, and embody them in appendices.

IRRIGATION DEVELOPMENT ENTERPRISE.

The business enterprise for which I here find apparently a favorable field, is of a class peculiar to the State of California.

In a report on one of the Southern California districts, very recently submitted to the President of the State Association of Irrigation Districts, the writer hereof took occasion to describe and speak of this particular class of irrigation development; and what was therein said seems so fitting as an explanation of the subject for the present report that some of the more appropriate paragraphs are here quoted:—

"The irrigation works of this district, as designed and in

"construction, represent a type believed to be original in Califor-
"nia. Such works are practicable, commercially, only where
"lands of low value without irrigation can be raised to more
"than ordinarily high value with it. A number of conditions
"must be present to render this possible. Southern California
"and localities in the middle and northern part of the State,
"alone, so far as the writer knows, have been shown to possess
"all of these. It is not asserted that all and equal advantages
"are not present elsewhere ; but merely that their presence has
"not as yet been widely demonstrated to the knowledge of
"that class of people who are seeking them."

Then, after detailing the advantages found in these localities, the report went on to say that they "are such as not only to "make possible, but to invite, the residence of a more intelli-"gent, energetic, ingenious, and thrifty class of people to en-"gage in irrigation than are found elsewhere as irrigators. "They come to these neighborhoods with capital—some large, "some small, so far as money goes,—but nearly all with some "capital in money, and with much more than the old-fashioned "agriculturist's or of the foreign irrigator's capital of intelli-"gence, pluck, and business training."

"This is what makes commercially practicable the construc-"tion of the expensive class of irrigation works, of which this "district presents an example medium in cost."

"There is a class of people who will live in this kind of ir-"rigation region and become horticulturists, who can, because "of advantages above recounted, make a greater horticultural "success on, and a correspondingly greater revenue from the "lands, and hence can afford to pay more for them than peo-"ple who have had less advantages of education and business "training, and have been raised in communities of less thrift. "Now, this other class of people is often found in ordinary "farming neighborhoods, and dominates many irrigation quar-"ters elsewhere. Hence, one potent reason for the justification "of higher values on irrigated lands, and greater costs of irri-"gation works, here than in such 'elsewheres.'"

"Irrigation, of the higher orders particularly, in California "has not been made what it is by those who were before either "irrigators, farmers or horticulturists, but by a class of intelli-

"gent, thrifty and industrious business men. And this class "come here, settle, and become irrigators, not only because of "business enterprise, but on account of pleasant and healthful "surroundings and conditions, which notably prevail in at "least a number of California irrigation neighborhoods. The "expenditure of thirty to thirty-five dollars per acre, and even "more, on lands worth one to twenty dollars dry, in works to "make them yield large margins of profit over interest on "several hundred dollars per acre, and in rendering possible a "business at once pleasant and healthful, as well as profitable, "for cultivated people, has been to such men not only a solid "business proposition, but an operation for enthusiasm. This "constitutes the business of irrigation enterprise development. "Irrigation is its supplement."

And, finally, after speaking of the district then being reported upon, as a development of this class, and pointing out how its lands are being divided, settled and cultivated in small tracts, the report concludes its general picturing of irrigation growth of this particular kind in the following words:

"Because of these things, we find irrigation works of a "character in California whose prototypes would be not only "commercially impossible, but socially absurd, to be proposed "in any of the great irrigation countries of Asia or Africa; "and would not be much more fitting for enterprise even in "France."

One of the localities in Northern California, referred to in the above paragraphs as being favorable to this class of development, is that which you have now asked me to specially examine and report upon for the guidance of your private enterprise.

As to this particular region, in a report on another one of the irrigation districts made (also to the President of the State Association of Irrigation Districts) but a few months ago, the writer had occasion to speak as follows:

"On the eastern side of the Sacramento valley, immediate-"ly opposite the northern part of the Central Irrigation Dis-"trict, and only 20 miles away from it, is a region 20,000 to

"30,000 acres in extent, with soil good and rich, and receiving a rainfall each year several inches in excess of that in the Central District, where even wheat farming by the most economical methods is a failure. That special region will not, in its dry state, continue for long to support its one voter to the square mile. And yet these red, gravelly lands west and north of Oroville and south of Chico, *when irrigated*, are as fine fruit lands as any, except in a few limited localities, in the state; and, as has been amply demonstrated, will support a population as dense as it is desirable to have in any country. In this example the necessity for irrigation is due to the composition and physical condition of the soils and subsoils, and is not consequent upon deficiency in rainfall."

THE PROPOSED ENTERPRISE.

The present proposition, then, is to create actual high values for the red, gravelly lands of this body, that have hitherto been productive of nothing but failure in wheat farming, by serving them in irrigation with waters which your ditch rights control, and to deliver which these old works themselves can in great measure be utilized.

THE IRRIGABLE LANDS.— There are, in the first plains regions described, and readily commanded by the works spoken of, about 40,000 acres of good tillable lands, but not over 28,000 acres are adapted in character of soil to irrigation.

Of this area, about 5,000 acres are thin in soil. Of the balance, your present Thermalito tract embraces 8,000 acres, of which you have sold about 3,000. Thus, there are 20,000 acres, including your unsold balance, available for speculative enterprise, and 23,000 here available for water service.

The foothills area, third above described, embraces about 12,000 acres; of which, according to my examination, about one-half, or six thousand acres, may well be counted upon in the enterprise.

The second plains area south of the river extends away, southward, indefinitely; but there are 5,000 to 10,000 acres of suitable land within reach of economic service there.

In my opinion, an irrigation enterprise at this general locality should be based on the expectation of ultimately serving 30,000 acres of land: 5,000 acres of the mesa or plateau, 20,000 on the plains north of the Feather, and 5,000 on the rolling lands and plains south.

CULTIVATIONS AND WATER DUTY.—This region is adapted to the growth of a remarkable variety of most valuable products by irrigation. For the plateau district, I mention hardy fruits — apples, pears, prunes and peaches, especially; for the higher plain and rolling lands (the warm and frostless belt), citrus fruits, olives, figs, and the vine; for the river bottom lands, deciduous fruits in general, except the apple, but more especially the cherry, apricot and fig; and for the lower plains, the vine, alfalfa, field vegetables, besides a variety of deciduous fruits.

The unit of water-supply generally used in estimates for large open-canal irrigation projects on the plains of this country is the cubic foot per second, or "second-foot" in technical phraseology. In dealing with water in smaller volumes for irrigation enterprises of higher order, especially in the southern part of this State, and also in the foothill and mountain counties of Central and Northern California, where mining practice established the custom, the "miner's inch," or simply the "inch," is, however, more often employed as the unit.

The miner's inch, according to the form, size, and condition of the measuring apparatus used, (and these were not the same in different localities and on different works,) varied in actual volume of flow. That used in the locality and on the old works here reported upon, was equivalent to about the fortieth part of a cubic foot per second.

But the inch now generally used in irrigation districts is the equivalent of about the fiftieth part of the second-foot, and hence this is the measure herein adopted.

In speaking of water duty, we refer to the extent of service which water will perform in irrigation. According to the character of crop and of soil and subsoil, method of irrigation, skill

and care on the part of the irrigator, and kind of works for delivery and distribution, the duty of water in California varies between half an acre and ten acres to the inch.

Citrus fruit orchards in full bearing require, on the average, the actual service of one inch of water to five acres, on such lands and soils as are available for their growth in this region, somewhat less being required during the first part of the season, and somewhat more during the last part. Alfalfa and clover should have more in the early part of the season, but not necessarily so much during the last half. Deciduous fruits and vines may be averaged as requiring an inch to four acres, for the shorter season of their demand.

Citrus fruits require irrigation during all the dry months; alfalfa and clover, also, demand water-service throughout an equally long season — both fully covering the long-water period of the streams. The irrigation of deciduous fruits ends with July; and vines, well set, should not be irrigated later than June.

In an irrigation district principally devoted to deciduous fruits, and not growing citrus fruits, where one inch to four acres is demanded during the first three months of each season, experience shows that there is a water demand for sundry small irrigations during the last three months, of about 1 inch to 12½ acres.

Measure of Water Demand.—Upon the basis of these general ideas, I estimate that with the classes and distribution of cultivations which, in my judgment, should be looked forward to here, you would, to serve 30,000 acres, as above, have to deliver during the months of May, June and July, an average, in round numbers, of 6,900; and during August, September and October, an average of 3,840 inches of water. The following is an illustration of this adjustment and conclusion. The first period embraces May, June and July; the second period August, September and October.

District.	Amt. Water Required 1st Period.	2d Period.
The plateau district, 5,000 acres, all in deciduous fruits, clover, etc.		
At 1 inch to 4 acres	1,250	
At 1 inch to 12½ acres		400
The higher plains and rolling lands, 12,000 acres, all in citrus fruits, etc.		
At 1 inch to 5 acres	2,400	2,400
The lower plains and bottom lands, 13,000 acres, all in deciduous fruits, etc.		
At 1 inch to 4 acres	3,250	
At 1 inch to 12½ acres		1,040
Totals, for the two periods	6,900	3,840

The project should, in my opinion, contemplate the supplying of a population of 10,000 people in the towns of Chico and Oroville. There is now a combined number of about 6,500 in these two places and their immediate suburbs. Such supply should be at the rate of about 75 gallons per day per capita. This would require a steady flow of about 59 miner's inches. Making a liberal allowance, 100 miner's inches would meet all demands for municipal purposes.

The total average demand, then, for the two periods would be 7,000 and 3,940 inches. Based upon experience on this point, where observations of water consumption in irrigations of this class have been very exact for long periods, this average service would be accompanied by maximum demands in the several months about as follows:

1st Period.		2nd Period.	
May	6,000 inches.	August	5,500 inches.
June	8,000 inches.	September	4,000 inches.
July	7,000 inches.	October	3,500 inches.

MEASURE OF WATER SUPPLY.—The supply of water commanded would have to be sufficient to meet the maximum demands during each month. On this point there would never be any question of sufficiency during the months of the first

period. Little Butte and the West Branch will unquestionably, during those months, afford enough and to spare, available for your diversion and this utilization.

For the several months of the second period also, according to the best data I can secure, and so far as my own observation and examination goes, I am justified in the opinion that the supply available and at command of your rights would in most years meet the demand above scheduled. It is probable, however, that you would ultimately have to meet, by reservoiring surplus waters of spring, a deficiency equal to the flow of about 1,000 to 1,200 inches for 60 days, in some years. The plans and estimates have provided for this probable deficiency by the following project for storage.

WATER STORAGE PROJECT.—A very thorough reconnoisance of the commanding watersheds heretofore described has shown a singular absence of favorable storage sites. One only seems available for this enterprise. Most fortunately, you have from an old right the privilege of utilizing it; and still more fortunately, it seems just sufficient in capacity to avail you to meet the deficiency in low-water supply. This is at Philbrook Valley, as shown on the map, where, according to a special survey and careful estimate, 133,730,000 cubic feet of water can be stored by a dam 66 feet in height, and at a cost of $37,500. This is equivalent to a flow of 1,200 inches for 60 days, which is somewhat more than the probable deficiency heretofore referred to.

WATER DELIVERY AND WORKS.

From the foregoing, it will be seen that the maximum duty which the works would have to perform would be to deliver 8,000 inches (160 cubic feet per second) of water, and this then, would, of course, be the gauge of aggregate full capacity of all the main works necessary.

Of this maximum amount 1,300 inches would be required to supply the Paradise plateau and Chico; 1,000 inches would go to the rolling lands south of Feather river; and 5,700 inches to the plains north, and to supply Oroville.

MAIN DELIVERY WORKS.—For the sake of brevity and directness I do not at this point discuss the problem of different ways and means to divert and deliver this supply as demanded. Some details of the subject will be found in an appendix. Conclusions only are here announced.

The Snow ditch, now in bad order and with its flumes absolutely gone, can cheaply and to advantage be cleared, and generally rehabilitated to carry 1,500 inches of water. This was formerly a good ditch, on a good location, and will be again when reconstructed as above. Its diversion dam is still good.

The Nickerson ditch is a good ditch, in good order, with a present capacity, for three miles, of about 800 to 1,000 inches. It can readily and cheaply be increased in capacity to 2,500 inches, and extended to deliver 1,500 inches to the Miocene at Kunkle Point. Its diversion dam in Little Butte is good and in good condition.

These two ditches, then, would, with the intervening natural channels of Little Butte and other small creeks availed of (as per detailed description elsewhere), form a means of bringing a maximum of 1,500 inches of West Branch waters to the Miocene line at the point named, and would *en route* meet the demand for irrigation on the Paradise plateau, and of the branch line to supply the city of Chico.

The Hendricks ditch for any purpose of the water delivery heretofore scheduled is useless. It is, in large part, in exceeding bad repair; its location is bad, its alignment unfavorable and excessive in length. The desired object can be better effected by counting this work out, except as to its water right, of course.

The Miocene ditch proper, down to Kunkle Point, is now capable of delivering about 2000 inches of water, and even more for some parts of the route; but the flume work on the way, of which there is an aggregate length of 7200 feet, is old and in weak condition. Its present safe capacity throughout will not exceed 1250 inches. This line of delivery can at moderate cost, as elsewhere explained in detail, be put in condition to permanently deliver 2500 inches also at the Kunkle Point.

By the means thus outlined we could supply all the demand above, (on Paradise plateau and for the Chico line,) and deliver 4000 (1500+2500) inches to this point. The next objective and governing location is Reservoir Hill, at Parish's. The Old Flea Valley Ditch, which rounds the point and comes into Kunkle ravine 400 feet lower than, and a mile away from, the above point of delivery on the Miocene, is the best conduit for service here. It can be cheaply cleared, and made to carry the above volume of water over this portion of the route efficiently and permanently. It has a good location for the purpose.

The narrow divide, known as Reservoir Hill or Parish's, is the controlling point in topography for this scheme. An examination of the topographical maps submitted, shows this better than words can in brief space explain.

Leaving 1300 inches of water to supply the maximum demand on the Paradise plateau and at Chico, the works just outlined, with a full capacity to deliver 4000 inches, will bring to Parish's 3700 inches of water. Then the further problem of new construction or repair of old works would be to deliver west of the divide at that point the remaining 3000 inches to meet the maximum demand of 6700 inches beyond there.

The Thompson Flat ditch from Little Butte to Parish's is of no use in this project. It would cost more to rehabilitate and put it in proper condition, than to enlarge the Nickerson to perform all the desired service for this part of the route. Concentration of waters into one, rather than conducting them in two parallel channels, is of course, an object. The Nickerson ditch, enlarged as above, will conduct all the water which the Snow ditch from the upper West Branch, and the natural flow of Little Butte, will afford at the critical periods. Hence, the Thompson Flat ditch is not to be counted on for this enterprise above Parish's.

The Flea Valley ditch above Kunkle Point was, when in use, almost all in flume work, carried around the most precipitous and almost inaccessible rock cliffs. This fluming is now practically gone — rotted away and tumbled down.

The question which had to be considered in providing means of delivery for the additional 3000 inches to the west side of

the divide at Parish's, was, *first*, one of availibility of supply ; *second*, one of cost.

For reasons given elsewhere, it appeared that the additional supply must come from the West Branch, and not from Little Butte Creek. The latter could not be counted upon to afford it when wanted.

Even the West Branch, to insure a sufficiency, should be tapped for the purpose as low as the Miocene diversion, and not as high as the Snow diversion.

Hence, the alternative was: (1) to enlarge the Miocene to carry 3000 more than the 2500 inches already projected as its renewed capacity, or 5500 inches in all ; (2) to rebuild out from the Flea Valley dam on the former flume line to the Flea Valley ditch in Kunkle ravine, (at the point from whence it is proposed to be utilized for Miocene waters, in the part of the project already reviewed,) and enlarge the Flea Valley ditch from there on to carry 6700 inches (net) to Parish's ; or (3) to build a new ditch of 3000 inches (net) capacity out from the river on a lower grade line. As elsewhere shown, these figures, to insure the net delivery desired, and cover contingencies, would really have to be 7000 and 3300 inches respectively.

The question was complicated, also, with the one of conducting capacity beyond Parish's. The whole matter was considered on the basis of actual surveys and by comparative preliminary estimates. As a result, I am of the opinion that, for the purpose of this enterprise, the additional 3,000 inches of water can best be brought out on a new grade line from the West Branch, commencing just above Cape Horn—tunneling through that point, or rounding it by means of an iron flume,—and tunneling through the dividing ridge at Parish's, as shown by the detailed topographical map covering this locality herewith submitted, in addition to those heretofore described.

I do not stop here to explain the course of reasoning in the matter, or to point out why this is the best policy. The data are embodied in appendices hereto.

The result is that the scheme of works, as now outlined, provides a capacity of 4,000 inches by the combined old upper lines, as already described, to a point on the Flea Valley ditch overlooking the Parish divide, and about 1,070 feet above the

sea level ; and provides for a new ditch to deliver 3,300 inches at the lower end of a tunnel on the west side of the divide, 270 feet lower than the point of delivery on the Flea Valley, above described, and 2,000 feet distant therefrom, as shown on the detail map last above referred to.

This disposition provides for 300 inches of capacity in excess of the demand schedule, by each of the lines,—a precaution taken to cover losses, and for reasons not necessary to discuss here.

The problem beyond the Parish divide was as to how far the old works could, to advantage, be utilized in carrying forward these waters from the two points named.

Again, the inadvisability of dividing the waters more than really necessary, and decidedly economical, had to be kept clearly in review.

The tunnel output of the new ditch line would be at a lower elevation than any of the old works at this point. Hence, this lower line would have to be continued as a new construction. But all of the old ditches — the Flea Valley, Miocene, and Powers,— would be available to carry forward for several miles more the 3,700 to 4,000 inches brought to the Parish divide on the upper line of supply.

The Flea Valley, however, extends only a couple of miles further, and the Thompson Flat, or Powers, makes a big drop at about the same point. The Miocene alone goes forward for a considerable distance on an even gradient. It has, with clearing, capacity to Coal Cañon of about 2,500 inches.

The plan recommended is therefore to avail of the full capacity of this latter ditch to the point last named, but to abandon the Flea Valley ditch beyond Parish's, and also the Thompson Flat ditch to its middle level beyond the Cherokee branch of Dry creek. Hence, of the 4,000 inches maximum delivery on the upper line at the Parish divide, 2,500 would be crossed over in pressure pipes to the present Miocene ditch, beyond the low saddle of the divide, and 1,500 would be dropped into the New ditch at the tunnel output, immediately below.

The New ditch would thence have a capacity of (3,300 + 1,500) 4,800 inches to Miller's Point, where distribution would

commence; thence to Coal Cañon Point its capacity would be 4,600 inches. Here 200 inches more would be distributed, and 1,500 received by it from the Miocene above. Crossing Coal Cañon ravine the capacity would be 5,900 inches. Thence to Wick's Point, 200 would be dropped in distribution. Capacity at Wick's Point, 5,700 inches. This would be the first main point of division. A branch pipe line, 900 inches capacity, would go west, and another south and west, of 1,100 inches capacity, as shown in the map. Thence to the second main point of division the ditch would have capacity of 3,700 inches, bringing it to Byrne's Point. From here a line, part ditch, part pipe, would lead forward to the present Thermalito reservoir; and from the same point a branch pipe line would go out upon the plain toward Biggs, or west of South Thermalito. This delivery and division of the waters may appear somewhat more clearly from the following schedule.

TABULAR STATEMENT—MAIN DELIVERY WORKS.

Snow Ditch.

	Inches.	Inches.
Capacity at Head	1,500	
Distribution—		
Discharges into Little Butte		1,500

Nickerson Ditch.

Capacity at Head	2,500	
Distribution—		
Honey Run and Clear Creek Ridge.....500 in.		
Clear Creek and Dry Creek Ridge.....400 in.		
Dry Creek and W. Branch Ridge.....400 in.—	1,300	
Discharges to Miocene Ditch		1,200 to 1,500

Miocene Ditch.

Capacity to Kunkle Flat	2,500
Supplied from Nickerson	+ 1,200 to 1,500
Drop to Flea Valley	3,700 to 4,000

Flea Valley D. Capacity to Reservoir Hill...	4,000
Drop to New Ditch.....	—1,500
Capacity to Coal Cañon.....	2,500
Drop to New Ditch	—1,500
Capacity to Miocene Reservoir and South of River	1,000

New Ditch.

Capacity to lower end of Tunnel.....	3,300
Supply from Miocene (Flea Valley)	+ 1,500
Capacity to Miller's Point.....	4,800
Miller's Point Distribution.....	— 200
Capacity to Coal Cañon Point.....	4,600
Coal Cañon Point Distribution	— 200
Supply dropped from Miocene.....	+ 1,500
Capacity crossing Coal Cañon.....	5,900
Distribution before arriving at Wick's Point	— 200
Capacity at Wick's Point.....	5,700
Wick's Point Branch (1) West	— 900
Wick's Point Branch (2) South.	—1,100
Capacity to Byrne's Point.....	3,700
South Thermalito Branch.....	—2,700
Upper Thermalito Branch.....	—1,000

Branch Delivery Works.—The foregoing system of works would provide for delivery across the head of the Paradise plateau. All other works there can properly be ranked as distributaries, and be so estimated. The Miocene, or high line of delivery, simply serves in part to supply the low line, and conducts 1,000 inches of water to the Miocene reservoir on the south point of South Table Mountain, ultimately to be piped across the river to the rolling land district, south. This extension of the Miocene system is referred to in the estimates as the South Side Branch.

From the New Ditch, low line of delivery, four main branches would be taken: A pipe line from Byrne's Point to Thermalito reservoir, called the Upper Thermalito line; the Lower Thermalito line, from Byrne's Point southwesterly into the plain towards Biggs; and two branches, Nos. 1 and 2, from Wick's Point. The estimates refer to them by the foregoing names.

SPECULATIVE IRRIGATION ENTERPRISE.

The development of irrigation neighborhoods affords a legitimate field for speculative enterprise, and, rightly managed, yields rich returns. At the bottom of this truth lies the fact that irrigation not only removes doubt as to farming and horticultural harvests, but fixes those returns at figures that pay interest on high land values, and enables a man of moderate capital to establish an independent business on a comparatively very small area of land. Men have grown well-off, on ten-acre tracts in California, and twenty acres is all a farmer of moderate abilities cares to handle in fruits and other high produce under irrigation.

Lands with water-rights (water delivered, not distributed) and all conditions suited to deciduous fruit growing, command in the ordinary irrigation neighborhoods in California, from $50 to $100, unimproved; and in the better neighborhoods prices range to $200 per acre. For citrus fruit-growing, suitable land and water-right prices scale 50 to 100 per cent higher.

The best fruit lands, when irrigated, are generally those which were not good for much without water. They are usually so situated that heavy outlays of capital for large and expensive works have to be made to deliver and advantageously distribute water to them. No mere cultivator can alone provide for irrigating his tract on these great areas of fruit lands. Capital, organization and special enterprise has to provide for the development of such areas in bulk, in order that the result may be attained at reasonable cost per acre.

Then the intending cultivator, in buying his small tract, looks at the large yield he will get from it annually. In his purchase price, he freely pays the developing company a price that covers its outlay, proportionately to acreage bought, and a profit besides, and enters into an agreement to pay thereafter, annually, for water service, a rate that affords the company a handsome revenue on cost of works, for which it has probably been fully recouped in the land sales.

Or the owner of dry lands in large area, desiring to cut up his property and sell to small farmers, buys, from the water-

supplying company, rights to water for his tract in bulk, paying as much as it costs to deliver it, and usually with a profit also ; and in making the purchase, he puts upon the land a contract that it is to be served with water thereafter at rates yielding the revenue to the developing company, as above written.

Where first-rate lands, well located, can be bought and served with water by a really high-class system of works, such as I have planned, at a total outlay of $60 per acre, there should be, when adapted to citrus growth, a first profit averaging $60 to $100 an acre in their sale, or $30 to $60 when intended for deciduous fruit raising, and an annual net revenue for water service of $1.50 to $3 per acre from them, thereafter.

Granting natural conditions favorable in every respect, however, such result will yet depend on the manner in which the works are planned and carried out, and on business management in marketing the property. It is easy enough to show large profits in irrigation, to cite examples without number, to give well authenticated figures from individual cases, and from aggregate neighborhood results, as to how fruit raising, vine growing, raisin making and the olive industry pay. But while speculative enterprise in irrigation development depends on these irrigation successes, it has now come to be a separate business, and is to be studied of itself. Its problem is to promptly bring in a people to buy the lands at good figures, improve them well, and to keep this population satisfied with the management. This class of enterprise requires not only "a fair field and no favor," but a thoroughly competent and peculiarly fitted manager, — a man of special experience, tact and judgment.

Moreover, completeness must be assured from the beginning. It will not do to start such an enterprise with any less money in sight than enough to carry it out. The hand-to-mouth method of carrying land and water developments along is omnipresent in California. If a project is strong, financially, and is carried forward with boldness and proper show of strength, in advance of demand for the lands, and with displayed ability,

it succeeds. People are anxious to buy property thereunder, when it is skillfully advertised and shown that plenty of money and good management are building well planned, good and extensive works, covering good lands in a good neighborhood.

The application of this lesson is apparent to the case of your project. A whole lot of money can be made for original investors with the ditch properties you own and the lands you control, if you have capital enough to carry out a notable enterprise,—and do carry it out,—and able men of irrigation engineering ability and business experience to manage it.

There is competition in this class of enterprise. The best schemes and the best management are making, and will continue to make, money for the original investors.

CHARACTER OF WORKS ESSENTIAL.

This brings me to a description of the character which, in my judgment, should be given the works of your enterprise, in order to assure success. In a report on a Southern California Irrigation District recently submitted to the President of the State Association, I reviewed the general class of works which now-a-days commands attention, and makes salable the lands served, in the following words:—"Consider for a moment the "supplying, delivery, and distribution of water to these * * * "lands. It is brought in a steel pipe under high pressure, from "a far water-shed not tributary to the * * * Valley, a dis- "tance of 10 miles; then it is put through a concrete-lined tun- "nel about half a mile in length, piercing a dividing mountain "ridge; then in concrete-lined ditches, steel pipes, wooden "pipes, and 'iron-stone' cement-laid pipes, 20 miles additional, "to the commanding corner of each 20-acre tract on which it "is to be used. Practically, none of it is lost. It is brought "from its mountain home pure, sweet, and quite cool. It is "delivered fit for domestic use. It will be so used up to the "limit of demand. And even in its distribution within the "fields and orchards, it will be conducted in pipes or cement "ditches, to within a few feet of the especial square yard of "ground into which it will be permitted to soak in irrigation.

"There are no irrigation works of as high an economic

"grade, projected to supply tens, and almost hundreds, of thous-
"ands of acres, elsewhere, as are some of the California series
"into which the * * * District system enters."

There are now large areas of land already served and being prepared for irrigation service in this way in Southern California. The projects are well managed; the managers are examples of the theory of *the survival of the fittest*, as working in irrigation development business. Your enterprise would have to cope with those of the southern counties. Your field is of a description, and the conditions of your water-supply are such, as to fix only one character possible for your works. They must be first class.

Mountain-side ditches and flumes, where water is carried in good volume so as to retain its purity, will do as main conduits out from the cañons; but distribution must be made by pipes, or for main branch lines, by cement-lined or concrete ditches; and for secondary distribution, by glazed earthenware ("ironstone") pipes.

This is the character of works which I have planned and estimated upon. There is no example of the kind in either Central or Northern California. Your enterprise, thus materialized, would be a long step in advance for its region. I do not know of another likely soon to follow in this line in Northern California, and only one or two in the central part of the State. The material conditions, therefore, seeming favorable for a successful venture of a certain kind at your locality, the character to be given your works must not be mistaken.

TOWN WATER-SUPPLYING ENTERPRISE.

Naturally coupled with this irrigation development project, as with all projects of its class, is one of municipal supply. Wherever such an irrigation district succeeds, a dense and thrifty population is established. Prosperous towns and cities grow up. The rural neighborhood, from the nature of the irrigation works, has a good supply of clear water for domestic use. The towns then naturally demand water service also of high grade—pure water under pressure in pipes, and in abundance. There are already two large towns in the immediate

neighborhood of the field of your possible enterprise,—Chico and Oroville,—having a total population of about 7,000 people. Biggs has several hundred more. With any reasonable success in your irrigation neighborhood, there would in a very few years be 10,000 people in the two first-named places. It is conservative to count on this forecast of results to follow such development enterprise here.

Except for the cost of good service reservoirs and a better distribution system, the Oroville works would cost nothing extra above the irrigation outlay. Delivery to service reservoirs near town, of the extra few inches required for the municipal and domestic use of say 3,000 people, would not make a material difference in outlay for the main irrigation water-supply works.

To serve Chico would require an outlay for delivery works as elsewhere described and estimated, and located as shown on the general map.

There is certainly to be a profit realized from this adjunct to the main scheme. Municipal water-supply franchises for towns between 3,000 and 10,000 inhabitants are handsomely paying properties throughout the West.

I know of no neighborhood where two such good municipal customers could be so advantageously and cheaply served with good water as Chico and Oroville could be, in connection with the irrigation system I have planned for you.

WATER-POWER AND ITS APPLICATIONS.

The recent advances in electric lighting, and the transmission and application of power by electricity, have much enhanced the value of, and made available water-power privileges wherever favorably located for generation of electricity for such utilization.

It has now come to be recognized, that because of these advances, every such privilege located near existing populations, or where settlement is rapidly progressing, has an immediate and not inconsiderable value, and a prospective worth often mounting to figures representing large capital.

All these water privileges, in good localities, will in a few

years be used, and be very valuable — the best and most available first, of course.

There is no place in California where more favorable conditions exist for water-power utilization for transportation purposes, than at the locality of your contemplated irrigation water-supply enterprise; and there are no water-supply works existing, or projected, in California, where a greater amount of water power, favorably located for this purpose, is or will be developed.

Referring to the general map, for identification of localities, and to the general description heretofore given of your ditch system, as it is proposed to remodel and add to it for purposes of the contemplated irrigation water-supply project, the following will be easily understood:

The Snow ditch waters (1500 inches or 30 cubic feet per second) are dropped (1) near Thompson's, 44 feet into Kanaka Creek; and (2) two miles below Powellton, 400 feet, into Little Butte Creek.

The combined Nickerson and Miocene waters, (3300 to 4000 inches, 66 to 80 cubic feet per second) are planned to be dropped from Kunkle Point, 400 feet, to the Flea Valley ditch line in Kunkle Ravine.

A portion of these same waters, (1200 to 1500 inches) are planned to be dropped from the point of ridge above the Parish divide, 270 feet, to the level of the New Ditch in the ravine at the tunnel output below the divide.

Another portion, also 1200 to 1500 inches, are planned to be dropped from the Miocene ditch at Coal Cañon Point, 210 feet, into the New Ditch.

And 2400 to 2700 inches of the New Ditch waters are planned to be dropped 200 feet, to the head of the South Thermalito distributary, at Byrne's Point.

The five principal drops above enumerated can be made to afford from 4000 to 6500 horsepower, according to the stage of water in the ditches, developed on Pelton water wheels, to be applied to the generation of electricity.

AN ELECTRIC RAILWAY PROJECT.

These drops are so located that power developed at them could be applied most advantageously for the operation of an electric railway from Biggs to Powellton (or even higher up the ridge), and a cross line from Oroville to Chico.

The amount of power developed on water-wheels would be much more than sufficient for the electric service of roads on these routes, even with the heaviest traffic such roads are adapted to.

The main line (Biggs to Powellton) would pass lengthwise through the greater areas and more important parts of the territory your irrigation enterprises would seek to develop. It would connect a most fruitful and beautiful foothill region, destined, in my opinion, to be one of the most densely-populated and prosperous in the State, by a direct and good route, with one of the main railway arteries of the country.

The cross line (Oroville to Chico) would cross the territory irrigated, and connect a large town, the county seat of Butte County, now at the end of a branch line of steam railway, with the largest city in the county, and, indeed, in the northern interior part of the State, and on the main railway already spoken of.

Both lines would be on routes naturally important, and destined, in my opinion, to become very important in railway traffic.

It seems to me that only a thoughtful consideration of this situation is necessary, to show the value of this opportunity for local railway enterprise.

These electric railroads, though not inexpensive in matters of track, power stations, and wiring, are, where water-power of no cost is available and favorably located, very economical of operation. A remarkably large portion of gross earnings, where there is a reasonably good field and a fair traffic, is applicable to interest account on capitalization.

They will pay, and are paying well on routes where running expenses, even, would not be met by any other system we yet know of. In my judgment, a road of this character would pay

from the start on the route I have indicated, and in a few years would be a handsomely paying property.

As an adjunct to your water-supply and land-development project, this electrical railway would be the one desired additional thing; it would be invaluable. As I have elsewhere indicated, success in large irrigation development enterprises involves the population of a neighborhood. Transportation conveniences and advertising are the potent factors in this problem, in addition to those directly a part of the water-supply and land development works, and management themselves.

This electric railway realized, would make the water-supply and land development enterprise a success beyond question, and this in turn would immediately put the railway on its feet as a valuable paying property.

I commend a careful study of the general map, in this connection. Observe the application of that which has already been said. Note that the foothill or mountain road would be located through a fine agricultural country for three-fourths of its length, and the other fourth in one of the best timber belts in the State, and reaching into a region the most desirable for summer residence.

THE SCOPE OF THE ENTERPRISE.

To sum up, and review the ground traversed in the foregoing: In my judgment, there is a remarkably good opportunity for money making enterprise and paying investment in this Butte county neighborhood, to which your ditch properties and water-rights in great measure hold the key. But the opportunity is one for a large operation by a financially strong and thoroughly organized company, and not one for small capital, or for weak and ordinary business management.

I would advocate the formation of a general development company,* with sufficient capital to handle all the enterprises

*It may be advantageous to organize two companies to carry forward this enterprise—one for water-supplying and one for land handling. The formation of irrigation districts, it is believed, however, does away with some apparent reasons for such plan of organization.

of irrigation and municipal water supply and land development, and probably the electrical railway construction and operation also. The following summary of the estimates of cost will show how much capital would be required for construction purposes.

ESTIMATES OF COST.

Irrigation Water Supply and Delivery.

Snow Ditch—			
Construction new ditch	$1,435 50		
" flumes	1,755 00		
Clearing old ditch	2,446 00		$5,636 50
Nickerson Ditch—			
Enlarging and Clearing	1,930 00		
New flumes	125 80		
		$2,055 80	
Clearing portion of Power's Ditch		880 00	
Construction, extension ditch		419 60	3,355 40
Miocene Ditch—			
Construction, new ditch	3,311 90		
" " flumes	1,979 10		
" iron flumes	5,197 50		
Clearing old ditch	2,635 00		
		13,123 50	
Flea Valley Ditch		1,505 40	14,628 90
New Ditch—			
Earth and rock work	28,018 00		
Flumes	2,586 60		
Iron Flumes	4,180 00		
Pipe lines	18,810 00		
Tunnel	14,250 00		
Ditch		67,844 60	
Dam		15,000 00	
			82,844 60
Total cost of Ditches			$106,465 40

Main Branch Works—		
Wick's Point, W. Branch	10,932 00	
" " S. "	34,880 00	
South Thermalito	71,560 00	
Upper Thermalito	8,872 00	
South side	20,600 00	146,844 00
		253,309 40
Engineering, Supt. and contingent expenses, 10 %		24,618 00
Total Cost, Delivery		277,927 40
Phillbrook Valley Reservoir		37,218 00
Total Irrigating, Supply and Delivery		$315,145 40

Chico Water Delivery.

Reservoir at Nickerson Ditch	$ 2,145.00
Pipe down the ridge	14,256.00
Reservoir at point of ridge	3,645.00
Pipe to edge of Chico	30,360.00
Engineering, Supt. and contingent expenses	5,041.00
	$55,447.00

Electric Railway.

BIGGS TO POWELLTON AND OROVILLE.

Grading and track laid	$358,718.00
Power Appliances	18,700.00
Electrical Apparatus and Locomotives	126,000.00
Car Equipment—passenger and freight	6,575.00
Stations and Termini	5,000.00
Total Electric Railway	$514,993.00

Summary of Works.

Irrigation, Water-supply, and Delivery	$315,145.40
Municipal (Chico) Special Delivery	55,447.00
Total for Water-supply and Delivery Works	$370,592.40
Electric Railway, adjunct to Main Project	514,993.00
Grand Total	$885,585.40

A FINANCIAL PROJECT.

The electric railway, while to my mind a most valuable adjunct to the water and land scheme, is not a necessary feature of it. The suggestion having come entirely from myself, (consequent on my contemplation of the exceptionally favorable water-power privileges which my proposed re-arrangement of your ditch properties would afford), I leave it out of the following financial project as first presented, and embody it in an alternative proposition afterwards.

WORKS.—The foregoing estimates on Water-supply and Delivery Works, I regard as so liberal in details and in contingent allowances that, in the following summary, I place the probable cost of works at the round thousand figure next lower.

RIGHTS.—The item of *rights* is intended to cover payment to yourselves, individually, for your existing water-rights and works, consisting of:

Snow Ditch and water-right,
Miocene Ditch and water-right,
Hendricks Ditch and water-right,
Flea Valley Ditch and water-right,
Nickerson Ditch and water-right,
Thompsom Flat Ditch and water-right,
Phillbrook Valley reservoir privilege,
Thermalito Pipe Lines.

LANDS.—Your Thermalito Colony Company has about 5,000 acres of lands left unsold, which I understand you will be willing to put into a project, such as I have outlined, at $30 per acre. I understand, also, that you will soon have as much as 15,000 acres additional of the suitable lands, on the first plains area, under bond, at an average of about $25 per acre; and about 3,000 acres of the foothills land, at an average of about $15 per acre. Hence, I make use of these figures in the following project.

I am of the opinion that these lands, with water delivered as herein contemplated, and with perpetual water rights attached, could, under proper management, be marketed in three or four

years after completion of the works, as follows: About 10,000 acres, for citrus fruit growing, at an average rate of about $150 per acre; about 15,000, for deciduous fruit growing, on the plains, at an average of $100 per acre; and the 3,000 on the foothill or Paradise plateau, at, say, $50 per acre.

DISTRIBUTION.—The estimates for works thus far herein made were for supply and delivery, but not for distribution. They cover only main canals and ditches, and five branch pipe lines out into the body of the lands to be served. To effect these irrigations with this supply, and to make the neighborhood one in which lands will command high selling prices, distribution would have to be effected to each 20-acre tract by pipes. "Iron-stone" or earthenware glazed pipes are those best adapted to this purpose. They are used as simple grade channels or under light pressures. The cost of such distribution, based on ample precedent, would be, for the lands you contemplate handling, not more than $8.00 per acre; and hence, this figure is used in the following financial project. The cost of distribution is estimated only, however, for the 23,000 acres proposed to be handled by the company. The owners of the 4,000 acres purchasing water-rights would have to bear the expense of distribution throughout their tracts. This estimate is on the supposition that you will serve water to the 3000 acres of Thermalito lands already sold, without further charge for water-rights.

EXPENSES.—In all great development projects of this kind there are expenses not properly chargeable under any of the foregoing headings. They include commissions, business management, preliminaries of various kinds, etc. The item *Expenses* is intended to cover these in the following financial project.

ADVERTISING.—Success of enterprises of this class depends no little upon judicious advertising. This is apt to be a large source of expense. Hence, it is made a separate item in the following summing up.

MUNICIPAL SUPPLY.—The city of Chico ought to pay a bonus of $100,000 for such a water supply as you could, in the way indicated, deliver at its limits, and also pay an annual rental

for water delivered. Supplying water thus for 10,000 inhabitants (Chico and Oroville) should net you at least $1.00 per capita per annum.

IRRIGATION SUPPLY.—The works I recommend are planned to supply 30,000 acres in irrigation. The project provides for your handling, by purchase, development and sale, 23,000 acres of this. Rights to irrigate with the waters of the (7,000) acreage capacity additional would be sold to owners of other lands for $15 per acre, as a first payment for the water-right, and with contracts to pay $2.50 per acre per year. This annual payment would net you about $2.00 per acre per annum.

CAPITALIZATION.—A yearly net water rental of $2.00 per acre on 30,000 acres would, of course, represent 6 per cent interest on $1,000,000; and $1.00 per capita per year net on 10,000 people supplied in the towns, would represent interest, at a similar rate, on $166,666. These rentals being continuous, justifies capitalization as a permanent property return, as I have done in the following summary.

Upon the foregoing facts and considerations I now submit a statement of the gross outlay, and gross return which might reasonably, in my judgment, be looked forward to in carrying out the enterprise purely as a water and land development project.

Estimated Outlay.

Works—Water-supply and Delivery	$370,000
" —Distribution 23,000 acres at $8	184,000
Rights—Existing Ditches, Water-rights, etc	375,000
Lands—Thermalito, 5,000 acres at $30	150,000
" —Plains.....15,000 " " 25	375,000
" —Foothills.. 3,000 " " 15	45,000
Expenses—Commissions, Office, Administration	100,000
" —Advertising	50,000
Total	$1,649,000

Estimated Return.—In Money.

Land Sales,	10,000 acres at $150 ave.	$1,500,000
"	10,000 " " 100 "	1,000,000
"	3,000 " " 50 "	150,000

Water-rights, 4,000 " " 15 "	60,000
Chico Bonus.....	100,000
Total Money Return.....	$2,810,000

Capitalized Income.

Net Water Rentals on 30,000 acres at $2.....	$1,000,000
" " " from 10,000 people at $1	166,666
Total Invested Return.....	$1,166,666
Grand Total Return.....	$3,976,666
Money Profit.....	$1,161,000
Total Profit.....	$2,327,666

ELECTRIC RAILWAY PROJECT.—The electric railway hereinbefore planned would cost, in round numbers, $520,000 additional to the $1,649,000 estimated total outlay for the project. It would probably take half a million dollars more money to start the project, including it. It would offset nearly one half the money profit above figured on.

But in my judgment, (1) the returns from land sales would be much more prompt, with the railway project included; (2) the lands sold would realize an average of 20 per cent higher prices; (3) you could profitably handle for irrigation a larger area of foothill or plateau lands at a greater profit, with the railway included in the general project; (4) you could handle at very considerable profit as much as 5,000 acres of mountain forest and woodland, additional, for lumber business and summer residence purposes; and (5), in my judgment, the railroad would pay as an investment.

I am not able, in the short time in which I am to make this report, to collect the data, and work out a demonstration of this opinion. It will be time enough to do that when you are prepared to take the whole subject up, on the basis of an organization to handle the land and water project.

WAYS AND MEANS.

To secure the means to carry out the land and water enterprise, I recommend as follows:

(1) Organize a general development company, with $1,500,000 capital; $700,000 to be paid up in money, $200,000 to be used in purchase of properties, etc., and the balance to be held for the present, by the company, and marketed later, if need be.

(2) Organize one or two irrigation districts under the state law, covering in all say 15,000 acres of land; have district bonds voted and issued on the basis of the lands, to the value of $22 per acre.

(3) Have your company take the district bonds to the value of $14 per acre, for water rights and water delivered, leaving $8 per acre in bonds for use of the district in construction of distribution works, the contract also to provide for paying your company an annual water rental of $2.50 per acre served.

(4) Buy or bond 20,000 to 25,000 acres of the land to be irrigated, whether inside or outside of the proposed irrigation district does not matter very much, but preferably outside.

(5) Make contracts with owners of as much more of the 30,000 acres to be served, to take the water and pay a bonus of $15 per acre for it, and $2.50 per year, giving mortgages on the lands as security for contract, as you can.

I. Thus, before you commence construction of the proposed works, you should have:

(*a*)	From stock of company, either paid up or subject to call and pledged for stated times.	$ 700,000
(*b*)	Contracts to supply Irrigation Districts, with bonds pledged, to par value of (10,000 acres at $14)	140,000
(*c*)	Contracts to supply lands not in districts with lands pledged, (4000 acres at $15)	60,000
(*d*)	Contracts to supply Chico, with bonus placed at	100,000
	Available initial assets	$1,000,000

II. You should have, also, contracts to purchase, bonds on, or actual ownership of 20,000 to 25,000 acres of land at such figures as have been above written.

To entirely effect this purpose, you should have the project worked up in detail, with fine maps, plans, prospectus, illustrations ; an organization in good hands ; skillful advertising through writings by authority that will be recognized.

First, get your capital stock subscribed ; *second*, get your managers ; *third*, get your organization perfected ; *fourth*, get your project worked up in detail ; *fifth*, get your land districts and town contracts. Then go ahead.

Preliminary to all this, get whatever desirable lands, etc., in the region, tied up on provisional contracts or bonds, that you can.

By yourselves taking $200,000 in stock of the company in part payment for your rights and existing works, this $1,000,000 of assets available before commencing work would leave $449,000 to be put in as the project progressed. And, in my judgment, this amount would certainly be received from land sales and bonusses, as required.

It may be noticed that I have made no provision for interest account. The omission has been intentional. The amount of the item would be difficult to determine—depending so much on the manner in which the financial part of the project is organized, and on the degree of promptness attained in carrying the project to completion—one hundred and fifty thousand dollars, however, ought to more than cover interest on the paid-up capital until returned, this being more than the aggregate of 6 per cent per annum for over three years, on the $700,000 stock proposed to be paid for.

CONCLUSION.

In making this report I have endeavored to be liberal and full in estimates of cost, and conservative in forecasts of results and returns. In so far as costs are concerned, I write from an intimate knowledge of construction of such works and carrying out of such enterprises, except the electric portion of the railway project, and the estimates on this are based on figures

furnished by several of the principal electrical construction and power companies, on the basis of specifications covering the case in hand.

At the same time, I know from experience that the cost of works often depends very much on the engineering and business management of the enterprises.

The success of this enterprise as well as the cost of the works would, if carried forward, depend very largely on the management, both engineering and business.

Hence, I am bound to say to you, as I now say in every preliminary report of this character, that I am not in the future to be held responsible, professionally, for the result of any enterprise or work, or subsequent apparent untruth of any estimate put forward by me, on any enterprise, unless the construction of the works shall have been placed in my hands, or under my close supervision, and the management conducted under my advice.

I shall be glad to go over this subject, preliminarily, in the utmost detail, with any one contemplating investment in this enterprise, or with any representative of such persons. But my estimates are based on my own ideas and experience. An engineer should never be held responsible for the result of execution of works or realization of projects which he himself has not the management of.

I firmly believe in the value of your project. Without doubt there are others who can realize it as well as myself. But whoever is to have charge of the management and execution, let them first make an independent estimate on what they propose to do, and take the responsibility of their own acts.

You will understand that these concluding paragraphs are not written for this report alone. They are found at the end of every preliminary report now made by me.

Very respectfully yours,

WM. HAM HALL,

Consulting Civil Engineer

MEMORANDUM.

For the information of those to whose attention the foregoing report may be brought, and who may not be familiar with the history of irrigation development in the Far West and on the Pacific Slope, the following correspondence is here introduced by way of identifying the expert whose opinion and advice we have sought in the matter.

F. McL.
A. F. J.
E. W. F.

OROVILLE, CAL.,
Oct. 8th, 1891.

CORRESPONDENCE WITH LEADING FINANCIERS OF SAN FRANCISCO.

PALACE HOTEL, SAN FRANCISCO,
June 12, 1891.

THOMAS BROWN, ESQ.,
IGNATZ STEINHART, ESQ.,
LLOYD TEVIS, ESQ.,
A. MONTPELLIER, ESQ.,
R. C. WOOLWORTH, ESQ.,
And others.

GENTLEMEN:

In their endeavors to establish credit before the financial world, the Irrigation District authorities in this State have come to realize the necessity for having the several district schemes and organizations reported upon by experts whose qualifications and good standing would be vouched for by those persons controlling financial matters in San Francisco—the recognized center of business and money for California.

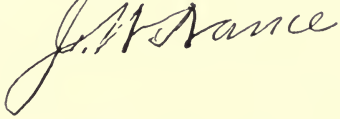
Each district has had its engineers and its attorneys, in whom the respective district authorities have all due confidence; but the districts are many, and the experts of engineering who have participated in the work are several for each district.

The advisability of centering upon some one engineer to review the labors of the many heretofore engaged, for the information of the financial public, suggested by yourselves to several district representatives a short while ago, has been brought home to the district authorities. Speaking for many with whom I have communicated, they generally see it, and approve of it.

Now, in order to expedite matters, and to be able to suggest to the several District Boards some definite line of action, and lay before them the name of an engineer whom you and other controllers of local financial sentiment will recognize as of good professional and personal standing, I, as President of the Association of Irrigation Districts, profiting by the personal interviews had with you by representatives of our districts, address you the following inquiry:

In case the respective Boards of Directors of Irrigation Districts in this State employ Mr. Wm. Ham. Hall, consulting engineer, to report on the questions of water supply, plans and estimates for works, suitability of lands, and generally the physical, engineering and business questions involved in each district scheme, giving him all desired latitude for thoroughness of work, will you thereafter, when in the course of business you are applied to for information concerning the standing of such district, reply that its affairs have been examined by an engineer competent, in your opinion, for the task, and familiar with the subject in this State, and a man whom you believe to be trustworthy for the service; in other words, that, in your opinion, he is an engineer on whose reports careful investors may rely as much as on those of any engineer in this line of business?

Very respectfully yours,



President State Association of Irrigation Districts.

To J. W. Nance, Esq.,

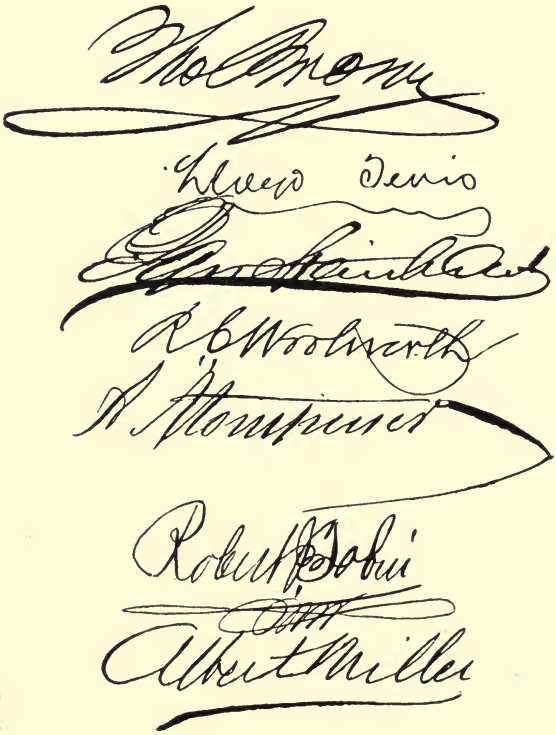
President State Association Irrigation Districts.

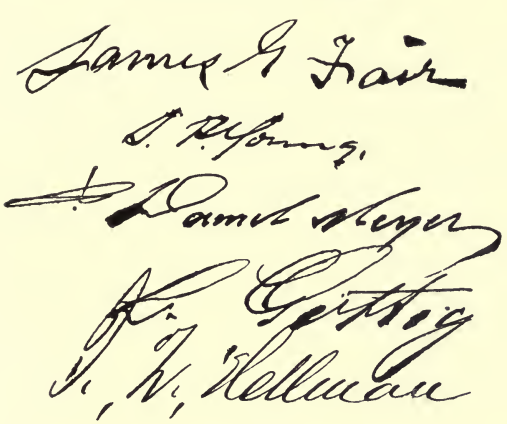
Sir:

We have read your foregoing letter of June 12, 1891, and we hereby answer in the affirmative relative to the inquiries respecting Mr. Hall.

In this connection we would suggest that it might be well for your Association to employ some competent attorney to investigate the status of the several districts, and assist Mr. Hall in his work.

Respectfully yours,





NOTE.—As will be seen, the above represent personal signatures. The gentlemen were addressed individually, and not as presidents and managers of banks; and so, in replying, they signed for themselves and not for the banks. But in order that the value of this certificate may be known to those persons not familiar with San Francisco banking organization, the following memorandum of identification is appended;

MR. THOMAS BROWN is Cashier and Manager of the Bank of California.

MR. LLOYD TEVIS is President and Manager of the Bank of Wells, Fargo & Co.

MR. IGNATZ STEINHART is the Manager of the Anglo-Californian Bank.

MR. A. MONTPELLIER is Cashier and Manager of the Grangers' Bank of California.

MR. R. C. WOOLWORTH is President and Manager of the Crocker-Woolworth Bank.

MR. I. W. HELLMAN is President and Manager of the Nevada Bank of California.

MR. ROBERT J. TOBIN is Secretary and Manager of the Hibernia Savings and Loan Society.

MR. L. GOTTIG is President and Manager of the German Savings and Loan Society.

MR. JAMES G. FAIR is President of the Mutual Savings Bank.

MR. S. P. YOUNG is Secretary and Manager of the California Safe Deposit and Trust Co.

MR. ALBERT MILLER is President and Manager of the San Francisco Savings Union.

MR. DANIEL MEYER is an individual Banker, and extensive Dealer in Securities.